

Adaptive Arrays and Diversity Antenna Configurations for Handheld Wireless Communication Terminals

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(ABSTRACT)

This dissertation reports results of an investigation into the performance of adaptive beamforming and diversity combining using antenna arrays that can be mounted on handheld radios. Handheld arrays show great promise for improving the coverage, capacity, and power efficiency of wireless communication systems.

Diversity experiments using a handheld antenna array testbed (HAAT) are reported here. These experiments indicate that signals received by the antennas in two-element handheld antenna arrays with spacing of 0.15 wavelength or greater can be combined to provide 7-9 dB diversity gain against fading at the 99% reliability level in non line-of-sight multipath channels. Thus, peer-to-peer systems of handheld transceivers that use antenna arrays can achieve reliability comparable to systems of single-antenna handheld units, with only one-fifth the transmitter power, resulting in lower overall power consumption and increased battery life. Similar gains were observed for spatial, polarization, and pattern diversity

Adaptive beamforming with single- and multi-polarized four-element arrays of closely spaced elements was investigated by experiment using the HAAT, and by computer simulation using a polarization-sensitive vector multipath propagation simulator developed for this purpose. Small and handheld adaptive arrays were shown to provide 25 to 40 dB or more of interference rejection in the presence of a single interferer in rural, suburban, and urban channels including line-of-sight and non line-of-sight cases. In multipath channels, these performance levels were achieved even when there was no separation between the transmitters in azimuth angle as seen from the receiver, and no difference in the orientations of the two transmitting antennas. This interference rejection capability potentially allows two separate spatial channels to coexist in the same time/frequency channel, doubling system capacity.

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TABLE OF CONTENTS

Abstract	ii
Acknowledgements	iii
CHAPTER 1 INTRODUCTION	1
CHAPTER 2 OVERVIEW OF MOBILE COMMUNICATION SYSTEMS	7
2.1 The Wireless Communication Link	7
2.2 Types of Systems	8
2.3 Mobile Radio Channels	11
2.3.1 Large scale path loss	11
2.3.2 Shadowing	11
2.3.3 Multipath effects: fading, intersymbol interference, and Doppler Spread	12
2.4 Polarization	13
2.4.1 Polarization states	14
2.4.2 Polarization in a multipath channel	15
2.5 Modulation	16
2.5.1 Analog modulation	16
2.5.2 Digital modulation	16
2.5.3 Spread spectrum and ultra wideband	17
2.6 Multiple Access Techniques and Frequency Reuse	18
2.6.1 Capacity of a band-limited AWGN channel	18
2.6.2 Multiple access	19
2.6.2.1 Frequency division multiple access (FDMA)	20
2.6.2.2 Time division multiple access (TDMA)	20
2.6.3 Frequency reuse strategies	21
2.6.3.1 Cellular frequency reuse	22
2.6.3.2 Code division multiple access (CDMA)	24
2.6.3.3 Spatial division multiple access.(SDMA)	26
2.6.3.4 Polarization Reuse	27
2.7 Conclusion	28
CHAPTER 3 ANTENNA ARRAYS AND BEAMFORMING	29
3.1 Pattern of a Generalized Array	29
3.1.1 Array factor	30
3.1.2 Array pattern	31
3.2 Phase and Time Scanning	31
3.2.1 Phase scanning	32
3.2.2 Time scanning	34
3.3 Fixed Beam Forming Techniques	35
3.3.1 Butler matrix	35
3.3.2 Blass matrix	36
3.3.3 Wullenweber array	37
3.3.4 Other fixed beamforming techniques	38
3.4 Optimum Beamforming	38

