RESOURCE ALLOCATION IN THE FINITE BLOCKLENGTH REGIME IN 5G

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ABSTRACT

RESOURCE ALLOCATION IN THE FINITE BLOCKLENGTH REGIME IN 5G

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With the enhancements in 5G Technology, URLLC (Ultra-reliable low-latency communication) Systems have become more and more important. Related to URLLC Systems with known packet arrival processes and channel conditions, many studies have been done. The objective of this thesis is to present a formulation of allocating resource blocks, modulation and coding rates to multiple short packet machine-type information flows to provide age and delay violation guarantees. The scenario is motivated by the scheduling of URLLC flows on the uplink of a 5G cellular base station. The problem involves the selections of frequency allocation policy and modulation and coding scheme (MCS) under full CSI. Moreover, the sensitivity of the information packet size on the choice of modulation and coding parameters as well as the number of resource blocks and the choice of the number of pilot symbols is demonstrated. The results of this formulation is compared with resource allocation algorithms in the literature.

Keywords: 5G, Age of Information, Resource Allocation, Modulation and Coding Scheme, Finite Blocklength

ÖZ

5G SİSTEMLERİNDE SONLU BLOK UZUNLUĞU KULLANIMI ESNASINDA KAYNAK TAHSİSİ

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5G Teknolojisindeki gelişmelerle birlikte URLLC (Ultra Güvenilir ve Düşük Gecikmeli İletişim) Sistemleri giderek daha önemli hale geldi. Bilinen paket varış süreçleri ve kanal koşulları olan URLLC Sistemleri ile ilgili birçok çalışma yapılmıştır. Bu tezin amacı, yaş ve gecikme ihlali garantileri sağlamak amacıyla çok sayıda kısa paket makine tipi bilgi akışına kaynak blokları, modülasyon ve kodlama oranlarını tahsis eden bir formülasyon sunmaktır. Senaryo, bir 5G hücresel baz istasyonunun yer-uydu bağlantısı üzerindeki URLLC akışlarının programlanmasıyla motive edilir. Problem tam CSI altında frekans tahsis politikası ve modülasyon ve kodlama şeması (MCS) seçimlerini içerir. Ayrıca, bilgi paketi boyutunun, modülasyon ve kodlama parametrelerinin yanı sıra kaynak bloklarının sayısı ve pilot sembollerin sayısının seçimi üzerindeki hassasiyeti gösterilmektedir. Bu formülasyonun sonuçları, literatürdeki kaynak tahsisi algoritmaları ile karşılaştırılmıştır.

Anahtar Kelimeler: 5G, Bilgi Yaşı, Kaynak Tahsisi, Modülasyon ve Kodlama Şeması, Sonlu Blok Uzunluğu

To my beloved family

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LIST OF ABBREVIATIONS

3GPP	The 3rd Generation Partnership Project
5G	The Fifth Generation
6G	The Sixth Generation
ACK	Acknowledgment
AMC	Adaptive Modulation and Coding
AoI	Age of Information
ARQ	Automatic Repeat Request
BLER	Block Error Rate
BS	Base Station
CSI	Channel State Information
dB	Decibel
eMBB	Enhanced Mobile Broadband Communication
FDD	Frequency Division Duplexing
Geom	Geometric
i.i.d.	Independent and Identically Distributed
IMT	International Mobile Telecommunications
ITU	International Telecommunication Union
LCFS	Last Come First Serve
LDPC	Low Density Parity Check
MAB	Multi Armed Bandit
MAC	Medium Access Control
MATLAB	Matrix Laboratory
MIMO	Multiple Input Multiple Output
ML	Maximum Likelihood

mMTC	Massive Machine Type Communication
NACK	Negative Acknowledgment
NR	New Radio
OLLA	Outer Loop Link Adaptation
PAoI	Peak Age of Information
PAM	Pulse Amplitude Modulation
PDF	Probability Density Function
PDSCH	Physical Downlink Shared Channel
PSK	Phase Shift Keying
PUSCH	Physical Uplink Shared Channel
QAM	Quadrature Amplitude Modulation
QAoI	Query Age of Information
QL-ABM	Q-Learning Based Adaptive Blocklength Selection
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
RB	Resource Block
RX	Receiver
SCA	Successive Convex Approximation
SCS	Subcarrier Spacing
SDP	Semi Definite Programming
SNR	Signal-To-Noise Ratio
TDD	Time Division Duplexing
TX	Transmitter
URLLC	Ultra Reliable and Low Latency Communication
VI-ABM	Value Iteration Based Adaptive Blocklength Selection

CHAPTER 1

INTRODUCTION

1.1 Motivation and Problem Definition

With the enhancements in 5G Technology, URLLC Systems have become more and more important. URLLC data transmission is important to real-time networked applications and is often characterized by quite stringent QoS requirements such as 99.999% reliability and 1 ms delay [9].

For applications such as remote tracking, monitoring and control, the freshness of the most recently received information packet tends to be more directly relevant to the performance of the application, than the delays experienced by individual packets serving that application. Freshness or timeliness of information has been captured by the metric Age of Information (AoI) [10, 11, 12]. The AoI of a flow at time t is defined as $\Delta(t) = t - u(t)$, where $u(t)$ is the time that the newest sample available at the destination of the flow was sampled or generated at the source side. Metrics derived from AoI, such as the average AoI, peak AoI (PAoI) [10], or query AoI (QAoI) try to capture timeliness as it relates to remote monitoring or status update type flows, more directly than it can be captured by latency experienced by individual packets or the average latency of a flow. For one thing, a low delay in the MAC layer does not guarantee end-to-end data freshness, as it ignores application layer queuing. Conversely, end-to-end connections over the Internet with fast transport connections may be forced to reduce their rates below the bottleneck rate to avoid queuing at slower RAN links [13]. Moreover, meeting an average latency requirement does not guarantee a low AoI [14]. Also, in certain cases a strict latency requirement is by itself not necessary, and can lead to over-provisioning.

To satisfy the reliability, latency/age requirements in a shared access link, the resource allocation needs to be optimized. The spectrum resource has been organized through the numerology concept in 5G which offers ample flexibility for assigning resource blocks (RBs) to information packets, and selecting a modulation and coding scheme (MCS) for each RB. Increasing the number of RBs occupied by a URLLC flow can increase rate and reliability, while stealing from resources that would otherwise be available to non-URLLC services, i.e. eMBB. As for MCS selection, increasing the modulation order helps reduce the transmission delay to within acceptable bounds, while increasing the error probability. Too much of this can lead to even more delay due to re-transmissions. This tradeoff must be carefully navigated, to satisfy to various degrees the performance objectives. In this thesis, parts of this tradeoff surface are explored.

1.2 Related Work

There is already a quite rich literature on resource allocation in 5G systems. A related formulation is Outer Loop Link Adaptation (OLLA) [15] for Block Error Rate (BLER) optimization using Multi Armed Bandit (MAB) methods. System capacity and spectrum efficiency optimization was achieved in [16] through three proposed algorithms named mode allocation algorithm, neighbor graph establishment algorithm and resource selection algorithm. Introducing AoI to resource allocation, several allocation policies were considered in [17].

There have been studies of resource allocation in the finite blocklength regime. [18] is a backbone paper serving achievability and converse bounds related to channel coding. In [19], transmit power minimization and energy-efficiency maximization was addressed using the semidefinite programming (SDP) relaxation and successive convex approximation (SCA). In [20], the throughput of a communication system utilizing incremental redundancy hybrid automatic repeat request (HARQ) was analyzed in the finite blocklength power limited regime. In [7], the study on the minimization of the age violation probability was conducted by adaptive blocklength and MCS selection using dynamic programming and reinforcement learning. [8] mentioned about the maximization of the metric named effective energy efficiency by proposing a joint

power and rate allocation which also considered outage and delay violation events. In [21], the analysis of PAoI violation probability under LCFS-S and simple ARQ transmission over a MIMO, spatially white, Rayleigh block-fading channel was considered. Moreover, the assumed transmission model in [21] is pilot-assisted QPSK transmission involving ML channel estimation and nearest neighbor decoding. The analysis in [21] aims to find the optimum physical layer parameters such as SNR, pilot symbol count and number of RBs.

1.3 Contributions and Novelties

The contributions are as follows:

- In Chapter 3, the two hop multiflow communication model using finite blocklength and AMC scheme is developed. The resource allocation mechanism and optimization problems basing on the minimizations of delay and RB count are formulated. The theoretical solution is sought.
- In Chapter 4, a MATLAB Simulation basing on a numerical search is conducted.
- In Chapter 4, the resource allocation mechanism formulated is compared with resource allocation algorithms in the literature.

1.4 The Outline of the Thesis

The background information regarding concepts 5G, URLLC, Modulation and Coding Schemes, and Age of Information and Derived Definitions are given in Chapter 2. Chapter 3 gives at first the system model for the resource allocation in the finite blocklength regime under PAoI and delay violation constraints and then the theoretical solution for the posed problems. The simulation setup and the numerical study of the problem by tables and plots are given in Chapter 4. Comparisons with resource allocation algorithms in the literature are also given in Chapter 4. The thesis is concluded in Chapter 5.

CHAPTER 2

BACKGROUND INFORMATION REGARDING CONCEPTS

2.1 5G

5G (Fifth Generation) is a technology standard for cellular networks. It has been defined by ITU (International Telecommunication Union) and standardized by 3GPP (3rd Generation Partnership Project) in the late 2010s. Its worldwide use is envisioned in the early 2020s with the requirements called as IMT-2020 [22]. 5G Communication and Network Systems focuses on metrics such as system capacity, latency, connection density, energy efficiency, spectral efficiency, peak data rate and user experienced data rate and for serving these metrics, 5G NR (New Radio) has been designed [23]. 5G Communication and Network Systems comprise of three categories aka use cases which are eMBB (Enhanced Mobile Broadband Communication), URLLC (Ultra-reliable and Low Latency Communication) and mMTC (Massive Machine Type Communication) [3]. Important metrics for eMBB systems include spectral efficiency and data rate [24]. For URLLC systems, reliability and latency are key metrics [9]. For mMTC systems, connection density and energy are the mainly considered metrics [25]. In Figures 2.1, 2.2 and 2.3, the use cases and the importance of the key metrics for these use cases which have been standardized in IMT-2020 can be seen.

For the 5G NR, numerology and resource block configuration are defined and can be summarized in Figures 2.4, 2.5, 2.6 and 2.7. Figures 2.4 and 2.5 demonstrate that there are five Subcarrier Spacing (SCS) values available in 5G NR given by the formula $2^{\mu}\cdot$ 15kHz and the numerology $\mu \in \{0, 1, 2, 3, 4\}$. In a 1ms subframe, there exists 2^{μ} slots. In the 5G NR, both TDD and FDD exist and Figure 2.6 shows the resource grid pattern consisting of RBs. The parameters of RBs vary according to the

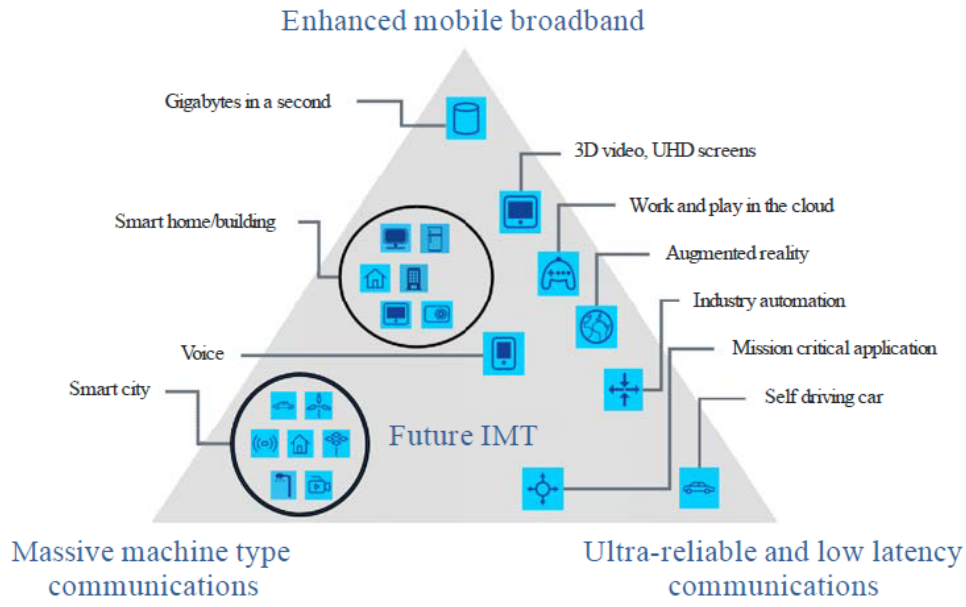

Figure 2.1: Usage scenarios of IMT for 2020 and beyond [1]

Category	eMBB	mMTC	uRLLC
Main motivations	Increase spectral efficiency and increase peak throughput	Increase the number of support devices and support low-cost devices	Reduce end-to-end latency and increase robustness of data transmission
Key requirements	20x peak throughput 100x area throughput 5x spectral efficiency	10^6 devices/km^2 100x energy efficiency	10 msec end-to-end latency (e.g., 0.5 msec physical-layer latency) BLER $<10^{-5}$ within 1 msec
Packet size	≫100 bytes	Hundreds of bytes	Tens to hundreds of bytes
Physical-layer solutions	Massive antennas, mmWave band-aggregation, and new waveforms	Non-orthogonal multiple access, overloaded data transmission, and active-user detection	Instant access, errorless data transmission
Applications	Virtual reality, real-time security, 3-dimensional image, and 4K-resolution video streaming	Logging, metering, lodging, tagging, and measuring	Tactile internet, remote control, self-car driving, argument reality, and industrial automation

Figure 2.2: Comparison of three use cases [2]

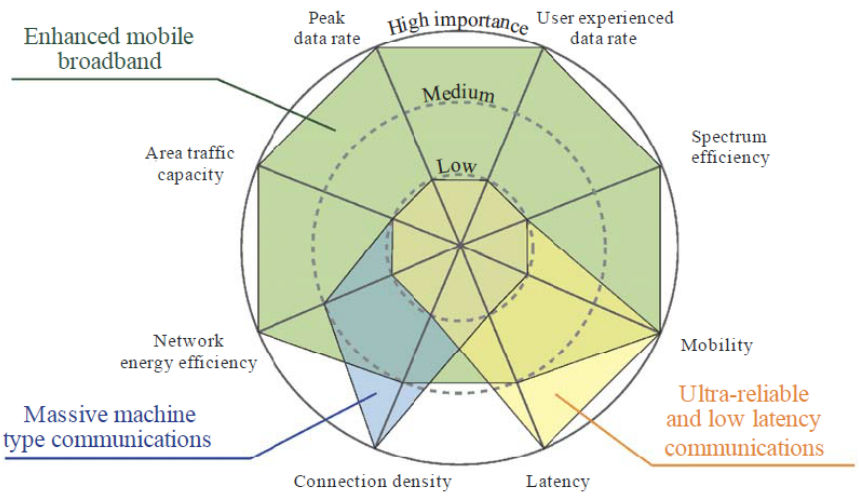

Figure 2.3: The importance of key capabilities in different usage scenarios [1]

numerology and Figure 2.7 points out the relation.

2.2 URLLC

URLLC (Ultra Reliable Low Latency Communication) data transmission is important to real-time networked applications such as tactile internet [26], remote control [27], autonomous vehicles [28], augmented reality [29] and industrial automation [30]. The significant requirements for URLLC can be exemplified as (i) QoS, (ii) coexistence with eMBB and mMTC, (iii) packet structure, and (iv) scheduling.

URLLC is often characterized by quite stringent QoS requirements which are 99.999% reliability and 1 ms delay [9]. In other words, error rate becomes below 10^{-5}. Moreover, areas such as industrial automation requires error rate on the order of 10^{-9} [31]. In all cases, the purpose is to have low latency and high reliability. For example, in industrial automation, the automated car assembly line has low latency to catch up with the moving tray and has high reliability to beware from damages during the assembly [31]. When it is aimed to minimize the latency, short packet usage is required. However, short packet usage causes a severe degradation in channel coding gain and so severe degradation in reliability. On the other hand, when it is aimed to enhance reliability, usage of more resources (e.g. parity, redundancy) is required and this situation simply increases the latency. So there is a trade-off between the objectives ultra

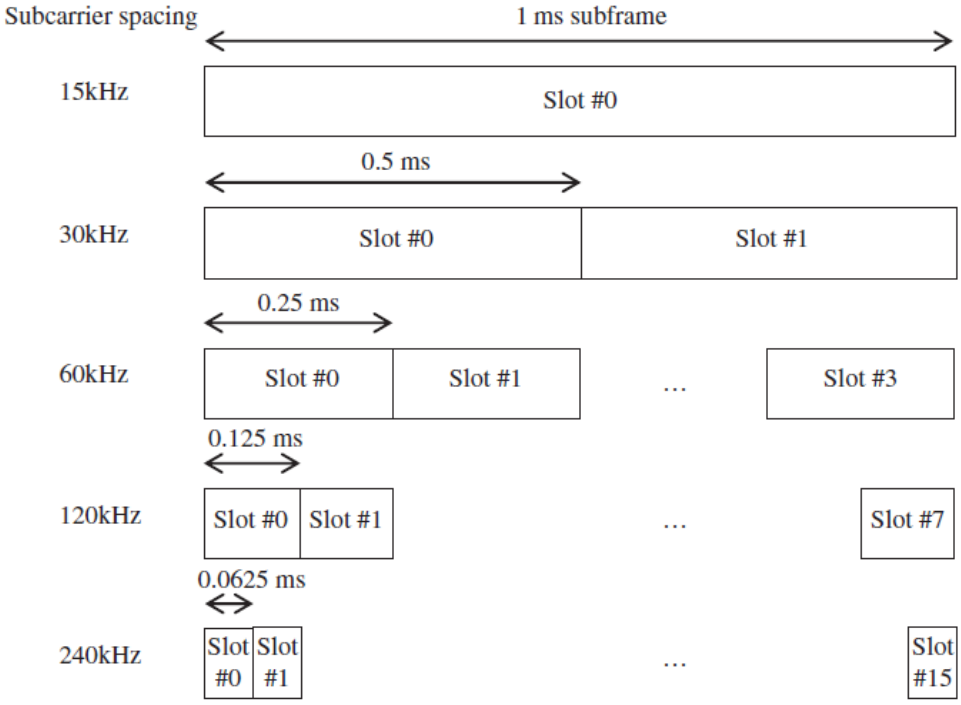

Figure 2.4: 5G numerology and slot length [3]

Subcarrier spacing (kHz)	Slot configuration				
	15	30	60	120	240
Symbol duration (μs)	66.7	33.3	16.6	8.33	4.17
CP duration (μs)	4.7	2.41	1.205 (normal CP), 4.13 (extended CP)	0.6	0.3
Nominal max. bandwidth (MHz)	50	100	100 (sub-6 GHz), 200 (mmWAVE)	400	400
Max. FFT size	4096	4096	4096	4096	4096
Symbols per slot	14	14	14 (normal CP), 12 (extended CP)	14	14
Slots per subframe	1	2	4	8	16
Usage	Outdoor large cell (<3 GHz)	Outdoor small cell (>3 GHz)	Indoor wideband cell (5 GHz) Small cell (>6 GHz)	Very small cell (28 GHz)	Indoor very small cell

Figure 2.5: 5G NR numerology [3]

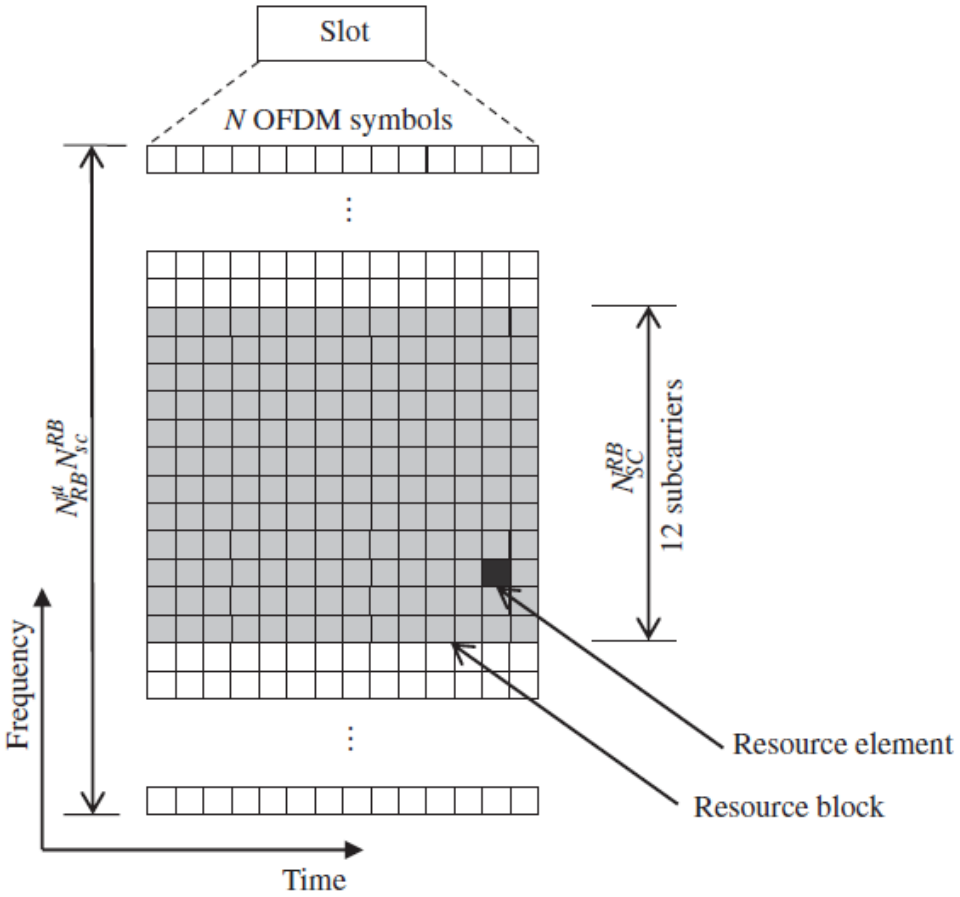

Figure 2.6: 5G NR resource grid and resource blocks [3]

μ	0	1	2	3	4
Subcarrier spacing (kHz)	15	30	60 (normal CP)	120	240
RB bandwidth (kHz)	180 (15×12)	360 (30×12)	720 (60×12)	1440 (120×12)	2880 (240×12)
RB duration (ms)	1	0.5	0.25	0.125	0.0625
Min. RBs	24	24	24	24	24
Max. RBs	275	275	275	275	138
Min. channel BW (MHz)	4.32	8.64	17.28	34.56	69.12
Max. channel BW (MHz)	49.5	99	198	396	397.44

Figure 2.7: 5G NR RB configuration [3]

reliability and low latency.

Coming to the coexistence with eMBB and mMTC, the issue can be explained as follows: Requesting for URLLC service leads base station to access the wireless medium in order to transmit the URLLC packets instantly and this may happen in the middle of another data transmission period [2]. This situation induces stopping the transmission of eMBB and mMTC packets without any notice to transmit URLLC packets and so a coexistence problem occurs [2]. In other words, due to not being aware of URLLC packets, eMBB and mMTC packet error rates increase. To cope with this coexistence problem, reactive and proactive strategies can be developed [2]. Reactive strategies are related to assigning high precedence to the URLLC transmission and are based on retransmission mechanisms that are for either transport block, selected symbols or selected code blocks [2]. Proactive strategies are related to assuring the reliability of data channel by using additional resources such as parity bits and proactive strategies involve robust channel coding or sharing [2].

Packet structure should be designed for decreasing latency in terms of packet processing and transmission time [2]. Packet processing time is sum of five terms which are packet acquirement, channel information access, control information extraction, packet decoding for data and error checking [2]. For reducing transmission time, packets consist of three parts which are pilot part used for channel estimation, control part employing polar code and data part employing LDPC (Low Density Parity Check code) [2].

There are three scheduling mechanisms for URLLC which are instant access (no reservation), semi-static reservation and dynamic reservation [31]. Instant access bases on transmitting generated URLLC packets which leads to the interrupt of the ongoing data transmission and so throughput loss due to abrupt increase in the packet error rate of stopped services [31]. In semi-static reservation, the frame structure configuration (e.g. frequency, numerology, service time) is broadcasted infrequently by the BS and this situation provides avoiding abrupt performance loss of the ongoing data transmission [2]. In dynamic reservation, the frame structure configuration is broadcasted frequently by the BS via using the control channel of scheduled user and this approach has a drawback due to the wasted reserved resources if no URLLC data

is present to be sent [2].

2.3 Modulation and Coding Schemes

Not only 5G Communication and Network Systems, but each communication system involves Modulation and Coding Schemes in its physical layer design. Brief information about Modulation and Coding Schemes can be given as follows.

2.3.1 M-PAM

In M-PAM, b bit symbols are used to select $M = 2^b$ signal amplitudes [32]. When m = 1, 2, ..., M; the M-ary PAM signal $s_m(t)$ is given by

$$s_m(t) = A_m p(t) = (2m - 1 - M)Ap(t) \tag{2.1}$$

where p(t) is the pulse signal of duration T and A_m is the signal amplitude and A is an arbitrary scale factor [32]. Each signal can be given in a geometric representation as

$$s_m = (2m - 1 - M)A\sqrt{\varepsilon_p} \tag{2.2}$$

where $\sqrt{\varepsilon_p}$ is the 2-norm of p(t) [32]. Assuming that $A\sqrt{\varepsilon_p} = 1$, the sample M-PAM Constellation Diagram is given in Figure 2.8.

2.3.2 M-PSK

In M-PSK, M signal phases are selected and assuming that $\phi_m = 2\pi m/M$ is the phase of the mth signal, m = 1, 2, ..., M, the geometric representation of the M-ary PSK signal $s_m(t)$, i.e. s_m, is given by

$$s_m = (\sqrt{\varepsilon_s}\cos 2\pi m/M, \sqrt{\varepsilon_s}\sin 2\pi m/M) \tag{2.3}$$

where ε_s is the energy in each signal [32]. Assuming that $\varepsilon_s = 1$, the sample M-PSK Constellation Diagram is given in Figure 2.9.

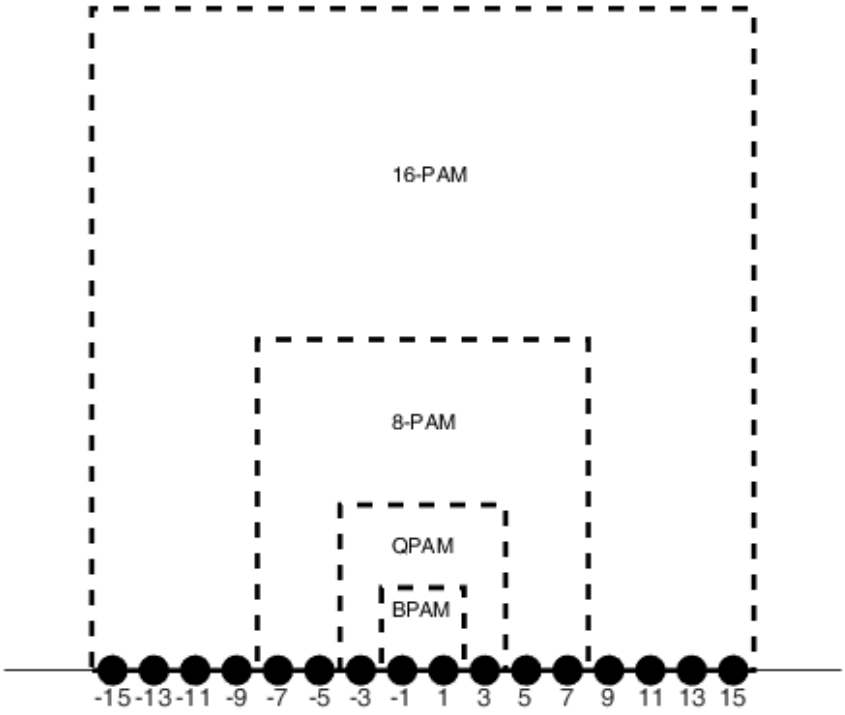

Figure 2.8: The M-PAM Constellation Diagram

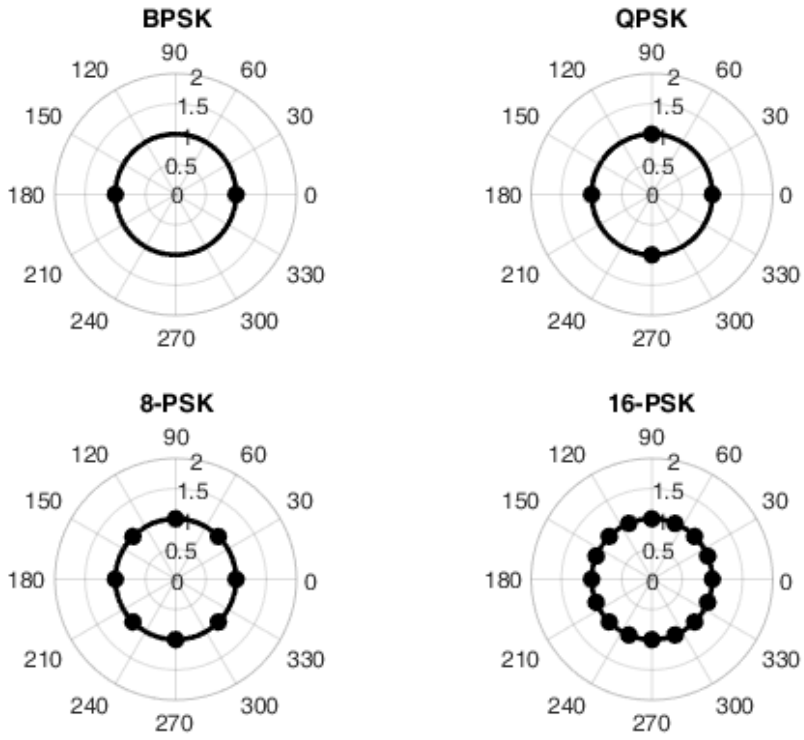

Figure 2.9: The M-PSK Constellation Diagram

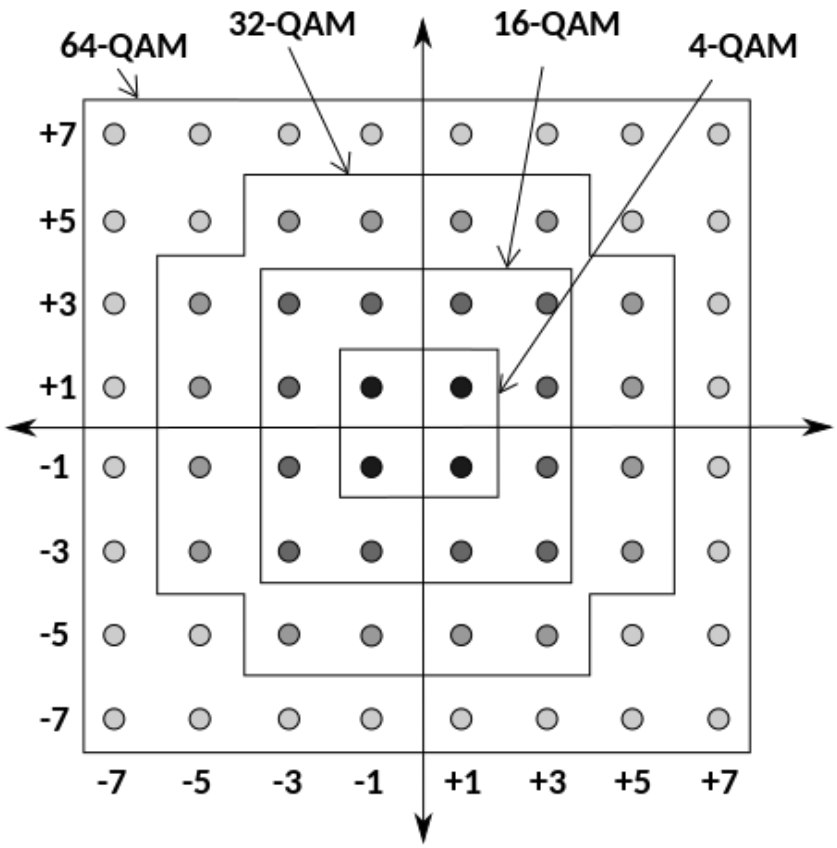

Figure 2.10: The M-QAM Constellation Diagram [4]

2.3.3 M-QAM

M-QAM involves both pulse amplitude modulation and phase shift keying and the sample M-QAM Constellation Diagram is given in Figure 2.10.

2.3.4 Modulation Constants

For QAM modulated signals, modulation constants can be defined in order to relate the energy of the signal to its moments and powers. Assuming that b_{l_k} is the modulation order, base 2 logarithm of the number of constellation points M (for $b_{l_k} = 1$, i.e. for so called 2-QAM, it is assumed that the set of signal constellation points is $\{1 + j, -1 - j\}$); modulation constants $C_{b_{l_k}}$, $D_{b_{l_k}}$, $F_{b_{l_k}}$, $G_{b_{l_k}}$, $J_{b_{l_k}}$ and $R_{b_{l_k}}$ can be defined and some of their values can be seen on Tables 2.1, 2.2, 2.3, 2.4, 2.5, and 2.6, respectively. As b_{l_k} increases, $C_{b_{l_k}}$ takes values around 1.4. $D_{b_{l_k}}$ is always equal to

Table 2.1: $C_{b_{l_k}}$ values

b_{l_k}	$E[\|.\|^2]$	$E[\|.\|^4]$	$C_{b_{l_k}} = \frac{E[\|.\|^4]}{(E[\|.\|^2])^2}$
1	$\frac{1}{2}(2 \cdot 2) = 2$	$\frac{1}{2}(2 \cdot 4) = 4$	1
2	$\frac{1}{4}(4 \cdot 2) = 2$	$\frac{1}{4}(4 \cdot 4) = 4$	1
3	$\frac{1}{8}(4 \cdot 2 + 4 \cdot 10) = 6$	$\frac{1}{8}(4 \cdot 4 + 4 \cdot 100) = 52$	$\frac{13}{9} = 1.44$
4	10	132	1.32
5	20	524	1.31
6	42	2436	$\frac{29}{21} = 1.38$
8	170	40324	$\frac{593}{425} = 1.4$
10	682	650628	$\frac{477}{341} = 1.4$
12	2730	10431876	$\frac{9553}{6825} = 1.4$

zero except for the cases when $b_{l_k} = 1$ and when $b_{l_k} = 3$. As b_{l_k} increases, $F_{b_{l_k}}$ takes values around 2.31. As b_{l_k} increases, $G_{b_{l_k}}$ takes values around 4.2. $J_{b_{l_k}}$ is always equal to zero except for the cases when $b_{l_k} = 1$ and when $b_{l_k} = 3$. $R_{b_{l_k}}$ is always equal to zero except for the cases when $b_{l_k} = 1$ and when $b_{l_k} = 3$.

2.3.5 MCS Index Tables

In order to select the modulation order for QAM and channel coding rate, there exist MCS Index Tables defined by 3GPP standards and these tables used in PDSCH and PUSCH channels [5]. Figures 2.11, 2.12, 2.13, 2.14 and 2.15 demonstrate these tables.

