

# Contents

## Part I Fundamentals of Feedback Strategies for Wireless Communication

<b>1</b>	<b>Introduction</b>	3
<b>2</b>	<b>Background on Wireless Communication</b>	7
2.1	Introduction	7
2.2	Wireless Communication Channel Models	7
2.2.1	Introduction	7
2.2.2	Path Loss and Shadowing	8
2.2.3	Multipath Channel Models	10
2.2.4	MIMO Channel	17
2.2.5	Dual-Polarized Antennas	25
2.3	Orthogonal Frequency Division Multiplexing	30
2.4	MIMO Systems	35
2.4.1	Introduction	35
2.4.2	Capacity of MIMO Systems	37
2.4.3	Gain of MIMO Systems	41
2.4.4	Diversity Multiplexing Tradeoff	42
2.4.5	MIMO Codes	43
2.4.6	Design Criteria for Space-Time Codes	44
	References	52
<b>3</b>	<b>Feedback in SISO Single User Wireless Communication</b>	55
3.1	Introduction	55
3.2	Narrowband Single Input Single Output Systems	55
3.2.1	Introduction	55
3.2.2	Finite-State Channel	56
3.2.3	Fading Channel	58
3.3	Wideband Systems	69
3.4	Adaptive Modulation and Coding	70
3.4.1	Introduction	70

3.4.2	Adaptive Discrete Rate Technique .....	71
3.4.3	Adaptive Power Technique .....	73
3.4.4	Adaptive Discrete Rate and Power .....	74
3.4.5	Adaptive Modulation and Coding .....	76
3.4.6	Channel Prediction .....	78
3.4.7	Wideband Channel .....	83
3.5	Automatic Repeat Request .....	89
3.6	Conclusion .....	92
	References .....	93
<b>4</b>	<b>Feedback in MIMO Wireless Communication</b> .....	<b>97</b>
4.1	Introduction .....	97
4.2	Beamforming .....	98
4.2.1	System Model .....	98
4.2.2	Codebook Design .....	101
4.2.3	Analog Feedback .....	118
4.2.4	Performance Analysis .....	119
4.3	Linear Precoding for Spatial Multiplexing .....	124
4.3.1	System Model .....	126
4.3.2	Codebook Design .....	127
4.4	Improved Space-Time Codes .....	134
4.4.1	Limited Feedback for Orthogonal Space-Time Block Codes .....	134
4.4.2	Limited Feedback for Non-orthogonal Space-Time Block Codes .....	137
4.5	Antenna Selection .....	137
4.5.1	System Model .....	138
4.6	Codebook Design for Spatial Correlated Channel .....	143
4.7	Codebook Design for Time-Correlated Channels .....	145
4.7.1	Differential Feedback Codebook .....	146
4.7.2	Polar-Cap Differential Codebook .....	150
4.7.3	Rotation-Based Differential Codebook .....	151
4.8	Extension to Wideband Communication Systems .....	154
4.9	Conclusion .....	159
	References .....	160
<b>5</b>	<b>Feedback Strategies for Multiuser Systems</b> .....	<b>165</b>
5.1	Introduction .....	165
5.2	Multiuser Systems .....	165
5.2.1	Gaussian MAC Communication System .....	166
5.2.2	Gaussian BC Communication System .....	168
5.2.3	Fading MAC Transmission .....	170
5.2.4	Fading BC Transmission .....	171
5.3	User Scheduling .....	171
5.3.1	Opportunistic Scheduling .....	173
5.3.2	Proportional Fair Scheduling .....	175

