

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
	Awais Khawar, Jasmin Mahal and Chowdhury Shahriar	
	References	4
<b>2</b>	<b>A Projection-Based Approach to Spectrum Sharing</b>	<b>7</b>
	Awais Khawar, Ahmed Abdelhadi and T. Charles Clancy	
2.1	System Model	8
2.1.1	Radar Model	8
2.1.2	Target Model/Channel	8
2.1.3	Signal Model	9
2.1.4	Modeling Assumptions	9
2.1.5	Statistical Assumptions	10
2.1.6	Orthogonal Waveforms	10
2.1.7	Communication System	10
2.1.8	Interference Channel	11
2.1.9	Cooperative RF Environment	11
2.2	Radar-Cellular System Spectrum Sharing	12
2.2.1	Architecture	12
2.3	Spectrum Sharing Algorithms for Small MIMO Radar	13
2.3.1	Performance Metrics	13
2.3.2	Interference-Channel-Selection Algorithm	14
2.3.3	Modified-Null-Space Projection (NSP) Algorithm	15
2.3.4	Simulation Results	18
2.4	Spectrum Sharing Algorithms for Large MIMO Radar	20
2.4.1	Projection Matrix	21
2.4.2	Spectrum Sharing and Projection Algorithms	24
2.4.3	Statistical Decision Test for Target Detection	25
2.4.4	Numerical Results	30
2.5	Conclusion	35

2.6	MATLAB Code . . . . .	35
	References . . . . .	37
<b>3</b>	<b>Coloacted MIMO Radar and CoMP Cellular System . . . . .</b>	<b>39</b>
	Jasmin Mahal, Awais Khawar, Ahmed Abdelhadi and T. Charles Clancy	
3.1	Radar/CoMP System Spectral-Coexistence Models . . . . .	41
3.1.1	Coordinated Multi-point (CoMP) System . . . . .	41
3.1.2	Clustering Algorithms. . . . .	43
3.1.3	Colocated MIMO Radar . . . . .	44
3.1.4	Spectral-Coexistence Scenario . . . . .	46
3.2	Signal Design for Spectral Coexistence . . . . .	46
3.2.1	Radar Precoder Design for Interference Mitigation. . . . .	47
3.2.2	Radar Precoder Design for Cooperation . . . . .	50
3.2.3	CoMP Signal Design for Interference Mitigation . . . . .	50
3.2.4	CoMP Signal Design for Cooperation . . . . .	52
3.2.5	The Impact of Ship's Motion on Radar Precoder Design . . . . .	53
3.2.6	The Two Modes of Operation and the PRI of Radar . . . . .	53
3.3	Spectrum Sharing Algorithms . . . . .	53
3.3.1	Optimal Cluster Selection Algorithm . . . . .	54
3.3.2	Small Singular Value Space Projection (SSVSP) Algorithm. . . . .	54
3.4	Theoretical Performance Analysis of the Radar Precoder. . . . .	55
3.5	Simulation Results . . . . .	58
3.5.1	Performance Analysis of Interference Mitigating Precoder . . . . .	58
3.5.2	Performance Analysis of Information Exchange Precoder . . . . .	61
3.6	Conclusion. . . . .	61
3.7	MATLAB Code. . . . .	62
3.7.1	Interference Mitigation Mode . . . . .	62
3.7.2	Cooperation Mode . . . . .	71
3.7.3	Several Functions for both Modes . . . . .	72
	References . . . . .	73
<b>4</b>	<b>Overlapped-MIMO Radar and MIMO Cellular System . . . . .</b>	<b>75</b>
	Chowdhury Shahriar, Ahmed Abdelhadi and T. Charles Clancy	
4.1	System Model for Coexistence . . . . .	76
4.1.1	Radar Model. . . . .	76
4.1.2	Communications System Model . . . . .	77
4.1.3	Coexistence Channel Model . . . . .	77
4.1.4	Key Assumptions . . . . .	77

4.2	Colocated MIMO Radar . . . . .	79
4.3	Overlapped-MIMO Radar . . . . .	81
4.4	Performance Metrics for Overlapped-MIMO Radar . . . . .	84
4.4.1	Beampattern Improvement . . . . .	84
4.4.2	SNR Gain Improvement . . . . .	85
4.5	Optimum Subarray Size for Overlapped-MIMO Radar . . . . .	86
4.6	Radar-Centric Spectrum Sharing Algorithm . . . . .	87
4.6.1	Null Space Projection (NSP) . . . . .	87
4.6.2	Projection Matrix . . . . .	87
4.7	Assumptions and Limiting Factors of NSP . . . . .	89
4.8	Simulation and Results . . . . .	90
4.9	Conclusion . . . . .	92
4.10	MATLAB Code . . . . .	94
4.10.1	Overlapped-MIMO Main Module . . . . .	94
4.10.2	Uplink Beamforming Matrix . . . . .	95
4.10.3	Virtual Steering Vector . . . . .	96
4.10.4	Number of Subarray . . . . .	97
	References . . . . .	97
	<b>Index</b> . . . . .	<b>99</b>

Spectrum Sharing Between Radars and Communication  
Systems

A MATLAB Based Approach

Khawar, A.; Abdelhadi, A.; Clancy, T.C.

2018, XV, 102 p. 24 illus., 22 illus. in color., Softcover

ISBN: 978-3-319-56683-2