

Contents

Abstract	II
Resumen	IV
Resum	VII
Acknowledgements	IX
List of Symbols	XXVI
Abbreviations and Acronyms	XXIX
1 Introduction and Scope	1
1.1 Motivation	1
1.2 Objectives	3
1.3 Organization of the thesis	4
2 State of the art	7
2.1 Acoustic Sensor Networks (ASN)	7
2.2 Distributed signal processing	11
2.3 Adaptive filtering algorithms	14
2.3.1 The LMS algorithm	16
2.3.2 The NLMS algorithm	17
2.3.3 The Affine projection algorithm	18
2.3.4 The Block LMS algorithm	18

2.3.5	The Fast BLMS algorithm	18
2.3.6	The Partitioned FBLMS algorithm	20
2.4	Sound Field Control applications	21
2.4.1	Active Noise Control (ANC)	22
2.4.2	Active Noise equalization (ANE)	25
2.5	Conclusions	33
3	On the implementation of ANC systems over distributed networks	35
3.1	Analysis of acoustical interaction over distributed networks	35
3.1.1	Generic ANC problem statement	36
3.1.2	Centralized ANC system	37
3.1.3	Decentralized ANC system	39
3.1.4	Introduction to the acoustic coupling	41
3.2	Generic ANC formulation based on the LMS algorithm	44
3.2.1	Generic formulation for the ANC problem	44
3.3	Performance measures	49
3.3.1	Simulation setting	50
4	ANC applications over non-collaborative networks	53
4.1	Introduction	53
4.2	Decentralized problem statement	55
4.3	Decentralized FxLMS algorithm	57
4.3.1	Convergence analysis	58
4.3.2	Interference model	62
4.4	Decentralized FxLMS algorithm using control effort	67
4.4.1	Convergence analysis	68
4.5	Decentralized FxLMS algorithm using interference control	69
4.5.1	Convergence analysis	71
4.6	Other decentralized strategies	73
4.7	Simulation results	74
4.8	Conclusions	79

5 ANC applications over collaborative networks	81
5.1 Introduction	81
5.2 Collaborative distributed algorithm	84
5.2.1 DMEFxLMS algorithm	85
5.2.2 Convergence analysis	88
5.2.3 Simulation results	93
5.2.4 Conclusions	96
5.3 Collaborative distributed algorithm using control effort	96
5.3.1 Leaky DMEFxLMS algorithms	97
5.3.2 Simulation results	102
5.3.3 Conclusions	115
5.4 Collaborative distributed algorithm based on affine projection approach	115
5.4.1 DFxAPL-I algorithm	116
5.4.2 Simulation results	120
5.4.3 Conclusions	122
5.5 Blockwise collaborative distributed algorithm	122
5.5.1 FPBFxLMS algorithm	122
5.5.2 Incremental DFPBFxLMS algorithm	124
5.5.3 Diffusion DFPBFxLMS algorithm	128
5.5.4 Conclusions of this section	130
5.6 Collaborative distributed algorithm using clusters	134
5.6.1 cl-DMEFxLMS algorithm	136
5.6.2 Convergence analysis	139
5.6.3 Simulation results	144
5.6.4 Conclusions	150
5.7 Collaborative distributed algorithm using remote sensing technique .	152
5.7.1 Distributed RM-MEFxLMS algorithms	153
5.7.2 Simulation results	163
5.7.3 Conclusions	172
5.8 Conclusions	173

6 ANE applications over distributed networks	175
6.1 Distributed narrowband ANE algorithms	175
6.1.1 Single-frequency multichannel ANE algorithm	178
6.1.2 Distributed multiple-frequency ANE algorithms	182
6.1.3 Simulation results	186
6.2 Distributed broadband ANE algorithms	190
6.2.1 Distributed broadband MEFxLMS ANE algorithm	191
6.2.2 Distributed broadband MEFeLMS ANE algorithm	195
6.2.3 Simulation results	198
6.3 Conclusions	199
7 Practical implementation of SFC applications over distributed networks	201
7.1 Introduction	201
7.2 Prototype description	203
7.3 Hardware and software integration	205
7.4 Implementation aspects	209
7.5 Experimental results	211
7.5.1 ANC application	213
7.5.2 Narrowband ANE application	214
7.6 Conclusions	217
8 Conclusions	219
8.1 Main contributions	219
8.2 Further work	223
8.3 List of publications	225
Appendices	228
A Experimental methods to obtain the collaboration matrix	229
A.1 Methods to obtain the collaboration matrix	229
A.2 Methods based on the stability analysis	230
A.3 Methods based on acoustic parameters	233
A.4 Conclusions	239

B Simulator of sound field controller over ASNs	240
B.1 Introduction	240
B.2 Description of the simulation tool	241
B.2.1 Simulation of the algorithms	244
B.2.2 Simulation of the communication system	246
B.2.3 Simulation of the acoustic system	247
B.2.4 Analysis of the performance	247
B.2.5 Limitations	247
B.3 Conclusions	248
BIBLIOGRAPHY	248