- 5.4 Feedback Strategies ..... 176
  - 5.4.1 Reduced Feedback Strategies ..... 176
  - 5.4.2 Limited Feedback Strategies ..... 185
- 5.5 Feedback in OFDMA-Based Wireless Systems ..... 186
- 5.6 Conclusion ..... 188
- References ..... 189
- 6 Feedback Strategies for Multiantenna Multiuser Systems ..... 191**
  - 6.1 Introduction ..... 191
    - 6.1.1 Capacity for Uplink Transmission ..... 192
    - 6.1.2 Capacity for Downlink Transmission ..... 195
  - 6.2 Multiuser MIMO Systems with Single Receive Antenna ..... 198
    - 6.2.1 Precoding..... 198
    - 6.2.2 User Scheduling Algorithms ..... 207
    - 6.2.3 User Selection at Receiver Side ..... 214
    - 6.2.4 Opportunistic Beamforming..... 218
    - 6.2.5 OFDMA-Based Wireless Systems ..... 222
    - 6.2.6 MAT Algorithm ..... 228
    - 6.2.7 Massive MIMO ..... 230
    - 6.2.8 PMI Feedback Schemes ..... 231
  - 6.3 Multiuser MIMO Systems with Multiple Receive Antennas ..... 233
    - 6.3.1 Precoding Strategies ..... 233
    - 6.3.2 User Scheduling Methods ..... 237
    - 6.3.3 Limited Feedback Strategies ..... 240
    - 6.3.4 Opportunistic Beamforming..... 241
  - 6.4 Conclusion ..... 243
  - References ..... 244

**Part II Advanced Issues and Standard**

- 7 Feedback Strategies for Multicell Systems ..... 249**
  - 7.1 Introduction ..... 249
  - 7.2 Cooperative Networks ..... 250
  - 7.3 Resource Allocation for Cooperative Multicell Networks ..... 251
    - 7.3.1 System Model for Multicell Network ..... 253
    - 7.3.2 State of the Art ..... 256
    - 7.3.3 Centralized Joint User Scheduling and Power Allocation .... 259
    - 7.3.4 Semi-Distributed User Scheduling and Power Allocation .... 259
  - 7.4 Reduced Feedback Links for Multi-user OFDM Multicell Systems ..... 265
    - 7.4.1 System Model ..... 266
    - 7.4.2 The Reduced Feedback Link Designs ..... 268
    - 7.4.3 Distributed User Scheduling and Power Allocation..... 269
    - 7.4.4 Performance Results ..... 272
  - 7.5 Limited Feedback Designs for Multiantenna Multicell Systems ..... 272
    - 7.5.1 System Model ..... 276

7.5.2	Bit Partitioning Strategies .....	280
7.5.3	Performance Results .....	282
7.6	Interference Alignment for $K$ -User Interference Channel .....	287
7.7	Conclusion .....	290
	References .....	290
<b>8</b>	<b>Feedback Strategies in LTE Systems .....</b>	<b>295</b>
8.1	Introduction .....	295
8.2	Overview of LTE Standard .....	295
8.2.1	Frame Structure and Transmission Modes .....	297
8.2.2	Reference Signals .....	298
8.3	Link Adaptation in LTE.....	301
8.4	Reporting Modes .....	303
8.5	Single User MIMO Transmission .....	306
8.6	Multuser MIMO Transmission .....	307
8.7	Multi-cell MIMO Transmission .....	308
8.7.1	Static Coordination Techniques .....	308
8.7.2	Dynamic Coordination Techniques .....	310
8.8	Codebooks in the LTE Standard .....	313
8.8.1	Codebooks for Two Transmit Antennas .....	313
8.8.2	Codebooks for Four Transmit Antennas .....	314
8.8.3	Dual Codebook for Eight Transmit Antennas .....	315
8.8.4	Codebooks for Uplink .....	318
8.9	Further Works .....	320
	References .....	322
<b>9</b>	<b>Conclusions .....</b>	<b>325</b>
	<b>Index .....</b>	<b>329</b>



<http://www.springer.com/978-1-4614-7740-2>

Feedback Strategies for Wireless Communication

Özbek, B.; Le Ruyet, D.

2014, XVII, 332 p. 105 illus., 51 illus. in color.,

Hardcover

ISBN: 978-1-4614-7740-2