

Contents

Part I: Techniques for Resource-Intensive Problems

1	A Survey of Fitness Approximation Methods Applied in Evolutionary Algorithms	3
	<i>L. Shi, K. Rasheed</i>	
1.1	Introduction	3
1.2	Fitness Approximation Methods	5
1.2.1	Instance-Based Learning Methods	5
1.2.2	Machine Learning Methods	7
1.2.3	Statistical Learning Methods	9
1.2.4	Existing Research in Multi-surrogate Assisted EAs	11
1.3	Comparative Studies for Different Approximate Models ...	14
1.4	The Working Styles of Fitness Approximation	17
1.4.1	Direct Fitness Replacement Methods	17
1.4.2	Indirect Fitness Approximation Methods	17
1.5	The Management of Fitness Approximation	18
1.5.1	Evolution Control	18
1.5.2	Offline Model Training	19
1.5.3	Online Model Updating	19
1.5.4	Hierarchical Approximate Models and Model Migration	20
1.6	Case Studies: Two Surrogate-Assisted EA Real-World Applications	20
1.6.1	The Welded Beam Design Domain	20
1.6.2	Supersonic Aircraft Design Domain	21
1.7	Final Remarks	23
	References	24

2	A Review of Techniques for Handling Expensive Functions in Evolutionary Multi-Objective Optimization	29
	<i>Luis V. Santana-Quintero, Alfredo Arias Montaño, Carlos A. Coello Coello</i>	
2.1	Introduction	29
2.2	Basic Concepts	30
2.2.1	Pareto Dominance	31
2.2.2	Pareto Optimality	31
2.2.3	Pareto Front	32
2.3	Knowledge Incorporation	32
2.3.1	Surrogates	33
2.3.2	Polynomials: Response Surface Methods (RSM) ...	34
2.3.3	Gaussian Process or Kriging	35
2.3.4	Radial Basis Functions	36
2.3.5	Artificial Neural Networks	37
2.3.6	Support Vector Machines	38
2.3.7	Clustering	40
2.3.8	Fitness Inheritance	41
2.4	Real-World Applications	42
2.4.1	Use of Problem Approximation	43
2.4.2	Use of RSM by Polynomial Approximation	45
2.4.3	Use of Artificial Neural Networks	46
2.4.4	Use of a Gaussian Process or Kriging	48
2.4.5	Use of Clustering	52
2.4.6	Use of Radial Basis Functions	52
2.5	Conclusions and Future Research Paths	53
	References	54
3	Multilevel Optimization Algorithms Based on Metamodel- and Fitness Inheritance-Assisted Evolutionary Algorithms	61
	<i>Kyriakos C. Giannakoglou, Ioannis C. Kampolis</i>	
3.1	Introduction	62
3.2	Metamodel-Assisted EAs and Distributed MAEAs	64
3.3	Surrogate Evaluation Models for MAEAs	65
3.3.1	Fitness Inheritance	65
3.3.2	Radial Basis Function (RBF) Networks	66
3.4	Assessment of MAEA and DMAEA	67
3.5	Multilevel Search Algorithms and the Underlying Hierarchy	68
3.5.1	The Three Multilevel Modes – Defining a HDMAEA	68
3.5.2	Distributed Hierarchical Search – DHMAEA vs. HDMAEA	70

3.6	Assessment of Multilevel–Hierarchical Optimization	71
3.7	Optimization of an Annular Cascade	75
3.8	Conclusions	79
	References	80
4	Knowledge-Based Variable-Fidelity Optimization of Expensive Objective Functions through Space Mapping	85
	<i>Slawomir Koziel, John W. Bandler</i>	
4.1	Introduction	85
4.2	Space Mapping Optimization	88
4.2.1	Formulation of the Space Mapping Algorithm	88
4.2.2	Space Mapping Surrogate Models	90
4.2.3	Characterization of Space Mapping	91
4.2.4	Practical Issues and Open Problems	92
4.2.5	Space Mapping Illustration	92
4.3	Space Mapping Efficiency	95
4.3.1	Example 1: Microstrip Bandpass Filter	95
4.3.2	Example 2: Ring Antenna [51]	99
4.3.3	Discussion	101
4.4	Exploiting Extra Knowledge: Tuning Space Mapping	101
4.4.1	Tuning Space Mapping Formulation	102
4.4.2	TSM Optimization of Chebyshev Bandpass Filter	103
4.4.3	Summary	106
4.5	Conclusions	106
	References	107
5	Reducing Function Evaluations Using Adaptively Controlled Differential Evolution with Rough Approximation Model	111
	<i>Tetsuyuki Takahama, Setsuko Sakai</i>	
5.1	Introduction	111
5.2	Optimization and Approximation Models	113
5.2.1	Optimization Problems	113
5.2.2	Evolutionary Algorithms Using Approximation Models	113
5.2.3	Estimated Comparison Method	114
5.3	Rough Approximation Model	115
5.3.1	Potential Model	115
5.3.2	Estimated Comparison	116
5.3.3	Adaptive Control	117
5.4	Differential Evolution with the Estimated Comparison Method	118
5.4.1	Differential Evolution	118

