

Contents

Abstract	iii
Contents	xv
1 Introduction	1
1.1 Introduction	1
1.2 Justification	3
1.3 Objectives.	5
1.4 Outlines of the Thesis.	6
2 Background of Inverter-based Microgrids	9
2.1 Introduction	9
2.2 Overview of Inverter-based Microgrids.	10
2.3 Components of the Inverter-based Microgrid.	17
2.4 Overview of Single-Phase Inverters Topologies	27
2.5 Microgrid Energy Management.	33
2.6 Microgrid's Opportunity on Environmental Concerns.	39
2.7 Microgrid Management and Operation Standards	43

2.8 Conclusions of the Chapter	50
3 State of the Art: Multi-objective Control Approach	53
3.1 Introduction	53
3.2 Multi-objective Functions Approach on IBMGs	54
3.3 Multi-objective Optimization Methods	77
3.4 Evaluation Indexes on Multi-objective Optimization	82
3.5 Conclusions of the Chapter	85
4 New Methodology: Multi-objective Approach for Optimizing the Closed-loop Control of Active Power in Inverter-based Microgrids	87
4.1 Introduction	87
4.2 Microgrid Modelling	89
4.3 Sliding Mode Controller Approach	97
4.4 Single Function Optimization Approach	107
4.5 Multiple Function Optimization Approach	113
4.6 Performance Indexes	121
4.7 Conclusions of the Chapter	122
5 Case Study: Analysis of an Experimental Inverter-based Microgrid for Active Power Management	125
5.1 Introduction	125
5.2 Experimental Microgrid at Universitat Politècnica de València	126
5.3 Meteorological Data	129
5.4 Proposal of a Microgrid at Universidad de Las Américas	135
5.5 Conclusions of the Chapter	149
6 Results of Multi-objective Approach for Active Power Management on Microgrids	151
6.1 Introduction	151
6.2 Simulation Proposal Under SMC-2 + PSO Method	152
6.3 Experimental Microgrid Improvement Under SMC-2 + PSO Methodology	168

6.4 Experimental Microgrid Improvement Under SMC-2 + MOO Methodology	176
6.5 Conclusions of the Chapter	200
7 Thesis Conclusions	203
7.1 Conclusions of the Dissertation.	203
7.2 Main Contributions	206
7.3 Future Developments	207
7.4 Publications	208
A Microgrid at Universitat Politècnica de València	209
B HOQ for microgrid implementation	213
C Microgrid at Universidad de Las Américas	215
Bibliography	219