3.4.1 Array response vector.....	40
3.4.2 Spatial-polarization signature.....	40
3.4.3 Spatial-polarization signature matrix.....	40
3.4.4 Signals and noise.....	41
3.4.5 Optimum weights.....	41
3.5 Adaptive Algorithms.....	42
3.5.1 Least mean squares (LMS).....	42
3.5.2 Direct sample covariance matrix inversion (DMI).....	42
3.5.3 Recursive least squares (RLS) algorithm.....	43
3.5.4 Decision-directed algorithms.....	43
3.5.5 Constant modulus algorithm (CMA).....	43
3.5.6 Other techniques.....	45
3.6 Effects of Array Geometry and Element Patterns.....	47
3.7 Diversity Combining.....	49
3.8 Conclusion.....	51
CHAPTER 4 APPLICATION OF SMART ANTENNAS TO MOBILE COMMUNICATION SYSTEMS.....	53
4.1 Strategies for Coverage and Capacity Improvement.....	54
4.1.1 Range extension.....	54
4.1.2 Capacity.....	57
4.1.3 Interference reduction and rejection.....	58
4.1.4 Spatial division multiple access (SDMA).....	63
4.1.5 Tradeoff between interference reduction and SDMA.....	66
4.2 Multipath Mitigation.....	67
4.3 Direction Finding.....	70
4.4 System Evolution.....	70
4.5 Requirements and Implementation Issues.....	74
4.6 Conclusions.....	74
CHAPTER 5 STRATEGIES FOR SYSTEM PERFORMANCE IMPROVEMENT USING MULTI-POLARIZED ARRAYS.....	77
5.1 Diversity and Reuse Concepts.....	77
5.1.1 Diversity.....	77
5.1.2 Reuse and multiple access.....	78
5.2 Previous Research on Multi-Polarized Adaptive Arrays.....	82
5.3 Possible Deployments of Multi-Polarized Adaptive Arrays.....	93
5.3.1 Array at base station only.....	93
5.3.2 Arrays at base station and mobile/handheld units.....	93
5.3.3 Peer-to-peer systems.....	94
CHAPTER 6 HANDHELD ANTENNA ARRAY TESTBED (HAAT).....	96
6.1 Introduction.....	96
6.2 System Overview.....	96
6.3 Transmitters.....	99
6.4 Linear Positioning System.....	99

6.5 Two-Channel Handheld Receiver Unit and Data Logger	100
6.6 Four-Channel HAAT Receiver and Data Logger	102
6.6.1 Calibration of the four-channel receiver	104
6.7 Data Processing Hardware	107
6.8 Data Processing Software.....	107
6.8.1 Diversity combining evaluation software	108
6.8.1.1 Demeaning	111
6.8.1.2 Normalization of branch envelopes.....	114
6.8.1.3 Ricean CDF curve fit.....	116
6.8.1.4 Diversity gain.....	116
6.8.2 Adaptive beamforming evaluation software	119
6.9 Conclusions	124
CHAPTER 7 POLARIZATION-SENSITIVE MULTIPATH PROPAGATION MODELING	126
.....	126
7.1 Introduction	126
7.2 Existing Multipath Propagation Models	126
7.2.1 Ring of scatterers model (Lee).....	127
7.2.2 Geometrically-based single-bounce circular model (Petrus)	128
7.2.3 Geometrically-based single-bounce elliptical model (Liberti).....	128
7.3 Reflection of Polarized Waves.....	129
7.4 Geometric Components for Modeling Transmission and Reception of Polarized Waves in a Mobile Communication System.....	131
7.4.1 Antenna pattern representation for polarization sensitive channel modeling dc	132
7.4.2 Antenna pattern rotation and resampling	133
7.4.3 Antenna pattern repolarization	135
7.4.4 Gain of an arbitrarily polarized antenna.....	136
7.4.5 Polarization in multipath channels	137
7.5 Simulation of Polarization-Sensitive Multipath Propagation.....	138
7.5.1 Description of VMPS	139
7.5.2 Simulation Procedure	140
7.5.3 Example: diversity combining in a non line-of-sight multipath channel	144
7.6 Conclusion.....	146
CHAPTER 8 SPATIAL, POLARIZATION, AND PATTERN DIVERSITY FOR WIRELESS HANDHELD TERMINALS.....	148
8.1 Introduction	148
8.2 Diversity Principles	149
8.3 Experimental Configuration.....	152
8.3.1 Handheld antenna array testbed (HAAT).....	153
8.3.2 Antenna configurations	155
8.3.3 Mutual coupling	156
8.3.4 Measurement cases.....	159
8.3.5 Repeatability of measurements	160
8.3.6 Data processing	160
8.4 Experimental Results	160