5.4.2	Adaptive DE with the Estimated Comparison Method	119
5.5	Numerical Experiments	120
5.5.1	Test Problems	120
5.5.2	Conditions of Experiments	122
5.5.3	Experimental Results	122
5.6	Discussion	126
5.7	Conclusions	128
	References	128
6	Kriging Is Well-Suited to Parallelize Optimization	131
	<i>David Ginsbourger, Rodolphe Le Riche, Laurent Carraro</i>	
6.1	Introduction	132
6.1.1	Motivations: Efficient Optimization Algorithms for Expensive Computer Experiments	132
6.1.2	Where Computational Intelligence and Kriging Meet	132
6.1.3	Towards Kriging-Based Parallel Optimization: Summary of Obtained Results and Outline of the Chapter	134
6.2	Background in Kriging for Sequential Optimization	135
6.2.1	The Ordinary Kriging Metamodel and Its Gaussian Process Interpretation	135
6.2.2	Kriging-Based Optimization Criteria	137
6.3	The Multi-points Expected Improvement (q -EI) Criterion	142
6.3.1	Analytical Calculation of 2 -EI	143
6.3.2	q -EI Computation by Monte Carlo Simulations ...	147
6.4	Approximated q -EI Maximization	149
6.4.1	A First Greedy Strategy to Build a q -Points Design with the 1-Point EI	150
6.4.2	The Kriging Believer (KB) and Constant Liar (CL) Strategies	150
6.4.3	Empirical Comparisons with the Branin-Hoo Function	151
6.5	Towards Kriging-Based Parallel Optimization: Conclusion and Perspectives	155
6.6	Appendix	157
6.6.1	Gaussian Processes for Machine Learning	157
6.6.2	Conditioning Gaussian Vectors	157
6.6.3	Simple Kriging Equations	158
6.6.4	Ordinary Kriging Equations	159
	References	160

7	Analysis of Approximation-Based Memetic Algorithms for Engineering Optimization	163
	<i>Frederico Gadelha Guimarães, David Alister Lowther, Jaime Arturo Ramírez</i>	
7.1	Memetic Algorithms and Computer-Aided Design	164
7.2	Approximation-Based Memetic Algorithms	168
7.2.1	Varying Accuracy in Black-Box Functions	170
7.2.2	Approximation-Based Local Search	171
7.3	Analysis of Memetic Algorithms	175
7.3.1	Convergence Analysis	175
7.3.2	Computational Cost	180
7.4	Numerical Results	182
7.4.1	Analytical Problems	182
7.4.2	Electromagnetic Benchmark Problem	185
7.5	Final Remarks	188
	References	189
8	Opportunities for Expensive Optimization with Estimation of Distribution Algorithms	193
	<i>Alberto Ochoa</i>	
8.1	Introduction	193
8.2	Estimation of Distribution Algorithms	195
8.2.1	Boltzmann Estimation of Distribution Algorithms	195
8.3	Three Opportunities for Enhancing the Efficiency of EDAs	197
8.3.1	Right-Sized Selection	197
8.3.2	Probabilistic Elitism	198
8.3.3	Maximum Entropy	199
8.4	Evolutionary Backtracking from Log-Probability Landscapes	200
8.4.1	Selecting a Bayesian EDA Algorithm	201
8.4.2	Partial Evaluation in Boltzmann EDAs	202
8.4.3	A Simple Algorithm for Partial Evaluation with Backtracking	205
8.5	Regularization in Estimation of Distribution Algorithms	208
8.5.1	Entropic Mutation	208
8.5.2	Shrinkage Estimation of Distribution Algorithms	210
8.6	Summary and Conclusions	213
	Appendix	214
	References	216