2.4 Age of Information and Derived Definitions

For applications such as remote tracking, monitoring and control, the freshness of the most recently received information packet tends to be more directly relevant to the performance of the application, than the delays experienced by individual packets serving that application. Freshness or timeliness of information has been captured by the metric Age of Information (AoI) [10, 11, 12]. The AoI of a flow at time t is de-

Table 2.2: $D_{b_{l_k}}$ values

b_{l_k}	$E[\|.\|^2]$	$E[(.)^2]$	$D_{b_{l_k}} = \frac{E[(.)^2]}{E[\|.\|^2]}$
1	$\frac{1}{2}(2 \cdot 2) = 2$	$\frac{1}{2}(2j + 2j) = 2j$	j
2	$\frac{1}{4}(4 \cdot 2) = 2$	$\frac{1}{4}(2 \cdot 2j + 2 \cdot (-2j)) = 0$	0
3	$\frac{1}{8}(4 \cdot 2 + 4 \cdot 10) = 6$	$\frac{1}{8}(2 \cdot 2j + 2 \cdot (-2j)$ $+2 \cdot (8 + 6j)$ $+2 \cdot (8 - 6j)) = 4$	$\frac{2}{3} = 0.67$
4	10	0	0
5	20	0	0
6	42	0	0
8	170	0	0
10	682	0	0
12	2730	0	0

Table 2.3: $F_{b_{l_k}}$ values

b_{l_k}	$E[\|.\|^2]$	$E[\|.\|^6]$	$F_{b_{l_k}} = \frac{E[\|.\|^6]}{(E[\|.\|^2])^3}$
1	$\frac{1}{2}(2 \cdot 2) = 2$	$\frac{1}{2}(2 \cdot 8) = 8$	1
2	$\frac{1}{4}(4 \cdot 2) = 2$	$\frac{1}{4}(4 \cdot 8) = 8$	1
3	$\frac{1}{8}(4 \cdot 2 + 4 \cdot 10) = 6$	$\frac{1}{8}(4 \cdot 8 + 4 \cdot 1000) = 504$	$\frac{7}{3} = 2.33$
4	10	1960	1.96
5	20	15200	1.9
6	42	164904	$\frac{6871}{3087} = 2.23$
8	170	11261480	$\frac{16561}{7225} = 2.29$
10	682	732372520	$\frac{268465}{116281} = 2.31$
12	2730	47059320360	$\frac{30166231}{13042575} = 2.31$

Table 2.4: $G_{b_{l_k}}$ values

b_{l_k}	$E[\|.\|^2]$	$E[\|.\|^8]$	$G_{b_{l_k}} = \frac{E[\|.\|^8]}{(E[\|.\|^2])^4}$
1	$\frac{1}{2}(2 \cdot 2) = 2$	$\frac{1}{2}(2 \cdot 16) = 16$	1
2	$\frac{1}{4}(4 \cdot 2) = 2$	$\frac{1}{4}(4 \cdot 16) = 8$	1
3	$\frac{1}{8}(4 \cdot 2 + 4 \cdot 10) = 6$	$\frac{1}{8}(4 \cdot 16 + 4 \cdot 10000) = 5008$	$\frac{313}{81} = 3.86$
4	10	31248	3.1248
5	20	463952	2.8997
6	42	12331536	$\frac{107}{27} = 3.96$
8	170	3500370448	$\frac{12869009}{3070625} = 4.19$
10	682	919253576208	$\frac{168484893}{39651821} = 4.25$
12	2730	236830349617680.2	4.26

Table 2.5: $J_{b_{l_k}}$ values

b_{l_k}	$E[\|.\|^2]$	$E[(.)^2\|.\|^2]$	$J_{b_{l_k}} = \frac{E[(.)^2\|.\|^2]}{(E[\|.\|^2])^2}$
1	$\frac{1}{2}(2 \cdot 2) = 2$	$\frac{1}{2}(4j + 4j) = 4j$	j
2	$\frac{1}{4}(4 \cdot 2) = 2$	$\frac{1}{4}(2 \cdot 4j + 2 \cdot (-4j)) = 0$	0
3	$\frac{1}{8}(4 \cdot 2 + 4 \cdot 10) = 6$	$\frac{1}{8}(2 \cdot 4j + 2 \cdot (-4j)$ $+2 \cdot (80 + 60j)$ $+2 \cdot (80 - 60j)) = 40$	$\frac{10}{9} = 1.11$
4	10	0	0
5	20	0	0
6	42	0	0
8	170	0	0
10	682	0	0
12	2730	0	0

Table 2.6: $R_{b_{l_k}}$ values

b_{l_k}	$E[\|.\|^2]$	$E[(.)^2\|.\|^4]$	$R_{b_{l_k}} = \frac{E[(.)^2\|.\|^4]}{(E[\|.\|^2])^3}$
1	$\frac{1}{2}(2 \cdot 2) = 2$	$\frac{1}{2}(8j + 8j) = 8j$	j
2	$\frac{1}{4}(4 \cdot 2) = 2$	$\frac{1}{4}(2 \cdot 8j + 2 \cdot (-8j)) = 0$	0
3	$\frac{1}{8}(4 \cdot 2 + 4 \cdot 10) = 6$	$\frac{1}{8}(2 \cdot 8j + 2 \cdot (-8j)$ $+2 \cdot (800 + 600j)$ $+2 \cdot (800 - 600j)) = 400$	$\frac{50}{27} = 1.85$
4	10	0	0
5	20	0	0
6	42	0	0
8	170	0	0
10	682	0	0
12	2730	0	0

MCS Index I_{MCS}	Modulation Order Q_m	Target code Rate R x [1024]	Spectral efficiency
0	2	120	0.2344
1	2	157	0.3066
2	2	193	0.3770
3	2	251	0.4902
4	2	308	0.6016
5	2	379	0.7402
6	2	449	0.8770
7	2	526	1.0273
8	2	602	1.1758
9	2	679	1.3262
10	4	340	1.3281
11	4	378	1.4766
12	4	434	1.6953
13	4	490	1.9141
14	4	553	2.1602
15	4	616	2.4063
16	4	658	2.5703
17	6	438	2.5664
18	6	466	2.7305
19	6	517	3.0293
20	6	567	3.3223
21	6	616	3.6094
22	6	666	3.9023
23	6	719	4.2129
24	6	772	4.5234
25	6	822	4.8164
26	6	873	5.1152
27	6	910	5.3320
28	6	948	5.5547
29	2	reserved	
30	4	reserved	
31	6	reserved	

Figure 2.11: MCS index table 1 for PDSCH [5]

MCS Index I_{MCS}	Modulation Order Q_m	Target code Rate R x [1024]	Spectral efficiency
0	2	120	0.2344
1	2	193	0.3770
2	2	308	0.6016
3	2	449	0.8770
4	2	602	1.1758
5	4	378	1.4766
6	4	434	1.6953
7	4	490	1.9141
8	4	553	2.1602
9	4	616	2.4063
10	4	658	2.5703
11	6	466	2.7305
12	6	517	3.0293
13	6	567	3.3223
14	6	616	3.6094
15	6	666	3.9023
16	6	719	4.2129
17	6	772	4.5234
18	6	822	4.8164
19	6	873	5.1152
20	8	682.5	5.3320
21	8	711	5.5547
22	8	754	5.8906
23	8	797	6.2266
24	8	841	6.5703
25	8	885	6.9141
26	8	916.5	7.1602
27	8	948	7.4063
28	2	reserved	
29	4	reserved	
30	6	reserved	
31	8	reserved	

Figure 2.12: MCS index table 2 for PDSCH [5]

MCS Index I_{MCS}	Modulation Order Q_m	Target code Rate R x [1024]	Spectral efficiency
0	2	30	0.0586
1	2	40	0.0781
2	2	50	0.0977
3	2	64	0.1250
4	2	78	0.1523
5	2	99	0.1934
6	2	120	0.2344
7	2	157	0.3066
8	2	193	0.3770
9	2	251	0.4902
10	2	308	0.6016
11	2	379	0.7402
12	2	449	0.8770
13	2	526	1.0273
14	2	602	1.1758
15	4	340	1.3281
16	4	378	1.4766
17	4	434	1.6953
18	4	490	1.9141
19	4	553	2.1602
20	4	616	2.4063
21	6	438	2.5664
22	6	466	2.7305
23	6	517	3.0293
24	6	567	3.3223
25	6	616	3.6094
26	6	666	3.9023
27	6	719	4.2129
28	6	772	4.5234
29	2	reserved	
30	4	reserved	
31	6	reserved	

Figure 2.13: MCS index table 3 for PDSCH [5]

MCS Index I_{MCS}	Modulation Order Q_m	Target code Rate R x 1024	Spectral efficiency
0	q	240/ q	0.2344
1	q	314/ q	0.3066
2	2	193	0.3770
3	2	251	0.4902
4	2	308	0.6016
5	2	379	0.7402
6	2	449	0.8770
7	2	526	1.0273
8	2	602	1.1758
9	2	679	1.3262
10	4	340	1.3281
11	4	378	1.4766
12	4	434	1.6953
13	4	490	1.9141
14	4	553	2.1602
15	4	616	2.4063
16	4	658	2.5703
17	6	466	2.7305
18	6	517	3.0293
19	6	567	3.3223
20	6	616	3.6094
21	6	666	3.9023
22	6	719	4.2129
23	6	772	4.5234
24	6	822	4.8164
25	6	873	5.1152
26	6	910	5.3320
27	6	948	5.5547
28	q	reserved	
29	2	reserved	
30	4	reserved	
31	6	reserved	

Figure 2.14: MCS index table for PUSCH with transform precoding and 64QAM [5]

MCS Index I_{MCS}	Modulation Order Q_m	Target code Rate R x 1024	Spectral efficiency
0	q	60/q	0.0586
1	q	80/q	0.0781
2	q	100/q	0.0977
3	q	128/q	0.1250
4	q	156/q	0.1523
5	q	198/q	0.1934
6	2	120	0.2344
7	2	157	0.3066
8	2	193	0.3770
9	2	251	0.4902
10	2	308	0.6016
11	2	379	0.7402
12	2	449	0.8770
13	2	526	1.0273
14	2	602	1.1758
15	2	679	1.3262
16	4	378	1.4766
17	4	434	1.6953
18	4	490	1.9141
19	4	553	2.1602
20	4	616	2.4063
21	4	658	2.5703
22	4	699	2.7305
23	4	772	3.0156
24	6	567	3.3223
25	6	616	3.6094
26	6	666	3.9023
27	6	772	4.5234
28	q	reserved	
29	2	reserved	
30	4	reserved	
31	6	reserved	

Figure 2.15: MCS index table 2 for PUSCH with transform precoding and 64QAM [5]

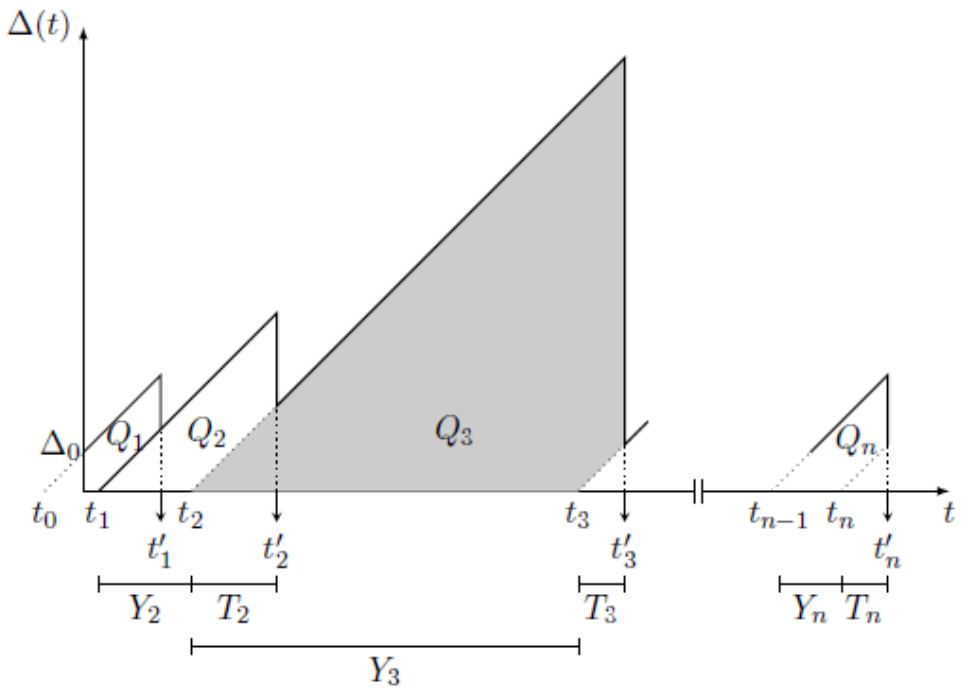

Figure 2.16: Age Evolution [6]

fined as $\Delta(t) = t - u(t)$, where $u(t)$ is the time that the newest sample available at the destination of the flow was sampled or generated at the source side. Metrics derived from AoI, such as the average AoI, peak AoI (PAoI) [10], or query AoI (QAoI) try to capture timeliness as it relates to remote monitoring or status update type flows, more directly than it can be captured by latency experienced by individual packets or the average latency of a flow. For one thing, a low delay in the MAC layer does not guarantee end-to-end data freshness, as it ignores application layer queuing. Conversely, end-to-end connections over the Internet with fast transport connections may be forced to reduce their rates below the bottleneck rate to avoid queuing at slower RAN links [13]. Moreover, meeting an average latency requirement does not guarantee a low AoI [14]. Also, in certain cases a strict latency requirement is by itself not necessary, and can lead to over-provisioning. An age evolution example can be given in Figure 2.16.

The time average AoI is defined as

$$\Delta_T = \frac{1}{T} \int_0^T \Delta(t) dt \tag{2.4}$$

and the ensemble average age is defined as

$$\Delta = \lim_{T \longrightarrow \infty} \Delta_T \tag{2.5}$$

where T is the length of the time interval [6].

For the ith packet to be serviced, PAoI is defined as (see Figure 2.16)

$$A_i = Y_i + T_i \tag{2.6}$$

where Y_i is the interarrival time and T_i is the system time [6].

The time average PAoI is defined as

$$A = \lim_{T \longrightarrow \infty} \frac{1}{T} \sum_{i=1}^{N(T)} A_i \tag{2.7}$$

where N(T) is the number of packets whose services are completed by time T [6].

CHAPTER 3

RESOURCE ALLOCATION IN THE FINITE BLOCKLENGTH REGIME UNDER PAOI AND DELAY VIOLATION CONSTRAINTS

3.1 System Model

It is assumed that there are K independent transmitter receiver pairs, connected through a base station. The kth pair is assigned an information flow k, transmitted over two hops, i.e., from TX_k to BS and BS to RX_k, where $1 \leq k \leq K$. The focus is on the transmission of a finite number of information bits, B_k, by flow k over these two hops. The transmission of this data block over each hop will take a frame duration, Δ, if there are no errors, but if there is a decoding error (*block error*), the transmission will be repeated through a simple ARQ mechanism. Two optimization problems with different objectives will be posed. In the first, it is desired that the transmission over the two hops takes no more than 3Δ, with high probability, i.e., it is aimed to minimize the number of used resource blocks while satisfying a delay violation probability constraint. In the second, a per flow RB minimization, which will also serve as a stepping stone to solve the first problem, is carried out with the aim of satisfying a Peak Age Violation probability constraint.

The problem is to assign a number of resource blocks to flow k in every uplink frame, and a number of resource blocks on the downlink frame, as well as modulation orders in each of the allocated resource blocks (RBs). Let the numbers of RBs allocated to flow k in the uplink and downlink be $L_k^{(1)}$, and $L_k^{(2)}$, respectively. Without loss of generality, let the resource blocks $\Xi_k^{(1)} \triangleq \{\xi_{k1}, \ldots, \xi_{kL_k^{(1)}}\}$ be assigned to flow k in the uplink frame, and $\Xi_k^{(2)} \triangleq \{\xi_{kL_k^{(1)}+1}, \ldots, \xi_{kL_k^{(1)}+L_k^{(2)}}\}$ be assigned to flow k in the downlink frame.

Each resource block consists of $n_c = n_d + n_p$ symbols, n_d for transmitting data and n_p for transmitting pilot symbols. The total number of coded bits used for sending the B_k information bits of flow k is thus $n_k^{(1)} = L_k^{(1)} n_c$ in the uplink, and $n_k^{(2)} = L_k^{(2)} n_c$ in the downlink, thereby yielding the rates $R_k^{(1)} = B_k / n_k^{(1)}$ and $R_k^{(2)} = B_k / n_k^{(2)}$ respectively. Let the modulation order for each resource block l_k be chosen (adaptively) from a set of possible modulation orders $b_{l_k} \in \{1, \ldots, b_{max}\}$ bits per symbol. For the system model, the selected modulation type is QAM. For $b_{l_k} = 1$, i.e. for so called 2-QAM, it is assumed that the set of signal constellation points is $\{1 + j, -1 - j\}$.

The transmitters and the receivers are all assumed to have $N^{(1)} = N$ antennas, and the BS is assumed to have $N^{(2)} = N_B$ antennas. For a given resource block l_k, transmitter k selects each of the n_d symbols independently from an M_{l_k}-ary constellation with the same prior probability $p_{l_k} = \frac{1}{M_{l_k}}$ where $M_{l_k} = 2^{b_{l_k}}$; each of n_p pilot symbols from a deterministic sequence, initially drawn from the same constellation as the data and fixed throughout; and forms the codeword $X_{l_k}^{(1)}$. Each symbol in the uplink (downlink) has energy $\frac{\rho_1}{N}$ ($\frac{\rho_2}{N_B}$) per antenna (as precoding is ignored) where ρ_1 (ρ_2) is the SNR value in the uplink (downlink). For any symbol $x_{l_k}^{(i)}$,

$$
\begin{aligned}
E[x_{l_k}^{(i)}] &= 0 \\
E[|x_{l_k}^{(i)}|^2] &= \frac{\rho_i}{N^{(i)}}, i = 1, 2 \\
E[|x_{l_k}^{(i)}|^4] &= (\frac{\rho_i}{N^{(i)}})^2 C_{b_{l_k}}, i = 1, 2 \\
E[(x_{l_k}^{(i)})^2] &= \frac{\rho_i}{N^{(i)}} D_{b_{l_k}}, i = 1, 2 \\
E[|x_{l_k}^{(i)}|^6] &= (\frac{\rho_i}{N^{(i)}})^3 F_{b_{l_k}}, i = 1, 2 \\
E[|x_{l_k}^{(i)}|^8] &= (\frac{\rho_i}{N^{(i)}})^4 G_{b_{l_k}}, i = 1, 2 \\
E[(x_{l_k}^{(i)})^2 |x_{l_k}^{(i)}|^2] &= (\frac{\rho_i}{N^{(i)}})^2 J_{b_{l_k}}, i = 1, 2 \\
E[(x_{l_k}^{(i)})^2 |x_{l_k}^{(i)}|^4] &= (\frac{\rho_i}{N^{(i)}})^3 R_{b_{l_k}}, i = 1, 2
\end{aligned}
\tag{3.1}
$$

where $C_{b_{l_k}}$, $D_{b_{l_k}}$, $F_{b_{l_k}}$, $G_{b_{l_k}}$, $J_{b_{l_k}}$ and $R_{b_{l_k}}$ are constants depending on the modulation order and some of their values can be seen on Tables 2.1, 2.2, 2.3, 2.4, 2.5, and 2.6, respectively. These modulation constants appear in theoretical solutions given in Appendix.

The entries of the codeword $X_{l_k}^{(i)}$ and the entries of codewords $X_{l_k}^{(i)}$ and $X_{l_j}^{(i)}$, $j \neq k$,

are i.i.d.. The received signal at the base station is given by

$$Y_{l_k}^{(1)} = H_{l_k}^{(1)} X_{l_k}^{(1)} + W_{l_k}^{(1)} \tag{3.2}$$

where $H_{l_k}^{(1)} \in C^{N_B x N}$ is the channel gain matrix on resource block l_k in the uplink, $X_{l_k}^{(1)} \in C^{N x n_c}$ is the codeword transmitted and $W_{l_k}^{(1)} \in C^{N_B x n_c}$ is noise matrix. The received signal at the receivers, on the other hand, is given by

$$Y_{l_k}^{(2)} = H_{l_k}^{(2)} X_{l_k}^{(2)} + W_{l_k}^{(2)} \tag{3.3}$$

where $H_{l_k}^{(2)} \in C^{N x N_B}$ is the channel gain matrix on resource block l_k in the downlink, $X_{l_k}^{(2)} \in C^{N_B x n_c}$ is the codeword transmitted and $W_{l_k}^{(2)} \in C^{N x n_c}$ is the noise matrix. The (N)ACKs are per RB per hop. Deducing that

$$\begin{aligned} E[X_{l_k}^{(i)}] &= 0 \\ E[(X_{l_k}^{(i)})^H X_{l_k}^{(i)}] &= \rho_i I_{n_c} \\ E[X_{l_k}^{(i)} (X_{l_k}^{(i)})^H] &= n_c \frac{\rho_i}{N^{(i)}} I_{N^{(i)}} \end{aligned} \tag{3.4}$$

The matrices $H_{l_k}^{(1)}$, $W_{l_k}^{(1)}$, $H_{l_k}^{(2)}$ and $W_{l_k}^{(2)}$ are all assumed to follow circularly symmetric complex standard Gaussian distribution. In other words,

$$\begin{aligned} \begin{bmatrix} Re\{H_{l_k}^{(i)}\} \\ Im\{H_{l_k}^{(i)}\} \end{bmatrix} &\sim \mathcal{N}\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \right. \\ \left. \begin{bmatrix} var(Re\{H_{l_k}^{(i)}\}) & cov(Re\{H_{l_k}^{(i)}\}, Im\{H_{l_k}^{(i)}\}) \\ cov(Im\{H_{l_k}^{(i)}\}, Re\{H_{l_k}^{(i)}\}) & var(Im\{H_{l_k}^{(i)}\}) \end{bmatrix} \right) \\ \begin{bmatrix} Re\{W_{l_k}^{(i)}\} \\ Im\{W_{l_k}^{(i)}\} \end{bmatrix} &\sim \mathcal{N}\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \right. \\ \left. \begin{bmatrix} var(Re\{W_{l_k}^{(i)}\}) & cov(Re\{W_{l_k}^{(i)}\}, Im\{W_{l_k}^{(i)}\}) \\ cov(Im\{W_{l_k}^{(i)}\}, Re\{W_{l_k}^{(i)}\}) & var(Im\{W_{l_k}^{(i)}\}) \end{bmatrix} \right) \end{aligned} \tag{3.5}$$

$$
\begin{aligned}
E[H_{l_k}^{(i)}] &= 0 \\
E[W_{l_k}^{(i)}] &= 0 \\
E[(H_{l_k}^{(i)})^H H_{l_k}^{(i)}] &= N^{(3-i)} I_{N^{(i)}} \\
E[H_{l_k}^{(i)} (H_{l_k}^{(i)})^H] &= N^{(i)} I_{N^{(3-i)}} \\
E[(W_{l_k}^{(i)})^H W_{l_k}^{(i)}] &= N^{(3-i)} I_{n_c} \\
E[W_{l_k}^{(i)} (W_{l_k}^{(i)})^H] &= n_c I_{N^{(3-i)}} \\
E[(H_{l_k}^{(i)})^T H_{l_k}^{(i)}] &= 0 \\
E[H_{l_k}^{(i)} (H_{l_k}^{(i)})^T] &= 0 \\
E[(W_{l_k}^{(i)})^T W_{l_k}^{(i)}] &= 0 \\
E[W_{l_k}^{(i)} (W_{l_k}^{(i)})^T] &= 0
\end{aligned}
\tag{3.6}
$$

Let h_w be an entry of any matrices $H_{l_k}^{(1)}$, $W_{l_k}^{(1)}$, $H_{l_k}^{(2)}$ and $W_{l_k}^{(2)}$. Then, it can be said that [33, Exercise 3.24]

$$
\begin{aligned}
E[|h_w|^4] &= 3(E[(Re\{h_w\})^2])^2 + 3(E[(Im\{h_w\})^2])^2 \\
&+2E[(Re\{h_w\})^2]E[(Im\{h_w\})^2] + 4(E[Re\{h_w\}Im\{h_w\}])^2 \\
&= 3(E[(Re\{h_w\})^2])^2 + 3(1 - E[(Re\{h_w\})^2])^2 \\
&+2E[(Re\{h_w\})^2](1 - E[(Re\{h_w\})^2]) + 4(E[Re\{h_w\}Im\{h_w\}])^2 \\
&= 4(E[(Re\{h_w\})^2])^2 - 4E[(Re\{h_w\})^2] + 3 + 4(E[Re\{h_w\}Im\{h_w\}])^2
\end{aligned}
\tag{3.7}
$$

Assuming that $Re\{h_w\}$ and $Im\{h_w\}$ are i.i.d, then

$$
E[|h_w|^4] = 4(E[(Re\{h_w\})^2])^2 - 4E[(Re\{h_w\})^2] + 3 \tag{3.8}
$$

Assuming also that $E[(Re\{h_w\})^2] = \frac{1}{2}$, then

$$
E[|h_w|^4] = 2 \tag{3.9}
$$

The channel estimation is performed as follows. For each RB per hop, the transmitted and received symbols can be decomposed into dedicated pilot and data components as,

$$
\begin{aligned}
X_{l_k}^{(1)} &= [X_{l_k}^{(1,p)} X_{l_k}^{(1,d)}] \\
X_{l_k}^{(2)} &= [X_{l_k}^{(2,p)} X_{l_k}^{(2,d)}] \\
Y_{l_k}^{(1)} &= [Y_{l_k}^{(1,p)} Y_{l_k}^{(1,d)}] \\
Y_{l_k}^{(2)} &= [Y_{l_k}^{(2,p)} Y_{l_k}^{(2,d)}]
\end{aligned}
\tag{3.10}
$$

Deducing that

$$\begin{aligned} E[X_{l_k}^{(i,p)}] &= 0 \\ E[(X_{l_k}^{(i,p)})^H X_{l_k}^{(i,p)}] &= \rho_i I_{n_p} \\ E[X_{l_k}^{(i,p)}(X_{l_k}^{(i,p)})^H] &= n_p \frac{\rho_i}{N^{(i)}} I_{N^{(i)}} \\ E[X_{l_k}^{(i,d)}] &= 0 \\ E[(X_{l_k}^{(i,d)})^H X_{l_k}^{(i,d)}] &= \rho_i I_{n_d} \\ E[X_{l_k}^{(i,d)}(X_{l_k}^{(i,d)})^H] &= n_d \frac{\rho_i}{N^{(i)}} I_{N^{(i)}} \end{aligned} \tag{3.11}$$

The estimated channel gain matrices from the pilot symbols are therefore given by

$$\begin{aligned} \widehat{H_{l_k}^{(1)}} &= \frac{N^{(1)}}{\rho_1 n_p} Y_{l_k}^{(1,p)} [X_{l_k}^{(1,p)}]^H = \frac{N}{\rho_1 n_p} Y_{l_k}^{(1,p)} [X_{l_k}^{(1,p)}]^H \\ \widehat{H_{l_k}^{(2)}} &= \frac{N^{(2)}}{\rho_2 n_p} Y_{l_k}^{(2,p)} [X_{l_k}^{(2,p)}]^H = \frac{N_B}{\rho_2 n_p} Y_{l_k}^{(2,p)} [X_{l_k}^{(2,p)}]^H \end{aligned} \tag{3.12}$$

At this point, it should be pointed out that several variants of the resource allocation problem, based on different assumptions on CSI knowledge, estimation and use can be solved. Once the channel state is estimated, it can be used to instantaneously adapt the number of RBs needed, as well as the modulation orders assigned to them. However, this is rarely done in practice due to the complexity involved, particularly considering the short packet scenario. In this thesis, the use of the estimated CSI will be limited to decoding only, and the resource blocks will be allocated with respect to the average channel SNR. The CSI will be estimated from pilots, and the decoding of data will be done based on these estimates, by employing mismatched decoding. By using random coding union bounds from finite blocklength literature [18, 21], the following problem statement can be obtained:

$$\min_{\Xi_k^{(1)}, \Xi_k^{(2)}, b_{l_k}} \quad \sum_{k=1}^{K} (L_k^{(1)} + L_k^{(2)}) \tag{3.13}$$

$$\begin{aligned} \text{s.t.} \quad & n_c \mathcal{R}_k^{(1)} \sum_{l_k \in \Xi_k^{(1)}} b_{l_k} \geq B_k \\ & n_c \mathcal{R}_k^{(2)} \sum_{l_k \in \Xi_k^{(2)}} b_{l_k} \geq B_k \end{aligned} \tag{3.14}$$

$$\begin{aligned} P_{e,k}^{(1)} &\leq E[\exp(-[(\sum_{l_k \in \Xi_k^{(1)}} I_\alpha(X_{l_k}^{(1)}, Y_{l_k}^{(1)})) - \log(2^{B_k} - 1)]^+)] = \bar{\epsilon}_k^{(1)} \leq \epsilon_1 \\ P_{e,k}^{(2)} &\leq E[\exp(-[(\sum_{l_k \in \Xi_k^{(2)}} I_\alpha(X_{l_k}^{(2)}, Y_{l_k}^{(2)})) - \log(2^{B_k} - 1)]^+)] = \bar{\epsilon}_k^{(2)} \leq \epsilon_2 \end{aligned} \tag{3.15}$$

where $\mathcal{R}_k^{(i)}$, $i = 1, 2$ is the coding rate in ith hop and kth flow, $P_{e,k}^{(i)}$, $i = 1, 2$ is the packet error probability in ith hop, ϵ_i is the bound on packet error probability, i.e. the mismatched decoding error bound, $I_\alpha(X_{l_k}^{(1)}, Y_{l_k}^{(1)})$ and $I_\alpha(X_{l_k}^{(2)}, Y_{l_k}^{(2)})$ are the generalized information densities defined in terms of the corresponding nearest-neighbor decoding metrics as in [21]. The threshold on packet error probability ϵ_i, which is stated as an external parameter here, will later be tied to one of two constraints: delay violation probability and Peak AoI violation probability, and will be determined accordingly.

The generalized information densities $I_\alpha(X_{l_k}^{(1)}, Y_{l_k}^{(1)})$ and $I_\alpha(X_{l_k}^{(2)}, Y_{l_k}^{(2)})$ are

$$\begin{aligned} I_\alpha(X_{l_k}^{(1)}, Y_{l_k}^{(1)}) &= \log \frac{q(X_{l_k}^{(1)}, Y_{l_k}^{(1)})^\alpha}{E_{\overline{X_{l_k}^{(1)}}}[q(\overline{X_{l_k}^{(1)}}, Y_{l_k}^{(1)})^\alpha]} \\ I_\alpha(X_{l_k}^{(2)}, Y_{l_k}^{(2)}) &= \log \frac{q(X_{l_k}^{(2)}, Y_{l_k}^{(2)})^\alpha}{E_{\overline{X_{l_k}^{(2)}}}[q(\overline{X_{l_k}^{(2)}}, Y_{l_k}^{(2)})^\alpha]} \end{aligned} \tag{3.16}$$

where $\overline{X_{l_k}^{(1)}}$ (resp. $\overline{X_{l_k}^{(2)}}$) has the same distribution with $X_{l_k}^{(1)}$ (resp. $X_{l_k}^{(2)}$) and is independent from $X_{l_k}^{(1)}$ and $Y_{l_k}^{(1)}$ (resp. $X_{l_k}^{(2)}$ and $Y_{l_k}^{(2)}$) and

$$\begin{aligned} q(X_{l_k}^{(1)}, Y_{l_k}^{(1)}) &= \prod_{c=1}^{n_d} \exp(-||y_{l_k,c}^{(1,d)} - \widehat{H_{l_k}^{(1)}} x_{l_k,c}^{(1,d)}||^2) \\ q(X_{l_k}^{(2)}, Y_{l_k}^{(2)}) &= \prod_{c=1}^{n_d} \exp(-||y_{l_k,c}^{(2,d)} - \widehat{H_{l_k}^{(2)}} x_{l_k,c}^{(2,d)}||^2) \end{aligned} \tag{3.17}$$

given that $x_{l_k,c}^{(1,d)}$, $y_{l_k,c}^{(1,d)}$, $x_{l_k,c}^{(2,d)}$ and $y_{l_k,c}^{(2,d)}$ are the cth column of $X_{l_k}^{(1,d)}$, $Y_{l_k}^{(1,d)}$, $X_{l_k}^{(2,d)}$ and $Y_{l_k}^{(2,d)}$, respectively.

Assuming that resource block allocation is done at the beginning of the transmission, is not a function of the instantaneous fading, and the total number of available resource blocks large enough so that it can practically be considered unbounded, the problem of minimizing the number of total resource blocks to satisfy a certain delay violation probability threshold reduces to minimizing the number of resource blocks assigned to each flow in each hop separately, under block error probability constraints. The corresponding single hop problem, $\forall k$ is

$$\min_{\Xi_k^{(i)}, b_{l_k}} \qquad L_k^{(i)} \tag{3.18}$$

$$\text{s.t.} \qquad n_k^{(i)} = n_c L_k^{(i)} \geq B_k \tag{3.19}$$

$$P_{e,k}^{(i)} \leq E[\exp(-[(\sum_{l_k \in \Xi_k^{(i)}} I_\alpha(X_{l_k}^{(i)}, Y_{l_k}^{(i)})) - \log(2^{B_k} - 1)]^+)] = \bar{\epsilon}_k^{(i)} \leq \epsilon_i \tag{3.20}$$

Now, it is time to the characterize additional constraints on packet error probability thresholds ϵ_i to optimize the number of resource blocks for (i) a given delay violation probability threshold and (ii) a given peak age violation probability threshold.

For the delay violation case, let's assume that only one retransmission is allowed in at most one of the hops, i.e., the total transmission time can be at most 3Δ. Then, the delay violation probability threshold, d_k is related to ϵ_i, through

$$\begin{aligned} Pr\{\tau_{k,1} + \tau_{k,2} \leq 3\Delta\} &= Pr\{\tau_{k,1} = \Delta, \tau_{k,2} = \Delta\} + Pr\{\tau_{k,1} = 2\Delta, \tau_{k,2} = \Delta\} \\ &\quad + Pr\{\tau_{k,1} = \Delta, \tau_{k,2} = 2\Delta\} \\ &= (1 - \bar{\epsilon}_k^{(1)})(1 - \bar{\epsilon}_k^{(2)}) + \bar{\epsilon}_k^{(1)}(1 - \bar{\epsilon}_k^{(1)})(1 - \bar{\epsilon}_k^{(2)}) + (1 - \bar{\epsilon}_k^{(1)})\bar{\epsilon}_k^{(2)}(1 - \bar{\epsilon}_k^{(2)}) \\ &= 1 - d_k \end{aligned} \tag{3.21}$$

which need to be jointly solved with Equations (3.13)-(3.15). Here, $\tau_{k,i}$ is the transmission time in ith hop. For the Peak AoI violation case, a LCFS with preemption queueing model as in [21] is assumed, and using [21, Theorem 2] to compute the peak age violation probability $P_{av,k}^{(i)}(a)$,

$$P_{av,k}^{(i)}(a) = Pr\left[G^{(i)} \geq \frac{a}{n_k^{(i)}} - 1\right] = \bar{\epsilon}_k^{(i)\left[\frac{a}{n_k^{(i)}} - 1\right]^+} = \bar{a}_k^{(i)} \leq a_i \tag{3.22}$$

where a is the age threshold in terms of number of symbols, and $G^{(1)} \sim Geom(1 - \bar{\epsilon}_k^{(i)})$. Incorporating these additional constraints into Equations (3.13)-(3.15) to couple Peak AoI violation probability and packet error probability, will yield the optimum resource allocation under prescribed PAoI violation constraints.

