

Contents

Abstract	iii
Résumé	v
Acknowledgement	vii
Notations	viii
1 Introduction	1
1.1 Wireless Sensor Networks	2
1.2 Participatory Sensing Systems	4
1.3 Adaptive Selection Problems	5
1.3.1 Active Base-Station Selection	5
1.3.2 Joint Selection of Active Base-Stations and Routing	6
1.3.3 Sparse Sensor-Selection by Exploiting Temporal Correlations	7
1.3.4 Sparse Sensor-Selection by Exploiting Spatial Correlations	8
1.4 Contributions	8
2 Active Base-Station Selection in Wireless Sensor Networks	11
2.1 Introduction	11
2.2 System Architecture	12
2.2.1 Network Details	13
2.2.2 Starting the Network	13
2.2.3 Gathering the Information for Adaptive Selections	15
2.2.4 Handing Over the Active BS	15
2.2.5 Recovering from Failures	16
2.3 Adaptive BS-Selection Problem Formulation	16
2.4 The “Highest Energy First” (HEF) Algorithm	19
2.5 Simulations	21
2.5.1 General Settings	21
2.5.2 Performance of Different Algorithms	22
2.5.3 Validations of Optimality Conditions	25
2.6 Real Experiments	27
2.7 Conclusion	29
2.A Appendix	30

2.A.1	Azuma-Hoeffding inequality	30
2.A.2	Proof of Theorem 2.1	31
2.A.3	Proof of Theorem 2.2	34
3	Joint Selection of Base Stations and Routing	43
3.1	Introduction	43
3.2	System Model	45
3.2.1	Data Communication	45
3.2.2	Energy Consumption	45
3.3	Problem Formulations	46
3.3.1	The Optimization Space	46
3.3.2	The Virtually-Moving BSs Problem	46
3.3.3	Comparisons to Other Schemes	47
3.4	Complexity Analysis	48
3.5	Scheduling Algorithm	50
3.5.1	The Constrained Gradient Method	51
3.5.2	The Min-Weight Configuration Problem	53
3.6	Simulations	56
3.6.1	Parameter Selection	57
3.6.2	Performance Comparison	58
3.7	Conclusion	60
3.A	Appendix	60
3.A.1	Proof of Theorem 3.2	60
3.A.2	Proof of Theorem 3.3	63
4	Sparse Sensor-Selection by Exploiting Temporal Correlations	67
4.1	Introduction	67
4.2	Related Works	69
4.3	Problem Formulation	71
4.4	Building Blocks	73
4.4.1	Signal Approximation and Reconstruction	74
4.4.2	Learning from Incomplete Data over Time	77
4.4.3	Sampling-Schedule Algorithm	78
4.5	Comparisons with Baseline Methods	79
4.6	Evaluations of DASS and Sparse-Sensing Methods	81
4.6.1	Components of DASS	81
4.6.2	DASS versus Baseline Methods	84
4.6.3	DASS on Multiple Sensor Nodes	85
4.7	Energy Saving over Traditional Data Collection Schemes	86
4.8	Conclusions	89
4.A	Appendix	89
5	Sparse Sensor-Selection by Exploiting Spatial Correlations	91
5.1	Introduction	91
5.2	Related Works	92
5.3	Problem Formulations	93

5.4	The Proposed Framework	94
5.5	Analyses in the Static WSN Scenarios	97
5.6	Performance Evaluation	98
5.6.1	Ideal Scenarios	99
5.6.2	Practical Scenarios	100
5.7	Conclusions	101
5.A	Appendix	102
5.A.1	Proof of Lemma 5.1	102
5.A.2	Proof of Theorem 5.1	102
5.A.3	Proof of Theorem 5.2	104
6	Conclusion and Future Work	107
	Bibliography	111
	Curriculum Vitæ	117