9	On Similarity-Based Surrogate Models for Expensive Single- and Multi-objective Evolutionary Optimization	219
	<i>L.G. Fonseca, H.J.C. Barbosa, A.C.C. Lemonge</i>	
9.1	Introduction	219
9.2	The Optimization Problem	221
9.3	Surrogate-Assisted Evolutionary Optimization	221
9.3.1	Similarity-Based Surrogate Models (SBSMs)	222
9.3.2	Surrogate-Assisted Framework	224
9.3.3	The Surrogate-Assisted Evolutionary Algorithm	225
9.4	Computational Experiments	227
9.4.1	Single-Objective Optimization	229
9.4.2	Multi-objective Optimization	235
9.5	Concluding Remarks	244
	References	245
10	Multi-objective Model Predictive Control Using Computational Intelligence	249
	<i>Hiroataka Nakayama, Yeboon Yun, Masakazu Shirakawa</i>	
10.1	Introduction	250
10.2	Meta-modeling Using Computational Intelligence	250
10.3	Aspiration Level Approach to Interactive Multi-objective Optimization	255
10.4	Multi-objective Model Predictive Control	257
10.5	Concluding Remarks	263
	References	263
11	Improving Local Convergence in Particle Swarms by Fitness Approximation Using Regression	265
	<i>Stefan Bird, Xiaodong Li</i>	
11.1	Introduction	265
11.2	Background	267
11.2.1	Fitness Approximation	267
11.2.2	Particle Swarms	268
11.2.3	Speciated Particle Swarms	269
11.2.4	Guaranteed Convergence PSO	270
11.2.5	mQSO	270
11.3	Using Regression to Locate Optima	271
11.4	Experimental Setup	274
11.4.1	Static Functions	275
11.4.2	Moving Peaks	277
11.5	Results	281
11.5.1	Static Functions	281

11.5.2 Moving Peaks	283
11.6 Conclusion	291
References	291

Part II: Techniques for High-Dimensional Problems

12 Differential Evolution with Scale Factor Local Search for Large Scale Problems	297
<i>Andrea Caponio, Anna V. Kononova, Ferrante Neri</i>	
12.1 Introduction	297
12.2 Differential Evolution for Large Scale Problems	299
12.2.1 Differential Evolution	299
12.2.2 Self-Adaptive Control Parameter Update	301
12.2.3 Population Size Reduction	301
12.2.4 Scale Factor Local Search	302
12.3 Numerical Results	305
12.3.1 Results in 100 Dimensions	307
12.3.2 Results in 500 Dimensions	310
12.3.3 Results in 1000 Dimensions	313
12.3.4 Discussion about the Algorithmic Components	316
12.4 Conclusion	320
References	321
13 Large-Scale Network Optimization with Evolutionary Hybrid Algorithms: Ten Years' Experience with the Electric Power Distribution Industry	325
<i>Pedro M.S. Carvalho, Luis A.F.M. Ferreira</i>	
13.1 Introduction	325
13.2 Optimization of Electric Power Distribution Networks	327
13.3 Evolutionary Approach	330
13.3.1 Working within the Feasibility Domain	331
13.3.2 Lamarckian Hybridization	335
13.4 Application Examples and Illustration	337
13.5 Summary	342
References	342
14 A Parallel Hybrid Implementation Using Genetic Algorithms, GRASP and Reinforcement Learning for the Salesman Traveling Problem	345
<i>João Paulo Queiroz dos Santos, Francisco Chagas de Lima Júnior, Rafael Marrocos Magalhães, Jorge Dantas de Melo, Adrião Duarte Doria Neto</i>	
14.1 Introduction	345
14.2 Theoretical Foundation	347
14.2.1 GRASP Metaheuristic	347