3.2 Theoretical Solution Approach

The single hop problem given by Equations (3.18)-(3.20) can be solved. The expectation term in Equation (3.20) can be dealt.

$$\bar{\epsilon}_k^{(i)} = E[\exp(-[(\sum_{l_k \in \Xi_k^{(i)}} I_\alpha(X_{l_k}^{(i)}, Y_{l_k}^{(i)})) - \log(2^{B_k} - 1)]^+)]$$

$$= E[\exp(-[(\sum_{l_k \in \Xi_k^{(i)}} \log \frac{q(X_{l_k}^{(i)}, Y_{l_k}^{(i)})^\alpha}{E_{\overline{X_{l_k}^{(i)}}}[q(\overline{X_{l_k}^{(i)}}, Y_{l_k}^{(i)})^\alpha]}) - \log(2^{B_k} - 1)]^+)]$$

$$= E[\exp(-[\log(\prod_{l_k \in \Xi_k^{(i)}} \frac{q(X_{l_k}^{(i)}, Y_{l_k}^{(i)})^\alpha}{E_{\overline{X_{l_k}^{(i)}}}[q(\overline{X_{l_k}^{(i)}}, Y_{l_k}^{(i)})^\alpha]}) - \log(2^{B_k} - 1)]^+)]$$

$$= E[\exp(-\max\{0, \log(\prod_{l_k \in \Xi_k^{(i)}} \frac{q(X_{l_k}^{(i)}, Y_{l_k}^{(i)})^\alpha}{E_{\overline{X_{l_k}^{(i)}}}[q(\overline{X_{l_k}^{(i)}}, Y_{l_k}^{(i)})^\alpha]}) - \log(2^{B_k} - 1)\})]$$

$$= E[\exp(\min\{0, \log(2^{B_k} - 1) - \log(\prod_{l_k \in \Xi_k^{(i)}} \frac{q(X_{l_k}^{(i)}, Y_{l_k}^{(i)})^\alpha}{E_{\overline{X_{l_k}^{(i)}}}[q(\overline{X_{l_k}^{(i)}}, Y_{l_k}^{(i)})^\alpha]})\})]$$

$$= E[\min\{1, (2^{B_k} - 1)(\prod_{l_k \in \Xi_k^{(i)}} E_{\overline{X_{l_k}^{(i)}}}[\frac{q(\overline{X_{l_k}^{(i)}}, Y_{l_k}^{(i)})^\alpha}{q(X_{l_k}^{(i)}, Y_{l_k}^{(i)})^\alpha}])\}]$$

$$\implies \bar{\epsilon}_k^{(i)} = E[\min\{1, (2^{B_k} - 1)(\prod_{l_k \in \Xi_k^{(i)}} E_{\overline{X_{l_k}^{(i)}}}[\frac{q(\overline{X_{l_k}^{(i)}}, Y_{l_k}^{(i)})^\alpha}{q(X_{l_k}^{(i)}, Y_{l_k}^{(i)})^\alpha}])\}] \tag{3.23}$$

The terms related to q function can be expanded. The first one can be calculated as follows:

$$q(X_{l_k}^{(i)}, Y_{l_k}^{(i)}) = \prod_{c=1}^{n_d} \exp(-||y_{l_k,c}^{(i,d)} - \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)}||^2)$$

$$= \prod_{c=1}^{n_d} \exp(-||H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} + w_{l_k,c}^{(i,d)} - \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)}||^2)$$

$$= \prod_{c=1}^{n_d} \exp(-||(H_{l_k}^{(i)} - \widehat{H_{l_k}^{(i)}}) x_{l_k,c}^{(i,d)} + w_{l_k,c}^{(i,d)}||^2)$$

Let $T_{l_k}^{(i,p)} = H_{l_k}^{(i)} - \widehat{H_{l_k}^{(i)}}$, then

$$q(X_{l_k}^{(i)}, Y_{l_k}^{(i)}) = \prod_{c=1}^{n_d} \exp(-||T_{l_k}^{(i,p)} x_{l_k,c}^{(i,d)} + w_{l_k,c}^{(i,d)}||^2)$$

$$= \prod_{c=1}^{n_d} \exp(-([x_{l_k,c}^{(i,d)}]^H [T_{l_k}^{(i,p)}]^H T_{l_k}^{(i,p)} x_{l_k,c}^{(i,d)} + [x_{l_k,c}^{(i,d)}]^H [T_{l_k}^{(i,p)}]^H w_{l_k,c}^{(i,d)}$$

$$+[w_{l_k,c}^{(i,d)}]^H T_{l_k}^{(i,p)} x_{l_k,c}^{(i,d)} + [w_{l_k,c}^{(i,d)}]^H w_{l_k,c}^{(i,d)}))$$

$$= \exp(-\sum_{c=1}^{n_d} ([x_{l_k,c}^{(i,d)}]^H [T_{l_k}^{(i,p)}]^H T_{l_k}^{(i,p)} x_{l_k,c}^{(i,d)} + [x_{l_k,c}^{(i,d)}]^H [T_{l_k}^{(i,p)}]^H w_{l_k,c}^{(i,d)}$$

$$+[w_{l_k,c}^{(i,d)}]^H T_{l_k}^{(i,p)} x_{l_k,c}^{(i,d)} + [w_{l_k,c}^{(i,d)}]^H w_{l_k,c}^{(i,d)}))$$

$$\implies q(X_{l_k}^{(i)}, Y_{l_k}^{(i)}) = \exp(-\sum_{c=1}^{n_d} ([x_{l_k,c}^{(i,d)}]^H [T_{l_k}^{(i,p)}]^H T_{l_k}^{(i,p)} x_{l_k,c}^{(i,d)}$$

$$+[x_{l_k,c}^{(i,d)}]^H [T_{l_k}^{(i,p)}]^H w_{l_k,c}^{(i,d)} + [w_{l_k,c}^{(i,d)}]^H T_{l_k}^{(i,p)} x_{l_k,c}^{(i,d)} + [w_{l_k,c}^{(i,d)}]^H w_{l_k,c}^{(i,d)}))$$

The second one can be calculated as follows:

$$q(\overline{X_{l_k}^{(i)}}, Y_{l_k}^{(i)}) = \prod_{c=1}^{n_d} \exp(-||y_{l_k,c}^{(i,d)} - \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}||^2)$$

$$= \prod_{c=1}^{n_d} \exp(-||H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} + w_{l_k,c}^{(i,d)} - \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}||^2)$$

$$= \prod_{c=1}^{n_d} \exp(-([x_{l_k,c}^{(i,d)}]^H [H_{l_k}^{(i)}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} + [x_{l_k,c}^{(i,d)}]^H [H_{l_k}^{(i)}]^H w_{l_k,c}^{(i,d)}$$

$$-[x_{l_k,c}^{(i,d)}]^H [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}} + [w_{l_k,c}^{(i,d)}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} + [w_{l_k,c}^{(i,d)}]^H w_{l_k,c}^{(i,d)} - [w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}$$

$$-[\overline{x_{l_k,c}^{(i,d)}}]^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} - [\overline{x_{l_k,c}^{(i,d)}}]^H [\widehat{H_{l_k}^{(i)}}]^H w_{l_k,c}^{(i,d)} + [\overline{x_{l_k,c}^{(i,d)}}]^H [\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}))$$

$$= \exp(-\sum_{c=1}^{n_d} ([x_{l_k,c}^{(i,d)}]^H [H_{l_k}^{(i)}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} + [x_{l_k,c}^{(i,d)}]^H [H_{l_k}^{(i)}]^H w_{l_k,c}^{(i,d)}$$

$$-[x_{l_k,c}^{(i,d)}]^H [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}} + [w_{l_k,c}^{(i,d)}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} + [w_{l_k,c}^{(i,d)}]^H w_{l_k,c}^{(i,d)} - [w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}$$

$$-[\overline{x_{l_k,c}^{(i,d)}}]^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} - [\overline{x_{l_k,c}^{(i,d)}}]^H [\widehat{H_{l_k}^{(i)}}]^H w_{l_k,c}^{(i,d)} + [\overline{x_{l_k,c}^{(i,d)}}]^H [\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}))$$

$$\implies q(\overline{X_{l_k}^{(i)}}, Y_{l_k}^{(i)}) = \exp(-\sum_{c=1}^{n_d} ([x_{l_k,c}^{(i,d)}]^H [H_{l_k}^{(i)}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} + [x_{l_k,c}^{(i,d)}]^H [H_{l_k}^{(i)}]^H w_{l_k,c}^{(i,d)}$$

$$-[x_{l_k,c}^{(i,d)}]^H [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}} + [w_{l_k,c}^{(i,d)}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} + [w_{l_k,c}^{(i,d)}]^H w_{l_k,c}^{(i,d)} - [w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}$$

$$-[\overline{x_{l_k,c}^{(i,d)}}]^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} - [\overline{x_{l_k,c}^{(i,d)}}]^H [\widehat{H_{l_k}^{(i)}}]^H w_{l_k,c}^{(i,d)} + [\overline{x_{l_k,c}^{(i,d)}}]^H [\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}))$$

So the ratio of the terms related to q function can be calculated as follows:

$$\frac{q(\overline{X_{l_k}^{(i)}}, Y_{l_k}^{(i)})}{q(X_{l_k}^{(i)}, Y_{l_k}^{(i)})} = \exp(\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H[T_{l_k}^{(i,p)}]^H T_{l_k}^{(i,p)} x_{l_k,c}^{(i,d)}$$
$$+[x_{l_k,c}^{(i,d)}]^H[T_{l_k}^{(i,p)}]^H w_{l_k,c}^{(i,d)} + [w_{l_k,c}^{(i,d)}]^H T_{l_k}^{(i,p)} x_{l_k,c}^{(i,d)} + [w_{l_k,c}^{(i,d)}]^H w_{l_k,c}^{(i,d)}$$
$$-[x_{l_k,c}^{(i,d)}]^H[H_{l_k}^{(i)}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} - [x_{l_k,c}^{(i,d)}]^H[H_{l_k}^{(i)}]^H w_{l_k,c}^{(i,d)} + [x_{l_k,c}^{(i,d)}]^H[H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}$$
$$-[w_{l_k,c}^{(i,d)}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} - [w_{l_k,c}^{(i,d)}]^H w_{l_k,c}^{(i,d)} + [w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}$$
$$+[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} + [\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H w_{l_k,c}^{(i,d)} - [\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))$$

$$= \exp(\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([T_{l_k}^{(i,p)}]^H T_{l_k}^{(i,p)} - [H_{l_k}^{(i)}]^H H_{l_k}^{(i)}) x_{l_k,c}^{(i,d)}$$
$$+[x_{l_k,c}^{(i,d)}]^H([T_{l_k}^{(i,p)}]^H - [H_{l_k}^{(i)}]^H) w_{l_k,c}^{(i,d)} + [w_{l_k,c}^{(i,d)}]^H(T_{l_k}^{(i,p)} - H_{l_k}^{(i)}) x_{l_k,c}^{(i,d)}$$
$$+[x_{l_k,c}^{(i,d)}]^H[H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}} + [w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}$$
$$+[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} + [\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H w_{l_k,c}^{(i,d)} - [\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))$$

$$= \exp(\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}} - [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}) x_{l_k,c}^{(i,d)}$$
$$-[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H w_{l_k,c}^{(i,d)} - [w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)}$$
$$+[x_{l_k,c}^{(i,d)}]^H[H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}} + [w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}$$
$$+[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} + [\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H w_{l_k,c}^{(i,d)} - [\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))$$

$$= \exp(\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}} - [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}) x_{l_k,c}^{(i,d)}$$
$$-2Re\{[w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)}\} + 2Re\{[w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$
$$+2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\} - [\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))$$

$$\implies \frac{q(\overline{X_{l_k}^{(i)}}, Y_{l_k}^{(i)})}{q(X_{l_k}^{(i)}, Y_{l_k}^{(i)})} = \exp(\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}}$$
$$-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}) x_{l_k,c}^{(i,d)} - 2Re\{[w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)}\} + 2Re\{[w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$
$$+2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\} - [\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))$$

So

$$\bar{\epsilon}_k^{(i)} = E[\min\{1,(2^{B_k}-1)(\prod_{l_k\in\Xi_k^{(i)}} E_{\overline{X_{l_k}^{(i)}}}[\exp(\alpha\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}$$
$$-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})x_{l_k,c}^{(i,d)} - 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\} + 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$
$$+2Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\} - \overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))])\}] \tag{3.24}$$

and Jensen's inequality for the concave minimum function can be used, i.e.

$$\bar{\epsilon}_k^{(i)} = E[\min\{1,(2^{B_k}-1)(\prod_{l_k\in\Xi_k^{(i)}} E_{\overline{X_{l_k}^{(i)}}}[\exp(\alpha\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}$$
$$-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})x_{l_k,c}^{(i,d)} - 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\} + 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$
$$+2Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\} - \overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))])\}]$$
$$\leq \min\{1, E[(2^{B_k}-1)\prod_{l_k\in\Xi_k^{(i)}}(E_{\overline{X_{l_k}^{(i)}}}[\exp(\alpha\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}$$
$$-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})x_{l_k,c}^{(i,d)} - 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\} + 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$
$$+2Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\} - \overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))])]\}$$

Let's define

$$\bar{\epsilon}'^{(i)}_k = E[(2^{B_k}-1)\prod_{l_k\in\Xi_k^{(i)}}(E_{\overline{X_{l_k}^{(i)}}}[\exp(\alpha\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}$$
$$-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})x_{l_k,c}^{(i,d)} - 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\} + 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$
$$+2Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\} - \overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))])] \tag{3.25}$$

3.2.1 Applying Jensen's Inequality

So after applying Jensen's Inequality and thereby loosing the expectation bound,

$$\bar{\epsilon}'^{(i)}_k = E[(2^{B_k}-1)\prod_{l_k\in\Xi_k^{(i)}}(E_{\overline{X_{l_k}^{(i)}}}[\exp(\alpha\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}$$
$$-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})x_{l_k,c}^{(i,d)} - 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\} + 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$
$$+2Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\} - \overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))])]$$

$$= (2^{B_k} - 1) \prod_{l_k \in \Xi_k^{(i)}} E[E_{\overline{X_{l_k}^{(i)}}}[\exp(\alpha \sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}}$$
$$-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}) x_{l_k,c}^{(i,d)} - 2Re\{[w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)}\} + 2Re\{[w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}\}$$
$$+2Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\} - \overline{[x_{l_k,c}^{(i,d)}]}^H [\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}))]]$$

$$= (2^{B_k} - 1)(E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}}[\exp(\alpha \sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}}$$
$$-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}) x_{l_k,c}^{(i,d)} - 2Re\{[w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)}\} + 2Re\{[w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}\}$$
$$+2Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\} - \overline{[x_{l_k,c}^{(i,d)}]}^H [\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}))])^{L_k}$$

$$\implies \bar{\epsilon}_k^{(i)} = (2^{B_k} - 1)(E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}}[\exp(\alpha \sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}}$$
$$-[H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}} - [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}) x_{l_k,c}^{(i,d)} - 2Re\{[w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)}\} \quad (3.26)$$
$$+2Re\{[w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}\} + 2Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\}$$
$$-\overline{[x_{l_k,c}^{(i,d)}]}^H [\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}))])^{L_k}$$

3.2.2 Preparation for Taylor Expansion

Let's examine the terms in the summation in Equation (3.26). The first one can be calculated as follows:

$$[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} = [\frac{N^{(i)}}{\rho_i n_p} Y_{l_k}^{(i,p)} [X_{l_k}^{(i,p)}]^H]^H H_{l_k}^{(i)} = \frac{N^{(i)}}{\rho_i n_p} X_{l_k}^{(i,p)} [Y_{l_k}^{(i,p)}]^H H_{l_k}^{(i)}$$
$$= \frac{N^{(i)}}{\rho_i n_p} X_{l_k}^{(i,p)} [H_{l_k}^{(i)} X_{l_k}^{(i,p)} + W_{l_k}^{(i,p)}]^H H_{l_k}^{(i)}$$
$$= \frac{N^{(i)}}{\rho_i n_p} (X_{l_k}^{(i,p)} [X_{l_k}^{(i,p)}]^H [H_{l_k}^{(i)}]^H H_{l_k}^{(i)} + X_{l_k}^{(i,p)} [W_{l_k}^{(i,p)}]^H H_{l_k}^{(i)})$$

The second one can be calculated as follows:

$$[\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} = [\frac{N^{(i)}}{\rho_i n_p} Y_{l_k}^{(i,p)} [X_{l_k}^{(i,p)}]^H]^H \frac{N^{(i)}}{\rho_i n_p} Y_{l_k}^{(i,p)} [X_{l_k}^{(i,p)}]^H$$
$$= (\frac{N^{(i)}}{\rho_i n_p})^2 X_{l_k}^{(i,p)} [Y_{l_k}^{(i,p)}]^H Y_{l_k}^{(i,p)} [X_{l_k}^{(i,p)}]^H$$
$$= (\frac{N^{(i)}}{\rho_i n_p})^2 X_{l_k}^{(i,p)} [H_{l_k}^{(i)} X_{l_k}^{(i,p)} + W_{l_k}^{(i,p)}]^H (H_{l_k}^{(i)} X_{l_k}^{(i,p)} + W_{l_k}^{(i,p)}) [X_{l_k}^{(i,p)}]^H$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 X_{l_k}^{(i,p)}([X_{l_k}^{(i,p)}]^H[H_{l_k}^{(i)}]^H H_{l_k}^{(i)} X_{l_k}^{(i,p)} + [W_{l_k}^{(i,p)}]^H H_{l_k}^{(i)} X_{l_k}^{(i,p)}$$
$$+[X_{l_k}^{(i,p)}]^H[H_{l_k}^{(i)}]^H W_{l_k}^{(i,p)} + [W_{l_k}^{(i,p)}]^H W_{l_k}^{(i,p)})[X_{l_k}^{(i,p)}]^H$$
$$= (\frac{N^{(i)}}{\rho_i n_p})^2 (X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H[H_{l_k}^{(i)}]^H H_{l_k}^{(i)} X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H$$
$$+X_{l_k}^{(i,p)}[W_{l_k}^{(i,p)}]^H H_{l_k}^{(i)} X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H + X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H[H_{l_k}^{(i)}]^H W_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H$$
$$+X_{l_k}^{(i,p)}[W_{l_k}^{(i,p)}]^H W_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H)$$

Let's calculate the expectations of these terms with respect to $H_{l_k}^{(i)}$ and $W_{l_k}^{(i)}$. The first one can be calculated as follows:

$$E_{H_{l_k}^{(i)}, W_{l_k}^{(i)}}[[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}] = \frac{N^{(i)}}{\rho_i n_p}(X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H E[[H_{l_k}^{(i)}]^H H_{l_k}^{(i)}]$$
$$+X_{l_k}^{(i,p)} E[[W_{l_k}^{(i,p)}]^H]E[H_{l_k}^{(i)}])$$
$$= N^{(3-i)}\frac{N^{(i)}}{\rho_i n_p} X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H$$

The second one can be calculated as follows:

$$E_{H_{l_k}^{(i)}, W_{l_k}^{(i)}}[[\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}}] = (\frac{N^{(i)}}{\rho_i n_p})^2 (X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H E[[H_{l_k}^{(i)}]^H H_{l_k}^{(i)}] X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H$$
$$+X_{l_k}^{(i,p)} E[[W_{l_k}^{(i,p)}]^H]E[H_{l_k}^{(i)}] X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H$$
$$+X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H E[[H_{l_k}^{(i)}]^H]E[W_{l_k}^{(i,p)}][X_{l_k}^{(i,p)}]^H$$
$$+X_{l_k}^{(i,p)} E[[W_{l_k}^{(i,p)}]^H W_{l_k}^{(i,p)}][X_{l_k}^{(i,p)}]^H)$$
$$= N^{(3-i)}(\frac{N^{(i)}}{\rho_i n_p})^2 (X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H + X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H)$$

Let's calculate the expectation of the overall term with respect to $H_{l_k}^{(i)}$ and $W_{l_k}^{(i)}$ in the summation in Equation (3.26).

$$\mu(X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}) = E_{H_{l_k}^{(i)}, W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}} - [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}) x_{l_k,c}^{(i,d)}$$
$$-2Re\{[w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)}\} + 2Re\{[w_{l_k,c}^{(i,d)}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}\} +$$
$$2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\} - [\overline{x_{l_k,c}^{(i,d)}}]^H [\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}]$$
$$= [x_{l_k,c}^{(i,d)}]^H E[([\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}} - [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})] x_{l_k,c}^{(i,d)}$$
$$+2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H E[[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}] x_{l_k,c}^{(i,d)}\} - [\overline{x_{l_k,c}^{(i,d)}}]^H E[[\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}}] \overline{x_{l_k,c}^{(i,d)}}$$
$$= [x_{l_k,c}^{(i,d)}]^H E[[\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}}] x_{l_k,c}^{(i,d)} - 2Re\{[x_{l_k,c}^{(i,d)}]^H E[[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}] x_{l_k,c}^{(i,d)}\}$$
$$+2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H E[[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}] x_{l_k,c}^{(i,d)}\} - [\overline{x_{l_k,c}^{(i,d)}}]^H E[[\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}}] \overline{x_{l_k,c}^{(i,d)}}$$

$$= [x_{l_k,c}^{(i,d)}]^H N^{(3-i)} (\frac{N^{(i)}}{\rho_i n_p})^2 (X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H + X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H) x_{l_k,c}^{(i,d)}$$

$$-2Re\{([x_{l_k,c}^{(i,d)}]^H - [\overline{x_{l_k,c}^{(i,d)}}]^H) N^{(3-i)} \frac{N^{(i)}}{\rho_i n_p} X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H x_{l_k,c}^{(i,d)}\}$$

$$-[\overline{x_{l_k,c}^{(i,d)}}]^H N^{(3-i)} (\frac{N^{(i)}}{\rho_i n_p})^2 (X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H + X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H) \overline{x_{l_k,c}^{(i,d)}}$$

$$= N^{(3-i)} (\frac{N^{(i)}}{\rho_i n_p})^2 ([x_{l_k,c}^{(i,d)}]^H X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H x_{l_k,c}^{(i,d)}$$

$$-[\overline{x_{l_k,c}^{(i,d)}}]^H X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H \overline{x_{l_k,c}^{(i,d)}} + [x_{l_k,c}^{(i,d)}]^H X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H x_{l_k,c}^{(i,d)}$$

$$-2\frac{\rho_i n_p}{N^{(i)}} Re\{([x_{l_k,c}^{(i,d)}]^H - [\overline{x_{l_k,c}^{(i,d)}}]^H) X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H x_{l_k,c}^{(i,d)}\} - [\overline{x_{l_k,c}^{(i,d)}}]^H X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H \overline{x_{l_k,c}^{(i,d)}})$$

$$\implies \mu(X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}) = N^{(3-i)} (\frac{N^{(i)}}{\rho_i n_p})^2 (||X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H x_{l_k,c}^{(i,d)}||^2$$

$$-||X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H \overline{x_{l_k,c}^{(i,d)}}||^2 + |||[X_{l_k}^{(i,p)}]^H x_{l_k,c}^{(i,d)}||^2 - |||[X_{l_k}^{(i,p)}]^H \overline{x_{l_k,c}^{(i,d)}}||^2$$

$$-2\frac{\rho_i n_p}{N^{(i)}} Re\{([x_{l_k,c}^{(i,d)}]^H - [\overline{x_{l_k,c}^{(i,d)}}]^H) X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H x_{l_k,c}^{(i,d)}\})$$

Let's calculate $E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}}[\mu(X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}})]]$.

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}}[\mu(X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}})]] = E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}}[N^{(3-i)} (\frac{N^{(i)}}{\rho_i n_p})^2 (||X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H x_{l_k,c}^{(i,d)}||^2$$

$$-||X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H \overline{x_{l_k,c}^{(i,d)}}||^2 + |||[X_{l_k}^{(i,p)}]^H x_{l_k,c}^{(i,d)}||^2 - |||[X_{l_k}^{(i,p)}]^H \overline{x_{l_k,c}^{(i,d)}}||^2$$

$$-2\frac{\rho_i n_p}{N^{(i)}} Re\{([x_{l_k,c}^{(i,d)}]^H - [\overline{x_{l_k,c}^{(i,d)}}]^H) X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H x_{l_k,c}^{(i,d)}\})]$$

$$= E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}}[N^{(3-i)} (\frac{N^{(i)}}{\rho_i n_p})^2 (-2\frac{\rho_i n_p}{N^{(i)}} Re\{([x_{l_k,c}^{(i,d)}]^H - [\overline{x_{l_k,c}^{(i,d)}}]^H) X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H x_{l_k,c}^{(i,d)}\})]$$

$$= -2N^{(3-i)} \frac{N^{(i)}}{\rho_i n_p} Re\{E_{X_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H X_{l_k}^{(i,p)}[X_{l_k}^{(i,p)}]^H x_{l_k,c}^{(i,d)}]\}$$

$$= -2N^{(3-i)} \frac{N^{(i)}}{\rho_i n_p} Re\{E_{X_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H n_p \frac{\rho_i}{N^{(i)}} I_{N^{(i)}} x_{l_k,c}^{(i,d)}]\}$$

$$= -2N^{(3-i)} Re\{E_{X_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H x_{l_k,c}^{(i,d)}]\} = -2\rho_i N^{(3-i)}$$

So

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}}[\mu(X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}})] = -2\rho_i N^{(3-i)} \tag{3.27}$$

In Equation (3.26), it can be deduced that

$$
\begin{aligned}
&E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\alpha\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}-[H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}-[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)})x_{l_k,c}^{(i,d)}\\
&\quad -2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}+2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}\\
&\quad +2Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}-\overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}})]\\
&=\alpha\sum_{c=1}^{n_d}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}-[H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}-[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)})x_{l_k,c}^{(i,d)}\\
&\quad -2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}+2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}\\
&\quad +2Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}-\overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}]\\
&\quad =\alpha\sum_{c=1}^{n_d}(-2\rho_iN^{(3-i)})=-2\alpha\rho_in_dN^{(3-i)}
\end{aligned}
\tag{3.28}
$$

3.2.3 Second Order Taylor Expansion

Using the Second Order Taylor Expansion

$$
\begin{aligned}
\exp(\alpha t)&\approx e^{-2\alpha\rho_in_dN^{(3-i)}}(1+\alpha t+2\alpha\rho_in_dN^{(3-i)}+\frac{(\alpha t+2\alpha\rho_in_dN^{(3-i)})^2}{2})\\
&=e^{-2\alpha\rho_in_dN^{(3-i)}}(1+2\alpha\rho_in_dN^{(3-i)}+\alpha t\\
&\quad +\frac{\alpha^2}{2}(t^2+4\rho_in_dN^{(3-i)}t+4(\rho_in_dN^{(3-i)})^2))\\
&=e^{-2\alpha\rho_in_dN^{(3-i)}}(1+2\alpha\rho_in_dN^{(3-i)}+2\alpha^2(\rho_in_dN^{(3-i)})^2\\
&\quad +(\alpha+2\alpha^2\rho_in_dN^{(3-i)})t+\frac{\alpha^2}{2}t^2)
\end{aligned}
$$

Equation (3.26) becomes

$$
\begin{aligned}
\bar{\epsilon}_k^{(i)}&=(2^{B_k}-1)(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\exp(\alpha\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\\
&\quad -[H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}-[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)})x_{l_k,c}^{(i,d)}-2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}\\
&\quad +2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}+2Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}\\
&\quad -\overline{[x_{l_k,c}^{(i,d)}]}^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))])^{L_k}
\end{aligned}
$$

$$= (2^{B_k}-1)(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[e^{-2\alpha\rho_i n_d N^{(3-i)}}(1+2\alpha\rho_i n_d N^{(3-i)}$$

$$+2\alpha^2(\rho_i n_d N^{(3-i)})^2+(\alpha+2\alpha^2\rho_i n_d N^{(3-i)})\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}-[H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}$$

$$-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})x_{l_k,c}^{(i,d)}-2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}+2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$

$$+2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}-[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}})$$

$$+\frac{\alpha^2}{2}(\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}-[H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}$$

$$-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})x_{l_k,c}^{(i,d)}-2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}+2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$

$$+2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}-[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))^2)])^{L_k}$$

$$= (2^{B_k}-1)e^{-2\alpha\rho_i n_d N^{(3-i)}L_k}(1+2\alpha\rho_i n_d N^{(3-i)}$$

$$+2\alpha^2(\rho_i n_d N^{(3-i)})^2+(\alpha+2\alpha^2\rho_i n_d N^{(3-i)})E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}$$

$$-[H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})x_{l_k,c}^{(i,d)}-2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}+2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$

$$+2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}-[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}})]$$

$$+\frac{\alpha^2}{2}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}-[H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}$$

$$-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})x_{l_k,c}^{(i,d)}-2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}+2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$

$$+2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}-[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))^2])^{L_k}$$

$$= (2^{B_k}-1)e^{-2\alpha\rho_i n_d N^{(3-i)}L_k}(1+2\alpha\rho_i n_d N^{(3-i)}$$

$$+2\alpha^2(\rho_i n_d N^{(3-i)})^2+(\alpha+2\alpha^2\rho_i n_d N^{(3-i)})(-2\rho_i n_d N^{(3-i)})$$

$$+\frac{\alpha^2}{2}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}-[H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}$$

$$-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})x_{l_k,c}^{(i,d)}-2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}+2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$

$$+2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}-[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))^2])^{L_k}$$

$$= (2^{B_k}-1)e^{-2\alpha\rho_i n_d N^{(3-i)}L_k}(1-2\alpha^2(\rho_i n_d N^{(3-i)})^2$$

$$+\frac{\alpha^2}{2}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}-[H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}-[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})x_{l_k,c}^{(i,d)}$$

$$-2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}+2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$

$$+2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}-[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))^2])^{L_k}$$

$$\implies \bar{\epsilon'}_k^{(i)} = (2^{B_k}-1)e^{-2\alpha\rho_i n_d N^{(3-i)} L_k}(1-2\alpha^2(\rho_i n_d N^{(3-i)})^2$$
$$+\frac{\alpha^2}{2}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H([\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}} - [H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}} - [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)})x_{l_k,c}^{(i,d)}$$
$$-2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\} + 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$
$$+2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\} - [\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))^2])^{L_k} \tag{3.29}$$

3.2.4 Expectation of the Second Order Term

Let's calculate the expectation term in Equation (3.29).

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{c=1}^{n_d}([x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)} - 2Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}$$
$$-2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\} + 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}$$
$$+2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\} - [\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}))^2]$$
$$=\sum_{c=1}^{n_d}\sum_{e=1}^{n_d}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[([x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}$$
$$-2Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\} - 2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}$$
$$+2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\} + 2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}$$
$$-[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}})([x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,e}^{(i,d)}$$
$$-2Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\} - 2Re\{[w_{l_k,e}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,e}^{(i,d)}\}$$
$$+2Re\{[w_{l_k,e}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,e}^{(i,d)}}\} + 2Re\{[\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\}$$
$$-[\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,e}^{(i,d)}})]$$

$$
\begin{aligned}
&= \sum_{c=1}^{n_d}\sum_{e=1}^{n_d} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}([x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,e}^{(i,d)} \\
&\quad -2Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\} - [\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,e}^{(i,d)}}) \\
&\quad -2Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}([x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,e}^{(i,d)} \\
&\quad -2Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\} - [\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,e}^{(i,d)}}) \\
&\quad -2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}(-2Re\{[w_{l_k,e}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,e}^{(i,d)}\}) \\
&\quad +2Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}\}(2Re\{[w_{l_k,e}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,e}^{(i,d)}}\}) \\
&\quad +2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}(2Re\{[\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\}) \\
&\quad -[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}([x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,e}^{(i,d)} \\
&\quad -2Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\} - [\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,e}^{(i,d)}})] \\
&= \sum_{c=1}^{n_d}\sum_{e=1}^{n_d} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}(2[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,e}^{(i,d)} \\
&\quad -4Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\} - 2[\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,e}^{(i,d)}}) \\
&\quad -2Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}(-2Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\} \\
&-2[\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,e}^{(i,d)}}) + 8Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}Re\{[w_{l_k,e}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,e}^{(i,d)}\} \\
&\quad +4Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{[\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\}] \\
&= 2\sum_{c=1}^{n_d}\sum_{e=1}^{n_d} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,e}^{(i,d)} \\
&\quad -2[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\} \\
&\quad -[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,e}^{(i,d)}} \\
&\quad +2Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\} \\
&\quad +2Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}[\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,e}^{(i,d)}} \\
&\quad +4Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}Re\{[w_{l_k,e}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,e}^{(i,d)}\} \\
&\quad +2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{[\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\}]
\end{aligned}
$$

$$
\begin{aligned}
&= 2\sum_{c=1}^{n_d}\sum_{e=1}^{n_d} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,e}^{(i,d)} \\
&\quad -[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,e}^{(i,d)}} \\
&\quad -2[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\} \\
&\quad +2Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}[\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,e}^{(i,d)}} \\
&\quad +2Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\} \\
&\quad +2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{[\overline{x_{l_k,e}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\} \\
&\quad +4Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}Re\{[w_{l_k,e}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,e}^{(i,d)}\}] \\
&= 2(\sum_{c=1}^{n_d} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)} \\
&\quad -[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}} \\
&\quad -2[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\} \\
&\quad +2Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}} \\
&\quad +2Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\} \\
&\quad +2Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\} \\
&\quad +4Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}] \\
&\quad +\sum_{c=1}^{n_d}\sum_{e=1,e\neq c}^{n_d} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[2Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\} \\
&\quad Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\}])
\end{aligned}
$$

$$= 2(\sum_{c=1}^{n_d}(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}]$$

$$-E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}]$$

$$-2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}]$$

$$+4E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}])$$

$$+2\sum_{c=1}^{n_d}\sum_{e=1,e\neq c}^{n_d}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}$$

$$Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\}])$$

So Equation (3.29) becomes

$$\implies \bar{\epsilon'}_k^{(i)} = (2^{B_k}-1)e^{-2\alpha\rho_i n_d N^{(3-i)}L_k}(1-2\alpha^2(\rho_i n_d N^{(3-i)})^2+$$

$$\alpha^2(\sum_{c=1}^{n_d}(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}]$$

$$-E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}]$$

$$-2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}]$$

$$+4E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}]) + 2\sum_{c=1}^{n_d}\sum_{e=1,e\neq c}^{n_d}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,e}^{(i,d)}\}])))^{L_k} \tag{3.30}$$

Each of these eight expectation terms in Equation (3.30) are calculated in Appendix A, i.e. equations (A.37), (A.38), (A.39), (A.40), (A.41), (A.42), (A.43) and (A.44)

can be substituted into Equation (3.30) and

$$\bar{\epsilon}_k^{(i)} \leq \min\{1, \bar{\epsilon'}_k^{(i)}\} \tag{3.31}$$

CHAPTER 4

SIMULATION SETUP AND NUMERICALLY OPTIMIZED PARAMETERS

In this section, the simulation setup is provided, and the numerically optimized parameter sets which achieve target violation probabilities are presented. A symmetric system, with each user being subject to fading taking values from the same distribution, and same violation thresholds are assumed. Therefore, the numerical optimization of the parameters is only done for user 1, hop 1; the same look up tables can be used for all flows in both hops.

The simulation parameters take the values from Table 4.1. It must be emphasized that the cases $n_p \geq n_1^{(1)}/L_1^{(1)}$ are ignored.

During this simulation, the expression 3.31 found in Section 3.2 isn't used and Monte Carlo approach is used due to two reasons: (i) Jensen's Inequality and (ii) Second Order Taylor Expansion. Using Jensen's Inequality causes the fact that the probability of the expression being less than or equal to 1 isn't calculated and omitted thus, for low SNR values, the expression 3.31 becomes equal to 1 (see Figure 4.1 for the illustration). In Second Order Taylor Expansion of the expression, the second moment is larger than the mean and this situation leads to the pre-assumption that higher order moment terms have larger values and so cannot be ignored during the calculation of Second Order Taylor Expansion, however, in this thesis, mean and second moment are only calculated and higher order terms aren't calculated due to being challenging and thus, for high SNR values, the expression 3.31 becomes rapidly too small (see Figure 4.1 for the illustration). As a result of these two reasons, Monte Carlo approach is used.

During this simulation, MATLAB is used and bound on average packet error prob-

Table 4.1: Parameters used in the simulation.

B_1	32, 64
$n_1^{(1)}$	64, 128, 256
b_{l_1}	2 (4QAM), 4 (16QAM) 6 (64QAM)
l_1	1, 2, 4, 8, 16, 32
n_p	1, 3, 7, 15, 31, 63, 127, 255
N	1
N_B	1
ρ_1 in dB	-10, -6, -2, 2, 6, 10
α	0.4
a (age)	64, 128, 192, 256, 384, 512, 768

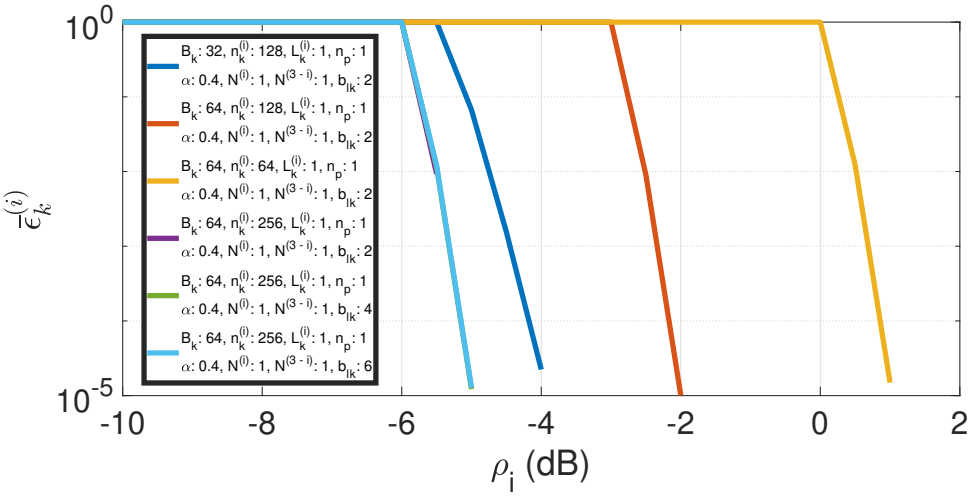

Figure 4.1: The expression 3.31 using parameters from the simulation setup given by Table 4.1

ability values, peak age of information violation probability values and delay violation probability values are calculated and thresholds are applied to these values. Numerically optimized parameters are found to satisfy these thresholds based on an exhaustive search as follows:

i. The first count of information bits value is selected.

ii. The first blocklength value is selected.

iii. index = 1 is selected.

iv. The age value is selected as index times blocklength.

v. The first smallest possible SNR in dB value is obtained.

vi. The smallest possible RB count is obtained.

vii. The smallest pilot symbol count is obtained.

viii. The modulation(s) satisfying the thresholds are reached.

ix. The modulation with whom the smallest peak age of information violation probability value is reached can finally be selected.

x. If there are remaining smallest possible SNR in dB values, the next one is selected and it is made to go to step (vi); else it is made to go to the next step.

xi. index is incremented by 1.

xii. If index < 4, it is made to go to step (iv); else it is made to go to the next step.

xiii. If there are remaining blocklengths, the next one is selected and it is made to go to step (iii); else it is made to go to the next step.

xiv. If there are remaining count of information bits values, the next one is selected and it is made to go to step (ii).

xv. If there is no remaining count of information bits value, numerically optimized parameters are finally reached.

