

Contents

Preface	III
1 Introduction	1
1.1 Motivation	1
1.2 Thesis Origin and Focus	2
1.3 Main Contributions	2
1.4 Thesis Structure	4
1.5 Notation	5
2 Fundamentals and Preliminaries	7
2.1 Overview	7
2.2 Basics of Digital Communications	7
2.2.1 Transmitter	8
2.2.2 Channel	8
2.2.3 Receiver	11
2.3 Orthogonal Frequency Division Multiplexing	11
2.4 Channel Coding	13
2.4.1 Rate Compatible Punctured Convolutional Codes . . .	14
2.4.2 Low-Density Parity-Check Codes	17
2.5 Digital Modulation	19
2.5.1 Alphabet Constrained Mapping	20
2.5.2 Soft-Output Demapping	22
2.6 Spatial Diversity	23
2.6.1 Maximum Ratio Combining	23
2.6.2 Orthogonal Space-Time Block Codes	25
2.7 Information Theory	30
2.7.1 Information and Entropy	30
2.7.2 Mutual Information	30
2.7.3 Capacity in AWGN Channels	32
2.7.4 Capacity with Discrete Alphabet	33

2.8	Chapter Summary	34
3	One-Way SISO Relaying	35
3.1	Overview	35
3.2	Basics of Relaying Communications	36
3.2.1	System Model	36
3.2.2	Conventional Relaying Schemes	37
3.3	OFDM-based Relaying Schemes	38
3.3.1	Amplify-Forward with Constant Power	40
3.3.2	Amplify-Forward with Constant Gain	42
3.3.3	Decode-Forward	42
3.3.4	Decode-Quantize-Forward	44
3.4	Performance Evaluation	47
3.5	Chapter Summary	53
4	One-Way Distributed Relaying	55
4.1	Overview	55
4.2	System Model	56
4.3	Introduction to Distributed MIMO Technologies	57
4.3.1	Cooperation at Receiver Side of VAA	58
4.3.2	Cooperation at Transmitter Side of VAA	59
4.4	Adaptive Inter-Relay Cooperation	60
4.4.1	General Description	61
4.4.2	Inter-Relay Cooperation with Correct Relays	64
4.4.3	Inter-Relay Cooperation without Correct Relays	65
4.4.4	Throughput Analysis	70
4.5	Performance Evaluation	72
4.6	Chapter Summary	82
5	Two-Way SISO Relaying	83
5.1	Overview	83
5.2	Basics of Two-Way Relaying Communications	84
5.2.1	Four-Phase Scheme	84
5.2.2	Three-Phase Scheme	86
5.2.3	Two-Phase Scheme with Physical-Layer Network Coding	87
5.3	APP-based Schemes	91
5.3.1	Definitions	91
5.3.2	Separated Channel Decoding	95
5.3.3	Joint Channel Decoding and Physical-Layer Network Coding	99
5.3.4	Generalized Joint Channel Decoding and Physical-Layer Network Coding	103

5.3.5	Performance Evaluation	107
5.4	Phase Control Strategy	109
5.4.1	Mutual Information with Optimal Phase Control . . .	110
5.4.2	Linear Approximation of Channel Phase	113
5.5	Carrier Frequency Offset Mismatch	116
5.5.1	System Formulation for CFO	117
5.5.2	Carrier Frequency Offset Compensation	119
5.5.3	Inter-Carrier Interference Cancellation	122
5.6	Extention to MIMO Relaying	127
5.6.1	System Model	127
5.6.2	Impact on APP-based Schemes	129
5.6.3	Common Multi-User MIMO Detection Schemes . . .	130
5.6.4	Performance Evaluation	134
5.7	Chapter Summary	137
6	Two-Way Distributed Relaying	139
6.1	Overview	139
6.2	System Model	140
6.3	Traditional Adaptive Broadcast Transmission	141
6.3.1	Scheme Description	142
6.3.2	Outage Analysis	142
6.4	Modified Adaptive Broadcast Transmission	145
6.4.1	Scheme Description	145
6.4.2	Outage Analysis	147
6.4.3	Signaling Overhead - CRC over the Air	150
6.5	Performance Evaluation	151
6.6	Chapter Summary	159
7	Summary	161
	Acronyms	165
	List of Symbols	169
	Bibliography	175
	Index	185