14.2.2	Genetic Algorithm	347
14.2.3	Reinforcement Learning: Q-Learning Algorithm ...	348
14.3	Hybrid Methods Using Metaheuristic and Reinforcement Learning	349
14.3.1	GRASP-Learning	350
14.3.2	Genetic-Learning	351
14.4	Parallel Hybrid Implementation Proposed	352
14.4.1	Methodology	352
14.5	Experimental Results	354
14.5.1	The Traveling Salesman Problem	355
14.5.2	Computational Test	356
14.6	Conclusions	368
	References	368
15	An Evolutionary Approach for the TSP and the TSP with Backhauls	371
	<i>Haldun Süral, Nur Evin Özdemirel, İlter Önder, Meltem Sönmez Turan</i>	
15.1	The Traveling Salesman Problem	372
15.1.1	Conventional TSP Heuristics	373
15.1.2	Metaheuristics for the TSP	374
15.1.3	Evolutionary TSP Algorithms	374
15.1.4	The TSP with Backhauls	375
15.1.5	Outline	376
15.2	The First Evolutionary Algorithm for the TSP	376
15.2.1	Generating Offspring from the Union Graph	377
15.2.2	Nearest Neighbor Crossover (NNX)	377
15.2.3	Greedy Crossover (GX)	379
15.2.4	Combined Use of the Crossover Operators	380
15.2.5	Proposed Mutation Operators	380
15.2.6	Other Settings of the First Evolutionary Algorithm	381
15.2.7	Computational Results for the TSP	383
15.3	The Second Evolutionary Algorithm for the TSP and the TSPB	387
15.3.1	More Than Two Parents and Multiple Offspring	387
15.3.2	Improved Mutation Operators	389
15.3.3	Computational Results for the TSP	390
15.3.4	Computational Results for the TSPB	391
15.4	Conclusion	394
	References	395

16 Towards Efficient Multi-objective Genetic Takagi-Sugeno Fuzzy Systems for High Dimensional Problems	397
<i>Marco Cococcioni, Beatrice Lazzerini, Francesco Marcelloni</i>	
16.1 Introduction	397
16.2 The Takagi-Sugeno Fuzzy Systems	399
16.3 Time Complexity	400
16.4 Fast Identification of Consequent Parameters	402
16.5 Reuse of Computed Parameters	403
16.5.1 Reuse in the Application of Mating Operators	403
16.5.2 Speeding Up the Calculus of the Output through Reuse	405
16.5.3 Speeding Up the Calculus of the Activation Degrees through Reuse	406
16.6 The Used MOEA to Learn TS Rules	406
16.7 Experimental Results	407
16.7.1 Regression Problem	409
16.7.2 Time Series Forecasting Problem	413
16.8 Conclusions	420
References	421
17 Evolutionary Algorithms for the Multi Criterion Minimum Spanning Tree Problem	423
<i>Madeleine Davis-Moradkhan, Will Browne</i>	
17.1 Introduction	423
17.1.1 Problem Definition	424
17.1.2 Solution Approaches	425
17.2 Knowledge-Based Evolutionary Algorithm (KEA)	429
17.3 Experimental Results	432
17.3.1 Benchmark Data Sets	432
17.3.2 Benchmark Algorithms	432
17.3.3 Performance Indicators	433
17.3.4 Numerical Results	434
17.3.5 Experimental Complexity of KEA and NSGA2	437
17.3.6 Scalability of KEA	440
17.3.7 Tri-Criterion Instances	441
17.4 Alternative Algorithms Based on KEA	442
17.5 Discussions and Analysis	447
17.6 Conclusions	448
References	449
18 Loss-Based Estimation with Evolutionary Algorithms and Cross-Validation	453
<i>David Shilane, Richard H. Liang, Sandrine Dudoit</i>	
18.1 Introduction	453

18.2	Loss-Based Estimation with Cross-Validation	455
18.2.1	The Estimation Road Map	455
18.2.2	Estimator Selection Procedure	456
18.3	The Parameter Space for Polynomial Regression	457
18.3.1	Parametrization	457
18.3.2	Constraints	458
18.3.3	Size of the Parameter Space	459
18.4	Evolutionary Algorithms as Risk Optimization Procedures	462
18.4.1	Proposed EA	463
18.5	Simulation Studies	468
18.5.1	Simulation Study Design	468
18.5.2	Simulation Study Results	470
18.6	Data Analysis for a Diabetes Study	476
18.7	Conclusion	481
18.8	Appendix	482
	References	483