Table 4.2: Numerically Optimized Parameters When $\frac{a}{n_1^{(1)}} = 2$

B_1	$n_1^{(1)}$	mod.	l_1	n_p	ρ_1 in dB	$\bar{\epsilon}_1^{(1)}$	$\bar{a}_1^{(1)}$
32	256	4QAM	1	1	6	9.4E-02	9.4E-02
32	64	4QAM	1	1	10	9.2E-02	9.2E-02
64	128	4QAM	1	15	10	6.1E-02	6.1E-02
64	256	4QAM	1	1	10	5.5E-02	5.5E-02
64	64	4QAM	2	1	10	5.3E-02	5.3E-02
32	128	4QAM	1	15	10	3.4E-02	3.4E-02
64	256	4QAM	32	3	2	1.4E-04	1.4E-04
64	256	4QAM	4	3	6	9.4E-06	9.4E-06
32	128	16QAM	8	3	6	3.9E-06	3.9E-06

To keep the simulation results concise, numerically optimized parameters for target peak age of information violation probabilities in selected regions, i.e., $[10^{-2}, 10^{-1})$, $[10^{-4}, 10^{-3})$, $[10^{-6}, 10^{-5})$, are only reported.

In Tables 4.2 and 4.3, numerically optimized parameters corresponding to unique (B_1, $n_1^{(1)}$, a) triplets are given. In other words, not all of numerically optimized parameters but the selected ones minimizing RB counts and probability values are tabulated. In Table 4.2, the age violation threshold is twice the blocklength, in Table 4.3, it is three times the blocklength, allowing more retransmissions.

Figures 4.2 and 4.3 plot the bounds on average packet error and PAoI Violation probability in a single flow/single hop setting. Fig. 4.4 plots the delay violation probability in a single flow/two hops setting. As expected, increasing the number of information bits within a fixed blocklength increases the error and violation probabilities. In Figures 4.5, 4.6 and 4.7, it is observed that for fixed information content, increasing the blocklength improves the error and violation performance. Note that the improvement through increased blocklength may be more modest in practice, in a time varying channel where the CSI may get stale during the block. The bounds were obtained assuming that the channel remained constant through the block, regardless of the duration of the block.

Table 4.3: Numerically Optimized Parameters When $\frac{a}{n_1^{(1)}} = 3$

B_1	$n_1^{(1)}$	mod.	l_1	n_p	ρ_1 in dB	$\bar{\epsilon}_1^{(1)}$	$\bar{a}_1^{(1)}$
32	256	4QAM	1	3	-2	2.6E-01	6.5E-02
64	256	16QAM	1	3	2	2E-01	3.8E-02
64	128	4QAM	1	1	6	1.8E-01	3.1E-02
64	64	4QAM	1	1	10	1.5E-01	2.1E-02
32	64	16QAM	1	1	10	1.3E-01	1.7E-02
32	128	4QAM	1	1	6	1.3E-01	1.7E-02
64	128	4QAM	4	1	6	2.7E-02	7.5E-04
32	128	4QAM	4	7	2	2.7E-02	7.3E-04
32	256	4QAM	1	31	6	2.7E-02	7.1E-04
32	64	4QAM	2	1	10	2.3E-02	5.4E-04
64	64	4QAM	4	1	10	2.2E-02	4.9E-04
64	128	4QAM	8	3	6	2.7E-03	7.3E-06
64	256	16QAM	16	3	2	2E-03	4.1E-06
32	64	4QAM	8	1	10	1E-03	1E-06
32	256	64QAM	4	15	6	1E-03	1E-06

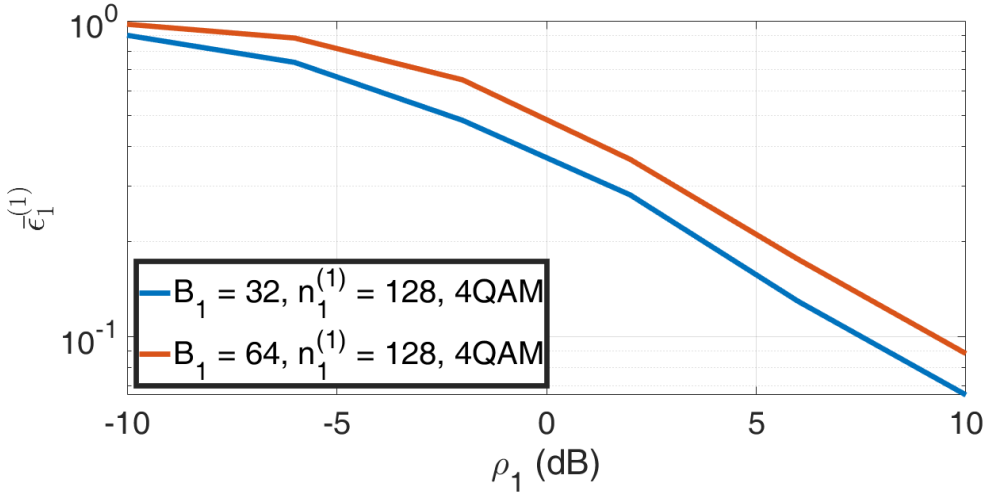

Figure 4.2: The bound on Average Packet Error Probability vs. SNR for two values of the number of information bits B_1, fixed codeword size $n_1^{(1)}$, modulation, l_1, n_p and a.

Figures 4.8, 4.9 and 4.10 depict the block error probability, PAoI violation probability and delay violation probability as a function of the modulation technique being used. While a higher order modulation technique yields a higher error probability, PAoI violation probability and delay violation probability in general, as expected since the constellation points come closer to each other, for low SNR values it is interestingly observed that 16 and 64 QAM perform nearly identically for both metrics. So in this case, it is better to choose 64 QAM in order to get higher bit rate to bandwidth ratio and for bandlimited channels, it is better to choose higher order modulation [32, Section 9.7 Comparison of Modulation Methods].

In Figure 4.11, the number of resource blocks needed on average to satisfy the corresponding Peak AoI Violation probabilities are plotted. To provide a general intuition regarding the required number of RBs, the average number of RBs under different PAoI intervals are plotted. Therefore, it is possible to read these curves as achievability results: any RB on or above the curves are feasible; as there exists at least one resource allocation scheme which will outperform the average for a given SNR. As expected, it is needed to spread out information bits onto more resource blocks, as it is aimed for lower violation probabilities.

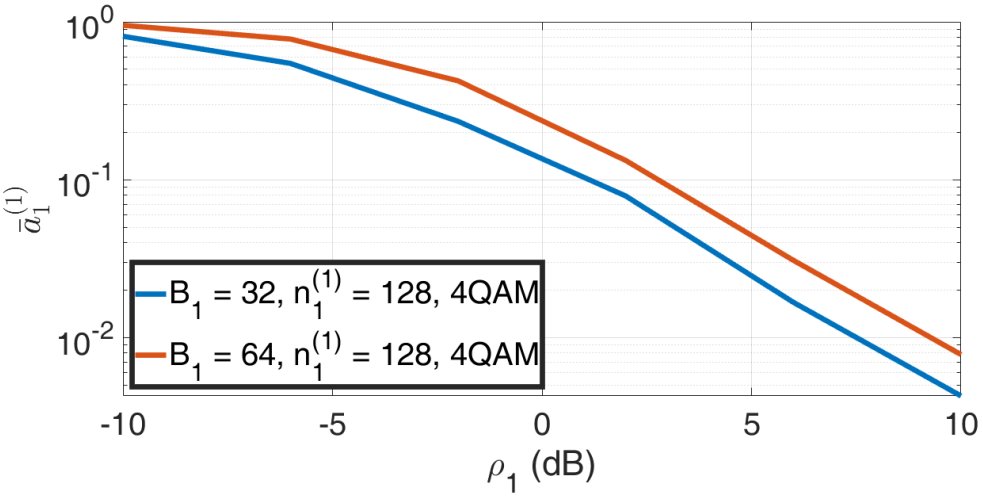

Figure 4.3: PAoI Violation Probability vs. SNR for two values of the number of information bits B_1, fixed codeword size $n_1^{(1)}$, modulation, l_1, n_p and a.

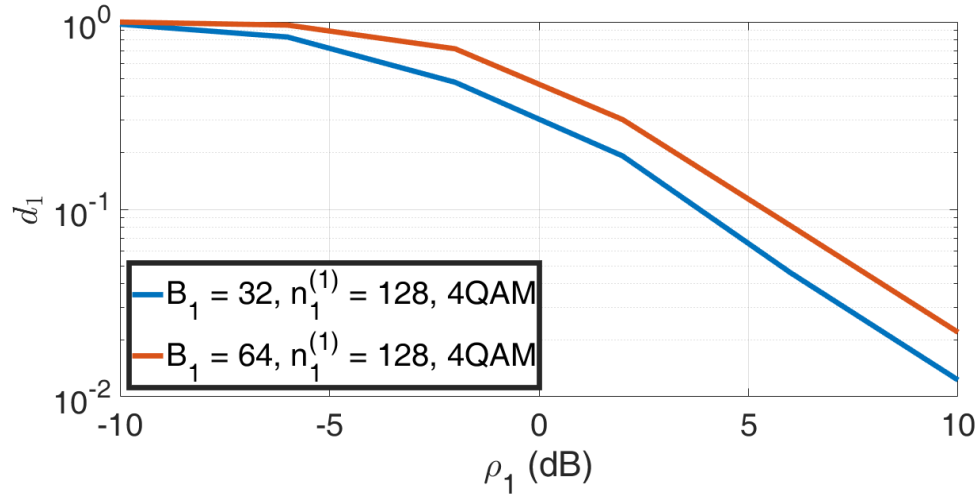

Figure 4.4: Delay Violation Probability vs. SNR for two values of the number of information bits B_1, fixed codeword size $n_1^{(1)}$, modulation, l_1, n_p and a.

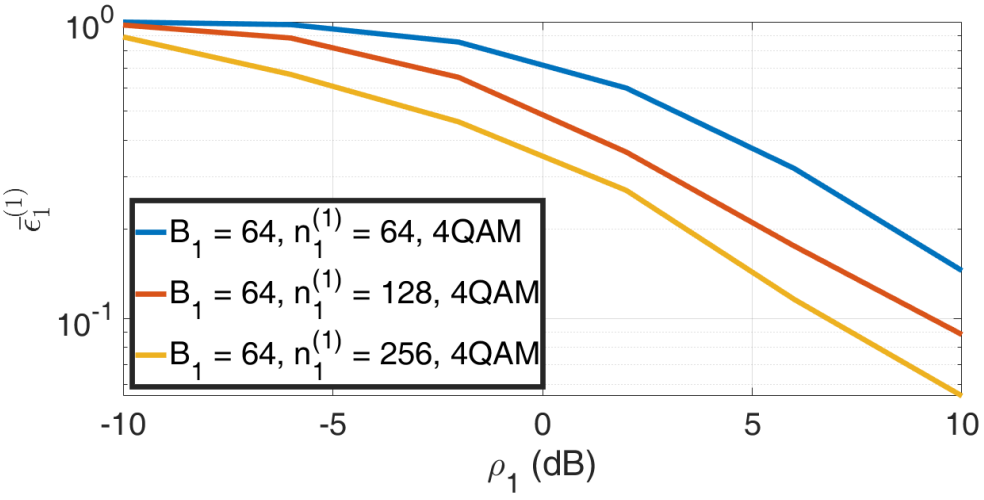

Figure 4.5: Bound On Average Packet Error Probability vs. SNR with respect to codeword length $n_1^{(1)}$ (B_1, modulation, l_1, n_p and a are fixed)

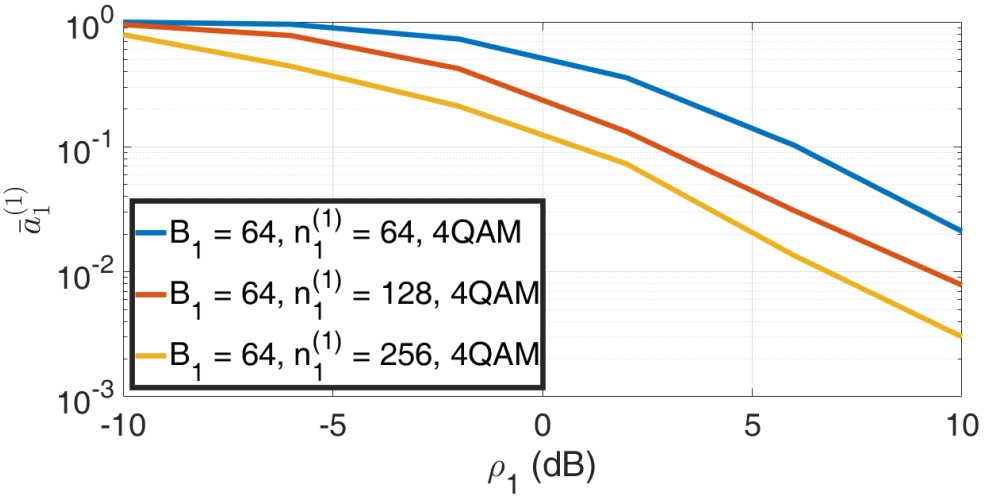

Figure 4.6: Peak Age of Information Violation Probability vs. SNR with respect to codeword length $n_1^{(1)}$ (B_1, modulation, l_1, n_p and a are fixed)

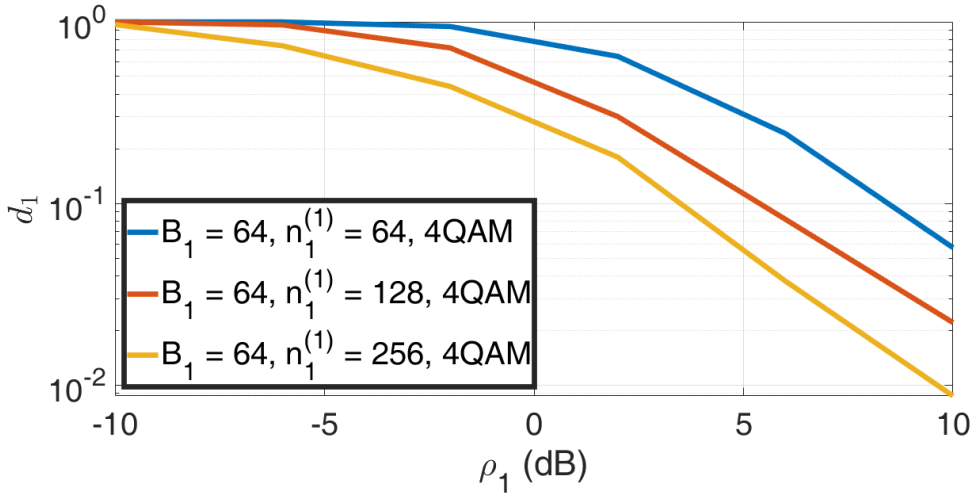

Figure 4.7: Delay Violation Probability vs. SNR with respect to codeword length $n_1^{(1)}$ (B_1, modulation, l_1, n_p and a are fixed)

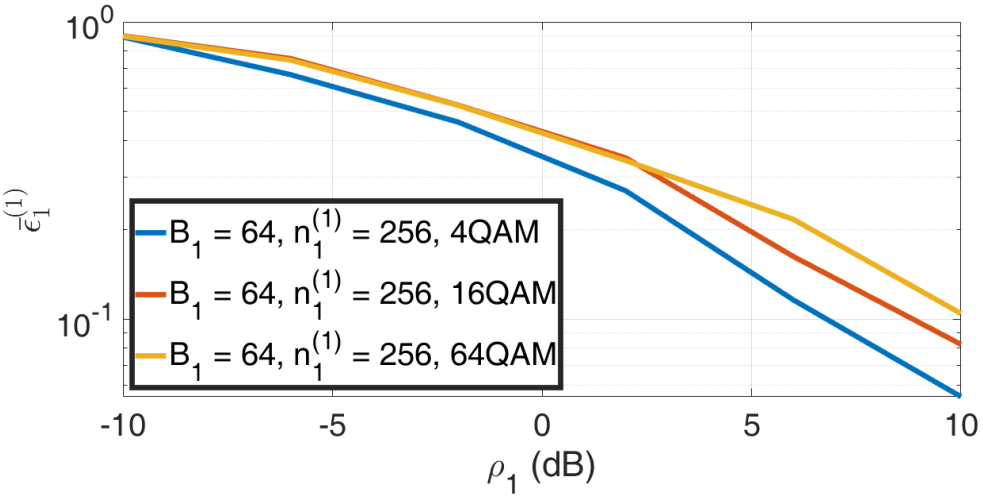

Figure 4.8: Bound On Average Packet Error Probability vs. SNR with respect to modulation (B_1, $n_1^{(1)}$, l_1, n_p and a are fixed

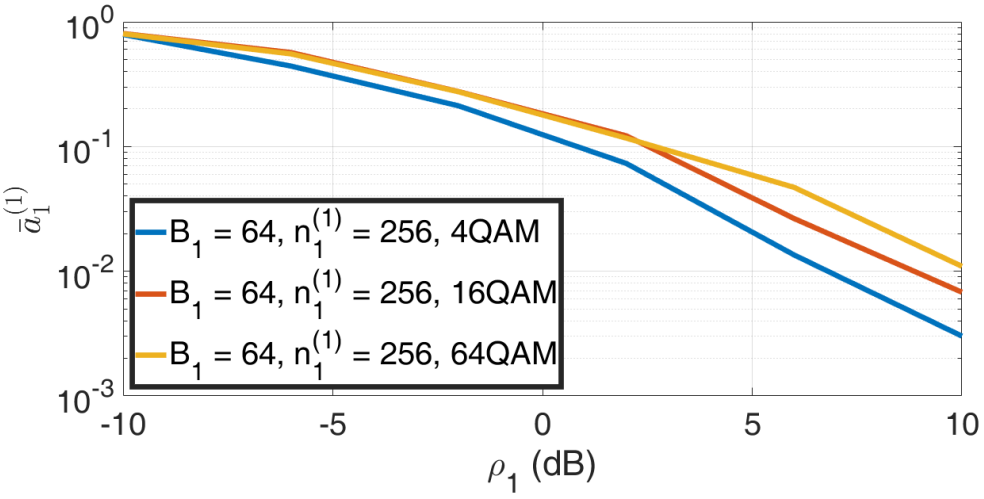

Figure 4.9: Peak Age of Information Violation Probability vs. SNR with changing modulation type (B_1, $n_1^{(1)}$, l_1, n_p and a are fixed)

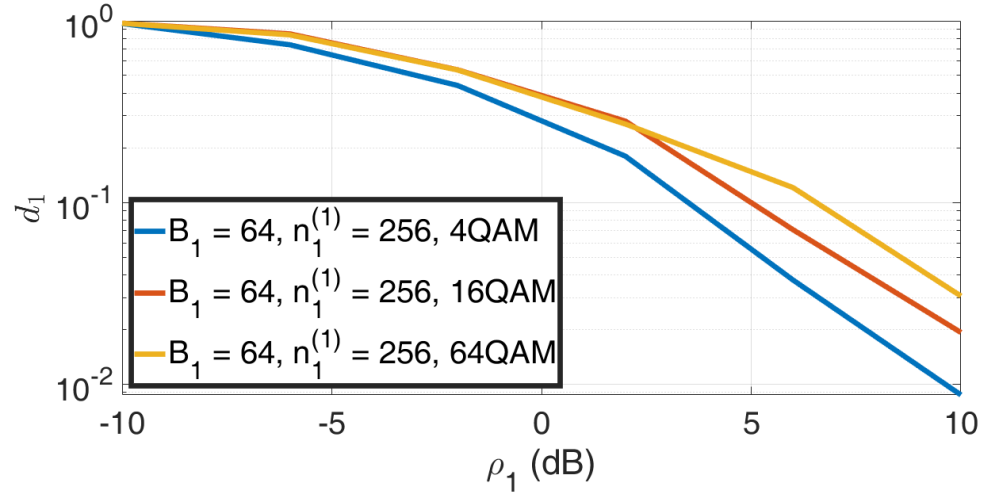

Figure 4.10: Delay Violation Probability vs. SNR with changing modulation type (B_1, $n_1^{(1)}$, l_1, n_p and a are fixed)

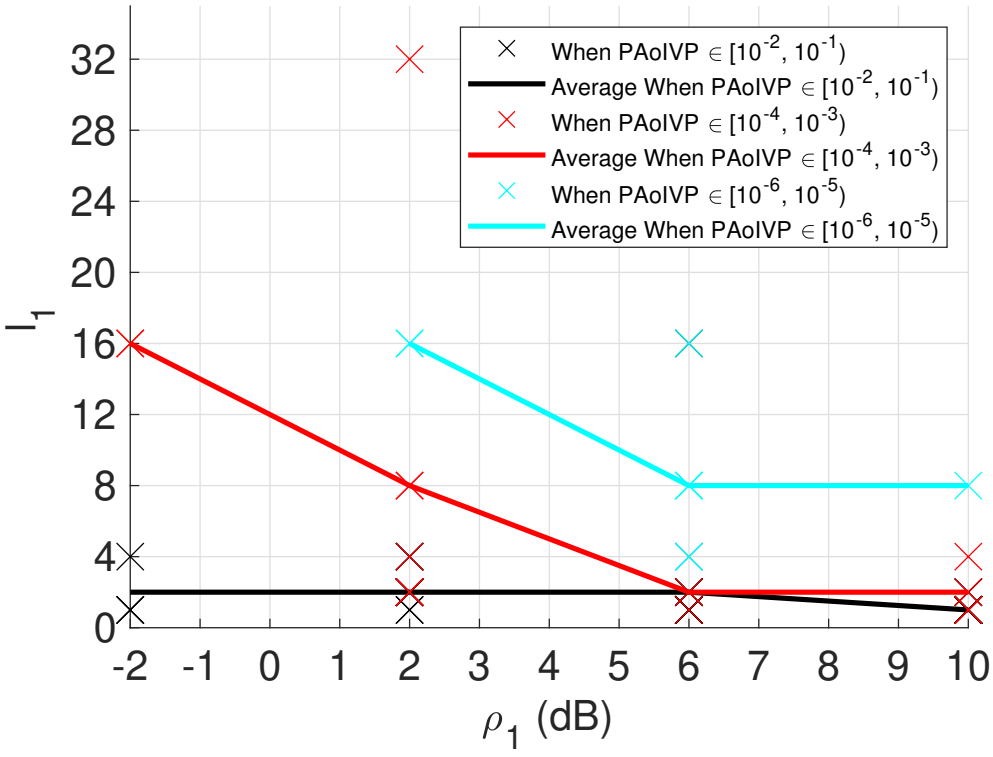

Figure 4.11: Number of resource blocks used vs. SNR

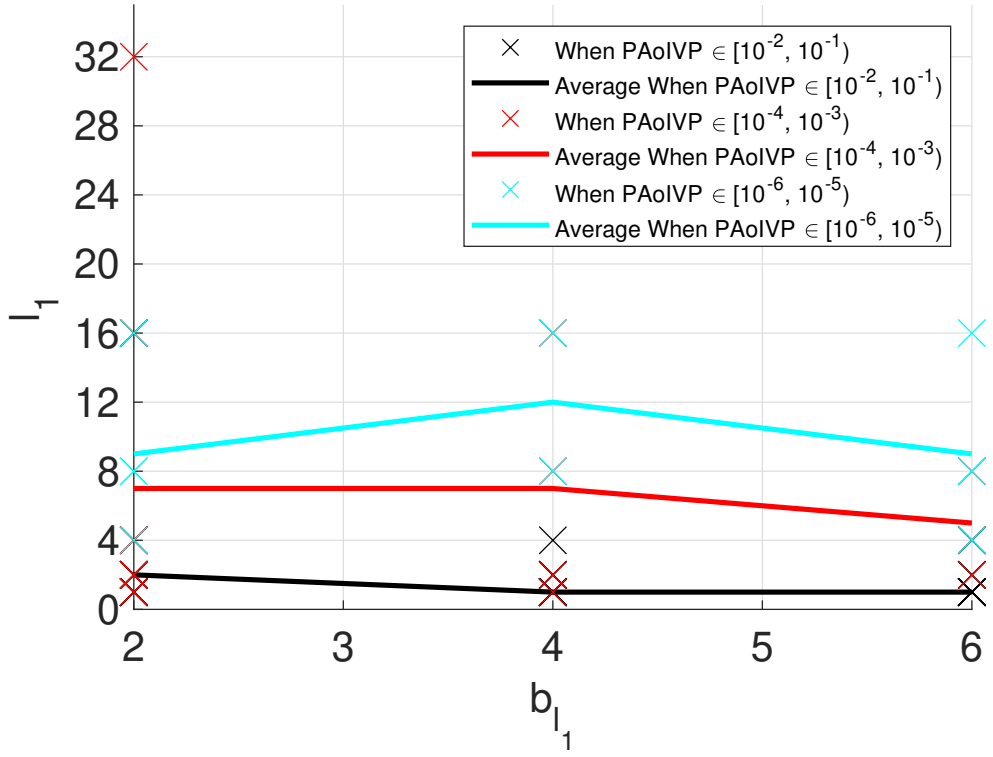

Figure 4.12: Number of resource blocks used vs. modulation order

Figure 4.12 demonstrates the interplay between modulation order and number of resource blocks needed. It is observed that, going from 4QAM to 64QAM, the resource block count does not change drastically.

Finally, it is time to return to the main problem of minimizing the number of resource blocks used under delay violation constraints. The solution to the two hop problem stated in (3.13)-(3.15), (3.21) can be numerically obtained by using the single hop optimal parameters tabulated in Tables 4.2 and 4.3. For the sake of an example, suppose that the uplink average SNR is 2dB, and downlink average SNR is 10dB, and the number of information bits is 32. From Tables 4.2 and 4.3, it is found out that the only feasible parameter set is $n_1^{(1)} = 128$ symbols, $l_1^{(1)} = 4$ blocks and $n_p^{(1)} = 7$ pilot symbols, under 4-QAM modulation. This set yields a packet error probability of 2.7E-02. For the downlink, however, there are 5 options; with $B_1 = 32$ and $\rho_1 = 10$dB. Since the goal is to use the minimal amount of resources, the parameter set $n_1^{(1)} = 64$ symbols, $l_1^{(1)} = 1$ blocks and $n_p^{(1)} = 1$ under 4-QAM is chosen as the most resource efficient option, with a packet error probability of 9.2E-02. Now,

Table 4.4: Parameters used in the simulation to make comparison with VI-ABM and QL-ABM.

B_1	100
$n_1^{(1)}$	100, 125, 150, 175, 200, 225, 250, 275, 300
b_{l_1}	2 (4QAM), 4 (16QAM) 6 (64QAM)
l_1	1, 5, 25
n_p	1, 3, 15, 31
N	1, 2
N_B	1, 2
ρ_1 in dB	-10, -8, -6, -4, -2, 0, 2, 4, 6, 8, 10
α	0.4
a (age)	400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900

using Equation (3.21), the delay violation probability is computed as 1.14E-02. If this value is within the acceptable limits, then the resource allocation is optimally found. If the target delay violation probability is lower, then a parameter set with a lower packet error probability in the downlink should be adopted, at the expense of increased resource block usage. The safest choice in terms of the delay violation probability is $n_1^{(1)} = 64$ symbols, $l_1^{(1)} = 9$ blocks and $n_p^{(1)} = 1$ under 4-QAM, with a packet error probability of 1E-03. This yields a delay violation probability of 7.6E-04.

4.0.1 Comparison with Resource Allocation Algorithms in the Literature

The simulation results can be compared with the resource allocation algorithms regarding peak age of information and delay violation probabilities.

In [7], adaptive blocklength selection was taken in order to minimize age violation probability and two algorithms were proposed: Value Iteration Based Adaptive Blocklength Selection (VI-ABM) [7, Table 3.1] and Q-Learning Based Adaptive Blocklength Selection (QL-ABM) [7, Table 3.2]. A new simulation with the setup given in Table 4.4 is conducted in order to make comparison with VI-ABM and QL-ABM.

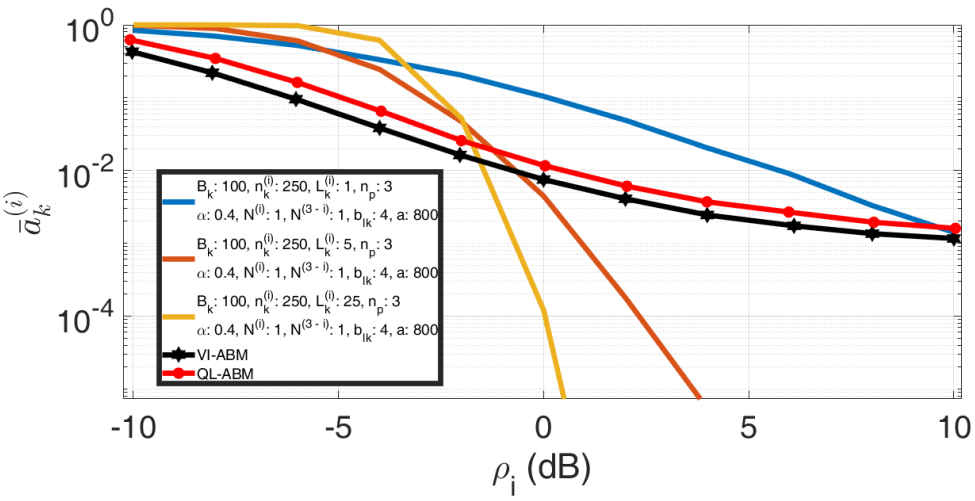

Figure 4.13: Comparing Peak Age of Information Violation Probability vs. SNR Values with VI-ABM and QL-ABM in [7]

Figures 4.13 and 4.14 demonstrate the peak age of information violation probability values for each RB count values vs. SNR and age, respectively, (other parameters kept fixed) and both figures include VI-ABM and QL-ABM related results [7, Figure 3.9 and Figure 3.11]. By looking at 4.13, it can be said that using only one RB leads to worse performance than VI-ABM and QL-ABM, on the other hand, increasing RB count and SNR give better performance than VI-ABM and QL-ABM. By looking at 4.14, it can be said that using only one RB leads to worse performance than VI-ABM and QL-ABM; using five RBs, similar performance with VI-ABM and QL-ABM is obtained; increasing RB count further, much better performance than VI-ABM and QL-ABM is obtained for each age.

In [8], the metric named effective energy efficiency was maximized by proposing a joint power and rate allocation which also considers the delay violation probability. A new simulation with the setup given in Table 4.5 is conducted in order to make comparison with joint power and rate allocation.

Figure 4.15 demonstrates the delay violation probability values for each modulation order values vs. blocklength (other parameters kept fixed) and includes joint power and rate allocation related results [8, Fig. 8.(a)]. By looking at 4.15, it can be said that for each modulation order, using larger blocklength values gives better performance

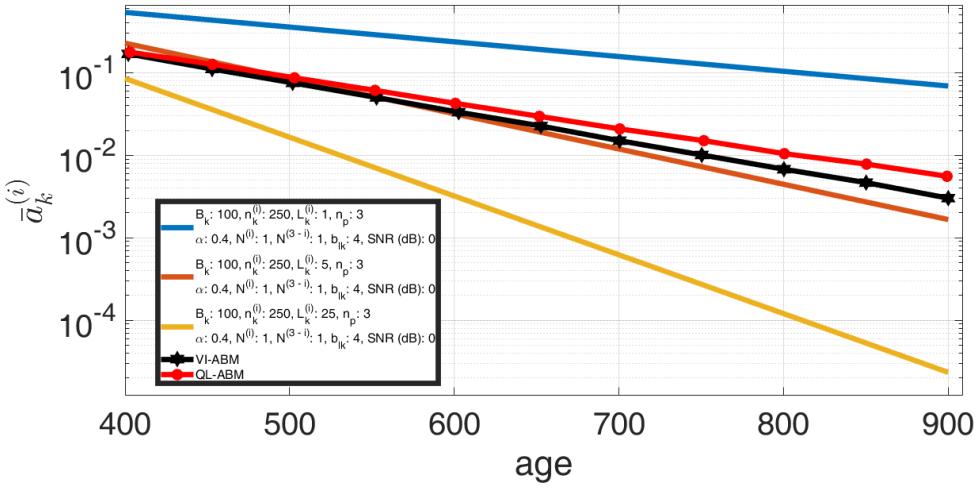

Figure 4.14: Comparing Peak Age of Information Violation Probability vs. Age Values with VI-ABM and QL-ABM in [7]

Table 4.5: Parameters used in the simulation to make comparison with joint power and rate allocation.

Code Rate	0.3
$n_1^{(1)}$	100, 200, 300, 400, 500, 600, 700, 800, 900, 1000
b_{l_1}	2 (4QAM), 4 (16QAM) 6 (64QAM)
l_1	1, 5, 10
n_p	7
N	1, 2
N_B	1, 2
ρ_1 in dB	10
α	0.4

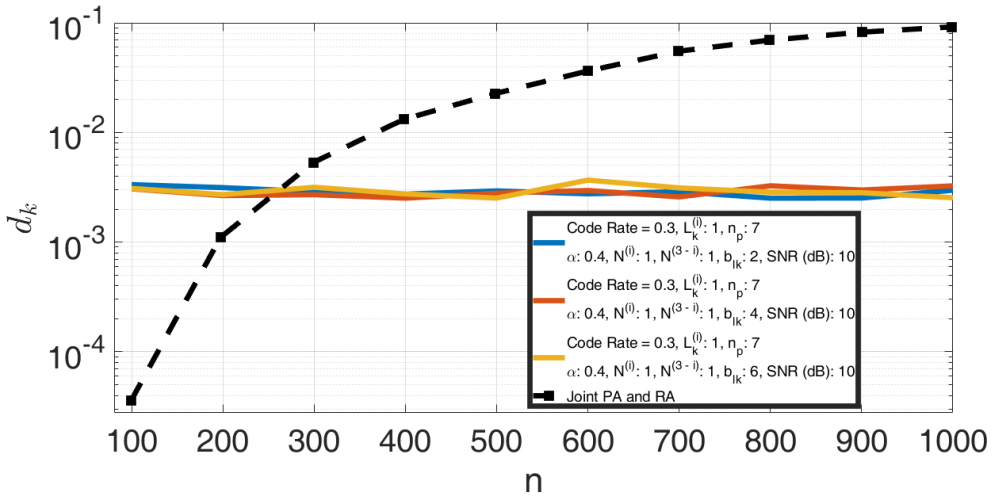

Figure 4.15: Comparing Delay Violation Probability vs. Blocklength Values with Joint Power and Rate Allocation in [8]

than joint power and rate allocation.

CHAPTER 5

CONCLUSION AND FUTURE WORK

In this thesis, two problem formulations for determining the number of resource blocks and modulation order needed to satisfy packet error probability, PAoI and delay violation probability requirements are explored. Numerical results indicate that the choices of modulation order and the number of resource blocks are significantly influenced by the number of information bits per packet, for the small blocklengths of interest. Numerical examples of selecting transmission parameters in the two-hop problem are provided. To sum up,

- In Chapter 3, the two hop multiflow communication model using finite blocklength and AMC scheme was developed. The resource allocation mechanism and optimization problems basing on the minimizations of delay and RB count were formulated. The theoretical solution was sought.
- In Chapter 4, a MATLAB Simulation basing on a numerical search was conducted.
- In Chapter 4, the resource allocation mechanism formulated was compared with algorithms in the literature.

As a further direction, the theoretical solution might be improved by (i) calculating the probability of the expression being less than or equal to 1 by consulting numerical methods if required and (ii) calculating the mean of the exponential function of the expression involving fading, codewords and noise by using the PDF of each three of them and consulting numerical methods if required.

