Contents

1 Introduction to Self-optimization and Dependability 1
1.1 Self-optimizing Mechatronic Systems 3
1.1.1 Operator Controller Module (OCM) 6
1.1.2 Basic Procedures for Self-optimization 7
1.2 Challenges 12
1.2.1 Definition of the Term Dependability 13
1.2.2 Dependability as a Challenge 13
1.2.3 Ensuring Dependability during the Development Process 14
1.3 Applications of Self-optimizing Systems 16
1.3.1 Rail Technology – The RailCab System 16
1.3.2 Miniature Robot BeBot 20
1.3.3 X-by-Wire Test Vehicle 21
1.4 Structure of This Book 22
References 22

2 Development of Self-optimizing Systems 25
2.1 Domain-Spanning Conceptual Design 27
2.2 Domain-Specific Design and Development 31
References 36

3 Methods of Improving the Dependability of Self-optimizing Systems 37
3.1 Conceptual Design Phase 37
3.1.1 Early Probabilistic Reliability Analysis of an Advanced Mechatronic System Based on Its Principle Solution 38
3.1.2 Early Design of the Multi-Level Dependability Concept 47
3.2 Design and Development 54
3.2.1 Increasing the Dependability of Self-optimizing Systems during Operation Using the Multi-Level Dependability Concept 55

Bibliografische Informationen
http://d-nb.info/1044796235

digitalisiert durch DEUTSCHE NATIONAL BIBLIOTHEK

3.2.2 Iterative Learning of Stochastic Disturbance Profiles ... 62
3.2.3 Mutation Testing of Electronic Component Design 69
3.2.4 Optimal Control with Uncertainty 76
3.2.5 Behavior Planning 84
3.2.6 Computation of Robust Pareto Points 89
3.2.7 Behavior-Based Adaptation of Differing Model Parameters 95
3.2.8 Analysis of Self-healing Operations 102
3.2.9 Safe Planning 113
3.2.10 Verification for Interacting Mechatronic Systems with Motion Profiles 119
3.2.11 Dependability-Oriented Multiobjective Optimization ... 128
3.2.12 Self-healing in Operating Systems 133
3.2.13 Self-healing via Dynamic Reconfiguration 141
3.2.14 Online Model Checking 147
3.2.15 Virtualization 152
3.3 Methodology for the Selection of Dependability Methods for the Development of Self-optimizing Systems 158
References 162

4 Case Study 173
4.1 Selecting Suitable Methods Using the Methodology 174
4.2 Development of the Active Guidance Module 178
4.2.1 Early Probabilistic Reliability Analysis of an Advanced Mechatronic Systems Based on Its Principle Solution 178
4.2.2 Early Design of the Multi-Level Dependability Concept 181
4.3 Development of the RailCab Vehicle 182
4.3.1 Verification with Motion Profiles for Interacting Mechatronic Systems 182
4.3.2 Analysis of Self-healing Operations 183
4.3.3 Safe Planning 184
4.3.4 Behavior Planning 185
4.3.5 Behavior-Based Adaptation of Differing Model Parameters 186
4.3.6 Virtualization 187
References 188

5 Conclusion and Outlook 189
Reference 190

Index 191