

Contents

Foreword	xiii
Abstract	xv
1 Introduction	1
1.1 Motivation	1
1.2 Contributions	5
1.3 Book structure	7
2 Bio-inspired design patterns	9
2.1 A Model to Describe Bio-Inspired Design Patterns	10
2.2 Pattern Scheme	13
2.3 Basic Patterns	15
2.3.1 Spreading Pattern	15
2.3.2 Replication Pattern	17
2.3.3 Aggregation Pattern	18
2.3.4 Evaporation Pattern	20
2.3.5 Repulsion Pattern	22
2.4 Composed Patterns	25
2.4.1 Gradient Pattern	25
2.4.2 Digital Pheromone Pattern	27
2.4.3 Gossip Pattern	29
2.5 Top Layer Patterns	30
2.5.1 Morphogenesis Pattern	30
2.5.2 Quorum Sensing Pattern	32
2.5.3 Chemotaxis Pattern	33
2.5.4 Flocking Pattern	35
2.5.5 Foraging Pattern	37
2.6 Summary	39
3 Dynamic Optimisation	41
3.1 Background	42
3.1.1 Particle Swarm Optimisation	43
3.1.2 PSO in Dynamic Environments	44

3.1.3	PSO in Noisy functions	45
3.2	Evaporation Mechanism	46
3.2.1	Evaporation Mechanism	47
3.2.2	mQSOE	48
3.2.3	Dynamic Evaporation	50
3.3	Experiments	51
3.3.1	Experimental framework	51
3.3.2	Determining the evaporation factor	53
3.3.3	Subtraction versus multiplication as evaporation operator	54
3.3.4	Independence of peak heights and peak shifts	55
3.3.5	mQSO versus mQSOE	56
3.3.6	Filtering noise in mQSO	57
3.3.7	Dynamic Evaporation	59
3.4	Conclusions	62
4	Hovering Information in Spatial Computing	67
4.1	Introduction	68
4.2	Background	69
4.3	Hovering Information Concept	71
4.3.1	Hovering Information	71
4.3.2	Anchor Areas	71
4.3.3	Assumptions	73
4.4	Hovering Information Algorithms	73
4.4.1	Replication with Broadcast	73
4.4.2	Replication with Attractor Point	74
4.4.3	Cleaning	74
4.4.4	Repulsion	74
4.4.5	Broadcast Repulsion	76
4.4.6	Attractor Point Repulsion	78
4.5	Simulation Results	78
4.5.1	Metrics	79
4.5.2	Indoor Scenario	81
4.5.3	Outdoor Scenario	83
4.5.4	Analysis of algorithms	83
4.6	Conclusions	91
5	Detecting Diffuse Event Sources in Noisy WSN Environments	93
5.1	Introduction	93
5.2	Related Work	95
5.3	Sleep/Wake Modes	96
5.4	Our Approach	97
5.4.1	Sensors	98
5.4.2	Mobile Agents	99
5.5	Experiments	101
5.5.1	Varying the number of sensors in WSN	103
5.5.2	Quality of Convergence	103

5.5.3	Varying the Noise Factor	104
5.5.4	Varying Local Exploration	104
5.5.5	Varying Global Exploration	105
5.5.6	The Exploration Cost	106
5.5.7	Tolerance to WSN failures	106
5.6	Conclusions	107
6	Conclusions and Future Work	109
6.1	Publications related to this research	111
A	Hovering Information	123