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APPENDICES

Appendix A

CALCULATION OF EIGHT EXPECTATIONS

Let $x_{l_k,c}^{(i,p,r)}$, $x_{l_k,c}^{(i,d,r)}$, $\overline{x_{l_k,c}^{(i,d,r)}}$, $h_{l_k,c}^{(i,r)}$, $w_{l_k,c}^{(i,p,r)}$ and $\widehat{h_{l_k,c}^{(i,r)}}$ be the entries in the rth row and the cth column of $X_{l_k}^{(i,p)}$, $X_{l_k}^{(i,d)}$, $\overline{X_{l_k}^{(i,d)}}$, $H_{l_k}^{(i)}$, $W_{l_k}^{(i,p)}$ and $\widehat{H_{l_k}^{(i)}}$, respectively. Before making calculations, let's expand $\widehat{H_{l_k}^{(i)}}$ term.

$$\begin{aligned}\widehat{H_{l_k}^{(i)}} &= \frac{N^{(i)}}{\rho_i n_p} Y_{l_k}^{(i,p)} [X_{l_k}^{(i,p)}]^H = \frac{N^{(i)}}{\rho_i n_p} (H_{l_k}^{(i)} X_{l_k}^{(i,p)} + W_{l_k}^{(i,p)}) [X_{l_k}^{(i,p)}]^H \\ &= \frac{N^{(i)}}{\rho_i n_p} (H_{l_k}^{(i)} X_{l_k}^{(i,p)} [X_{l_k}^{(i,p)}]^H + W_{l_k}^{(i,p)} [X_{l_k}^{(i,p)}]^H)\end{aligned} \tag{A.1}$$

So

$$\widehat{h_{l_k,f}^{(i,g)}} = \frac{N^{(i)}}{\rho_i n_p} (\sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)} x_{l_k,t}^{(i,p,u)} [x_{l_k,t}^{(i,p,f)}]^H + \sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)} [x_{l_k,t}^{(i,p,f)}]^H) \tag{A.2}$$

Throughout the following whole calculations, the equations (3.1), (3.5), (3.6) and (3.8) and statistical independences between fading, codewords and noise variables will be benefitted without mentioning explicitly. In addition, without mentioning explicitly, summation terms involving permutations with repetition will be faced and the expectations of all such permutations with repetition will be able to be calculated. The reader should look at the tables in Appendix B in order to understand how permutations are produced during the following derivations.

It is recommended to the reader that (s)he reads the Sections from A.2 to A.9 firstly and then reads Section A.1.

A.1 Expectations Involving $\widehat{h_{l_k,f}^{(i,g)}}$

Related to $\widehat{h_{l_k,f}^{(i,g)}}$, let's derive some expectations whose results will be used during the calculation of eight expectations. It is highly recommended to the reader that (s)he

utilises the following reading order for subsections: A.1.7, A.1.5, A.1.6, A.1.8, A.1.3, A.1.4, A.1.1 and A.1.2. Following this reading order will facilitate the understanding of the derivations.

A.1.1 For the 1st Term

The 1st term will consist of four subterms.

Subterm I The 1st subterm can be calculated as follows (derivations will be long and challenging):

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H\widehat{h_{l_k,f}^{(i,g')}}]$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)}x_{l_k,t}^{(i,p,u)})[x_{l_k,t}^{(i,p,f)}]^H$$

$$+\sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,f)}]^H))]^H(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)}x_{l_k,t'}^{(i,p,u')})[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H))[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}} h_{l_k,u''}^{(i,g')}x_{l_k,t''}^{(i,p,u'')})[x_{l_k,t''}^{(i,p,f)}]^H$$

$$+\sum_{t''=1}^{n_p} w_{l_k,t''}^{(i,p,g')}[x_{l_k,t''}^{(i,p,f)}]^H))]^H(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}} h_{l_k,u'''}^{(i,g')}x_{l_k,t'''}^{(i,p,u''')})[x_{l_k,t'''}^{(i,p,f)}]^H$$

$$+\sum_{t'''=1}^{n_p} w_{l_k,t'''}^{(i,p,g')}[x_{l_k,t'''}^{(i,p,f)}]^H))]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}$$

$$+\sum_{t=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H x_{l_k,t}^{(i,p,f)})(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)}x_{l_k,t'}^{(i,p,u')})[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H)(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u''}^{(i,g')}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}$$

$$+\sum_{t''=1}^{n_p}[w_{l_k,t''}^{(i,p,g')}]^H x_{l_k,t''}^{(i,p,f)})(\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}} h_{l_k,u'''}^{(i,g')}x_{l_k,t'''}^{(i,p,u''')})[x_{l_k,t'''}^{(i,p,f)}]^H$$

$$+\sum_{t'''=1}^{n_p} w_{l_k,t'''}^{(i,p,g')}[x_{l_k,t'''}^{(i,p,f)}]^H)]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}}[$$

$$\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H w_{l_k,t'}^{(i,p,g)}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u''}^{(i,g')}]^H$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H w_{l_k,t'}^{(i,p,g)} w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H$$

$$w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H$$

$$x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H h_{l_k,u'}^{(i,g)}h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H h_{l_k,u'}^{(i,g)}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H[h_{l_k,u''}^{(i,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}}[$$

$$\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'''}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'''}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)} [h_{l_k,u}^{(i,g')}]^H h_{l_k,u}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{u''=1, u'' \neq u}^{N^{(i)}} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)} [h_{l_k,u''}^{(i,g')}]^H h_{l_k,u''}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u'')} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1, u' \neq u}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} [h_{l_k,u}^{(i,g')}]^H h_{l_k,u'}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u')} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1, u' \neq u}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} [h_{l_k,u'}^{(i,g')}]^H h_{l_k,u}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} [x_{l_k,t''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t''}^{(i,p,g')}]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [w_{l_k,t'}^{(i,p,g)} [w_{l_k,t'}^{(i,p,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,u'}^{(i,g)}[h_{l_k,u'}^{(i,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u'')}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u''}^{(i,g')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}[w_{l_k,t}^{(i,p,g')}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t''}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t}^{(i,p,g')}]^H w_{l_k,t'}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t'}^{(i,p,g')}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{u''=1, u'' \neq u}^{N^{(i)}} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u'')} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u' \neq u}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} [x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u'=1}^{N^{(i)}} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{u''=1}^{N^{(i)}} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u'')} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ \frac{(N^{(i)})^2 C_{b_{l_k}}}{\rho_i^2 n_p^3} (1+\delta[g-g']) + \frac{(N^{(i)})^2 (n_p-1)}{\rho_i^2 n_p^3} + \frac{(N^{(i)})^2 (n_p-1)}{\rho_i^2 n_p^3} \delta[g-g']$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)} [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq u,u''\neq f}^{N^{(i)}}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} [x_{l_k,t'''}^{(i,p,f)}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')} [x_{l_k,t''}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq u,u'\neq f}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f}^{N^{(i)}}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]$$

$$+\frac{(N^{(i)})^2(C_{b_{l_k}}+n_p-1)}{\rho_i^2 n_p^3}(1+\delta[g-g'])$$

$$=(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'''=1,t'''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}\sum_{t'''=1,t'''\neq t,t'''\neq t''}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t'''=1,t'''\neq t,t'''\neq t'}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t'''=1,t'''\neq t,t'''\neq t'}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}\sum_{t'''=1,t'''\neq t,t'''\neq t',t'''\neq t''}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'''}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}[x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq u,u''\neq f}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq u,u'\neq f}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t'=1,t'\neq t}^{n_p} \sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} [x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f}^{N^{(i)}} \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} [x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'''=1,t'''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1,t'\neq t}^{n_p} \sum_{t'''=1,t'''\neq t,t'''\neq t'}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t'''=1,t'''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t''=1,t''\neq t}^{n_p} \sum_{t'''=1,t'''\neq t,t'''\neq t''}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{u''=1,u''\neq f}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,u'')}]$$

$$+\frac{(N^{(i)})^2(C_{b_{l_k}}+n_p-1)}{\rho_i^2 n_p^3}(1+\delta[g-g'])$$

$$=(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+4(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'''=1,t'''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+3(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+6(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}\sum_{t'''=1,t'''\neq t,t'''\neq t''}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}\sum_{t'''=1,t'''\neq t,t'''\neq t',t'''\neq t''}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'''}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}[x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq u,u''\neq f}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,u'')}]$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,u')}]^H]$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+6(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2(C_{b_{l_k}}+n_p-1)}{\rho_i^2 n_p^3}(1+\delta[g-g'])$$

$$= \frac{G_{b_{l_k}}}{n_p^3}(1+\delta[g-g'])+\frac{4F_{b_{l_k}}(n_p-1)}{n_p^3}(1+\delta[g-g'])$$
$$+\frac{3(C_{b_{l_k}})^2(n_p-1)}{n_p^3}(1+\delta[g-g'])+\frac{6C_{b_{l_k}}(n_p-1)(n_p-2)}{n_p^3}(1+\delta[g-g'])$$
$$+\frac{(n_p-1)(n_p-2)(n_p-3)}{n_p^3}(1+\delta[g-g'])+\frac{(C_{b_{l_k}})^2(N^{(i)}-1)}{n_p^3}(1+\delta[g-g'])$$
$$+\frac{2(N^{(i)}-1)(n_p-1)}{n_p^3}(1+\delta[g-g'])+\frac{|D_{b_{l_k}}|^4(N^{(i)}-1)(n_p-1)}{n_p^3}(1+\delta[g-g'])$$
$$+2\frac{(N^{(i)})^3(N^{(i)}-1)}{\rho_i^3 n_p^4}\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$
$$+\frac{(N^{(i)})^2(N^{(i)}-1)(N^{(i)}-2)}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$
$$+2\frac{(N^{(i)})^3(N^{(i)}-1)}{\rho_i^3 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$
$$+\frac{2F_{b_{l_k}}N^{(i)}}{\rho_i n_p^3}(1+\delta[g-g'])+\frac{6C_{b_{l_k}}N^{(i)}(n_p-1)}{\rho_i n_p^3}(1+\delta[g-g'])$$
$$+\frac{2N^{(i)}(n_p-1)(n_p-2)}{\rho_i n_p^3}(1+\delta[g-g'])$$
$$+2\frac{(N^{(i)})^3(N^{(i)}-1)}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$
$$+\frac{(N^{(i)})^2(C_{b_{l_k}}+n_p-1)}{\rho_i^2 n_p^3}(1+\delta[g-g'])$$

$$= \frac{G_{b_{l_k}} + 4F_{b_{l_k}}(n_p-1) + 3(C_{b_{l_k}})^2(n_p-1)}{n_p^3}(1+\delta[g-g'])$$
$$+\frac{6C_{b_{l_k}}(n_p-1)(n_p-2)+(n_p-1)(n_p-2)(n_p-3)}{n_p^3}(1+\delta[g-g'])$$
$$+\frac{(C_{b_{l_k}})^2(N^{(i)}-1)+2(N^{(i)}-1)(n_p-1)+|D_{b_{l_k}}|^4(N^{(i)}-1)(n_p-1)}{n_p^3}(1$$
$$+\delta[g-g'])$$
$$+2\frac{(N^{(i)})^3(N^{(i)}-1)}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$
$$+\frac{(N^{(i)})^2(N^{(i)}-1)(N^{(i)}-2)}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$
$$+\frac{2F_{b_{l_k}}N^{(i)}+6C_{b_{l_k}}N^{(i)}(n_p-1)+2N^{(i)}(n_p-1)(n_p-2)}{\rho_i n_p^3}(1+\delta[g-g'])$$
$$+2\frac{(N^{(i)})^3(N^{(i)}-1)}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$
$$+\frac{(N^{(i)})^2(C_{b_{l_k}}+n_p-1)}{\rho_i^2 n_p^3}(1+\delta[g-g'])$$
$$= \frac{G_{b_{l_k}} + 4F_{b_{l_k}}(n_p-1) + 3(C_{b_{l_k}})^2(n_p-1)}{n_p^3}(1+\delta[g-g'])$$
$$+\frac{6C_{b_{l_k}}(n_p-1)(n_p-2)+(n_p-1)(n_p-2)(n_p-3)}{n_p^3}(1+\delta[g-g'])$$
$$+\frac{(C_{b_{l_k}})^2(N^{(i)}-1)+2(N^{(i)}-1)(n_p-1)+|D_{b_{l_k}}|^4(N^{(i)}-1)(n_p-1)}{n_p^3}(1$$
$$+\delta[g-g'])$$
$$+2\frac{(N^{(i)})^3(N^{(i)}-1)}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+2\frac{(N^{(i)})^3(N^{(i)}-1)}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+2\frac{(N^{(i)})^3(N^{(i)}-1)}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+2\frac{(N^{(i)})^3(N^{(i)}-1)}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+2\frac{(N^{(i)})^3(N^{(i)}-1)}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2(N^{(i)}-1)(N^{(i)}-2)}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2(N^{(i)}-1)(N^{(i)}-2)}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+\frac{2F_{b_{l_k}}N^{(i)}+6C_{b_{l_k}}N^{(i)}(n_p-1)+2N^{(i)}(n_p-1)(n_p-2)}{\rho_i n_p^3}(1+\delta[g-g'])$$

$$+2\frac{(N^{(i)})^3(N^{(i)}-1)}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+2\frac{(N^{(i)})^3(N^{(i)}-1)}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2(C_{b_{l_k}}+n_p-1)}{\rho_i^2 n_p^3}(1+\delta[g-g'])$$

$$= \frac{G_{b_{l_k}} + 4F_{b_{l_k}}(n_p - 1) + 3(C_{b_{l_k}})^2(n_p - 1)}{n_p^3}(1 + \delta[g - g'])$$
$$+ \frac{6C_{b_{l_k}}(n_p - 1)(n_p - 2) + (n_p - 1)(n_p - 2)(n_p - 3)}{n_p^3}(1 + \delta[g - g'])$$
$$+ \frac{(C_{b_{l_k}})^2(N^{(i)} - 1) + 2(N^{(i)} - 1)(n_p - 1) + |D_{b_{l_k}}|^4(N^{(i)} - 1)(n_p - 1)}{n_p^3}(1$$
$$+\delta[g - g'])$$
$$+ \frac{2F_{b_{l_k}}(N^{(i)} - 1)}{n_p^3}(1 + \delta[g - g'])$$
$$+ \frac{6C_{b_{l_k}}(N^{(i)} - 1)(n_p - 1)}{n_p^3}(1 + \delta[g - g'])$$
$$+ \frac{2(N^{(i)} - 1)(n_p - 1)(n_p - 2)}{n_p^3}(1 + \delta[g - g'])$$
$$+ \frac{C_{b_{l_k}}(N^{(i)} - 1)(N^{(i)} - 2)}{n_p^3}(1 + \delta[g - g'])$$
$$+ \frac{(N^{(i)} - 1)(N^{(i)} - 2)(n_p - 1)}{n_p^3}(1 + \delta[g - g'])$$
$$+ \frac{2F_{b_{l_k}}N^{(i)} + 6C_{b_{l_k}}N^{(i)}(n_p - 1) + 2N^{(i)}(n_p - 1)(n_p - 2)}{\rho_i n_p^3}(1$$
$$+\delta[g - g'])$$
$$+ \frac{2C_{b_{l_k}}N^{(i)}(N^{(i)} - 1)}{\rho_i n_p^3}(1 + \delta[g - g'])$$
$$+ 2\frac{N^{(i)}(N^{(i)} - 1)(n_p - 1)}{\rho_i n_p^3}(1 + \delta[g - g'])$$
$$+ \frac{(N^{(i)})^2(C_{b_{l_k}} + n_p - 1)}{\rho_i^2 n_p^3}(1 + \delta[g - g'])$$

$$= \frac{1+\delta[g-g']}{\rho_i^2 n_p^3}(\rho_i^2(G_{b_{l_k}} + 4F_{b_{l_k}}(n_p-1) + 3(C_{b_{l_k}})^2(n_p-1)$$
$$+6C_{b_{l_k}}(n_p-1)(n_p-2)$$
$$+(n_p-1)(n_p-2)(n_p-3) + (C_{b_{l_k}})^2(N^{(i)}-1) + 2(N^{(i)}-1)(n_p-1)$$
$$+|D_{b_{l_k}}|^4(N^{(i)}-1)(n_p-1) + 2F_{b_{l_k}}(N^{(i)}-1) + 6C_{b_{l_k}}(N^{(i)}-1)(n_p-1)$$
$$+2(N^{(i)}-1)(n_p-1)(n_p-2) + C_{b_{l_k}}(N^{(i)}-1)(N^{(i)}-2)$$
$$+(N^{(i)}-1)(N^{(i)}-2)(n_p-1))$$
$$+\rho_i(2F_{b_{l_k}}N^{(i)} + 6C_{b_{l_k}}N^{(i)}(n_p-1) + 2N^{(i)}(n_p-1)(n_p-2)$$
$$+2C_{b_{l_k}}N^{(i)}(N^{(i)}-1) + 2N^{(i)}(N^{(i)}-1)(n_p-1))$$
$$+(N^{(i)})^2(C_{b_{l_k}} + n_p - 1))$$

So the 1st subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H \widehat{h_{l_k,f}^{(i,g')}}]$$
$$= \frac{1+\delta[g-g']}{\rho_i^2 n_p^3}(\rho_i^2(G_{b_{l_k}} + 4F_{b_{l_k}}(n_p-1) + 3(C_{b_{l_k}})^2(n_p-1)$$
$$+6C_{b_{l_k}}(n_p-1)(n_p-2) + (n_p-1)(n_p-2)(n_p-3) + (C_{b_{l_k}})^2(N^{(i)}-1)$$
$$+2(N^{(i)}-1)(n_p-1)$$
$$+|D_{b_{l_k}}|^4(N^{(i)}-1)(n_p-1) + 2F_{b_{l_k}}(N^{(i)}-1)$$
$$+6C_{b_{l_k}}(N^{(i)}-1)(n_p-1)$$
$$+2(N^{(i)}-1)(n_p-1)(n_p-2) + C_{b_{l_k}}(N^{(i)}-1)(N^{(i)}-2)$$
$$+(N^{(i)}-1)(N^{(i)}-2)(n_p-1))$$
$$+\rho_i(2F_{b_{l_k}}N^{(i)} + 6C_{b_{l_k}}N^{(i)}(n_p-1) + 2N^{(i)}(n_p-1)(n_p-2)$$
$$+2C_{b_{l_k}}N^{(i)}(N^{(i)}-1) + 2N^{(i)}(N^{(i)}-1)(n_p-1))$$
$$+(N^{(i)})^2(C_{b_{l_k}} + n_p - 1)) \tag{A.3}$$

Subterm II The 2nd subterm can be calculated as follows (derivations will be long and challenging):

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H\widehat{h_{l_k,f'}^{(i,g')}}](f'\neq f)$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}h_{l_k,u}^{(i,g)}x_{l_k,t}^{(i,p,u)})[x_{l_k,t}^{(i,p,f)}]^H$$

$$+\sum_{t=1}^{n_p}w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,f)}]^H))]^H(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}h_{l_k,u'}^{(i,g)}x_{l_k,t'}^{(i,p,u')})[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p}w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H))[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}h_{l_k,u''}^{(i,g')}x_{l_k,t''}^{(i,p,u'')})[x_{l_k,t''}^{(i,p,f')}]^H$$

$$+\sum_{t''=1}^{n_p}w_{l_k,t''}^{(i,p,g')}[x_{l_k,t''}^{(i,p,f')}]^H))]^H(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}h_{l_k,u'''}^{(i,g')}x_{l_k,t'''}^{(i,p,u''')})[x_{l_k,t'''}^{(i,p,f')}]^H$$

$$+\sum_{t'''=1}^{n_p}w_{l_k,t'''}^{(i,p,g')}[x_{l_k,t'''}^{(i,p,f')}]^H))]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}$$

$$+\sum_{t=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H x_{l_k,t}^{(i,p,f)})(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}h_{l_k,u'}^{(i,g)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p}w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H)(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u''}^{(i,g')}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}$$

$$+\sum_{t''=1}^{n_p}[w_{l_k,t''}^{(i,p,g')}]^H x_{l_k,t''}^{(i,p,f')})(\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}h_{l_k,u'''}^{(i,g')}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f')}]^H$$

$$+\sum_{t'''=1}^{n_p}w_{l_k,t'''}^{(i,p,g')}[x_{l_k,t'''}^{(i,p,f')}]^H)]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}}[$$

$$\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f')}]^H[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f')}]^H w_{l_k,t'}^{(i,p,g)}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u''}^{(i,g')}]^H$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H w_{l_k,t'}^{(i,p,g)} w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f')}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H$$

$$x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f')}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f')}]^H h_{l_k,u'}^{(i,g)}h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H h_{l_k,u'}^{(i,g)}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f')}]^H[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H[h_{l_k,u''}^{(i,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f')}]^H h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'''}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'''}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)} [h_{l_k,u}^{(i,g')}]^H h_{l_k,u}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{u''=1, u'' \neq u}^{N^{(i)}} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)} [h_{l_k,u''}^{(i,g')}]^H h_{l_k,u''}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u'')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1, u' \neq u}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} [h_{l_k,u}^{(i,g')}]^H h_{l_k,u'}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1, u' \neq u}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} [h_{l_k,u'}^{(i,g')}]^H h_{l_k,u}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')} [x_{l_k,t''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t''}^{(i,p,g')}]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [w_{l_k,t'}^{(i,p,g)} [w_{l_k,t'}^{(i,p,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,u'}^{(i,g)}[h_{l_k,u'}^{(i,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u'')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u''}^{(i,g')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}[w_{l_k,t}^{(i,p,g')}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t''}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t}^{(i,p,g')}]^H w_{l_k,t'}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f')}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t'}^{(i,p,g')}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{u''=1, u'' \neq u}^{N^{(i)}} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u'')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1, u' \neq u}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')} [x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u'=1}^{N^{(i)}} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f')} [x_{l_k,t}^{(i,p,f')}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{u''=1}^{N^{(i)}} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,u'')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+ \frac{(N^{(i)})^2}{\rho_i^2 n_p^3} (1+\delta[g-g']) + \frac{(N^{(i)})^2 (n_p-1)}{\rho_i^2 n_p^3}$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t'}^{(i,p,f')} [x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,f')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}} \sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)} [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,f')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} \sum_{u''=1,u''\neq f,u''\neq f'}^{N^{(i)}} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t'}^{(i,p,f')} x_{l_k,t''}^{(i,p,f')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} \sum_{u''=1,u''\neq f,u''\neq f'}^{N^{(i)}} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t'}^{(i,p,f')} x_{l_k,t''}^{(i,p,f')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}} \sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}} \sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}} \sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} \sum_{u''=1,u''\neq u,u''\neq f,u''\neq f'}^{N^{(i)}} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} \sum_{u'=1,u'\neq f,u'\neq f'}^{N^{(i)}} \sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f,u'\neq f'}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq u,u'\neq f,u'\neq f'}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t'}^{(i,p,f')}x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t'}^{(i,p,f')}x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f,u'\neq f'}^{N^{(i)}}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f,u''\neq f'}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])+\frac{(N^{(i)})^2(n_p-1)}{\rho_i^2 n_p^3}$$

$$=(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}[x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1,t'''\neq t''}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f,u''\neq f'}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,u'')}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')} x_{l_k,t}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')} x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t'}^{(i,p,f')} x_{l_k,t}^{(i,p,f')}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t'}^{(i,p,f')} x_{l_k,t'}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f,u''\neq f'}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')} x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{u''=1,u''\neq u,u''\neq f,u''\neq f'}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,u'')}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1,t'\neq t}^{n_p} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u'=1,u'\neq f,u'\neq f'}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,u')}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')} x_{l_k,t}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{t'''=1,t'''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')} x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u'=1,u'\neq f,u'\neq f'}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,u')}[x_{l_k,t}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{t'=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{u'=1,u'\neq u,u'\neq f,u'\neq f'}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,u')}[x_{l_k,t}^{(i,p,u')}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u'=1,u'\neq f,u'\neq f'}^{N^{(i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,u')}[x_{l_k,t}^{(i,p,u')}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f,u''\neq f'}^{N^{(i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,u'')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])+\frac{(N^{(i)})^2(n_p-1)}{\rho_i^2 n_p^3}$$

$$= \frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}[x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,u)}]$$

$$+\frac{(N^{(i)})^2 C_{b_{l_k}}}{\rho_i^2 n_p^3}\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2(n_p-1)}{\rho_i^2 n_p^3}\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2\max\{N^{(i)}-2,0\}}{\rho_i^2 n_p^3}\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+\frac{(C_{b_{l_k}})^2}{n_p^3}+\frac{n_p-1}{n_p^3}+\frac{n_p-1}{n_p^3}+\frac{(n_p-1)|D_{b_{l_k}}|^4}{n_p^3}$$

$$+\frac{(N^{(i)})^2\max\{N^{(i)}-2,0\}}{\rho_i^2 n_p^4}\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')} x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2\max\{N^{(i)}-2,0\}}{\rho_i^2 n_p^4}\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^2\max\{N^{(i)}-2,0\}}{\rho_i^2 n_p^3}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+\frac{\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^2}$$

$$+\frac{(N^{(i)})^2 C_{b_{l_k}}}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2\max\{N^{(i)}-2,0\}}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^2 C_{b_{l_k}}}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2(n_p-1)}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2\max\{N^{(i)}-2,0\}}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}x_{l_k,t'''}^{(i,p,f')}[x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2\max\{N^{(i)}-2,0\}}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2\max\{N^{(i)}-2,0\}}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+\frac{\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^3}\delta[g-g']$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3\sum_{t=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p} \sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^3}{\rho_i^3 n_p^4} \sum_{t=1}^{n_p} \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')} x_{l_k,t''}^{(i,p,f')} [x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+\frac{N^{(i)} \max\{N^{(i)}-2,0\}}{\rho_i n_p^2}$$

$$+\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}\delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}\delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')} x_{l_k,t'''}^{(i,p,f')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+\frac{N^{(i)} \max\{N^{(i)}-2,0\}}{\rho_i n_p^3}\delta[g-g']$$

$$+\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}\delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}\delta[g-g'] \sum_{t=1}^{n_p} \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')} [x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} [x_{l_k,t}^{(i,p,f')}]^H]$$

$$+\frac{N^{(i)} \max\{N^{(i)}-2,0\}}{\rho_i n_p^3}\delta[g-g']$$

$$+\frac{(N^{(i)})^3}{\rho_i^3 n_p^4} \sum_{t=1}^{n_p} \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t''}^{(i,p,f')} [x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t''=1}^{n_p} \sum_{t'''=1,t'''\neq t''}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')} x_{l_k,t'''}^{(i,p,f')} [x_{l_k,t'''}^{(i,p,f')}]^H]$$

$$+\frac{N^{(i)} \max\{N^{(i)}-2,0\}}{\rho_i n_p^2} + \frac{(N^{(i)})^2}{\rho_i^2 n_p^3}(1+\delta[g-g']) + \frac{(N^{(i)})^2(n_p-1)}{\rho_i^2 n_p^3}$$

$$= 2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}[x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,u)}]$$

$$+\frac{(N^{(i)})^2(C_{b_{l_k}}n_p+n_p(n_p-1)+2\max\{N^{(i)}-2,0\}(n_p+1))}{\rho_i^2 n_p^4}\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+\frac{(C_{b_{l_k}})^2+(n_p-1)(|D_{b_{l_k}}|^4+2)}{n_p^3}+\frac{\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^2}$$

$$+\frac{(N^{(i)})^2(2C_{b_{l_k}}+\max\{N^{(i)}-2,0\})}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2(n_p-1+3\max\{N^{(i)}-2,0\})}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^3}\delta[g-g']$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^3\sum_{t=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^3\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+2\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')} x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+\frac{N^{(i)}\max\{N^{(i)}-2,0\}}{\rho_i n_p^2}+2\frac{N^{(i)}\max\{N^{(i)}-2,0\}}{\rho_i n_p^3}\delta[g-g']$$

$$+\frac{N^{(i)}\max\{N^{(i)}-2,0\}}{\rho_i n_p^2}+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])+\frac{(N^{(i)})^2(n_p-1)}{\rho_i^2 n_p^3}$$

$$=2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq f'}^{N^{(i)}}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}[x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,u)}]$$

$$+\frac{(N^{(i)})^2(C_{b_{l_k}}n_p+n_p(n_p-1)+2\max\{N^{(i)}-2,0\}(n_p+1))}{\rho_i^2 n_p^4}\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2(C_{b_{l_k}}n_p+n_p(n_p-1)+2\max\{N^{(i)}-2,0\}(n_p+1))}{\rho_i^2 n_p^4}\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+\frac{(C_{b_{l_k}})^2+(n_p-1)(|D_{b_{l_k}}|^4+2)}{n_p^3}+\frac{\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^2}$$

$$+\frac{(N^{(i)})^2(2C_{b_{l_k}}+\max\{N^{(i)}-2,0\})}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2(2C_{b_{l_k}}+\max\{N^{(i)}-2,0\})}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t'}^{(i,p,f')}]^H x_{l_k,t'}^{(i,p,f')}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$+\frac{(N^{(i)})^2(n_p-1+3\max\{N^{(i)}-2,0\})}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2(n_p-1+3\max\{N^{(i)}-2,0\})}{\rho_i^2 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^3}\delta[g-g']+2\frac{N^{(i)}(C_{b_{l_k}}+n_p-1)}{\rho_i n_p^2}$$

$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+2\delta[g-g'])\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}x_{l_k,t}^{(i,p,f')}[x_{l_k,t}^{(i,p,f')}]^H]$$

$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+2\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}x_{l_k,t''}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H]$$

$$+2\frac{N^{(i)}\max\{N^{(i)}-2,0\}}{\rho_i n_p^2}+2\frac{N^{(i)}\max\{N^{(i)}-2,0\}}{\rho_i n_p^3}\delta[g-g']$$

$$
\begin{aligned}
&+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])+\frac{(N^{(i)})^2(n_p-1)}{\rho_i^2 n_p^3}\\
&=\frac{2F_{b_{l_k}}}{n_p^3}(1+\delta[g-g'])+\frac{6C_{b_{l_k}}(n_p-1)}{n_p^3}(1+\delta[g-g'])\\
&+\frac{2(n_p-1)(n_p-2)}{n_p^3}(1+\delta[g-g'])\\
&+\frac{C_{b_{l_k}}\max\{N^{(i)}-2,0\}}{n_p^3}(1+\delta[g-g'])\\
&+\frac{(n_p-1)\max\{N^{(i)}-2,0\}}{n_p^3}(1+\delta[g-g'])\\
&+\frac{C_{b_{l_k}}(C_{b_{l_k}}n_p+n_p(n_p-1)+2\max\{N^{(i)}-2,0\}(n_p+1))}{n_p^3}\\
&+\frac{(n_p-1)(C_{b_{l_k}}n_p+n_p(n_p-1)+2\max\{N^{(i)}-2,0\}(n_p+1))}{n_p^3}\\
&+\frac{(C_{b_{l_k}})^2+(n_p-1)(|D_{b_{l_k}}|^4+2)+n_p\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^3}\\
&+\frac{C_{b_{l_k}}(2C_{b_{l_k}}+\max\{N^{(i)}-2,0\})}{n_p^3}\delta[g-g']\\
&+\frac{(n_p-1)(2C_{b_{l_k}}+\max\{N^{(i)}-2,0\})}{n_p^3}\delta[g-g']\\
&+\frac{n_p-1}{n_p^3}\delta[g-g']+\frac{C_{b_{l_k}}(n_p-1)}{n_p^3}\delta[g-g']+\frac{(n_p-1)(n_p-2)}{n_p^3}\delta[g-g']\\
&+\frac{C_{b_{l_k}}(n_p-1+3\max\{N^{(i)}-2,0\})}{n_p^3}\delta[g-g']\\
&+\frac{(n_p-1)(n_p-1+3\max\{N^{(i)}-2,0\})}{n_p^3}\delta[g-g']\\
&+\frac{\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^3}\delta[g-g']\\
&+2\frac{N^{(i)}(C_{b_{l_k}}+n_p-1+\max\{N^{(i)}-2,0\})}{\rho_i n_p^2}\\
&+\frac{2N^{(i)}C_{b_{l_k}}}{\rho_i n_p^3}(1+2\delta[g-g'])+\frac{2N^{(i)}(n_p-1)}{\rho_i n_p^3}(1+2\delta[g-g'])\\
&+\frac{2N^{(i)}\max\{N^{(i)}-2,0\}}{\rho_i n_p^3}\delta[g-g']+\frac{(N^{(i)})^2}{\rho_i^2 n_p^2}+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}\delta[g-g']
\end{aligned}
$$

$$= \frac{1}{\rho_i^2 n_p^3}(\rho_i^2(2F_{b_{l_k}} + 6C_{b_{l_k}}(n_p-1) + 2(n_p-1)(n_p-2)$$
$$+(C_{b_{l_k}} + n_p - 1)(n_p(C_{b_{l_k}} + n_p - 1) + \max\{N^{(i)} - 2, 0\}(2n_p + 3))$$
$$+(C_{b_{l_k}})^2 + (n_p - 1)(|D_{b_{l_k}}|^4 + 2) + n_p \max\{N^{(i)} - 2, 0\}(N^{(i)} - 3))$$
$$+2\rho_i N^{(i)}((n_p + 1)(C_{b_{l_k}} + n_p - 1) + n_p \max\{N^{(i)} - 2, 0\}) + (N^{(i)})^2 n_p)$$
$$+\frac{\delta[g-g']}{\rho_i^2 n_p^3}(\rho_i^2(2F_{b_{l_k}} + 6C_{b_{l_k}}(n_p-1) + 2(n_p-1)(n_p-2)$$
$$+(C_{b_{l_k}} + n_p - 1)(2(C_{b_{l_k}} + n_p - 1) + 5\max\{N^{(i)} - 2, 0\})$$
$$+\max\{N^{(i)} - 2, 0\}(N^{(i)} - 3))$$
$$+2\rho_i N^{(i)}(2(C_{b_{l_k}} + n_p - 1) + \max\{N^{(i)} - 2, 0\}) + (N^{(i)})^2)$$

So the 2nd subterm is given by

$$\implies E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H \widehat{h_{l_k,f'}^{(i,g')}}](f' \neq f)$$
$$= \frac{1}{\rho_i^2 n_p^3}(\rho_i^2(2F_{b_{l_k}} + 6C_{b_{l_k}}(n_p-1) + 2(n_p-1)(n_p-2)$$
$$+(C_{b_{l_k}} + n_p - 1)(n_p(C_{b_{l_k}} + n_p - 1) + \max\{N^{(i)} - 2, 0\}(2n_p + 3))$$
$$+(C_{b_{l_k}})^2 + (n_p - 1)(|D_{b_{l_k}}|^4 + 2) + n_p \max\{N^{(i)} - 2, 0\}(N^{(i)} - 3))$$
$$+2\rho_i N^{(i)}((n_p + 1)(C_{b_{l_k}} + n_p - 1) + n_p \max\{N^{(i)} - 2, 0\}) + (N^{(i)})^2 n_p) \quad \text{(A.4)}$$
$$+\frac{\delta[g-g']}{\rho_i^2 n_p^3}(\rho_i^2(2F_{b_{l_k}} + 6C_{b_{l_k}}(n_p-1) + 2(n_p-1)(n_p-2)$$
$$+(C_{b_{l_k}} + n_p - 1)(2(C_{b_{l_k}} + n_p - 1) + 5\max\{N^{(i)} - 2, 0\})$$
$$+\max\{N^{(i)} - 2, 0\}(N^{(i)} - 3))$$
$$+2\rho_i N^{(i)}(2(C_{b_{l_k}} + n_p - 1) + \max\{N^{(i)} - 2, 0\}) + (N^{(i)})^2)$$

Subterm III The 3rd subterm can be calculated as follows (derivations will be long and challenging):