Part III: Real-World Applications

19 Particle Swarm Optimisation Aided MIMO Transceiver

Designs	487
<i>S. Chen, W. Yao, H.R. Palally, L. Hanzo</i>	
19.1	Introduction 487
19.2	Particle Swarm Optimisation 489
19.2.1	PSO Algorithm 490
19.2.2	Complexity of PSO Algorithm 492
19.2.3	Choice of PSO Algorithmic Parameters 492
19.3	PSO Aided Semi-blind Joint ML Estimation 493
19.3.1	MIMO System Model 493
19.3.2	Semi-blind Joint ML Channel Estimation and Data Detection 494
19.3.3	PSO Aided Semi-blind Joint ML Scheme 496
19.3.4	Simulation Study 497
19.4	PSO Based MBER Multiuser Transmitter Design 499
19.4.1	Downlink of SDMA Induced MIMO System 500
19.4.2	MBER MUT Design 501
19.4.3	PSO Aided MBER MUT Design 502
19.4.4	Simulation Study 503
19.5	Conclusions 508
References	 508

20 Optimal Design of a Common Rail Diesel Engine	
Piston	513
<i>Teresa Donateo</i>	
20.1 Presentation	513
20.2 Introduction	514
20.3 Automatic Definition of the Computational Mesh	516
20.4 Single-Objective and Multi-objective Approaches	522
20.5 Optimization Algorithms	524
20.5.1 Implementations on Computation Platform and Grids	525
20.6 Test Case	526
20.6.1 Problem Specifications	527
20.6.2 Engine Simulation Code	528
20.6.3 HIPEGEO	529
20.6.4 Required Computational Time	534
20.6.5 Analysis of the Results	534
20.6.6 Conclusions	537
References	539
21 Robust Preliminary Space Mission Design Under	
Uncertainty	543
<i>Massimiliano Vasile, Nicolas Croisard</i>	
21.1 Introduction	543
21.2 Uncertainties in Space Mission Design	545
21.3 Modelling Uncertainties through Evidence Theory	546
21.3.1 Frame of Discernment $\mathcal{U}$, Power Set $2^{\mathcal{U}}$ and Basic Probability Assignment	546
21.3.2 Belief and Plausibility Functions	548
21.3.3 Cumulative Functions: CBF, CCBF, CPF, CCPF	549
21.4 Solution of the OUU Problem	551
21.4.1 Problem Formulation	551
21.4.2 Direct Solution through a Population-Based Genetic Algorithm	553
21.4.3 Indirect Solution Approach	555
21.5 A Case Study: The BepiColombo Mission	559
21.5.1 Spacecraft Mass Model	559
21.5.2 The BPA Structure	562
21.6 Results and Comparisons	563
21.6.1 Direct Solution Simulations	564
21.6.2 Indirect Solution Simulations	566
21.7 Conclusions	568
References	568

22 Progressive Design Methodology for Design of Engineering Systems	571
<i>Praveen Kumar, Pavol Bauer</i>	
22.1 Introduction	571
22.2 Progressive Design Methodology	573
22.3 Synthesis Phase of PDM	575
22.3.1 System Requirements Analysis	576
22.3.2 Definition of System Boundaries	577
22.3.3 Determination of Performance Criterion/Criteria	577
22.3.4 Selection of Variables and Sensitivity Analysis	578
22.3.5 Development of System Model	579
22.3.6 Deciding on Optimising Strategy	580
22.4 Intermediate Analysis Phase of PDM	582
22.4.1 Identification of New Set of Criteria	584
22.4.2 Linguistic Term Set	584
22.4.3 The Semantic of Linguistic Term Set	585
22.4.4 Aggregation Operator for Linguistic Weighted Information	585
22.5 Final Analysis Phase of PDM	589
22.6 Model Suitable for PDM	589
22.7 Synthesis Phase of PDM for Design of a BLDC Motor Drive	590
22.7.1 Requirement Analysis	590
22.7.2 Definition of System Boundaries	591
22.7.3 Determining of Performance Criteria	591
22.7.4 Development of System Model	592
22.7.5 Optimisation Strategy	594
22.7.6 Results of Multiobjective Optimisation	594
22.8 Intermediate Analysis Phase of PDM for Design of a BLDC Motor Drive	595
22.8.1 Identification of New Set of Objectives	597
22.8.2 Linguistic Term Set	598
22.8.3 The Semantic of Linguistic Term Set	598
22.8.4 Aggregation Operator for Linguistic Weighted Information	599
22.8.5 The Screening Process	599
22.9 Final Analysis Phase of PDM for Design of a BLDC Motor Drive	600
22.9.1 Detailed Simulation Model	600
22.9.2 Independent Design Variables and Objectives	600
22.9.3 Set of Solutions	602
22.10 Conclusions	604
References	605