8.5 Conclusions	168
CHAPTER 9 ADAPTIVE BEAMFORMING MEASUREMENTS AND SIMULATIONS	172
9.1 Introduction	172
9.2 HAAT Verification Tests	173
9.3 Controlled Adaptive Beamforming Measurements Using the Linear Positioner	177
9.4 Simulation of Array Operation in Free-Space.....	180
9.4.1 Free-space simulation with first transmitter having fixed vertical polarization, varying polarization of second transmitter	182
9.4.2 Free-space simulation with first transmitter having fixed 45° linear polarization, varying polarization of second transmitter	184
9.4.3 Free-space simulations with both transmitters having fixed vertical polarization, varying azimuth separation between transmitters	186
9.4.4 Free-space simulations with both transmitters having fixed -45° polarization, varying azimuth separation between transmitters	188
9.5 Simulation of Array Operation in a Rural, Line-of-Sight Channel with Multipath Propagation.....	190
9.5.1 Rural LOS multipath channel simulations with first transmitter having fixed -45° linear polarization, varying polarization of second transmitter.....	191
9.5.2 Rural LOS multipath channel simulations with both transmitters having fixed -45° linear polarization, varying azimuth separation between transmitters.....	194
9.6 Experiments in a Rural, Line-of-Sight Channel (Site 1).....	196
9.6.1 Rural line-of-sight measurements with both transmitters having fixed -45° polarization, varying azimuth separation between transmitters	198
9.6.2 Rural line-of-sight measurements with first transmitter having fixed -45° polarization, varying polarization of second transmitter.....	201
9.7 Experiments in a Suburban, Line-of-Sight Channel (Site 2)	203
9.7.1 Suburban line-of-sight measurements with two transmitters having fixed vertical polarization, varying azimuth separation between transmitters.....	205
9.7.2 Suburban line-of-sight measurements with the first transmitter having fixed vertical polarization, varying the polarization of the second transmitter.....	207
9.8 Experiments in Urban Line-of-Sight and non Line-of-Sight Channels (Site 3)	209
9.8.1 Line-of-sight, co-polarized measurements.....	210
9.8.2 Line-of-sight, cross-polarized measurements	210
9.8.3 Line-of-sight/non line-of-sight, co-polarized measurements.....	210
9.9 Handheld Adaptive Array Measurements	212
9.9.1 Peer-to-peer scenario (Site 2).....	213
9.9.2 Microcell scenario	216
9.10 Conclusions	219
CHAPTER 10 CONCLUSIONS AND FUTURE WORK	221
10.1 Conclusions	221
10.2 Future Work	227
APPENDIX A APPROACH FOR EVALUATION OF DIVERSITY AND ADAPTIVE BEAMFORMING TECHNIQUES.....	229

APPENDIX B PROGRAMS USED IN POLARIZATION-SENSITIVE PROPAGATION	
MODELING.....	238
VITA.....	248

List of Figures

Figure 2-1. Block diagram of a wireless communication link	8
Figure 2-2. Mobile radio systems.....	10
Figure 2-3. A left-hand circularly polarized plane wave.....	14
Figure 2-4. The polarization ellipse showing parameters ϵ , τ , and γ	15
Figure 2-5. Multiple access techniques.	19
Figure 2-6. A TDMA frame	20
Figure 2-7. Multiple coexisting channels that use the same frequency and code at the same time, but are separated in space.....	21
Figure 2-8. Frequency reuse in geographically separated cells.....	22
Figure 2-9. Spatial division multiple access (SDMA) using adaptive antennas	26
Figure 2-10. Polarization reuse	27
Figure 3-1. An arbitrary three dimensional array.....	30
Figure 3-2. (a) a phase scanned linear array (b) a time-scanned linear array.....	32
Figure 3-3. Array factor of 8-element phase-scanned linear array.....	33
Figure 3-4. Array factor of 8-element time-scanned linear array.....	35
Figure 3-5. An 8x8 Butler matrix feeding an 8-element array	36
Figure 3-6. A Blass matrix	37
Figure 3-7. A Wullenweber array.....	38
Figure 3-8. An adaptive antenna array	39
Figure 3-9. Diversity combining techniques	50
Figure 4-1. Range extension using an adaptive antenna	55
Figure 4-2. Interference reduction using adaptive antennas.....	59
Figure 4-3. Spatial division multiple access (SDMA) using adaptive antennas	63
Figure 4-4. Top view of vehicle-mounted array configurations	69
Figure 4-5. Paths of evolution for European digital cellular/PCS systems	71
Figure 4-6. Paths of evolution from AMPS for rural North American cellular systems	72
Figure 4-7. Paths of evolution from AMPS for urban North American cellular systems.....	73
Figure 5-1. Polarization diversity	78
Figure 5-2. A multi-polarized adaptive array	82
Figure 5-3. The multi-polarized array used in [5.2]	83
Figure 5-4. The “tripole” array.....	84
Figure 5-5. The multi-polarized adaptive array investigated in [5.9]	86
Figure 6-1. High level system block diagram of the Handheld Antenna Array Testbed (HAAT) ..	97
Figure 6-2. Block diagram of the two-channel HAAT receiver/data logger and data processing system.....	98
Figure 6-3. Block diagram of a HAAT transmitter	99
Figure 6-4. Positioning system for controlled tests.....	100
Figure 6-5. Receiver architecture block diagram.	101
Figure 6-6. Block diagram of the 4-channel HAAT receiver.....	103
Figure 6-7. Block diagram of the equipment configuration used for receiver calibration.....	104
Figure 6-8. Data processing software modules for diversity measurements.....	110
Figure 6-9. Local means of measured envelopes in urban, non line-of-sight channel for different demeaning window lengths.....	113