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H\widehat{h_{l_k,m}^{(i,g')}}](m \neq f)$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)}x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,m)}]^H$$

$$+\sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,m)}]^H))]^H(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H))[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}} h_{l_k,u''}^{(i,g')}x_{l_k,t''}^{(i,p,u'')}[x_{l_k,t''}^{(i,p,f)}]^H$$

$$+\sum_{t''=1}^{n_p} w_{l_k,t''}^{(i,p,g')}[x_{l_k,t''}^{(i,p,f)}]^H))]^H(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}} h_{l_k,u'''}^{(i,g')}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H$$

$$+\sum_{t'''=1}^{n_p} w_{l_k,t'''}^{(i,p,g')}[x_{l_k,t'''}^{(i,p,m)}]^H))]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}$$

$$+\sum_{t=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H x_{l_k,t}^{(i,p,m)})(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H)(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u''}^{(i,g')}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}$$

$$+\sum_{t''=1}^{n_p}[w_{l_k,t''}^{(i,p,g')}]^H x_{l_k,t''}^{(i,p,f)})(\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}} h_{l_k,u'''}^{(i,g')}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H$$

$$+\sum_{t'''=1}^{n_p} w_{l_k,t'''}^{(i,p,g')}[x_{l_k,t'''}^{(i,p,m)}]^H)]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}}[$$

$$\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,m)}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,m)}]^H[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H w_{l_k,t'}^{(i,p,g)}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u''}^{(i,g')}]^H$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,m)}]^H w_{l_k,t'}^{(i,p,g)} w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'''}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,m)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H$$

$$x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,m)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H h_{l_k,u'}^{(i,g)}h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,m)}]^H h_{l_k,u'}^{(i,g)}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}$$

$$x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,m)}]^H[h_{l_k,u''}^{(i,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H h_{l_k,u'''}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'''}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'''}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)} [h_{l_k,u}^{(i,g')}]^H h_{l_k,u}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{u''=1, u'' \neq u}^{N^{(i)}} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)} [h_{l_k,u''}^{(i,g')}]^H h_{l_k,u''}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u'')} [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1, u' \neq u}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} [h_{l_k,u}^{(i,g')}]^H h_{l_k,u'}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u')} [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1, u' \neq u}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} [h_{l_k,u'}^{(i,g')}]^H h_{l_k,u}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} [x_{l_k,t''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t''}^{(i,p,g')}]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [w_{l_k,t'}^{(i,p,g)} [w_{l_k,t'}^{(i,p,g')}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u'=1}^{N^{(i)}} \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [h_{l_k,u'}^{(i,g)} [h_{l_k,u'}^{(i,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u'')}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u''}^{(i,g')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}[w_{l_k,t}^{(i,p,g')}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t''}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t}^{(i,p,g')}]^H w_{l_k,t'}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t'}^{(i,p,g')}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq u}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u'')}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq u}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[x_{l_k,t''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,u'')}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t'''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t'''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f,u''\neq m}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f,u''\neq m}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t'''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq m}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{u''=1,u''\neq u,u''\neq f,u''\neq m}^{N^{(i)}} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)} [x_{l_k,t''}^{(i,p,m)}]^H [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u'=1,u'\neq f,u'\neq m}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} [x_{l_k,t'''}^{(i,p,m)}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')} [x_{l_k,t''}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'''}^{(i,p,m)} [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u'=1,u'\neq f,u'\neq m}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'''}^{(i,p,m)} [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')} [x_{l_k,t''}^{(i,p,u')}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq m}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq u,u'\neq f,u'\neq m}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}x_{l_k,t'''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t'}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f,u'\neq m}^{N^{(i)}}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t'''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t'''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f,u''\neq m}^{N^{(i)}}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])+\frac{(N^{(i)})^2(n_p-1)}{\rho_i^2 n_p^3}\delta[g-g']$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,m)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)} [x_{l_k,t'}^{(i,p,m)}]^H x_{l_k,t'''}^{(i,p,m)} [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{u=1, u\neq f, u\neq m}^{N^{(i)}} \sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,m)}]^H] E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t'''}^{(i,p,m)} [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t'=1, t'\neq t}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t'''}^{(i,p,m)} [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u''=1, u''\neq f, u''\neq m}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,m)}]^H] E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u'')}]^H x_{l_k,t}^{(i,p,u'')}]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t'=1,t'\neq t}^{n_p} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)} [x_{l_k,t'}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u''=1,u''\neq f,u''\neq m}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)} [x_{l_k,t'}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,u'')}]^H x_{l_k,t'}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq m}^{N^{(i)}} \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq m}^{N^{(i)}} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t'''}^{(i,p,m)} [x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq m}^{N^{(i)}} \sum_{u''=1,u''\neq u,u''\neq f,u''\neq m}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,m)}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u'')}]^H x_{l_k,t}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,m)}]^H [x_{l_k,t}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t''=1,t''\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t}^{(i,p,m)} [x_{l_k,t''}^{(i,p,m)}]^H [x_{l_k,t''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H[x_{l_k,t'}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}[x_{l_k,t'}^{(i,p,m)}]^H[x_{l_k,t}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f,u'\neq m}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1,t'''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f,u'\neq m}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,u')}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}[x_{l_k,t'}^{(i,p,m)}]^H[x_{l_k,t}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq u,u'\neq f,u'\neq m}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,u')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}[x_{l_k,t'}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3\delta[g-g']\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t'}^{(i,p,m)}[x_{l_k,t'}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3\delta[g-g']\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f,u'\neq m}^{N^{(i)}}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t'''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{u''=1,u''\neq f,u''\neq m}^{N^{(i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u'')}]^H x_{l_k,t}^{(i,p,u'')}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}+\frac{(N^{(i)})^2}{\rho_i^2 n_p^2}\delta[g-g']$$

$$=2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$+\frac{(N^{(i)})^2(2C_{b_{l_k}}+n_p-1+4\max\{N^{(i)}-2,0\})}{\rho_i^2 n_p^4}\sum_{t=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t'''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}]$$

$$+\frac{\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^3}$$

$$+\frac{(C_{b_{l_k}})^2+(|D_{b_{l_k}}|^4+2)(n_p-1)}{n_p^3}\delta[g-g']$$

$$+\frac{(N^{(i)})^2(C_{b_{l_k}}n_p+n_p(n_p-1)+(2n_p+2)\max\{N^{(i)}-2,0\})}{\rho_i^2 n_p^4}\delta[g-g']$$

$$\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+\frac{\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^2}\delta[g-g']$$

$$+4\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+2\frac{N^{(i)}\max\{N^{(i)}-2,0\}}{\rho_i n_p^3}$$

$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}]$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^3\delta[g-g']\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^3\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'''=1,t'''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^3\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}+\frac{(N^{(i)})^2}{\rho_i^2 n_p^2}\delta[g-g']$$

$$= 2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+6\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$+\frac{(N^{(i)})^2(2C_{b_{l_k}}+n_p-1+4\max\{N^{(i)}-2,0\})}{\rho_i^2 n_p^4}\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$+\frac{(N^{(i)})^2(2C_{b_{l_k}}+n_p-1+4\max\{N^{(i)}-2,0\})}{\rho_i^2 n_p^4}\sum_{t=1}^{n_p}\sum_{t'''=1,t'''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t'''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,m)}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1,t''\neq t,t''\neq t'}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}]$$

$$+\frac{\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^3}$$

$$+\frac{(C_{b_{l_k}})^2+(|D_{b_{l_k}}|^4+2)(n_p-1)}{n_p^3}\delta[g-g']$$

$$+\frac{(N^{(i)})^2(C_{b_{l_k}}n_p+n_p(n_p-1)+(2n_p+2)\max\{N^{(i)}-2,0\})}{\rho_i^2 n_p^4}\delta[g-g']$$

$$\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^2(C_{b_{l_k}}n_p+n_p(n_p-1)+(2n_p+2)\max\{N^{(i)}-2,0\})}{\rho_i^2 n_p^4}\delta[g-g']$$

$$\sum_{t'=1}^{n_p}\sum_{t''=1,t''\neq t'}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+\frac{\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^2}\delta[g-g']$$

$$+4\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}\sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+4\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+2\frac{N^{(i)}\max\{N^{(i)}-2,0\}}{\rho_i n_p^3}$$

$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}\delta[g-g']\sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}]$$

$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}]$$

$$+2\frac{N^{(i)}(C_{b_{l_k}}+n_p-1+\max\{N^{(i)}-2,0\})}{\rho_i n_p^2}\delta[g-g']$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}+\frac{(N^{(i)})^2}{\rho_i^2 n_p^2}\delta[g-g']$$

$$= \frac{2F_{b_{l_k}} + 6C_{b_{l_k}}(n_p - 1) + 2(n_p - 1)(n_p - 2)}{n_p^3}(1 + \delta[g - g'])$$
$$+ \frac{(C_{b_{l_k}} + n_p - 1)\max\{N^{(i)} - 2, 0\}}{n_p^3}(1 + \delta[g - g'])$$
$$+ \frac{2(C_{b_{l_k}} + n_p - 1)(C_{b_{l_k}} + n_p - 1 + 2\max\{N^{(i)} - 2, 0\})}{n_p^3}$$
$$+ \frac{\max\{N^{(i)} - 2, 0\}(N^{(i)} - 3)}{n_p^3} + \frac{(C_{b_{l_k}})^2 + (|D_{b_{l_k}}|^4 + 2)(n_p - 1)}{n_p^3}\delta[g - g']$$
$$+ \frac{(C_{b_{l_k}} + n_p - 1)(n_p(C_{b_{l_k}} + n_p - 1) + (2n_p + 2)\max\{N^{(i)} - 2, 0\})}{n_p^3}\delta[g - g']$$
$$+ \frac{\max\{N^{(i)} - 2, 0\}(N^{(i)} - 3)}{n_p^2}\delta[g - g'] + 6\frac{N^{(i)}(C_{b_{l_k}} + n_p - 1)}{\rho_i n_p^3}$$
$$+2\frac{N^{(i)}\max\{N^{(i)} - 2, 0\}}{\rho_i n_p^3} + 2\frac{N^{(i)}(C_{b_{l_k}} + n_p - 1 + \max\{N^{(i)} - 2, 0\})}{\rho_i n_p^2}\delta[g - g']$$
$$+ \frac{(N^{(i)})^2}{\rho_i^2 n_p^3} + \frac{(N^{(i)})^2}{\rho_i^2 n_p^2}\delta[g - g']$$
$$= \frac{1}{\rho_i^2 n_p^3}(\rho_i^2(2F_{b_{l_k}} + 6C_{b_{l_k}}(n_p - 1)$$
$$+2(n_p - 1)(n_p - 2) + \max\{N^{(i)} - 2, 0\}(N^{(i)} - 3)$$
$$+(C_{b_{l_k}} + n_p - 1)(2C_{b_{l_k}} + 2n_p - 2 + 5\max\{N^{(i)} - 2, 0\}))$$
$$+2\rho_i N^{(i)}(3C_{b_{l_k}} + 3n_p - 3 + \max\{N^{(i)} - 2, 0\}) + (N^{(i)})^2)$$
$$+ \frac{\delta[g - g']}{\rho_i^2 n_p^3}(\rho_i^2(2F_{b_{l_k}} + 6C_{b_{l_k}}(n_p - 1) + 2(n_p - 1)(n_p - 2)$$
$$+(C_{b_{l_k}})^2 + (|D_{b_{l_k}}|^4 + 2)(n_p - 1) + n_p\max\{N^{(i)} - 2, 0\}(N^{(i)} - 3)$$
$$+(C_{b_{l_k}} + n_p - 1)(n_p(C_{b_{l_k}} + n_p - 1) + (2n_p + 3)\max\{N^{(i)} - 2, 0\}))$$
$$+n_p\rho_i N^{(i)}(C_{b_{l_k}} + n_p - 1 + \max\{N^{(i)} - 2, 0\}) + (N^{(i)})^2 n_p)$$

So the 3rd subterm is given by

$$
\begin{aligned}
\implies & E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]}^H \widehat{h_{l_k,f}^{(i,g)}}\widehat{[h_{l_k,f}^{(i,g')}]}^H \widehat{h_{l_k,m}^{(i,g')}}](m \neq f) \\
&= \frac{1}{\rho_i^2 n_p^3}(\rho_i^2(2F_{b_{l_k}} + 6C_{b_{l_k}}(n_p-1) \\
&+2(n_p-1)(n_p-2) + \max\{N^{(i)}-2,0\}(N^{(i)}-3) \\
&+(C_{b_{l_k}} + n_p - 1)(2C_{b_{l_k}} + 2n_p - 2 + 5\max\{N^{(i)}-2,0\})) \\
&+2\rho_i N^{(i)}(3C_{b_{l_k}} + 3n_p - 3 + \max\{N^{(i)}-2,0\}) + (N^{(i)})^2) \\
&+\frac{\delta[g-g']}{\rho_i^2 n_p^3}(\rho_i^2(2F_{b_{l_k}} + 6C_{b_{l_k}}(n_p-1) + 2(n_p-1)(n_p-2) \\
&+(C_{b_{l_k}})^2 + (|D_{b_{l_k}}|^4 + 2)(n_p-1) + n_p\max\{N^{(i)}-2,0\}(N^{(i)}-3) \\
&+(C_{b_{l_k}} + n_p - 1)(n_p(C_{b_{l_k}} + n_p - 1) + (2n_p+3)\max\{N^{(i)}-2,0\})) \\
&+n_p\rho_i N^{(i)}(C_{b_{l_k}} + n_p - 1 + \max\{N^{(i)}-2,0\}) + (N^{(i)})^2 n_p)
\end{aligned}
\tag{A.5}
$$

Subterm IV The 4th subterm can be calculated as follows (derivations will be long and challenging):

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]^H}\widehat{h_{l_k,f}^{(i,g)}}\widehat{[h_{l_k,m}^{(i,g')}]^H}\widehat{h_{l_k,f}^{(i,g')}}](m \neq f)$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'''}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,m)}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'''}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}\sum_{u'''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)}x_{l_k,t'''}^{(i,p,u''')}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u'''}^{(i,g')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t'''}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,m)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)} [h_{l_k,u}^{(i,g')}]^H h_{l_k,u}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{u''=1, u'' \neq u}^{N^{(i)}} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)} [h_{l_k,u''}^{(i,g')}]^H h_{l_k,u''}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t'''}^{(i,p,u'')} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1, u' \neq u}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} [h_{l_k,u}^{(i,g')}]^H h_{l_k,u'}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t'''}^{(i,p,u')} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1, u' \neq u}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} [h_{l_k,u'}^{(i,g')}]^H h_{l_k,u}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t'''}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,m)} [x_{l_k,t''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t''}^{(i,p,g')}]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [w_{l_k,t'}^{(i,p,g)} [w_{l_k,t'}^{(i,p,g')}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u'=1}^{N^{(i)}} \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [h_{l_k,u'}^{(i,g)} [h_{l_k,u'}^{(i,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t'''}^{(i,p,u'')}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u''}^{(i,g')}]^H h_{l_k,u''}^{(i,g')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}[w_{l_k,t}^{(i,p,g')}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H w_{l_k,t''}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,m)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t}^{(i,p,g')}]^H w_{l_k,t'}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t'}^{(i,p,g')}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^4 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t'''}^{(i,p,u)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq u}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t'''}^{(i,p,u'')}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq u}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t'''}^{(i,p,u)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,m)}[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,m)} x_{l_k,t'''}^{(i,p,u)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t'''}^{(i,p,u'')}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2|D_{b_{l_k}}|^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])$$

$$=(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t''}^{(i,p,m)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t'''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t''}^{(i,p,m)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}x_{l_k,t'''}^{(i,p,m)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f,u''\neq m}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t''}^{(i,p,m)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f,u''\neq m}^{N^{(i)}}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'''}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}x_{l_k,t'''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq m}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{u''=1,u''\neq u,u''\neq f,u''\neq m}^{N^{(i)}} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t'''}^{(i,p,f)}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)} [x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u'=1,u'\neq f,u'\neq m}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)} [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t''}^{(i,p,m)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')} [x_{l_k,t''}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t''}^{(i,p,m)} x_{l_k,t'''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u'=1,u'\neq f,u'\neq m}^{N^{(i)}} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t''}^{(i,p,m)} x_{l_k,t'''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')} [x_{l_k,t''}^{(i,p,u')}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{u=1,u\neq f,u\neq m}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p} \sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H [x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq u,u'\neq f,u'\neq m}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t''}^{(i,p,m)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t''}^{(i,p,m)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}x_{l_k,t'''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'''}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f,u'\neq m}^{N^{(i)}}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{t'''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}x_{l_k,t'''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1,u''\neq f,u''\neq m}^{N^{(i)}}\sum_{t'''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t'''}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t'''}^{(i,p,u'')}]$$

$$+\frac{(N^{(i)})^2|D_{b_{l_k}}|^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])$$

$$=2(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}Re\{$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}]\}$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$Re\{E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}]\}$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t''=1}^{n_p}Re\{$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}]\}$$

$$+4(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u''=1,u''\neq f,u''\neq m}^{N^{(i)}}Re\{$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u'')}]^H x_{l_k,t}^{(i,p,u'')}]\}$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{u''=1,u''\neq u,u''\neq f,u''\neq m}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u'')}]^H x_{l_k,t}^{(i,p,u'')}]$$

$$+4(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}Re\{$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}]\}$$

$$+2(\frac{N^{(i)}}{\rho_i n_p})^4(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2|D_{b_{l_k}}|^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])$$

$$=2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t'''=1}^{n_p}Re\{D_{b_{l_k}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]\}$$

$$+\frac{(N^{(i)})^2|D_{b_{l_k}}|^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$

$$+2\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}Re\{[J_{b_{l_k}}]^H$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}]\}$$

$$+2\frac{(N^{(i)})^2(n_p-1)}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}Re\{[D_{b_{l_k}}]^H$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}]\}$$

$$+4\frac{(N^{(i)})^2\max\{N^{(i)}-2,0\}}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}Re\{D_{b_{l_k}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]\}$$

$$+\frac{|D_{b_{l_k}}|^2\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^3}(1+\delta[g-g'])$$

$$+4\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}Re\{D_{b_{l_k}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]\}$$

$$+2\frac{N^{(i)}|D_{b_{l_k}}|^2\max\{N^{(i)}-2,0\}}{\rho_i n_p^3}(1+\delta[g-g'])$$
$$+\frac{(N^{(i)})^2|D_{b_{l_k}}|^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])$$
$$=2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p} Re\{D_{b_{l_k}}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]\}$$
$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'''=1,t'''\neq t}^{n_p} Re\{D_{b_{l_k}}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]\}$$
$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} Re\{D_{b_{l_k}}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]\}$$
$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} Re\{D_{b_{l_k}}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]\}$$
$$+2\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}\sum_{t'''=1,t'''\neq t,t'''\neq t'}^{n_p} Re\{D_{b_{l_k}}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'''}^{(i,p,f)}[x_{l_k,t'''}^{(i,p,f)}]^H]\}$$
$$+\frac{(N^{(i)})^2|D_{b_{l_k}}|^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$
$$+\frac{(N^{(i)})^2|D_{b_{l_k}}|^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1,t'\neq t}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}]$$
$$+2\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p} Re\{[J_{b_{l_k}}]^H$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}]\}$$

$$+2\frac{(N^{(i)})^2}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p} Re\{[J_{b_{l_k}}]^H$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t}^{(i,p,m)}]\}$$

$$+2\frac{(N^{(i)})^2(n_p-1)}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p} Re\{[D_{b_{l_k}}]^H$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t}^{(i,p,m)}]\}$$

$$+2\frac{(N^{(i)})^2(n_p-1)}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p} Re\{[D_{b_{l_k}}]^H$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)} x_{l_k,t}^{(i,p,m)}]\}$$

$$+4\frac{(N^{(i)})^2\max\{N^{(i)}-2,0\}}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p} Re\{D_{b_{l_k}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]\}$$

$$+4\frac{(N^{(i)})^2\max\{N^{(i)}-2,0\}}{\rho_i^2 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} Re\{D_{b_{l_k}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]\}$$

$$+\frac{|D_{b_{l_k}}|^2\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^3}(1+\delta[g-g'])$$

$$+4\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p} Re\{D_{b_{l_k}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]\}$$

$$+4\frac{(N^{(i)})^3}{\rho_i^3 n_p^4}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} Re\{D_{b_{l_k}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]\}$$

$$+2\frac{N^{(i)}|D_{b_{l_k}}|^2\max\{N^{(i)}-2,0\}}{\rho_i n_p^3}(1+\delta[g-g'])$$

$$+\frac{(N^{(i)})^2|D_{b_{l_k}}|^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])$$

$$= 2\frac{Re\{D_{b_{l_k}}[R_{b_{l_k}}]^H\}}{n_p^3}(1+\delta[g-g'])+8\frac{Re\{D_{b_{l_k}}[J_{b_{l_k}}]^H\}(n_p-1)}{n_p^3}(1+\delta[g-g'])$$
$$+2\frac{|D_{b_{l_k}}|^2C_{b_{l_k}}(n_p-1)}{n_p^3}(1+\delta[g-g'])+2\frac{|D_{b_{l_k}}|^2(n_p-1)(n_p-2)}{n_p^3}(1+\delta[g-g'])$$
$$+\frac{|D_{b_{l_k}}|^2C_{b_{l_k}}\max\{N^{(i)}-2,0\}}{n_p^3}(1+\delta[g-g'])$$
$$+\frac{|D_{b_{l_k}}|^4(n_p-1)\max\{N^{(i)}-2,0\}}{n_p^3}(1+\delta[g-g'])$$
$$+2\frac{|J_{b_{l_k}}|^2}{n_p^3}(1+\delta[g-g'])+2\frac{|D_{b_{l_k}}|^2(n_p-1)^2}{n_p^3}(1+\delta[g-g'])$$
$$+4\frac{Re\{D_{b_{l_k}}[J_{b_{l_k}}]^H\}\max\{N^{(i)}-2,0\}}{n_p^3}(1+\delta[g-g'])$$
$$+4\frac{|D_{b_{l_k}}|^2(n_p-1)\max\{N^{(i)}-2,0\}}{n_p^3}(1+\delta[g-g'])$$
$$+\frac{|D_{b_{l_k}}|^2\max\{N^{(i)}-2,0\}(N^{(i)}-3)}{n_p^3}(1+\delta[g-g'])$$
$$+4\frac{N^{(i)}Re\{D_{b_{l_k}}[J_{b_{l_k}}]^H\}}{\rho_i n_p^3}(1+\delta[g-g'])+4\frac{N^{(i)}|D_{b_{l_k}}|^2(n_p-1)}{\rho_i n_p^3}(1+\delta[g-g'])$$
$$+2\frac{N^{(i)}|D_{b_{l_k}}|^2\max\{N^{(i)}-2,0\}}{\rho_i n_p^3}(1+\delta[g-g'])+\frac{(N^{(i)})^2|D_{b_{l_k}}|^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])$$
$$= \frac{1+\delta[g-g']}{\rho_i^2 n_p^3}(\rho_i^2(2Re\{D_{b_{l_k}}[R_{b_{l_k}}]^H\}$$
$$+4Re\{D_{b_{l_k}}[J_{b_{l_k}}]^H\}(2n_p-2+\max\{N^{(i)}-2,0\})$$
$$+2|J_{b_{l_k}}|^2+2|D_{b_{l_k}}|^2(C_{b_{l_k}}+2n_p-3)(n_p-1)$$
$$+|D_{b_{l_k}}|^2(C_{b_{l_k}}+(|D_{b_{l_k}}|^2+4)(n_p-1)+N^{(i)}-3)\max\{N^{(i)}-2,0\})$$
$$+2\rho_i N^{(i)}(2Re\{D_{b_{l_k}}[J_{b_{l_k}}]^H\}+|D_{b_{l_k}}|^2(2n_p-2+\max\{N^{(i)}-2,0\}))$$
$$+(N^{(i)})^2|D_{b_{l_k}}|^2)$$

So the 4th subterm is given by

$$\begin{aligned}
\implies & E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,m}^{(i,g')}}]^H \widehat{h_{l_k,f}^{(i,g')}}](m \neq f) \\
&= \frac{1+\delta[g-g']}{\rho_i^2 n_p^3}(\rho_i^2(2Re\{D_{b_{l_k}}[R_{b_{l_k}}]^H\} \\
&+4Re\{D_{b_{l_k}}[J_{b_{l_k}}]^H\}(2n_p-2+\max\{N^{(i)}-2,0\}) \\
&+2|J_{b_{l_k}}|^2+2|D_{b_{l_k}}|^2(C_{b_{l_k}}+2n_p-3)(n_p-1) \\
&+|D_{b_{l_k}}|^2(C_{b_{l_k}}+(|D_{b_{l_k}}|^2+4)(n_p-1)+N^{(i)}-3)\max\{N^{(i)}-2,0\}) \\
&+2\rho_i N^{(i)}(2Re\{D_{b_{l_k}}[J_{b_{l_k}}]^H\}+|D_{b_{l_k}}|^2(2n_p-2+\max\{N^{(i)}-2,0\})) \\
&+(N^{(i)})^2|D_{b_{l_k}}|^2)
\end{aligned} \tag{A.6}$$

A.1.2 For the 2nd Term

The 2nd term can be calculated easily by using the corresponding Equations (A.3) and (A.4) as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H \widehat{h_{l_k,f'}^{(i,g')}}] = \begin{cases} \text{(A.3)}, & f'=f \\ \\ \text{(A.4)}, & f' \neq f \end{cases} \tag{A.7}$$

A.1.3 For the 3rd Term

The 3rd term will consist of eight subterms.

Subterm I The 1st subterm can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)} x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,f)}]^H + \sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,f)}]^H)]^H \frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H + \sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H)[\frac{N^{(i)}}{\rho_i n_p}(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}} h_{l_k,u''}^{(i,g')} x_{l_k,t''}^{(i,p,u'')}[x_{l_k,t''}^{(i,p,f)}]^H + \sum_{t''=1}^{n_p} w_{l_k,t''}^{(i,p,g')}[x_{l_k,t''}^{(i,p,f)}]^H)]^H h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} + \sum_{t=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H x_{l_k,t}^{(i,p,f)})(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H + \sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H)(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u''}^{(i,g')}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} + \sum_{t''=1}^{n_p}[w_{l_k,t''}^{(i,p,g')}]^H x_{l_k,t''}^{(i,p,f)})h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}$$

$$+ \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} h_{l_k,f}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+ \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} w_{l_k,t'}^{(i,p,g)}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,f}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H$$

$$x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} h_{l_k,u'}^{(i,g)} h_{l_k,f}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f}^{(i,g')}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,f}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f}^{(i,g')}[h_{l_k,f}^{(i,g)}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f}^{N^{(i)}}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f}^{(i,g')}[h_{l_k,f}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u'}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f}^{(i,g')}[h_{l_k,u}^{(i,g)}]^H h_{l_k,f}^{(i,g)}[h_{l_k,u}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H[x_{l_k,t''}^{(i,p,u)}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f}^{(i,g')}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H h_{l_k,f}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[w_{l_k,t'}^{(i,p,g)}[w_{l_k,t'}^{(i,p,g')}]^H$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t''=1, t'' \neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t'=1, t' \neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t'=1, t' \neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t'=1, t' \neq t}^{n_p} \sum_{t''=1, t'' \neq t, t'' \neq t'}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^2 (N^{(i)}-1)}{\rho_i^2 n_p^3} (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t'=1, t' \neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$= \frac{F_{b_{l_k}}}{n_p^2} (1+\delta[g-g']) + 3\frac{C_{b_{l_k}} (n_p-1)}{n_p^2} (1+\delta[g-g'])$$

$$+\frac{(n_p-1)(n_p-2)}{n_p^2} (1+\delta[g-g'])$$

$$+\frac{(N^{(i)})^2(N^{(i)}-1)}{\rho_i^2 n_p^3}(1+\delta[g-g'])\sum_{t=1}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$
$$+\frac{(N^{(i)})^2(N^{(i)}-1)}{\rho_i^2 n_p^3}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$
$$+\frac{N^{(i)}C_{b_{l_k}}}{\rho_i n_p^2}(1+\delta[g-g'])+\frac{N^{(i)}(n_p-1)}{\rho_i n_p^2}(1+\delta[g-g'])$$
$$=\frac{(1+\delta[g-g'])}{n_p^2}(F_{b_{l_k}}+3C_{b_{l_k}}(n_p-1)+(n_p-1)(n_p-2))$$
$$+\frac{C_{b_{l_k}}(N^{(i)}-1)}{n_p^2}(1+\delta[g-g'])$$
$$+\frac{(n_p-1)(N^{(i)}-1)}{n_p^2}(1+\delta[g-g'])$$
$$+\frac{(1+\delta[g-g'])}{\rho_i n_p^2}N^{(i)}(C_{b_{l_k}}+n_p-1)$$
$$=\frac{(1+\delta[g-g'])}{\rho_i n_p^2}(\rho_i(F_{b_{l_k}}+(n_p-1)(3C_{b_{l_k}}+n_p-2)$$
$$+(C_{b_{l_k}}+n_p-1)(N^{(i)}-1))+N^{(i)}(C_{b_{l_k}}+n_p-1))$$

So the 1st subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]$$
$$=\frac{(1+\delta[g-g'])}{\rho_i n_p^2}(\rho_i(F_{b_{l_k}}+(n_p-1)(3C_{b_{l_k}}+n_p-2) \tag{A.8}$$
$$+(C_{b_{l_k}}+n_p-1)(N^{(i)}-1))+N^{(i)}(C_{b_{l_k}}+n_p-1))$$

Subterm II The 2nd subterm can be easily calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,f}^{(i,g')}}] = [E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,f}^{(i,g)}}^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]]^H = \text{(A.8)}$$

So the 2nd subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,f}^{(i,g')}}] = \text{(A.8)} \tag{A.9}$$

Subterm III The 3rd subterm can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}](f'\neq f)$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)}x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,f)}]^H$$

$$+\sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,f)}]^H)]^H\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H)[\frac{N^{(i)}}{\rho_i n_p}(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}} h_{l_k,u''}^{(i,g')}x_{l_k,t''}^{(i,p,u'')}[x_{l_k,t''}^{(i,p,f')}]^H$$

$$+\sum_{t''=1}^{n_p} w_{l_k,t''}^{(i,p,g')}[x_{l_k,t''}^{(i,p,f')}]^H)]^H h_{l_k,f'}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}$$

$$+\sum_{t=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H x_{l_k,t}^{(i,p,f)})(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H)(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u''}^{(i,g')}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}$$

$$+\sum_{t''=1}^{n_p}[w_{l_k,t''}^{(i,p,g')}]^H x_{l_k,t''}^{(i,p,f')})h_{l_k,f'}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f'}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H}x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}h_{l_k,f'}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H}x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f'}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H}x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}w_{l_k,t'}^{(i,p,g)}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,f'}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')} w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H$$

$$x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')} h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f'}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')} h_{l_k,u'}^{(i,g)} h_{l_k,f'}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f'}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')} h_{l_k,f'}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f'}^{(i,g')}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,f'}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f')}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f')}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f'}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f'}^{(i,g')}[h_{l_k,f'}^{(i,g)}]^H h_{l_k,f'}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t'}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f'}^{N^{(i)}}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f'}^{(i,g')}[h_{l_k,f'}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u'}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f'}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f'}^{(i,g')}[h_{l_k,u}^{(i,g)}]^H h_{l_k,f'}^{(i,g)}[h_{l_k,u}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f')} x_{l_k,t''}^{(i,p,f')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f'}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f'}^{(i,g')}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f'}^{(i,g)}]^H h_{l_k,f'}^{(i,g')}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[w_{l_k,t}^{(i,p,g)}[w_{l_k,t}^{(i,p,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f'}^{(i,g')}]^H h_{l_k,f'}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}[x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \delta[g-g'] \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq f'}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f'}^{N^{(i)}} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+\frac{N^{(i)}}{\rho_i n_p^2}\delta[g-g'] + \frac{N^{(i)}}{\rho_i n_p}$$

$$= \frac{(N^{(i)})^2}{\rho_i^2 n_p^3}(1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')} [x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}\delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u'=1,u'\neq f'}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f',u\neq f}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{N^{(i)}}{\rho_i n_p^2}\delta[g-g'] + \frac{N^{(i)}}{\rho_i n_p}$$

$$= \frac{(N^{(i)})^2}{\rho_i^2 n_p^3}(1+\delta[g-g']) \sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')} [x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}(1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t''=1,t''\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f')} [x_{l_k,t''}^{(i,p,f')}]^H x_{l_k,t''}^{(i,p,f')}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}\delta[g-g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}\delta[g-g'] \sum_{t=1}^{n_p} \sum_{u'=1,u'\neq f',u'\neq f}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,u')} [x_{l_k,t}^{(i,p,u')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+\frac{\max\{N^{(i)}-2,0\}}{n_p}+\frac{N^{(i)}}{\rho_i n_p^2}\delta[g-g']+\frac{N^{(i)}}{\rho_i n_p}$$

$$=\frac{C_{b_{l_k}}}{n_p^2}(1+\delta[g-g'])+\frac{n_p-1}{n_p^2}(1+\delta[g-g'])$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}\delta[g-g']\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{\max\{N^{(i)}-2,0\}}{n_p^2}\delta[g-g']+\frac{C_{b_{l_k}}}{n_p}+\frac{n_p-1}{n_p}$$

$$+\frac{\max\{N^{(i)}-2,0\}}{n_p}+\frac{N^{(i)}}{\rho_i n_p^2}\delta[g-g']+\frac{N^{(i)}}{\rho_i n_p}$$

$$=\frac{C_{b_{l_k}}+n_p-1}{n_p^2}(1+\delta[g-g'])+\frac{C_{b_{l_k}}}{n_p^2}\delta[g-g']+\frac{n_p-1}{n_p^2}\delta[g-g']$$

$$+\frac{\max\{N^{(i)}-2,0\}}{n_p^2}\delta[g-g']+\frac{C_{b_{l_k}}+n_p-1+\max\{N^{(i)}-2,0\}}{n_p}$$

$$+\frac{N^{(i)}}{\rho_i n_p^2}\delta[g-g']+\frac{N^{(i)}}{\rho_i n_p}$$

$$=\frac{\rho_i(n_p+1)(C_{b_{l_k}}+n_p-1)+\rho_i n_p\max\{N^{(i)}-2,0\}+N^{(i)}}{\rho_i n_p}$$

$$+\frac{2\rho_i(C_{b_{l_k}}+n_p-1)+\rho_i\max\{N^{(i)}-2,0\}+N^{(i)}}{\rho_i n_p^2}\delta[g-g']$$

So the 3rd subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}](f'\neq f)$$

$$=\frac{\rho_i(n_p+1)(C_{b_{l_k}}+n_p-1)+\rho_i n_p\max\{N^{(i)}-2,0\}+N^{(i)}}{\rho_i n_p}$$

$$+\frac{2\rho_i(C_{b_{l_k}}+n_p-1)+\rho_i\max\{N^{(i)}-2,0\}+N^{(i)}}{\rho_i n_p^2}\delta[g-g'] \tag{A.10}$$

Subterm IV The 4th subterm can be easily calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}](f' \neq f) = [E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,f}^{(i,g)}}^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}]]^H = \text{(A.10)}$$

So the 4th subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}](f' \neq f) = \text{(A.10)} \qquad \text{(A.11)}$$

Subterm V The 5th subterm can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,m}^{(i,g')}](m \neq f)$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)} x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,m)}]^H$$

$$+\sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,m)}]^H)]^H \frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H)[\frac{N^{(i)}}{\rho_i n_p}(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}} h_{l_k,u''}^{(i,g')} x_{l_k,t''}^{(i,p,u'')}[x_{l_k,t''}^{(i,p,f)}]^H$$

$$+\sum_{t''=1}^{n_p} w_{l_k,t''}^{(i,p,g')}[x_{l_k,t''}^{(i,p,f)}]^H)]^H h_{l_k,m}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}$$

$$+\sum_{t=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H x_{l_k,t}^{(i,p,m)})(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H)(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u''}^{(i,g')}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}$$

$$+\sum_{t''=1}^{n_p}[w_{l_k,t''}^{(i,p,g')}]^H x_{l_k,t''}^{(i,p,f)})h_{l_k,m}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,m}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} h_{l_k,m}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} [w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H [h_{l_k,u''}^{(i,g')}]^H h_{l_k,m}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} w_{l_k,t'}^{(i,p,g)}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,m}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} w_{l_k,t'}^{(i,p,g)} [w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H$$

$$x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} h_{l_k,u'}^{(i,g)} [h_{l_k,u''}^{(i,g')}]^H h_{l_k,m}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H [w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} h_{l_k,u'}^{(i,g)} h_{l_k,m}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}$$

$$x_{l_k,t}^{(i,p,m)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)} [h_{l_k,u''}^{(i,g')}]^H h_{l_k,m}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)} [w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,m)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)} h_{l_k,m}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,m}^{(i,g')}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,m}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u''}^{(i,g')}]^H h_{l_k,m}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,m}^{(i,g')}[h_{l_k,m}^{(i,g)}]^H h_{l_k,m}^{(i,g)}[h_{l_k,m}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq m}^{N^{(i)}}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,m}^{(i,g')}[h_{l_k,m}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u'}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p}\sum_{u=1,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,m}^{(i,g')}[h_{l_k,u}^{(i,g)}]^H h_{l_k,m}^{(i,g)}[h_{l_k,u}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p} \sum_{u=1,u\neq m}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,m}^{(i,g')}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)}[h_{l_k,m}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H h_{l_k,m}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[w_{l_k,t'}^{(i,p,g)}[w_{l_k,t'}^{(i,p,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g')}]^H h_{l_k,m}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)}[x_{l_k,t'}^{(i,p,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \delta[g-g'] \sum_{t'=1}^{n_p} \sum_{u'=1,u'\neq m}^{N^{(i)}} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p} \sum_{u=1,u\neq m}^{N^{(i)}} \sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H] + \frac{N^{(i)}}{\rho_i n_p}\delta[g-g'] + \frac{N^{(i)}}{\rho_i n_p^2}$$

$$= \frac{(N^{(i)})^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)}[x_{l_k,t'}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2\delta[g-g']\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2\delta[g-g']\sum_{t'=1}^{n_p}\sum_{u'=1,u'\neq m,u'\neq f}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,u')}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}\sum_{t=1}^{n_p}\sum_{u=1,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+\frac{N^{(i)}}{\rho_i n_p}\delta[g-g']+\frac{N^{(i)}}{\rho_i n_p^2}$$

$$= \frac{(N^{(i)})^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])\sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)}[x_{l_k,t'}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2\delta[g-g']\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2\delta[g-g']\sum_{t'=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,f)}]$$

$$+\frac{\max\{N^{(i)}-2,0\}}{n_p}\delta[g-g']$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}\sum_{t=1}^{n_p}\sum_{u=1,u\neq m,u\neq f}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+\frac{N^{(i)}}{\rho_i n_p}\delta[g-g']+\frac{N^{(i)}}{\rho_i n_p^2}$$

$$= \frac{C_{b_{l_k}}}{n_p^2}(1+\delta[g-g']) + \frac{n_p-1}{n_p^2}(1+\delta[g-g']) + \frac{C_{b_{l_k}}}{n_p}\delta[g-g']$$
$$+\frac{n_p-1}{n_p}\delta[g-g'] + \frac{\max\{N^{(i)}-2,0\}}{n_p}\delta[g-g']$$
$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}\sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$
$$+\frac{(N^{(i)})^2}{\rho_i^2 n_p^3}\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$
$$+\frac{\max\{N^{(i)}-2,0\}}{n_p^2} + \frac{N^{(i)}}{\rho_i n_p}\delta[g-g'] + \frac{N^{(i)}}{\rho_i n_p^2}$$
$$= \frac{C_{b_{l_k}}+n_p-1}{n_p^2}(1+\delta[g-g']) + \frac{C_{b_{l_k}}+n_p-1+\max\{N^{(i)}-2,0\}}{n_p}\delta[g-g']$$
$$+\frac{C_{b_{l_k}}}{n_p^2} + \frac{n_p-1}{n_p^2} + \frac{\max\{N^{(i)}-2,0\}}{n_p^2} + \frac{N^{(i)}}{\rho_i n_p}\delta[g-g'] + \frac{N^{(i)}}{\rho_i n_p^2}$$
$$= \frac{2\rho_i(C_{b_{l_k}}+n_p-1)+\rho_i\max\{N^{(i)}-2,0\}+N^{(i)}}{\rho_i n_p^2}$$
$$+\frac{\rho_i(n_p+1)(C_{b_{l_k}}+n_p-1)+\rho_i n_p\max\{N^{(i)}-2,0\}+N^{(i)}n_p}{\rho_i n_p^2}\delta[g-g']$$