23	Reliable Network Design Using Hybrid Genetic Algorithm Based on Multi-Ring Encoding	609
	<i>Jin-Myung Won, Alice Malisia, Fakhreddine Karray</i>	
23.1	Reliable Network Design	609
23.2	Problem Formulation	611
23.3	Network Reliability	612
	23.3.1 Reliability Metrics	612
	23.3.2 Reliability Estimation	613
23.4	Previous Works	615
	23.4.1 Genetic Algorithm	615
	23.4.2 Ant Colony Optimization	615
	23.4.3 Hybrid Heuristics	616
23.5	Solution Representation	617
	23.5.1 Multi-Ring Encoding	617
	23.5.2 Contraction Model	618
23.6	Hybrid Genetic Algorithm	620
	23.6.1 Representation and Initialization	621
	23.6.2 Repair	622
	23.6.3 Fitness Evaluation	622
	23.6.4 Parent Selection and Offspring Generation	623
	23.6.5 Mutation	624
	23.6.6 Local Search Ant Colony System	625
	23.6.7 Selection for New Generation	627
23.7	Numerical Results	627
	References	632
24	Isolated Word Analysis Using Biologically-Based Neural Networks	637
	<i>Walter M. Yamada, Theodore W. Berger</i>	
24.1	Neural Engineering Speech Recognition Using the Genetic Algorithm	637
24.2	Input Description	642
24.3	Synapse Connectivity: The Dynamic Synapse Neural Network	644
	24.3.1 <i>DSNN</i> Architecture	646
	24.3.2 Synapse Functionality	647
24.4	Synapse Optimization	650
	24.4.1 Biased Selection: Word Micro-environment	651
	24.4.2 Objective Function: Fitness Evaluation	652
	24.4.3 Score Function Rational	654
	24.4.4 Genetic Algorithm: Mutation, Elitism, and Micro-environment	657
24.5	Output Description and Analysis	658
	24.5.1 Integrated Responses	658

24.5.2	Dynamic Model Emergence Via Cost-Weighted Classification	661
24.5.3	System Output Visualization	664
24.6	Discussion	665
24.6.1	Sound Processing Via the Dorsal Cochlear Nucleus	667
	References	668
25	A Distributed Evolutionary Approach to Subtraction Radiography	671
	<i>Gabriel Mañana Guichón, Eduardo Romero Castro</i>	
25.1	Introduction	671
25.2	Background	673
25.2.1	The Image Registration Problem	673
25.2.2	High Performance Computing	676
25.3	A Grid Computing Framework for Medical Imaging	678
25.4	Case Study: Automatic Subtraction Radiography Using Distributed Evolutionary Algorithms	680
25.4.1	Problem Statement	681
25.4.2	Parametric Transformations	681
25.4.3	Similarity Measure	682
25.4.4	Optimization Problem	684
25.4.5	Interpolation Approach	684
25.4.6	Search Strategy	684
25.4.7	Algorithms Distribution	686
25.4.8	Algorithms Validation	687
25.4.9	The Subtraction Service	692
25.5	Discussion and Conclusions	694
	Appendix	695
	References	698
26	Speeding-Up Expensive Evaluations in High-Level Synthesis Using Solution Modeling and Fitness Inheritance	701
	<i>Christian Pilato, Daniele Loiacono, Antonino Tumeo, Fabrizio Ferrandi, Pier Luca Lanzi, Donatella Sciuto</i>	
26.1	Introduction	701
26.2	Related Work	703
26.3	Design Space Exploration with Multi-Objective Evolutionary Computation	704
26.3.1	Design Space Exploration Core	705
26.3.2	Genetic Algorithm Design	706
26.3.3	Performance Measure	707
26.4	Solution Evaluation	707
26.5	Building Cost Models	709

26.5.1	Cost Models	710
26.5.2	Experimental Evaluation	711
26.6	Fitness Inheritance	714
26.6.1	Inheritance Model	715
26.6.2	Experimental Evaluation	716
26.7	Conclusions	721
	References	721
Index		725