Figure 6-10. Signal envelopes vs. position in an indoor, non line-of-sight channel	115
Figure 6-11 . CDF of signal envelope with best fit Ricean CDF, $K=1.5$	117
Figure 6-12. Cumulative distribution function of signals before and after diversity combining, showing diversity gain, for an urban, non line-of-sight measurement with antenna spacing $d=0.5\lambda$	118
Figure 6-13. Data processing software modules for adaptive beamforming measurements.....	121
Figure 6-14. Plots of SINR from adaptive beamforming measurements	122
Figure 6-15. Cumulative probability distributions showing diversity gain for: (a) maximal ratio combining and (b) LSCMA beamformer	124
Figure 7-1. Ring of scatterers model	128
Figure 7-2. Geometrically-based single-bounce circular model	128
Figure 7-3. Geometrically-based single-bounce elliptical model	129
Figure 7-4. Reflection and transmission of polarized wave	130
Figure 7-5. Coordinate systems for modeling transmission and reception of polarized waves.....	132
Figure 7-6. Sampled 3-dimensional pattern of a vertical half-wave dipole	133
Figure 7-7. A three step rotation procedure that provides the ability to point the antenna in an arbitrary direction.....	133
Figure 7-8. Pattern of a half-wave dipole that has been rotated by 20° from vertical	136
Figure 7-9. Geometry of link with multipath reflection for VMPS	142
Figure 7-10. Main screen of VMPS user interface.....	143
Figure 7-11. Diversity Simulation, location of transmitter, receiver, and scatterers	144
Figure 7-12. Fading envelopes of the signals before and after maximal ratio combining	145
Figure 7-13. Cumulative probability distribution and diversity gain.....	146
Figure 8-1. Three “dimensions” of antenna diversity	150
Figure 8-2. Overview of the Handheld Antenna Array Testbed (HAAT)	154
Figure 8-3. Diversity antenna configurations: (a) spatial, (b) polarization, (c) pattern	156
Figure 8-4. Effects of mutual coupling	158
Figure 8-5. Envelope correlations vs. antenna spacing for line-of-sight, non line-of-sight, urban canyon, and outdoor-to-indoor/indoor channels	162
Figure 8-6. Branch power imbalance vs. antenna spacing.....	163
Figure 8-7. Diversity gain vs. antenna spacing without demeaning	165
Figure 9-1. Currents and patterns of a vertically oriented dipole and a horizontally oriented big wheel antenna.....	174
Figure 9-2. SINR of signal 1 in Measurement 2 before and after beamforming with linear array of four half-wave dipoles with 0.17 wavelength spacing.....	176
Figure 9-3. Array configurations used in controlled adaptive beamforming measurements	179
Figure 9-4. Angles used in simulations and measurements	181
Figure 9-5. Results of simulated operation in free space (azimuth angle varied)	183
Figure 9-6. Results of simulated operation in free space (polarization angle varied).....	185
Figure 9-7. Results of simulated operation in free space (polarization angle varied).....	187
Figure 9-8. Results of simulated operation in free space (azimuth angle varied).....	189
Figure 9-9. Channel geometry for simulations reported in this section	191
Figure 9-10. Results of simulated operation in the rural LOS multipath channel (polarization angle varied).....	193