So the 5th subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,m}^{(i,g')}](m\neq f)$$
$$= \frac{2\rho_i(C_{b_{l_k}}+n_p-1)+\rho_i\max\{N^{(i)}-2,0\}+N^{(i)}}{\rho_i n_p^2}$$
$$+\frac{\rho_i(n_p+1)(C_{b_{l_k}}+n_p-1)+\rho_i n_p\max\{N^{(i)}-2,0\}+N^{(i)}n_p}{\rho_i n_p^2}\delta[g-g'] \quad \text{(A.12)}$$

Subterm VI The 6th subterm can be easily calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,m}^{(i,g')}}](m\neq f) = [E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,m}^{(i,g)}}^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,m}^{(i,g')}]]^H = \text{(A.12)}$$

So the 6th subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,m}^{(i,g')}}](m\neq f) = \text{(A.12)} \quad \text{(A.13)}$$

Subterm VII The 7th subterm can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,m}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}](m \neq f)$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)} x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,m)}]^H$$

$$+\sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,m)}]^H)]^H \frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H)[\frac{N^{(i)}}{\rho_i n_p}(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}} h_{l_k,u''}^{(i,g')} x_{l_k,t''}^{(i,p,u'')}[x_{l_k,t''}^{(i,p,m)}]^H$$

$$+\sum_{t''=1}^{n_p} w_{l_k,t''}^{(i,p,g')}[x_{l_k,t''}^{(i,p,m)}]^H)]^H h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}$$

$$+\sum_{t=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H x_{l_k,t}^{(i,p,m)})(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H)(\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u''}^{(i,g')}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)}$$

$$+\sum_{t''=1}^{n_p}[w_{l_k,t''}^{(i,p,g')}]^H x_{l_k,t''}^{(i,p,m)})h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} h_{l_k,f}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,m)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)} w_{l_k,t'}^{(i,p,g)}$$

$$+\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}[h_{l_k,u}^{(i,g)}]^H h_{l_k,f}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H}x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,m)}w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H$$

$$x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)}h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,m)}h_{l_k,u'}^{(i,g)}h_{l_k,f}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}$$

$$x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)}[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f}^{(i,g')}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H$$

$$x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,m)}h_{l_k,f}^{(i,g')}]$$

$$=(\frac{N^{(i)}}{\rho_i n_p})^3\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f}^{(i,g')}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}[h_{l_k,u''}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,f}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[w_{l_k,t'}^{(i,p,g)}[w_{l_k,t''}^{(i,p,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}\sum_{t''=1}^{n_p}\sum_{u''=1}^{N^{(i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t''}^{(i,p,u'')}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u''}^{(i,g')}]^H h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [h_{l_k,f}^{(i,g')} [h_{l_k,f}^{(i,g)}]^H h_{l_k,f}^{(i,g)} [h_{l_k,f}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,m)} x_{l_k,t''}^{(i,p,m)}]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} \sum_{u'=1, u' \neq f}^{N^{(i)}} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [h_{l_k,f}^{(i,g')} [h_{l_k,f}^{(i,g)}]^H h_{l_k,u'}^{(i,g)} [h_{l_k,u'}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p} \sum_{u=1, u \neq f}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [h_{l_k,f}^{(i,g')} [h_{l_k,u}^{(i,g)}]^H h_{l_k,f}^{(i,g)} [h_{l_k,u}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} [x_{l_k,t''}^{(i,p,u)}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p} \sum_{u=1, u \neq f}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [h_{l_k,f}^{(i,g')} [h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)} [h_{l_k,f}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)} x_{l_k,t''}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t'}^{(i,p,f)}]^H [x_{l_k,t''}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,f}^{(i,g)}]^H h_{l_k,f}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [w_{l_k,t}^{(i,p,g)} [w_{l_k,t}^{(i,p,g')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^3 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t}^{(i,p,m)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \delta[g-g'] \sum_{t=1}^{n_p} \sum_{u'=1,u'\neq f}^{N^{(i)}} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^3 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f}^{N^{(i)}} \sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)} x_{l_k,t'}^{(i,p,m)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t'}^{(i,p,f)}]^H] + \frac{N^{(i)}|D_{b_{l_k}}|^2}{\rho_i n_p^2}\delta[g-g']$$

$$+\frac{N^{(i)}|D_{b_{l_k}}|^2}{\rho_i n_p^2}$$

$$= \frac{(N^{(i)})^2 D_{b_{l_k}}}{\rho_i^2 n_p^3}(1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2[D_{b_{l_k}}]^H}{\rho_i^2 n_p^3}\delta[g-g'] \sum_{t=1}^{n_p} \sum_{u'=1,u'\neq f}^{N^{(i)}} \sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)} x_{l_k,t}^{(i,p,u')}[x_{l_k,t''}^{(i,p,u')}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$+\frac{(N^{(i)})^2[D_{b_{l_k}}]^H}{\rho_i^2 n_p^3} \sum_{t=1}^{n_p} \sum_{u=1,u\neq f}^{N^{(i)}} \sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)} x_{l_k,t'}^{(i,p,m)}]$$

$$+\frac{N^{(i)}|D_{b_{l_k}}|^2}{\rho_i n_p^2}\delta[g-g']+\frac{N^{(i)}|D_{b_{l_k}}|^2}{\rho_i n_p^2}$$

$$=\frac{(N^{(i)})^2 D_{b_{l_k}}}{\rho_i^2 n_p^3}(1+\delta[g-g'])\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2 D_{b_{l_k}}}{\rho_i^2 n_p^3}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{(N^{(i)})^2[D_{b_{l_k}}]^H}{\rho_i^2 n_p^3}\delta[g-g']\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$+\frac{(N^{(i)})^2[D_{b_{l_k}}]^H}{\rho_i^2 n_p^3}\delta[g-g']\sum_{t=1}^{n_p}\sum_{u'=1,u'\neq f,u'\neq m}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,u')}[x_{l_k,t}^{(i,p,u')}]^H x_{l_k,t}^{(i,p,m)}]$$

$$+\frac{(N^{(i)})^2[D_{b_{l_k}}]^H}{\rho_i^2 n_p^3}\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}]$$

$$+\frac{(N^{(i)})^2[D_{b_{l_k}}]^H}{\rho_i^2 n_p^3}\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,u)}x_{l_k,t}^{(i,p,m)}]$$

$$+\frac{N^{(i)}|D_{b_{l_k}}|^2}{\rho_i n_p^2}(1+\delta[g-g'])$$

$$=\frac{D_{b_{l_k}}[J_{b_{l_k}}]^H}{n_p^2}(1+\delta[g-g'])+\frac{|D_{b_{l_k}}|^2(n_p-1)}{n_p^2}(1+\delta[g-g'])$$

$$+\frac{(N^{(i)})^2[D_{b_{l_k}}]^H}{\rho_i^2 n_p^3}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}]$$

$$+\frac{|D_{b_{l_k}}|^2\max\{N^{(i)}-2,0\}}{n_p^2}(1+\delta[g-g'])+\frac{N^{(i)}|D_{b_{l_k}}|^2}{\rho_i n_p^2}(1+\delta[g-g'])$$

$$= \frac{D_{b_{l_k}}[J_{b_{l_k}}]^H}{n_p^2}(1+\delta[g-g'])+\frac{|D_{b_{l_k}}|^2(n_p-1)}{n_p^2}(1+\delta[g-g'])$$
$$+\frac{(N^{(i)})^2[D_{b_{l_k}}]^H}{\rho_i^2 n_p^3}(1+\delta[g-g'])\sum_{t=1}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}]$$
$$+\frac{(N^{(i)})^2[D_{b_{l_k}}]^H}{\rho_i^2 n_p^3}(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t''=1,t''\neq t}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t}^{(i,p,m)}[x_{l_k,t''}^{(i,p,m)}]^H x_{l_k,t''}^{(i,p,m)}]$$
$$+\frac{|D_{b_{l_k}}|^2\max\{N^{(i)}-2,0\}}{n_p^2}(1+\delta[g-g'])+\frac{N^{(i)}|D_{b_{l_k}}|^2}{\rho_i n_p^2}(1+\delta[g-g'])$$
$$= \frac{D_{b_{l_k}}[J_{b_{l_k}}]^H}{n_p^2}(1+\delta[g-g'])+\frac{|D_{b_{l_k}}|^2(n_p-1)}{n_p^2}(1+\delta[g-g'])$$
$$+\frac{[D_{b_{l_k}}]^H J_{b_{l_k}}}{n_p^2}(1+\delta[g-g'])+\frac{|D_{b_{l_k}}|^2(n_p-1)}{n_p^2}(1+\delta[g-g'])$$
$$+\frac{|D_{b_{l_k}}|^2\max\{N^{(i)}-2,0\}}{n_p^2}(1+\delta[g-g'])+\frac{N^{(i)}|D_{b_{l_k}}|^2}{\rho_i n_p^2}(1+\delta[g-g'])$$
$$= \frac{1+\delta[g-g']}{\rho_i n_p^2}(2\rho_i Re\{D_{b_{l_k}}[J_{b_{l_k}}]^H\}+2\rho_i|D_{b_{l_k}}|^2(n_p-1)$$
$$+\rho_i|D_{b_{l_k}}|^2\max\{N^{(i)}-2,0\}+N^{(i)}|D_{b_{l_k}}|^2)$$

So the 7th subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]^H}\widehat{h_{l_k,f}^{(i,g)}}\widehat{[h_{l_k,m}^{(i,g')}]^H}h_{l_k,f}^{(i,g')}](m\neq f)$$
$$= \frac{1+\delta[g-g']}{\rho_i n_p^2}(2\rho_i Re\{D_{b_{l_k}}[J_{b_{l_k}}]^H\}+2\rho_i|D_{b_{l_k}}|^2(n_p-1) \quad \text{(A.14)}$$
$$+\rho_i|D_{b_{l_k}}|^2\max\{N^{(i)}-2,0\}+N^{(i)}|D_{b_{l_k}}|^2)$$

Subterm VIII The 8th subterm can be easily calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]^H}\widehat{h_{l_k,f}^{(i,g)}}\widehat{[h_{l_k,m}^{(i,g')}]^H}\widehat{h_{l_k,f}^{(i,g')}}](m\neq f) = [E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,m}^{(i,g)}}^H\widehat{h_{l_k,f}^{(i,g)}}\widehat{[h_{l_k,m}^{(i,g')}]^H}h_{l_k,f}^{(i,g')}]]^H = \text{(A.14)}$$

So the 8th subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}](m \neq f) = \text{(A.14)} \qquad \text{(A.15)}$$

A.1.4 For the 4th Term

The 4th term will consist of two subterms.

Subterm I The 1st subterm can be calculated easily by using the corresponding Equations (A.8) and (A.10) as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f'}^{(i,g')}}]^H \widehat{h_{l_k,f'}^{(i,g')}}] = \begin{cases} \text{(A.8)}, & f' = f \\ \\ \text{(A.10)}, & f' \neq f \end{cases} \qquad \text{(A.16)}$$

Subterm II The 2nd subterm can be easily calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H \widehat{h_{l_k,f'}^{(i,g')}}] = [E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,f}^{(i,g)}}^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f'}^{(i,g')}}]^H \widehat{h_{l_k,f'}^{(i,g')}}]]^H = \text{(A.16)}$$

So the 2nd subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H \widehat{h_{l_k,f'}^{(i,g')}}] = \text{(A.16)} \qquad \text{(A.17)}$$

A.1.5 For the 5th Term

The 5th term will consist of twelve subterms.

Subterm I The 1st subterm can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}] = E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,f}^{(i,g)}}^H [\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,f}^{(i,g)} h_{l_k,f}^{(i,g')}]$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)} x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,f)}]^H$$

$$+\sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,f)}]^H)]^H[\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g')} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g')}[x_{l_k,t'}^{(i,p,f)}]^H)]^H h_{l_k,f}^{(i,g)} h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}$$

$$+\sum_{t=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H x_{l_k,t}^{(i,p,f)})$$

$$(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}[h_{l_k,u'}^{(i,g')}]^H[x_{l_k,t'}^{(i,p,u')}]^H x_{l_k,t'}^{(i,p,f)}$$

$$+\sum_{t'=1}^{n_p}[w_{l_k,t'}^{(i,p,g')}]^H x_{l_k,t'}^{(i,p,f)}) h_{l_k,f}^{(i,g)} h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u'}^{(i,g')}]^H h_{l_k,f}^{(i,g)} h_{l_k,f}^{(i,g')}[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,u')}]^H x_{l_k,t'}^{(i,p,f)}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t'}^{(i,p,g')}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} h_{l_k,f}^{(i,g)} h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u'}^{(i,g')}]^H h_{l_k,f}^{(i,g)} h_{l_k,f}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,u')}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t'}^{(i,p,g')}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f}^{(i,g)} h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H[h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)} h_{l_k,f}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{u=1,u\neq f}^{N^{(i)}} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H [h_{l_k,u}^{(i,g')}]^H h_{l_k,f}^{(i,g)} h_{l_k,f}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 (1+\delta[g-g']) \sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 (1+\delta[g-g']) \sum_{t=1}^{n_p} \sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$= \frac{C_{b_{l_k}}}{n_p}(1+\delta[g-g']) + \frac{n_p-1}{n_p}(1+\delta[g-g'])$$

$$= \frac{C_{b_{l_k}}+n_p-1}{n_p}(1+\delta[g-g'])$$

So the 1st subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)} [\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}] = \frac{C_{b_{l_k}}+n_p-1}{n_p}(1+\delta[g-g']) \tag{A.18}$$

Subterm II The 2nd subterm can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)} [h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}] = E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,f}^{(i,g)}}^H \widehat{h_{l_k,f}^{(i,g')}} [h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)}]$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)} x_{l_k,t}^{(i,p,u)} [x_{l_k,t}^{(i,p,f)}]^H$$

$$+ \sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)} [x_{l_k,t}^{(i,p,f)}]^H))]^H (\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p} \sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g')} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H$$

$$+ \sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g')} [x_{l_k,t'}^{(i,p,f)}]^H))[h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [(\sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} [h_{l_k,u}^{(i,g)}]^H [x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}$$

$$+ \sum_{t=1}^{n_p} [w_{l_k,t}^{(i,p,g)}]^H x_{l_k,t}^{(i,p,f)}) (\sum_{t'=1}^{n_p} \sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g')} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H$$

$$+ \sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g')} [x_{l_k,t'}^{(i,p,f)}]^H) [h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [$$

$$\sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1}^{N^{(i)}} [h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g')} [h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)} [x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H$$

$$+ \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} [w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g')} x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H [h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g')} [h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,f}^{(i,g)}]^H h_{l_k,f}^{(i,g')} [h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{u=1, u \neq f}^{N^{(i)}} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g')} [h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^2 \delta[g - g'] \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,f)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$
$$+(\frac{N^{(i)}}{\rho_i n_p})^2\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,f)}]^H]$$
$$+\frac{N^{(i)}}{\rho_i n_p}\delta[g-g']$$
$$= (\frac{N^{(i)}}{\rho_i n_p})^2(1+\delta[g-g'])\sum_{t=1}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$
$$+(\frac{N^{(i)}}{\rho_i n_p})^2(1+\delta[g-g'])\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$
$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$
$$+\frac{N^{(i)}-1}{n_p}\delta[g-g']+\frac{N^{(i)}}{\rho_i n_p}\delta[g-g']$$
$$= \frac{C_{b_{l_k}}}{n_p}(1+\delta[g-g'])+\frac{n_p-1}{n_p}(1+\delta[g-g'])$$
$$+\frac{N^{(i)}-1}{n_p}\delta[g-g']+\frac{N^{(i)}}{\rho_i n_p}\delta[g-g']$$
$$= \frac{\rho_i C_{b_{l_k}}+\rho_i n_p-\rho_i+(\rho_i C_{b_{l_k}}+\rho_i n_p+(\rho_i+1)N^{(i)}-2\rho_i)\delta[g-g']}{\rho_i n_p}$$

So the 2nd subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,f}^{(i,g')}}]$$
$$= \frac{\rho_i C_{b_{l_k}}+\rho_i n_p-\rho_i+(\rho_i C_{b_{l_k}}+\rho_i n_p+(\rho_i+1)N^{(i)}-2\rho_i)\delta[g-g']}{\rho_i n_p} \tag{A.19}$$

Subterm III The 3rd subterm can be easily calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,f}^{(i,g')}}] = [E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,f}^{(i,g)}}^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]]^H = \text{(A.18)}$$

So the 3rd subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,f}^{(i,g')}}] = \text{(A.18)} \tag{A.20}$$

Subterm IV The 4th subterm can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}](f' \neq f) = E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,f}^{(i,g)}}^H [\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f}^{(i,g)} h_{l_k,f'}^{(i,g')}]$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)} x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,f)}]^H$$

$$+\sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,f)}]^H))]^H[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g')} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f')}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g')}[x_{l_k,t'}^{(i,p,f')}]^H))]^H h_{l_k,f}^{(i,g)} h_{l_k,f'}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u'}^{(i,g')}]^H h_{l_k,f}^{(i,g)} h_{l_k,f'}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,u')}]^H x_{l_k,t'}^{(i,p,f')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t'}^{(i,p,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f')}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f}^{(i,g)} h_{l_k,f'}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H[h_{l_k,f'}^{(i,g')}]^H h_{l_k,f}^{(i,g)} h_{l_k,f'}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f')}]^H x_{l_k,t'}^{(i,p,f')}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f'}^{(i,g)}]^H[h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)} h_{l_k,f'}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f')}]$$

$$= 1 + (\frac{N^{(i)}}{\rho_i n_p})^2 \delta[g-g'] \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f')}]$$

$$= \frac{n_p + \delta[g-g']}{n_p}$$

So the 4th subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}](f' \neq f) = \frac{n_p + \delta[g-g']}{n_p} \tag{A.21}$$

Subterm V The 5th subterm can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}](f' \neq f) = E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,f}^{(i,g)}}^H \widehat{h_{l_k,f'}^{(i,g')}} h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H]$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)} x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,f)}]^H$$

$$+ \sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,f)}]^H))]^H(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g')} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f')}]^H$$

$$+ \sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g')}[x_{l_k,t'}^{(i,p,f')}]^H))h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g')} h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f')}]^H] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H)]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2(\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H h_{l_k,f'}^{(i,g')} h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f')}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2(\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f'}^{(i,g)}]^H h_{l_k,f}^{(i,g')} h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f')}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f')}]^H]$$

$$= 1 + 0 = 1$$

So the 5th subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}](f' \neq f) = 1 \tag{A.22}$$

Subterm VI The 6th subterm can be easily calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}](f' \neq f) = [$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}]]^H = \text{(A.21)}$$

So the 6th subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}](f' \neq f) = \text{(A.21)} \tag{A.23}$$

Subterm VII The 7th subterm can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,m}^{(i,g')}](m \neq f) = E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,m}^{(i,g)}}^H [\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,f}^{(i,g)} h_{l_k,m}^{(i,g')}]$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)} x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,m)}]^H$$

$$+\sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,m)}]^H))]^H[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g')} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g')}[x_{l_k,t'}^{(i,p,f)}]^H))]^H h_{l_k,f}^{(i,g)} h_{l_k,m}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u'}^{(i,g')}]^H h_{l_k,f}^{(i,g)} h_{l_k,m}^{(i,g')}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,u')}]^H x_{l_k,t'}^{(i,p,f)}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t'}^{(i,p,g')}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,f)} h_{l_k,f}^{(i,g)} h_{l_k,m}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H[h_{l_k,m}^{(i,g')}]^H h_{l_k,f}^{(i,g)} h_{l_k,m}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,m)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H[h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)} h_{l_k,m}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,f)}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,f)}] + \delta[g-g']$$

$$= \frac{1}{n_p} + \delta[g-g']$$

$$= \frac{1+n_p\delta[g-g']}{n_p}$$

So the 7th subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,m}^{(i,g')}](m \neq f) = \frac{1+n_p\delta[g-g']}{n_p} \tag{A.24}$$

Subterm VIII The 8th subterm can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,m}^{(i,g')}}](m \neq f) = E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,m}^{(i,g)}}^H \widehat{h_{l_k,m}^{(i,g')}} h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H]$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)} x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,m)}]^H$$

$$+\sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,m)}]^H))]^H(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g')} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,m)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g')}[x_{l_k,t'}^{(i,p,m)}]^H))h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g')} h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,m)}]^H + \textstyle\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g')}$$

$$x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,m)}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1}^{N^{(i)}} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g')} h_{l_k,f}^{(i,g)} [h_{l_k,f}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,m)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,m)} [x_{l_k,t'}^{(i,p,m)}]^H] E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [h_{l_k,f}^{(i,g)} [h_{l_k,f}^{(i,g')}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,f}^{(i,g)}]^H h_{l_k,f}^{(i,g')} h_{l_k,f}^{(i,g)} [h_{l_k,f}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,m)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{u=1, u \neq f}^{N^{(i)}} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g')} h_{l_k,f}^{(i,g)} [h_{l_k,f}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,m)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^2 \delta[g - g'] \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g')}]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,m)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 (1 + \delta[g - g']) \sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t}^{(i,p,f)} [x_{l_k,t}^{(i,p,m)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^2 \delta[g - g'] \sum_{t=1}^{n_p} \sum_{u=1, u \neq f}^{N^{(i)}} \sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)} [x_{l_k,t'}^{(i,p,m)}]^H]$$

$$+ \frac{N^{(i)}}{\rho_i n_p} \delta[g - g']$$

$$= \frac{1}{n_p} (1 + \delta[g - g'])$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^2 \delta[g - g'] \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)} [x_{l_k,t'}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}\sum_{t'=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,m)}]^H]$$

$$+\frac{N^{(i)}}{\rho_i n_p}\delta[g-g']$$

$$=\frac{1}{n_p}(1+\delta[g-g'])$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2\delta[g-g']\sum_{t=1}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2\delta[g-g']\sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)}[x_{l_k,t'}^{(i,p,m)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2\delta[g-g']\sum_{t=1}^{n_p}\sum_{u=1,u\neq f,u\neq m}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,m)}]^H]$$

$$+\frac{N^{(i)}}{\rho_i n_p}\delta[g-g']$$

$$=\frac{1}{n_p}(1+\delta[g-g'])+\frac{C_{b_{l_k}}}{n_p}\delta[g-g']+\frac{n_p-1}{n_p}\delta[g-g']$$

$$+\frac{\max\{N^{(i)}-2,0\}}{n_p}\delta[g-g']+\frac{N^{(i)}}{\rho_i n_p}\delta[g-g']$$

$$=\frac{\rho_i+(\rho_i C_{b_{l_k}}+\rho_i n_p+\rho_i\max\{N^{(i)}-2,0\}+N^{(i)})\delta[g-g']}{\rho_i n_p}$$

So the 8th subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,m}^{(i,g')}}](m\neq f)$$

$$=\frac{\rho_i+(\rho_i C_{b_{l_k}}+\rho_i n_p+\rho_i\max\{N^{(i)}-2,0\}+N^{(i)})\delta[g-g']}{\rho_i n_p} \tag{A.25}$$

Subterm IX The 9th subterm can be easily calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,m}^{(i,g')}}](m\neq f)=[E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,m}^{(i,g)}}^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,m}^{(i,g')}]]^H = \text{(A.24)}$$

So the 9th subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,m}^{(i,g')}}](m\neq f)=\text{(A.24)} \qquad \text{(A.26)}$$

Subterm X The 10th subterm can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,m}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}](m\neq f)=E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,m}^{(i,g)}}^H[\widehat{h_{l_k,m}^{(i,g')}}]^H h_{l_k,f}^{(i,g)}h_{l_k,f}^{(i,g')}]$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}h_{l_k,u}^{(i,g)}x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,m)}]^H$$

$$+\sum_{t=1}^{n_p}w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,m)}]^H))]^H[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}h_{l_k,u'}^{(i,g')}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,m)}]^H$$

$$+\sum_{t'=1}^{n_p}w_{l_k,t'}^{(i,p,g')}[x_{l_k,t'}^{(i,p,m)}]^H))]^H h_{l_k,f}^{(i,g)}h_{l_k,f}^{(i,g')}]$$

$$=(\frac{N^{(i)}}{\rho_i n_p})^2 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u'}^{(i,g')}]^H h_{l_k,f}^{(i,g)}h_{l_k,f}^{(i,g')}$$

$$\mathrm{x}_{l_k,t}^{(i,p,u)H}x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,u')}]^H x_{l_k,t'}^{(i,p,m)}$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t'}^{(i,p,g')}]^H x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}h_{l_k,f}^{(i,g)}h_{l_k,f}^{(i,g')}]$$

$$=(\frac{N^{(i)}}{\rho_i n_p})^2\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u'}^{(i,g')}]^H h_{l_k,f}^{(i,g)}h_{l_k,f}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,u')}]^H x_{l_k,t'}^{(i,p,m)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H[w_{l_k,t'}^{(i,p,g')}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,m)}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[h_{l_k,f}^{(i,g)}h_{l_k,f}^{(i,g')}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H[h_{l_k,f}^{(i,g')}]^H h_{l_k,f}^{(i,g)}h_{l_k,f}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H x_{l_k,t'}^{(i,p,m)}]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H[h_{l_k,u}^{(i,g')}]^H h_{l_k,f}^{(i,g)}h_{l_k,f}^{(i,g')}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,u)}]^H x_{l_k,t'}^{(i,p,m)}]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2(1+\delta[g-g'])\sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)}[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)}]$$

$$= \frac{|D_{b_{l_k}}|^2}{n_p}(1+\delta[g-g'])$$

So the 10th subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,m}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}](m\neq f) = \frac{|D_{b_{l_k}}|^2}{n_p}(1+\delta[g-g']) \tag{A.27}$$

Subterm XI The 11th subterm can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,m}^{(i,g')}]^H\widehat{h_{l_k,f}^{(i,g')}}](m\neq f) = E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,m}^{(i,g)}}^H\widehat{h_{l_k,f}^{(i,g')}}h_{l_k,f}^{(i,g)}[h_{l_k,m}^{(i,g')}]^H]$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)}x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,m)}]^H$$

$$+\sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,m)}]^H))]^H(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g')}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g')}[x_{l_k,t'}^{(i,p,f)}]^H))h_{l_k,f}^{(i,g)}[h_{l_k,m}^{(i,g')}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g')}h_{l_k,f}^{(i,g)}[h_{l_k,m}^{(i,g')}]^H$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H}x_{l_k,t}^{(i,p,m)}x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H$$

$$+\sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g')}x_{l_k,t}^{(i,p,m)}[x_{l_k,t'}^{(i,p,f)}]^H h_{l_k,f}^{(i,g)}[h_{l_k,m}^{(i,g')}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{u=1}^{N^{(i)}} \sum_{t'=1}^{n_p} \sum_{u'=1}^{N^{(i)}} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g')} h_{l_k,f}^{(i,g)} [h_{l_k,m}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,u')} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,f}^{(i,g)}]^H h_{l_k,m}^{(i,g')} h_{l_k,f}^{(i,g)} [h_{l_k,m}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,m)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+ (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} \sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,m}^{(i,g)}]^H h_{l_k,f}^{(i,g')} h_{l_k,f}^{(i,g)} [h_{l_k,m}^{(i,g')}]^H]$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,m)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t'}^{(i,p,f)} [x_{l_k,t'}^{(i,p,f)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,m)} x_{l_k,t}^{(i,p,m)} [x_{l_k,t}^{(i,p,f)}]^H]$$

$$= \frac{|D_{b_{l_k}}|^2}{n_p}$$

So the 11th subterm is given by

$$\implies E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)} [h_{l_k,m}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}](m \neq f) = \frac{|D_{b_{l_k}}|^2}{n_p} \quad \text{(A.28)}$$

Subterm XII The 12th subterm can be easily calculated as follows:

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,m}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}} [h_{l_k,m}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}](m \neq f) = [E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [$$

$$\widehat{h_{l_k,m}^{(i,g)}}^H h_{l_k,f}^{(i,g)} \widehat{[h_{l_k,m}^{(i,g')}]^H h_{l_k,f}^{(i,g')}}]]^H = \text{(A.27)}$$

So the 12th subterm is given by

$$\implies E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,m}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}} [h_{l_k,m}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}](m \neq f) = \text{(A.27)} \quad \text{(A.29)}$$

A.1.6 For the 6th Term

The 6th term will consist of three subterms.

Subterm I The 1st subterm can be calculated easily by using the corresponding Equations (A.18) and (A.27) as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,m}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}] = \begin{cases} \text{(A.18)}, & m = f \\ \text{(A.27)}, & m \neq f \end{cases} \tag{A.30}$$

Subterm II The 2nd subterm can be calculated easily by using the corresponding Equations (A.19) and (A.25) as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,m}^{(i,g')}}] = \begin{cases} \text{(A.19)}, & m = f \\ \text{(A.25)}, & m \neq f \end{cases} \tag{A.31}$$

Subterm III The 3rd subterm can be easily calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}] = [E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,m}^{(i,g)}}^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,m}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]]^H = \text{(A.30)}$$

So the 3rd subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}] = \text{(A.30)} \tag{A.32}$$

A.1.7 For the 7th Term

The 7th term can be calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g)}}]^H] = E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}]$$

$$= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}} h_{l_k,u}^{(i,g)} x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,f)}]^H + \sum_{t=1}^{n_p} w_{l_k,t}^{(i,p,g)}[x_{l_k,t}^{(i,p,f)}]^H))]^H$$

$$(\frac{N^{(i)}}{\rho_i n_p}(\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} h_{l_k,u'}^{(i,g)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H + \sum_{t'=1}^{n_p} w_{l_k,t'}^{(i,p,g)}[x_{l_k,t'}^{(i,p,f)}]^H))]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}}[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}$$

$$\mathbf{x}_{l_k,t}^{(i,p,u)H} x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H + \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p}[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p}\sum_{u'=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u'}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u')}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t'}^{(i,p,g)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{u=1}^{N^{(i)}}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,u}^{(i,g)}]^H h_{l_k,u}^{(i,g)}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,t}^{(i,p,g)}]^H w_{l_k,t}^{(i,p,g)}] E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}}\sum_{t'=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,u)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+\frac{N^{(i)}}{\rho_i n_p}$$

$$= (\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,f)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{t'=1,t'\neq t}^{n_p} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,f)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t'}^{(i,p,f)}[x_{l_k,t'}^{(i,p,f)}]^H]$$

$$+(\frac{N^{(i)}}{\rho_i n_p})^2 \sum_{t=1}^{n_p}\sum_{u=1,u\neq f}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,t}^{(i,p,u)}]^H x_{l_k,t}^{(i,p,f)} x_{l_k,t}^{(i,p,u)}[x_{l_k,t}^{(i,p,f)}]^H]$$

$$+\frac{N^{(i)}}{\rho_i n_p}$$

$$= \frac{C_{b_{l_k}}}{n_p} + \frac{n_p - 1}{n_p} + \frac{N^{(i)} - 1}{n_p} + \frac{N^{(i)}}{\rho_i n_p}$$

$$= \frac{\rho_i C_{b_{l_k}} + \rho_i n_p + (\rho_i + 1)N^{(i)} - 2\rho_i}{\rho_i n_p}$$

So the 7th term is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g)}}]^H] = \frac{\rho_i C_{b_{l_k}} + \rho_i n_p + (\rho_i + 1)N^{(i)} - 2\rho_i}{\rho_i n_p} \tag{A.33}$$

A.1.8 For the 8th Term

The 8th term will consist of three subterms.

Subterm I The 1st subterm can be calculated easily by using the corresponding Equations (A.18) and (A.21) as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}] = \begin{cases} \text{(A.18)}, & f' = f \\ \text{(A.21)}, & f' \neq f \end{cases} \tag{A.34}$$

Subterm II The 2nd subterm can be calculated easily by using the corresponding Equations (A.19) and (A.22) as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}] = \begin{cases} \text{(A.19)}, & f' = f \\ \text{(A.22)}, & f' \neq f \end{cases} \tag{A.35}$$

Subterm III The 3rd subterm can be easily calculated as follows:

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}] = [E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[$$

$$\widehat{h_{l_k,f}^{(i,g)}}^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}]]^H = \text{(A.34)}$$

So the 3rd subterm is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}] = \text{(A.34)} \tag{A.36}$$

A.2 Expectation of the 1st Term

The expectation of the 1st term can be calculated as follows:

$$
\begin{aligned}
&E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}] \\
&= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m)}]^H[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}x_{l_k,c}^{(i,d,f)} \\
&\quad \sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m')}]^H[\widehat{h_{l_k,m'}^{(i,g')}}]^H\widehat{h_{l_k,f'}^{(i,g')}}x_{l_k,c}^{(i,d,f')}] \\
&\quad = \sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}} \\
&\quad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,m')}]^H x_{l_k,c}^{(i,d,f')}] \\
&\quad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,m'}^{(i,g')}}]^H\widehat{h_{l_k,f'}^{(i,g')}}] \\
&= \sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,f)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,f)}]^H x_{l_k,c}^{(i,d,f)}] \\
&\quad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H\widehat{h_{l_k,f}^{(i,g')}}] \\
&+\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1,f'\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,f)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,f')}]^H x_{l_k,c}^{(i,d,f')}] \\
&\quad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H\widehat{h_{l_k,f'}^{(i,g')}}] \\
&+\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1,m\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,f)}]^H x_{l_k,c}^{(i,d,m)}] \\
&\quad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H\widehat{h_{l_k,m}^{(i,g')}}] \\
&+\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1,m\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}] \\
&\quad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,m}^{(i,g')}}]^H\widehat{h_{l_k,f}^{(i,g')}}]
\end{aligned}
$$

$$= (\frac{\rho_i}{N^{(i)}})^2 C_{b_{l_k}} \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}} [\widehat{h_{l_k,f}^{(i,g')}}]^H \widehat{h_{l_k,f}^{(i,g')}}]$$

$$+ (\frac{\rho_i}{N^{(i)}})^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{f'=1, f' \neq f}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}} [\widehat{h_{l_k,f'}^{(i,g')}}]^H \widehat{h_{l_k,f'}^{(i,g')}}]$$

$$+ (\frac{\rho_i}{N^{(i)}})^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{m=1, m \neq f}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}} [\widehat{h_{l_k,f}^{(i,g')}}]^H \widehat{h_{l_k,m}^{(i,g')}}]$$

$$+ (\frac{\rho_i}{N^{(i)}})^2 |D_{b_{l_k}}|^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{m=1, m \neq f}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}} [\widehat{h_{l_k,m}^{(i,g')}}]^H \widehat{h_{l_k,f}^{(i,g')}}]$$

So the expectation of the 1st term is given by

$$\implies E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,c}^{(i,d)}]^H [\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)} [x_{l_k,c}^{(i,d)}]^H [\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)}]$$

$$= (\frac{\rho_i}{N^{(i)}})^2 C_{b_{l_k}} \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}} [\widehat{h_{l_k,f}^{(i,g')}}]^H \widehat{h_{l_k,f}^{(i,g')}}]$$

$$+ (\frac{\rho_i}{N^{(i)}})^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{f'=1, f' \neq f}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}} [\widehat{h_{l_k,f'}^{(i,g')}}]^H \widehat{h_{l_k,f'}^{(i,g')}}]$$

$$+ (\frac{\rho_i}{N^{(i)}})^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{m=1, m \neq f}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}} [\widehat{h_{l_k,f}^{(i,g')}}]^H \widehat{h_{l_k,m}^{(i,g')}}]$$

$$+ (\frac{\rho_i}{N^{(i)}})^2 |D_{b_{l_k}}|^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{m=1, m \neq f}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}}$$

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}} [\widehat{h_{l_k,m}^{(i,g')}}]^H \widehat{h_{l_k,f}^{(i,g')}}] \tag{A.37}$$

and equations (A.3), (A.4), (A.5) and (A.6) are substituted.

