

Contents

Abstract	
Preface	7
Abbreviations	9
Symbols	11
Contents	15
1 Introduction	19
1.1 Background and History	19
1.1.1 Lossless Distributed Source Coding	20
1.1.2 Lossy Distributed Source Coding	21
1.2 Motivation	23
1.2.1 The state-of-the-art	23
1.2.2 Beyond the state-of-the-art	26
1.3 Outline of the Dissertation	27
1.4 Summary of Contributions	29
2 Preliminaries	31
2.1 Entropy and Mutual Information	31
2.2 Useful Inequalities	32
2.3 Theorems in Distributed Source Coding	34
2.3.1 Slepian-Wolf Theorem	34
2.3.2 Wyner-Ziv Bound	36
2.3.3 Multiterminal Source coding	38
2.3.4 The CEO Problem	40
2.4 Channel Coding Theorem	43
2.5 Source-Channel Separation Theorem	44
2.6 Channel Coding, Modulation and EXIT Chart Analysis	45
2.6.1 Channel Coding and Modulation	45
2.6.2 EXIT Chart Analysis	47
2.7 Decision of Binary Information Sensing	49
2.7.1 Binary Information Sensing	49
2.7.2 Majority Voting	50
2.7.3 Soft Combining	51

2.8	Summary	51
3	Analyses of Asymptotic Sum Rate Limit and Bit Error Rate Floor	53
3.1	Problem Statement	54
3.2	Achievable Sum Rate and SNR limit in AWGN Channels	55
3.3	BEP Floor Analysis	58
3.3.1	Poisson-Binomial Approximation	59
3.3.2	Theoretical Lower Bound on the BEP Floor	60
3.4	Encoding and Joint Decoding Algorithms	61
3.4.1	Encoding Scheme	61
3.4.2	Joint Decoding Algorithm	62
3.5	Simulations for Verification	64
3.5.1	Parameters in Encoding/Decoding Algorithm	64
3.5.2	Identical Observation Error Probability p_i	64
3.5.3	Diverse Observation Error Probability p_i	66
3.5.4	Verification by EXIT Analysis	69
3.6	Summary	70
4	Hamming Distortion Bounds of Binary Information Sensing	73
4.1	Problem Statement	74
4.2	Rate-Distortion Region Analysis	76
4.2.1	Outer Bound on the Rate-Distortion Region	76
4.2.2	Inner Bound	81
4.2.3	Remarks	81
4.3	Problem Formulation: Hamming Distortion Lower Bounds	85
4.3.1	Distortion Function	85
4.3.2	Convex Optimization: Minimizing Distortion	86
4.4	Verification of Hamming Distortion Lower Bounds	88
4.4.1	Simulation Settings	88
4.4.2	Numerical Results	90
4.5	Extension to Multiple Terminals	94
4.5.1	Problem Statement	94
4.5.2	Rate-Distortion Region Analysis	95
4.5.3	Sum Rate versus Distortion	99
4.5.4	Brief Discussions of using test BSC	100
4.5.5	Numerical Results	101
4.6	Summary	104

5	Power Allocation of Binary Information Sensing Networks	107
5.1	Problem Statement	107
5.2	Proposed Power Allocation Schemes	108
5.3	Numerical Results	111
5.4	Summary	116
6	Conclusion and Outlook	117
6.1	Conclusion	117
6.2	Future Studies	120
	References	122
	Appendices	129