

Contents

1	Introduction	1
1.1	Industrial Problems	1
1.2	A Brief History of Evolutionary Algorithms	2
1.2.1	Natural and Artificial Evolution	3
1.2.2	Genetic Algorithms	5
1.2.3	Evolutionary Programming	6
1.2.4	Evolution Strategies	7
1.2.5	Genetic Programming	9
2	Resources	11
2.1	Books	11
2.2	Journals	12
2.3	International Conferences and Workshops	12
2.4	Software	13
2.5	Suggested Readings on Natural Evolution and Biology	13

Part I Prototype-Based Validation Problems

3	Automatic Software Verification	17
3.1	Introduction	17
3.2	Background	18
3.2.1	Mobile Phones	18
3.2.2	Verification Techniques	19
3.3	Proposed Approach	22
3.3.1	Model	23
3.3.2	Candidate Solutions	25
3.3.3	Evaluator	25
3.4	Experimental Results	27
3.4.1	Video Recording Bug	28
3.4.2	Voice Call Bug	28

3.4.3	Incorrect Menu Behavior	29
3.5	Conclusions	30
4	Post-silicon Speed-Path Analysis in Modern Microprocessors	31
4.1	Background	31
4.2	Introduction	33
4.3	Generation and Evaluation of Test Programs	34
4.4	Evolutionary Approach	35
4.4.1	Fitness Function	36
4.4.2	Individual Evaluation	36
4.4.3	Evolution Start	37
4.4.4	Internal Representation, Multithreading and Multicore ...	37
4.4.5	Assembly Language	38
4.4.6	Cache	39
4.5	Experimental Evaluation	39
4.5.1	Overclockers' Stress Tests	40
4.5.2	Target System	41
4.5.3	Experimental Results	41
4.6	Conclusions and Future Works	44
 Part II Design and Reliability Problems		
5	Antenna Array Synthesis with Evolutionary Algorithms	47
5.1	Introduction	47
5.2	Antenna Arrays	48
5.3	Evolutionary Algorithm	49
5.4	Experimental Setup	50
5.5	Experimental Results	51
5.6	Conclusions	54
6	Drift Correction of Chemical Sensors	55
6.1	Introduction	55
6.2	Method and Theory	58
6.2.1	Correction Factor	59
6.2.2	Classification	60
6.2.3	Correction Factor Optimization	60
6.2.4	Distance Functions	62
6.3	Case Studies and Experimental Results	63
6.3.1	Artificial Dataset	63
6.3.2	Real Dataset	68
6.4	CMA-ES	72
6.5	Conclusions	73

7	Development of On-Line Test Sets for Microprocessors	75
7.1	Introduction	75
7.2	Proposed Methodology	77
7.2.1	Spore Generator Description	79
7.2.2	Set Covering	81
7.3	Case Study	82
7.4	Conclusions	84

Part III Test Generation Problems

8	Uncovering Path Delay Faults with Multi-Objective EAs	89
8.1	Introduction	89
8.2	Background	90
8.2.1	Software-Based Path Delay Testing	90
8.2.2	Exploiting Gate- and RT Level Descriptions for Path-Delay Testing	91
8.2.3	BDDs for Structural Path Delay Fault Tests	92
8.2.4	Basic Concepts on MOEAs	93
8.3	Proposed Approach	93
8.4	Experimental Data	96
8.5	Conclusions	99
9	Software-Based Self Testing of System Peripherals	101
9.1	Introduction	101
9.2	Peripheral Testing	102
9.2.1	Basics	102
9.2.2	Previous Works	103
9.3	Proposed Approach	104
9.3.1	Evolutionary Tool	105
9.3.2	Evaluator	107
9.4	Experimental Analysis	108
9.4.1	Test Case	108
9.4.2	Experimental Results	108
9.5	Conclusions	110
10	Software-Based Self-Testing on Microprocessors	111
10.1	Introduction	111
10.2	Background	112
10.2.1	Software-Based Self Testing	112
10.2.2	Evolutionary Algorithms on Software-Based Self Testing	114
10.3	Proposed Approach	115
10.3.1	μ GP	117
10.3.2	FSM Extractor	118
10.4	Case Study and Experimental Results	119
	References	121