A.3 Expectation of the 2nd Term

The expectation of the 2nd term can be calculated as follows:

$$
\begin{aligned}
&E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}] \\
&= E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m)}]^H[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}x_{l_k,c}^{(i,d,f)} \\
&\qquad \sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}\overline{[x_{l_k,c}^{(i,d,m')}]}^H[\widehat{h_{l_k,m'}^{(i,g')}}]^H\widehat{h_{l_k,f'}^{(i,g')}}\overline{x_{l_k,c}^{(i,d,f')}}] \\
&= \sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^Hx_{l_k,c}^{(i,d,f)}] \\
&\qquad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,m'}^{(i,g')}}]^H\widehat{h_{l_k,f'}^{(i,g')}}] \\
&\qquad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\overline{x_{l_k,c}^{(i,d,m')}}]^H\overline{x_{l_k,c}^{(i,d,f')}}] \\
&= \sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,f)}]^Hx_{l_k,c}^{(i,d,f)}] \\
&\qquad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H\widehat{h_{l_k,f'}^{(i,g')}}] \\
&\qquad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\overline{x_{l_k,c}^{(i,d,f')}}]^H\overline{x_{l_k,c}^{(i,d,f')}}] \\
&= (\frac{\rho_i}{N^{(i)}})^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H\widehat{h_{l_k,f'}^{(i,g')}}]
\end{aligned}
$$

So the expectation of the 2nd term is given by

$$
\begin{aligned}
&\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[\overline{x_{l_k,c}^{(i,d)}}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}\overline{x_{l_k,c}^{(i,d)}}] \\
&= (\frac{\rho_i}{N^{(i)}})^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H\widehat{h_{l_k,f'}^{(i,g')}}]
\end{aligned}
\tag{A.38}
$$

and the equation (A.7) is substituted.

A.4 Expectation of the 3rd Term

The expectation of the 3rd term can be calculated as follows:

$$
\begin{aligned}
&E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}]\\
&=\frac{1}{2}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\\
&\qquad+[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}[x_{l_k,c}^{(i,d)}]^H[H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}]\\
&=\frac{1}{2}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m)}]^H[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}x_{l_k,c}^{(i,d,f)}\\
&\qquad\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m')}]^H[\widehat{h_{l_k,m'}^{(i,g')}}]^Hh_{l_k,f'}^{(i,g')}x_{l_k,c}^{(i,d,f')}\\
&\qquad+\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m)}]^H[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}x_{l_k,c}^{(i,d,f)}\\
&\qquad\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m')}]^H[h_{l_k,m'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}}x_{l_k,c}^{(i,d,f')}]\\
&\qquad=\frac{1}{2}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}\\
&\qquad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^Hx_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,m')}]^Hx_{l_k,c}^{(i,d,f')}]\\
&\qquad(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,m'}^{(i,g')}}]^Hh_{l_k,f'}^{(i,g')}]\\
&\qquad+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}}])\\
&\qquad=\frac{1}{2}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{g'=1}^{N^{(3-i)}}\\
&\qquad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,f)}]^Hx_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,f)}]^Hx_{l_k,c}^{(i,d,f)}]\\
&\qquad(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^Hh_{l_k,f}^{(i,g')}]\\
&\qquad+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,f}^{(i,g')}}])
\end{aligned}
$$

$$+\frac{1}{2}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1,f'\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,f)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,f')}]^H x_{l_k,c}^{(i,d,f')}]$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}])$$

$$+\frac{1}{2}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1,m\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,f)}]^H x_{l_k,c}^{(i,d,m)}]$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,m}^{(i,g')}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,m}^{(i,g')}}])$$

$$+\frac{1}{2}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1,m\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}]$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,m}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}])$$

$$=\frac{1}{2}(\frac{\rho_i}{N^{(i)}})^2 C_{b_{l_k}}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}])$$

$$+\frac{1}{2}(\frac{\rho_i}{N^{(i)}})^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1,f'\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}])$$

$$+\frac{1}{2}(\frac{\rho_i}{N^{(i)}})^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1,m\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,m}^{(i,g')}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,m}^{(i,g')}}])$$

$$+\frac{1}{2}(\frac{\rho_i}{N^{(i)}})^2|D_{b_{l_k}}|^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1,m\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,m}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m}^{(i,g')}]^H\widehat{h_{l_k,f}^{(i,g')}}])$$

So the expectation of the 3rd term is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^HH_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}]$$

$$= \frac{1}{2}(\frac{\rho_i}{N^{(i)}})^2C_{b_{l_k}}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^Hh_{l_k,f}^{(i,g')}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,f}^{(i,g')}}])$$

$$+\frac{1}{2}(\frac{\rho_i}{N^{(i)}})^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1,f'\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^Hh_{l_k,f'}^{(i,g')}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}}])$$

$$\frac{1}{2}(\frac{\rho_i}{N^{(i)}})^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1,m\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g')}}]^Hh_{l_k,m}^{(i,g')}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,m}^{(i,g')}}])$$

$$+\frac{1}{2}(\frac{\rho_i}{N^{(i)}})^2|D_{b_{l_k}}|^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1,m\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,m}^{(i,g')}}]^Hh_{l_k,f}^{(i,g')}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m}^{(i,g')}]^H\widehat{h_{l_k,f}^{(i,g')}}]) \tag{A.39}$$

and equations (A.8), (A.9), (A.10), (A.11), (A.12), (A.13), (A.14) and (A.15) are substituted.

A.5 Expectation of the 4th Term

The expectation of the 4th term can be calculated as follows:

$$
\begin{aligned}
&E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\}\overline{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}}]\\
&=\frac{1}{2}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\overline{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}}\\
&\qquad+[x_{l_k,c}^{(i,d)}]^H[H_{l_k}^{(i)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\overline{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}}]\\
&\quad=\frac{1}{2}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m)}]^H\widehat{[h_{l_k,m}^{(i,g)}]}^H h_{l_k,f}^{(i,g)}x_{l_k,c}^{(i,d,f)}\\
&\qquad\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}\overline{[x_{l_k,c}^{(i,d,m')}]^H}[\widehat{h_{l_k,m'}^{(i,g')}}]^H\widehat{h_{l_k,f'}^{(i,g')}}\overline{x_{l_k,c}^{(i,d,f')}}\\
&\qquad+\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m)}]^H[h_{l_k,m}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}x_{l_k,c}^{(i,d,f)}\\
&\qquad\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}\overline{[x_{l_k,c}^{(i,d,m')}]^H}[\widehat{h_{l_k,m'}^{(i,g')}}]^H\widehat{h_{l_k,f'}^{(i,g')}}\overline{x_{l_k,c}^{(i,d,f')}}]\\
&\qquad=\frac{1}{2}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}\\
&\qquad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}]\\
&\qquad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\overline{[x_{l_k,c}^{(i,d,m')}]^H}\overline{x_{l_k,c}^{(i,d,f')}}]\\
&\qquad(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]}^H h_{l_k,f}^{(i,g)}\widehat{[h_{l_k,m'}^{(i,g')}]}^H\widehat{h_{l_k,f'}^{(i,g')}}]\\
&\qquad+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}\widehat{[h_{l_k,m'}^{(i,g')}]}^H\widehat{h_{l_k,f'}^{(i,g')}}])\\
&\qquad=\frac{1}{2}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\\
&\qquad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,f)}]^H x_{l_k,c}^{(i,d,f)}]\\
&\qquad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\overline{[x_{l_k,c}^{(i,d,f')}]^H}\overline{x_{l_k,c}^{(i,d,f')}}]\\
&\qquad(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,f}^{(i,g)}]}^H h_{l_k,f}^{(i,g)}\widehat{[h_{l_k,f'}^{(i,g')}]}^H\widehat{h_{l_k,f'}^{(i,g')}}]\\
&\qquad+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}\widehat{[h_{l_k,f'}^{(i,g')}]}^H\widehat{h_{l_k,f'}^{(i,g')}}])
\end{aligned}
$$

$$= \frac{1}{2}(\frac{\rho_i}{N^{(i)}})^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{f'=1}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} (E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)} [\widehat{h_{l_k,f'}^{(i,g')}}]^H \widehat{h_{l_k,f'}^{(i,g')}}]$$

$$+ E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}} [\widehat{h_{l_k,f'}^{(i,g')}}]^H \widehat{h_{l_k,f'}^{(i,g')}}])$$

So the expectation of the 4th term is given by

$$\implies E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [Re\{[x_{l_k,c}^{(i,d)}]^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\} [\overline{x_{l_k,c}^{(i,d)}}]^H [\widehat{H_{l_k}^{(i)}}]^H \widehat{H_{l_k}^{(i)}} \overline{x_{l_k,c}^{(i,d)}}]$$

$$= \frac{1}{2}(\frac{\rho_i}{N^{(i)}})^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{f'=1}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} (E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)} [\widehat{h_{l_k,f'}^{(i,g')}}]^H \widehat{h_{l_k,f'}^{(i,g')}}]$$

$$+ E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}} [\widehat{h_{l_k,f'}^{(i,g')}}]^H \widehat{h_{l_k,f'}^{(i,g')}}]) \tag{A.40}$$

and equations (A.16) and (A.17) are substituted.

A.6 Expectation of the 5th Term

The expectation of the 5th term can be calculated as follows:

$$E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [Re\{[x_{l_k,c}^{(i,d)}]^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\} Re\{[x_{l_k,c}^{(i,d)}]^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\}]$$

$$= \frac{1}{4} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[x_{l_k,c}^{(i,d)}]^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} [x_{l_k,c}^{(i,d)}]^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}$$

$$+ 2[x_{l_k,c}^{(i,d)}]^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)} [x_{l_k,c}^{(i,d)}]^H [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)}$$

$$+ [x_{l_k,c}^{(i,d)}]^H [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)} [x_{l_k,c}^{(i,d)}]^H [H_{l_k}^{(i)}]^H \widehat{H_{l_k}^{(i)}} x_{l_k,c}^{(i,d)}]$$

$$= \frac{1}{4} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [\sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{m=1}^{N^{(i)}} [x_{l_k,c}^{(i,d,m)}]^H \widehat{[h_{l_k,m}^{(i,g)}]}^H h_{l_k,f}^{(i,g)} x_{l_k,c}^{(i,d,f)}$$

$$\sum_{f'=1}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} \sum_{m'=1}^{N^{(i)}} [x_{l_k,c}^{(i,d,m')}]^H \widehat{[h_{l_k,m'}^{(i,g')}]}^H h_{l_k,f'}^{(i,g')} x_{l_k,c}^{(i,d,f')}$$

$$+2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{m=1}^{N^{(i)}} [x_{l_k,c}^{(i,d,m)}]^H \widehat{[h_{l_k,m}^{(i,g)}]}^H h_{l_k,f}^{(i,g)} x_{l_k,c}^{(i,d,f)}$$

$$\sum_{f'=1}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} \sum_{m'=1}^{N^{(i)}} [x_{l_k,c}^{(i,d,m')}]^H [h_{l_k,m'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}} x_{l_k,c}^{(i,d,f')}$$

$$+ \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{m=1}^{N^{(i)}} [x_{l_k,c}^{(i,d,m)}]^H [h_{l_k,m}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}} x_{l_k,c}^{(i,d,f)}$$

$$\sum_{f'=1}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} \sum_{m'=1}^{N^{(i)}} [x_{l_k,c}^{(i,d,m')}]^H [h_{l_k,m'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}} x_{l_k,c}^{(i,d,f')}]$$

$$= \frac{1}{4} E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [\sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{m=1}^{N^{(i)}} \sum_{f'=1}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} \sum_{m'=1}^{N^{(i)}}$$

$$\mathbf{x}_{l_k,c}^{(i,d,m)H} x_{l_k,c}^{(i,d,f)} [x_{l_k,c}^{(i,d,m')}]^H x_{l_k,c}^{(i,d,f')} \widehat{[h_{l_k,m}^{(i,g)}]}^H h_{l_k,f}^{(i,g)} \widehat{[h_{l_k,m'}^{(i,g')}]}^H h_{l_k,f'}^{(i,g')}$$

$$+2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{m=1}^{N^{(i)}} \sum_{f'=1}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} \sum_{m'=1}^{N^{(i)}}$$

$$\mathbf{x}_{l_k,c}^{(i,d,m)H} x_{l_k,c}^{(i,d,f)} [x_{l_k,c}^{(i,d,m')}]^H x_{l_k,c}^{(i,d,f')} \widehat{[h_{l_k,m}^{(i,g)}]}^H h_{l_k,f}^{(i,g)} [h_{l_k,m'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}$$

$$+ \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{m=1}^{N^{(i)}} \sum_{f'=1}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} \sum_{m'=1}^{N^{(i)}}$$

$$\mathbf{x}_{l_k,c}^{(i,d,m)H} x_{l_k,c}^{(i,d,f)} [x_{l_k,c}^{(i,d,m')}]^H x_{l_k,c}^{(i,d,f')} [h_{l_k,m}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}} [h_{l_k,m'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}]$$

$$= \frac{1}{4}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,m')}]^H x_{l_k,c}^{(i,d,f')}]$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,m'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,m'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}])$$

$$= \frac{1}{4}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,f)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,f)}]^H x_{l_k,c}^{(i,d,f)}]$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}])$$

$$+\frac{1}{4}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1,f'\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,f)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,f')}]^H x_{l_k,c}^{(i,d,f')}]$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}])$$

$$+\frac{1}{4}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1,m\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,f)}]^H x_{l_k,c}^{(i,d,m)}]$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,m}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,m}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,m}^{(i,g')}}])$$

$$+\frac{1}{4}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1,m\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}]$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,m}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,m}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}])$$

$$=\frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2 C_{b_{l_k}}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}])$$

$$+\frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1,f'\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}])$$

$$+\frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1,m\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,m}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,m}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H\widehat{h_{l_k,m}^{(i,g')}}])$$

$$+\frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2|D_{b_{l_k}}|^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1,m\neq f}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,m}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,m}^{(i,g')}]^H\widehat{h_{l_k,f}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m}^{(i,g')}]^H\widehat{h_{l_k,f}^{(i,g')}}])$$

So the expectation of the 5th term is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\}Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\}]$$

$$= \frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2 C_{b_{l_k}} \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}])$$

$$+\frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{f'=1,f'\neq f}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}])$$

$$+\frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{m=1,m\neq f}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f}^{(i,g')}}]^H h_{l_k,m}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,m}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f}^{(i,g')}]^H \widehat{h_{l_k,m}^{(i,g')}}])$$

$$+\frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2 |D_{b_{l_k}}|^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{m=1,m\neq f}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}}$$

$$(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,m}^{(i,g')}}]^H h_{l_k,f}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,m}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m}^{(i,g')}]^H \widehat{h_{l_k,f}^{(i,g')}}]) \tag{A.41}$$

and equations (A.18), (A.19), (A.20), (A.21), (A.22), (A.23), (A.24), (A.25), (A.26), (A.27), (A.28) and (A.29) are substituted.

A.7 Expectation of the 6th Term

The expectation of the 6th term can be calculated as follows:

$$
\begin{aligned}
&E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H\widehat{[H_{l_k}^{(i)}]}^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{\overline{[x_{l_k,c}^{(i,d)}]}^H\widehat{[H_{l_k}^{(i)}]}^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}] \\
&\quad=\frac{1}{4}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\overline{[x_{l_k,c}^{(i,d,m)}]}^H\widehat{[h_{l_k,m}^{(i,g)}]}^H h_{l_k,f}^{(i,g)}x_{l_k,c}^{(i,d,f)} \\
&\qquad\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}\overline{[x_{l_k,c}^{(i,d,m')}]}^H\widehat{[h_{l_k,m'}^{(i,g')}]}^H h_{l_k,f'}^{(i,g')}x_{l_k,c}^{(i,d,f')} \\
&\qquad+2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\overline{[x_{l_k,c}^{(i,d,m)}]}^H\widehat{[h_{l_k,m}^{(i,g)}]}^H h_{l_k,f}^{(i,g)}x_{l_k,c}^{(i,d,f)} \\
&\qquad\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m')}]^H[h_{l_k,m'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}}\overline{x_{l_k,c}^{(i,d,f')}} \\
&\qquad+\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m)}]^H[h_{l_k,m}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}\overline{x_{l_k,c}^{(i,d,f)}} \\
&\qquad\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m')}]^H[h_{l_k,m'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}}\overline{x_{l_k,c}^{(i,d,f')}}] \\
&\quad=\frac{1}{4}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\overline{[x_{l_k,c}^{(i,d,m)}]}^H\overline{[x_{l_k,c}^{(i,d,m')}]}^H] \\
&E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]}^H h_{l_k,f}^{(i,g)}\widehat{[h_{l_k,m'}^{(i,g')}]}^H h_{l_k,f'}^{(i,g')}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,c}^{(i,d,f)}x_{l_k,c}^{(i,d,f')}] \\
&\qquad+2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\overline{[x_{l_k,c}^{(i,d,m)}]}^H\overline{x_{l_k,c}^{(i,d,f')}}] \\
&\qquad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]}^H h_{l_k,f}^{(i,g)}[h_{l_k,m'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}}] \\
&\qquad\quad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,m')}]^H] \\
&\qquad+E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^H[x_{l_k,c}^{(i,d,m')}]^H] \\
&\qquad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}}] \\
&\qquad\quad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\overline{x_{l_k,c}^{(i,d,f)}x_{l_k,c}^{(i,d,f')}}])
\end{aligned}
$$

$$= \frac{1}{4}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\overline{[x_{l_k,c}^{(i,d,m)}]^H}\,\overline{[x_{l_k,c}^{(i,d,m)}]^H}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]^H}\,h_{l_k,f}^{(i,g)}\,\widehat{[h_{l_k,m}^{(i,g')}]^H}\,h_{l_k,f}^{(i,g')}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,c}^{(i,d,f)}x_{l_k,c}^{(i,d,f)}]$$

$$+\frac{1}{2}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\overline{[x_{l_k,c}^{(i,d,m)}]^H}\,\overline{x_{l_k,c}^{(i,d,m)}}]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]^H}\,h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H\,\widehat{h_{l_k,m}^{(i,g')}}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,f)}]^H]$$

$$+\frac{1}{4}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^H[x_{l_k,c}^{(i,d,m)}]^H]$$

$$E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H\,\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m}^{(i,g')}]^H\,\widehat{h_{l_k,f}^{(i,g')}}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\overline{x_{l_k,c}^{(i,d,f)}x_{l_k,c}^{(i,d,f)}}]$$

$$= \frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2|D_{b_{l_k}}|^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]^H}\,h_{l_k,f}^{(i,g)}\,\widehat{[h_{l_k,m}^{(i,g')}]^H}\,h_{l_k,f}^{(i,g')}]$$

$$+\frac{1}{2}(\frac{\rho_i}{N^{(i)}})^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]^H}\,h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H\,\widehat{h_{l_k,m}^{(i,g')}}]$$

$$+\frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2|D_{b_{l_k}}|^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H\,\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m}^{(i,g')}]^H\,\widehat{h_{l_k,f}^{(i,g')}}]$$

So the expectation of the 6th term is given by

$$\implies E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{\overline{[x_{l_k,c}^{(i,d)}]^H}[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}Re\{\overline{[x_{l_k,c}^{(i,d)}]^H}[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)}x_{l_k,c}^{(i,d)}\}]$$

$$= \frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2|D_{b_{l_k}}|^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]^H}\,h_{l_k,f}^{(i,g)}\,\widehat{[h_{l_k,m}^{(i,g')}]^H}\,h_{l_k,f}^{(i,g')}]$$

$$+\frac{1}{2}(\frac{\rho_i}{N^{(i)}})^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{[h_{l_k,m}^{(i,g)}]^H}\,h_{l_k,f}^{(i,g)}[h_{l_k,f}^{(i,g')}]^H\,\widehat{h_{l_k,m}^{(i,g')}}]$$

$$+\frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2|D_{b_{l_k}}|^2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H\,\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m}^{(i,g')}]^H\,\widehat{h_{l_k,f}^{(i,g')}}] \tag{A.42}$$

and equations (A.30), (A.31) and (A.32) are substituted.

A.8 Expectation of the 7th Term

The expectation of the 7th term can be calculated as follows:

$$
\begin{aligned}
&E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}] \\
&= \frac{1}{4}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}[w_{l_k,c}^{(i,d,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}x_{l_k,c}^{(i,d,f)}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}[w_{l_k,c}^{(i,d,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}}x_{l_k,c}^{(i,d,f')} \\
&\quad +2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}[w_{l_k,c}^{(i,d,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}x_{l_k,c}^{(i,d,f)}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}[x_{l_k,c}^{(i,d,f')}]^H[\widehat{h_{l_k,f'}^{(i,g')}}]^Hw_{l_k,c}^{(i,d,g')} \\
&\quad +\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}[x_{l_k,c}^{(i,d,f)}]^H[\widehat{h_{l_k,f}^{(i,g)}}]^Hw_{l_k,c}^{(i,d,g)}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}[x_{l_k,c}^{(i,d,f')}]^H[\widehat{h_{l_k,f'}^{(i,g')}}]^Hw_{l_k,c}^{(i,d,g')}] \\
&\quad = \frac{1}{4}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}(E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,c}^{(i,d,g)}]^H[w_{l_k,c}^{(i,d,g')}]^H] \\
&\quad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{h_{l_k,f}^{(i,g)}}\widehat{h_{l_k,f'}^{(i,g')}}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,c}^{(i,d,f)}x_{l_k,c}^{(i,d,f')}] \\
&\quad +2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,c}^{(i,d,g)}]^Hw_{l_k,c}^{(i,d,g')}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H] \\
&\quad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,f')}]^H] \\
&\quad +E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[w_{l_k,c}^{(i,d,g)}w_{l_k,c}^{(i,d,g')}]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H[\widehat{h_{l_k,f'}^{(i,g')}}]^H] \\
&\quad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,f)}]^H[x_{l_k,c}^{(i,d,f')}]^H]) \\
&\quad = \frac{1}{2}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[w_{l_k,c}^{(i,d,g)}]^Hw_{l_k,c}^{(i,d,g')}] \\
&\quad E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f'}^{(i,g')}}]^H]E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[x_{l_k,c}^{(i,d,f)}[x_{l_k,c}^{(i,d,f')}]^H] \\
&\quad = \frac{1}{2}\frac{\rho_i}{N^{(i)}}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g)}}]^H]
\end{aligned}
$$

So the expectation of the 7th term is given by

$$
\begin{aligned}
\implies\ & E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}Re\{[w_{l_k,c}^{(i,d)}]^H\widehat{H_{l_k}^{(i)}}x_{l_k,c}^{(i,d)}\}] \\
&= \frac{1}{2}\frac{\rho_i}{N^{(i)}}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\widehat{h_{l_k,f}^{(i,g)}}[\widehat{h_{l_k,f}^{(i,g)}}]^H]
\end{aligned}
\tag{A.43}
$$

and the equation (A.33) is substituted.

A.9 Expectation of the 8th Term

The expectation of the 8th term can be calculated as follows:

$$
\begin{aligned}
&E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[Re\{[x_{l_k,c}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\} Re\{[x_{l_k,e}^{(i,d)}]^H[\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,e}^{(i,d)}\}] \\
&= \frac{1}{4} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m)}]^H[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)} x_{l_k,c}^{(i,d,f)} \\
&\quad \sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}[x_{l_k,e}^{(i,d,m')}]^H[\widehat{h_{l_k,m'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')} x_{l_k,e}^{(i,d,f')} \\
&\quad +2\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m)}]^H[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)} x_{l_k,c}^{(i,d,f)} \\
&\quad \sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}[x_{l_k,e}^{(i,d,m')}]^H[h_{l_k,m'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}} x_{l_k,e}^{(i,d,f')} \\
&\quad +\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}[x_{l_k,c}^{(i,d,m)}]^H[h_{l_k,m}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}} x_{l_k,c}^{(i,d,f)} \\
&\quad \sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}}[x_{l_k,e}^{(i,d,m')}]^H[h_{l_k,m'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}} x_{l_k,e}^{(i,d,f')}] \\
&= \frac{1}{4}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{m=1}^{N^{(i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}}\sum_{m'=1}^{N^{(i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,m)}]^H x_{l_k,c}^{(i,d,f)}] \\
&E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,e}^{(i,d,m')}]^H x_{l_k,e}^{(i,d,f')}](E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,m'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}] \\
&\quad +2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,m}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,m'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}}] \\
&\quad +E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,m}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,m'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}}]) \\
&= \frac{1}{4}\sum_{f=1}^{N^{(i)}}\sum_{g=1}^{N^{(3-i)}}\sum_{f'=1}^{N^{(i)}}\sum_{g'=1}^{N^{(3-i)}} E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,c}^{(i,d,f)}]^H x_{l_k,c}^{(i,d,f)}] \\
&E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[x_{l_k,e}^{(i,d,f')}]^H x_{l_k,e}^{(i,d,f')}](E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}] \\
&\quad +2E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)}[h_{l_k,f'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}}] \\
&\quad +E_{X_{l_k}^{(i)},\overline{X_{l_k}^{(i)}},H_{l_k}^{(i)},W_{l_k}^{(i)}}[[h_{l_k,f}^{(i,g)}]^H\widehat{h_{l_k,f}^{(i,g)}}[h_{l_k,f'}^{(i,g')}]^H\widehat{h_{l_k,f'}^{(i,g')}}])
\end{aligned}
$$

$$= \frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{f'=1}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} (E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)} [\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)} [h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}} [h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}])$$

So the expectation of the 8th term is given by

$$\implies E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [Re\{[x_{l_k,c}^{(i,d)}]^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,c}^{(i,d)}\} Re\{[x_{l_k,e}^{(i,d)}]^H [\widehat{H_{l_k}^{(i)}}]^H H_{l_k}^{(i)} x_{l_k,e}^{(i,d)}\}]$$

$$= \frac{1}{4}(\frac{\rho_i}{N^{(i)}})^2 \sum_{f=1}^{N^{(i)}} \sum_{g=1}^{N^{(3-i)}} \sum_{f'=1}^{N^{(i)}} \sum_{g'=1}^{N^{(3-i)}} (E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)} [\widehat{h_{l_k,f'}^{(i,g')}}]^H h_{l_k,f'}^{(i,g')}]$$

$$+2E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[\widehat{h_{l_k,f}^{(i,g)}}]^H h_{l_k,f}^{(i,g)} [h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}]$$

$$+E_{X_{l_k}^{(i)}, \overline{X_{l_k}^{(i)}}, H_{l_k}^{(i)}, W_{l_k}^{(i)}} [[h_{l_k,f}^{(i,g)}]^H \widehat{h_{l_k,f}^{(i,g)}} [h_{l_k,f'}^{(i,g')}]^H \widehat{h_{l_k,f'}^{(i,g')}}])$$

and equations (A.34), (A.35) and (A.36) are substituted.

Appendix B

PERMUTATION TABLES

Table B.1: Some permutations of the 4 units length sequence f m f' m' used in the derivations

$\mathbf{f}$	$\mathbf{m}$	$\mathbf{f'}$	$\mathbf{m'}$
f	f	f	f
f	f	f'	f'
f	m	f	m
f	m	m	f

Table B.2: Some permutations of the 4 units length sequence t t' t'' t''' used in the derivations

$\mathbf{t}$	$\mathbf{t'}$	$\mathbf{t''}$	$\mathbf{t'''}$
t	t	t	t
t	t	t''	t''
t	t'	t	t'
t	t'	t'	t

Table B.3: Some permutations of the 4 units length sequence u u' u'' u''' used in the derivations

$\mathbf{u}$	$\mathbf{u'}$	$\mathbf{u''}$	$\mathbf{u'''}$
u	u	u	u
u	u	u''	u''
u	u'	u	u'
u	u'	u'	u

Table B.4: Some permutations of the 4 units length sequence f u u' u'' used in the derivations

$\mathbf{f}$	$\mathbf{u}$	$\mathbf{u'}$	$\mathbf{u''}$
f	f	f	f
f	f	u'	u'
f	u	f	u
f	u	u	f

Table B.5: Some permutations of the 4 units length sequence t t t' t''' used in the derivations

$\mathbf{t}$	$\mathbf{t}$	$\mathbf{t'}$	$\mathbf{t'''}$
t	t	t	t
t	t	t'	t'

Table B.6: Some permutations of the 4 units length sequence t t'' t''' t''' used in the derivations

$\mathbf{t}$	$\mathbf{t''}$	$\mathbf{t'''}$	$\mathbf{t'''}$
t	t	t	t
t	t	t'''	t'''

Table B.7: Some permutations of the 4 units length sequence t' t" t" t' used in the derivations

$\mathbf{t'}$	$\mathbf{t''}$	$\mathbf{t''}$	$\mathbf{t'}$
t'	t	t	t'
t'	t'	t'	t'
t'	t''	t''	t'

Table B.8: Some permutations of the 6 units length sequence t t t' t' t" t" used in the derivations

$\mathbf{t}$	$\mathbf{t}$	$\mathbf{t'}$	$\mathbf{t'}$	$\mathbf{t''}$	$\mathbf{t''}$
t	t	t	t	t	t
t	t	t	t	t''	t''
t	t	t'	t'	t	t
t	t	t'	t'	t'	t'
t	t	t'	t'	t''	t''

Table B.9: Some permutations of the 6 units length sequence t t t' t' t"' t"' used in the derivations

$\mathbf{t}$	$\mathbf{t}$	$\mathbf{t'}$	$\mathbf{t'}$	$\mathbf{t'''}$	$\mathbf{t'''}$
t	t	t	t	t	t
t	t	t	t	t'''	t'''
t	t	t'	t'	t	t
t	t	t'	t'	t'	t'
t	t	t'	t'	t'''	t'''

Table B.10: Some permutations of the 6 units length sequence f u' f u' f' f' used in the derivations

f	**u′**	**f**	**u′**	**f′**	**f′**
f	f	f	f	f'	f'
f	f'	f	f'	f'	f'
f	u'	f	u'	f'	f'

Table B.11: Some permutations of the 6 units length sequence f f u" f' u" f' used in the derivations

f	**f**	**u″**	**f′**	**u″**	**f′**
f	f	f	f'	f	f'
f	f	f'	f'	f'	f'
f	f	u''	f'	u''	f'

Table B.12: Some permutations of the 6 units length sequence u f u f f' f' used in the derivations

u	**f**	**u**	**f**	**f′**	**f′**
f	f	f	f	f'	f'
f'	f	f'	f	f'	f'
u	f	u	f	f'	f'

Table B.13: Some permutations of the 6 units length sequence u f f f' u f' used in the derivations

u	**f**	**f**	**f′**	**u**	**f′**
f	f	f	f'	f	f'
f'	f	f	f'	f'	f'
u	f	f	f'	u	f'

Table B.14: Some permutations of the 8 units length sequence t t t' t' t'' t'' t''' t''' used in the derivations

$\mathbf{t}$	$\mathbf{t}$	$\mathbf{t'}$	$\mathbf{t'}$	$\mathbf{t''}$	$\mathbf{t''}$	$\mathbf{t'''}$	$\mathbf{t'''}$
t	t	t	t	t	t	t	t
t	t	t	t	t	t	t'''	t'''
t	t	t	t	t''	t''	t	t
t	t	t'	t'	t	t	t	t
t	t	t'	t'	t'	t'	t'	t'
t	t	t	t	t''	t''	t''	t''
t	t	t'	t'	t	t	t'	t'
t	t	t'	t'	t'	t'	t	t
t	t	t	t	t''	t''	t'''	t'''
t	t	t'	t'	t	t	t'''	t'''
t	t	t'	t'	t''	t''	t	t
t	t	t'	t'	t'	t'	t'''	t'''
t	t	t'	t'	t''	t''	t'	t'
t	t	t'	t'	t''	t''	t''	t''
t	t	t'	t'	t''	t''	t'''	t'''

Table B.15: Some permutations of the 8 units length sequence u f u' f u' f u f used in the derivations

$\mathbf{u}$	$\mathbf{f}$	$\mathbf{u'}$	$\mathbf{f}$	$\mathbf{u'}$	$\mathbf{f}$	$\mathbf{u}$	$\mathbf{f}$
f	f	u'	f	u'	f	f	f
u	f	f	f	f	f	u	f
u	f	u'	f	u'	f	u	f

Table B.16: Some permutations of the 8 units length sequence u f u f u” f u” f used in the derivations

u	**f**	**u**	**f**	**u″**	**f**	**u″**	**f**
f	f	f	f	u''	f	u''	f
u	f	u	f	f	f	f	f
u	f	u	f	u''	f	u''	f

Table B.17: Some permutations of the 8 units length sequence u f u f u f’ u f’ used in the derivations

u	**f**	**u**	**f**	**u**	**f′**	**u**	**f′**
f	f	f	f	f	f'	f	f'
f'	f	f'	f	f'	f'	f'	f'
u	f	u	f	u	f'	u	f'

Table B.18: Some permutations of the 8 units length sequence u f u f u” f’ u” f’ used in the derivations

u	**f**	**u**	**f**	**u″**	**f′**	**u″**	**f′**
f	f	f	f	f'	f'	f'	f'
f	f	f	f	u''	f'	u''	f'
f'	f	f'	f	f	f'	f	f'
f'	f	f'	f	u''	f'	u''	f'
u	f	u	f	f	f'	f	f'
u	f	u	f	f'	f'	f'	f'
u	f	u	f	u''	f'	u''	f'

Table B.19: Some permutations of the 8 units length sequence u f u' f u' f' u f' used in the derivations

u	**f**	**u′**	**f**	**u′**	**f′**	**u**	**f′**
f	f	f'	f	f'	f'	f	f'
f	f	u'	f	u'	f'	f	f'
f'	f	f	f	f	f'	f'	f'
f'	f	u'	f	u'	f'	f'	f'
u	f	f	f	f	f'	u	f'
u	f	f'	f	f'	f'	u	f'
u	f	u'	f	u'	f	u	f'

Table B.20: Some permutations of the 8 units length sequence u m u f u m u f used in the derivations

u	**m**	**u**	**f**	**u**	**m**	**u**	**f**
f	m	f	f	f	m	f	f
m	m	m	f	m	m	m	f
u	m	u	f	u	m	u	f

Table B.21: Some permutations of the 8 units length sequence u m u f u" f u" m used in the derivations

u	**m**	**u**	**f**	**u″**	**f**	**u″**	**m**
f	m	f	f	m	f	m	m
f	m	f	f	u''	f	u''	m
m	m	m	f	f	f	f	m
m	m	m	f	u''	f	u''	m
u	m	u	f	f	f	f	m
u	m	u	f	m	f	m	m
u	m	u	f	u''	f	u''	m

Table B.22: Some permutations of the 8 units length sequence u m u' f u' f u m used in the derivations

u	**m**	**u′**	**f**	**u′**	**f**	**u**	**m**
f	m	m	f	m	f	f	m
f	m	u'	f	u'	f	f	m
m	m	f	f	f	f	m	m
m	m	u'	f	u'	f	m	m
u	m	f	f	f	f	u	m
u	m	m	f	m	f	u	m
u	m	u'	f	u'	f	u	m

Table B.23: Some permutations of the 8 units length sequence u m u f u" m u" f used in the derivations

u	**m**	**u**	**f**	**u″**	**m**	**u″**	**f**
f	m	f	f	m	m	m	f
f	m	f	f	u''	m	u''	f
m	m	m	f	f	m	f	f
m	m	m	f	u''	m	u''	f
u	m	u	f	f	m	f	f
u	m	u	f	m	m	m	f
u	m	u	f	u''	m	u''	f

Table B.24: Some permutations of the 8 units length sequence u m u' f u' m u f used in the derivations

u	**m**	**u′**	**f**	**u′**	**m**	**u**	**f**
f	m	m	f	m	m	f	f
f	m	u'	f	u'	m	f	f
m	m	f	f	f	m	m	f
m	m	u'	f	u'	m	m	f
u	m	f	f	f	m	u	f
u	m	m	f	m	m	u	f
u	m	u'	f	u'	m	u	f