Figure 9-11. Results of simulated operation in rural LOS multipath channel (azimuth angle varied).....	195
Figure 9-12. Rural Line-of-Sight Channel (Boley Fields in the Jefferson National Forest).....	197
Figure 9-13. Results of interference rejection measurements in rural environment (azimuth angle varied).....	200
Figure 9-14. Results of interference rejection measurements in rural environment (polarization angle varied).....	202
Figure 9-15. Suburban measurement location (field outside EE graduate student offices, Virginia Tech campus).....	204
Figure 9-16. Results of interference rejection measurements in suburban environment (azimuth angle varied).....	206
Figure 9-17. Results of interference rejection measurements in suburban environment (polarization angle varied)	208
Figure 9-18. Urban measurement area (between Whittemore and Hancock Halls, Virginia Tech campus)	209
Figure 9-19. Mean SINR after beamforming in an urban environment for three cases of line-of-sight conditions and polarization.....	211
Figure 9-20. Four-element handheld antenna arrays (single- and multi-polarized).....	212
Figure 9-21. Geometry of measurement Site 2 used for peer-to-peer handheld adaptive beamforming measurements	213
Figure 9-22. Microcell scenario showing transmitter and measurement locations.....	218
Figure A1. Diversity gain measured from cumulative distribution functions.....	232

List of Tables

Table 2.1	Polarization parameters and their definitions.....	15
Table 3-1	Summary of adaptive beamforming algorithms.....	46
Table 5-1	Reuse and Diversity Mechanisms.....	81
Table 5-2.	Summary of multi-polarized adaptive array and cross-polarized interference cancellation literature.....	91
Table 6-1.	Major Transmitter Components.....	99
Table 6-2.	Major Positioning System Components.....	100
Table 6-3.	Major Two-Channel Receiver Components.....	101
Table 6-4.	Link Budget for the Two-Channel HAAT Receiver.....	102
Table 6-4.	Link budget for the 4-channel HAAT receiver.....	105
Table 6.5	Power and Phase Balance Between Channels of the 4-channel HAAT Receiver.....	106
Table 6-6.	Correlation of local means of envelopes for different demeaning windows.....	114
Table 7-1.	List of m-files for polarization-sensitive propagation modeling (VMPS).....	142
Table 8-1	Description of diversity experiment locations including line-of-sight (LOS) and non line-of-sight (NLOS) channels.....	159
Table 8-2.	Categories of measurement sets with statistics of the measurement set mean values. G_{div} is the diversity gain at the 99% reliability level with maximal ratio combining.	161
Table 8-3.	Statistics for each measurement location (data processed without demeaning).	167
Table 8-4.	Statistics for spatial diversity measurement with and without operator's head present, vertical dipoles with $d=0.25\lambda$	168
Table 9-1.	SINR improvement in indoor interference rejection measurements using a uniform linear array of four vertically oriented dipoles spaced 0.17λ apart.....	177
Table 9-2	List of measurement sets.....	180
Table 9-3.	Results of peer-to-peer handheld measurements.....	215
Table 9-4.	Results of microcell handheld measure.....	217
Table B1.	Parameters for "leescatt".....	238
Table B2.	Parameters for "aoadist".....	238
Table B3.	Parameters for "reflect".....	239
Table B4.	Parameters for "frescoef".....	239
Table B5.	Parameters for "spsig".....	240
Table B6.	Parameters for "getazpat".....	240
Table B7.	Parameters for "ap".....	241
Table B8.	Parameters for "isovert".....	241
Table B9.	Parameters for "sdipole".....	242
Table B10.	Parameters for "halfwave".....	242
Table B11.	Parameters for "dirantv".....	243
Table B12.	Parameters for "gain".....	243
Table B13.	Parameters for "phipat".....	244
Table B14.	Parameters for "thetapat".....	244
Table B15.	Parameters for "threepat".....	244
Table B16.	Parameters for "rotpatvh".....	245
Table B17.	Parameters for "rotate2".....	246
Table B18.	Parameters for "resample".....	246
Table B19.	Parameters for "polarize".....	247