

Contents

1	Introduction	1
1.1	Evolutionary Computation and optimization	1
1.2	Objective of the Thesis	2
1.3	Structure of the Thesis	2
2	State of the art	5
2.1	Historical perspective of Evolutionary Computation	5
2.2	Introduction to Evolutionary Algorithms and to the EPSO	6
2.3	Particle Swarm Optimization (PSO), the swarm's intelligence	7
2.4	Evolutionary Particle Swarm Optimization (EPSO), a new paradigm	7
2.4.1	EPSO's ability for auto-adaptation	9
2.4.2	EPSO, description of the algorithm	9
2.4.3	Control of the communication among particles and the selection process .	10
2.5	Differential Evolutionary Particle Swarm Optimization (DEEPSO)	11
2.6	Conclusions	13
3	First variant to EPSO Proposal: Change of variable as dimension re-scale - "VAREPSO"	15
3.1	The differences of scale between Space Dimensions	15
3.2	The differences of standard deviation between Space Dimensions	16
3.3	Algorithm formulation	16
3.4	Testing functions	17
3.4.1	Rosenbrock function	18
3.4.2	Sphere function	18
3.4.3	Alpine function	19
3.4.4	Griewank function	19
3.4.5	Ackley function	20
3.5	Testing the modified EPSO	21
3.5.1	Rosenbrock function	22
3.5.2	Sphere function	25
3.5.3	Alpine function	28
3.5.4	Griewank function	30
3.5.5	Ackley function	32
3.6	Main conclusions	34
4	Second variant to EPSO Proposal: Satellite Swarms - "SUBEPSO"	35
4.1	Sub-swarms implementation	35
4.2	Algorithm Formulation	36
4.2.1	EPSO iterative model – sub-swarm based on the global optimum	36

4.2.2	EPSO iterative model – Sub-swarm based on a random particle	37
4.3	Testing the modified EPSO	38
4.3.1	Sub-swarm based on a global optimum particle	38
4.3.2	Summary	47
4.4	Tests to the modified EPSO – Other configurations	47
4.4.1	Sub-swarm based on a random particle	47
4.4.2	Increase of the amount of particles of the son-swarm	49
4.4.3	Increase of the exploration limit of the son-swarm	51
4.5	Main conclusions	52
5	Electric power system application	53
5.1	EPS Presentation	53
5.1.1	Network's topology	53
5.1.2	Network's parameters	55
5.2	EPSO Application	58
5.2.1	Objective function	58
5.2.2	System restrictions	58
5.2.3	Tests and results	58
5.3	Main conclusions	69
6	Conclusions and future work	71
6.1	Goals achieved	71
6.2	Future investigation work	73
References		75
A	Annex A - Optimization Functions - <i>Fitness</i> progression with VAREPSO	79
B	Annex B - Optimization Functions - <i>Fitness</i> progression with SUBEPSO	85
C	Annex C - Energy Power System - <i>Fitness</i> progression	89
D	Annex D - Article for submission	91