Contents

1 Introduction 1
1.1 Research Objectives 1
1.2 Book Contributions 3
1.3 Book Structure 4

2 Fault Detection and Isolation (FDI) 5
2.1 Model-Based FDI 8
2.1.1 Parity Space 9
2.1.2 Observer-Based 10
2.1.3 Fault Detection Filter 12
2.1.4 Parameter Estimation 13
2.1.5 Neural Networks 13
2.2 Performance Criteria 14
2.3 Examples and Trends 15
Conclusions 17

3 Introduction to FADS Systems 19
3.1 Air Data Boom 20
3.2 Background and History 23
3.3 FADS System Model 24
Conclusions 26

4 Neural Networks 29
4.1 NN Structure and Training 30
4.1.1 RBF NN 30
4.1.2 EMRAN RBF NN 31
4.1.3 NN Training Algorithm 33
4.2 Application to the SFDIA Scheme and FADS System 34
Conclusions 35

5 SFDA-Single Sensor Faults 37
5.1 General SFDA Outline and Terminologies 38
5.2 UAV Used in the SFDA Schemes 39
5.3 UAV Model 40
5.3.1 Longitudinal Equations of Motion 41
5.3.2 Longitudinal Trim 42
5.3.3 The Unknown Inputs 43
5.4 Extended Kalman Filter (EKF) 44

Bibliografische Informationen
http://d-nb.info/1014250358

digitalisiert durch DEUTSCHE NATIONAL BIBLIOTHEK

5.5 Residual Structures 47
5.5.1 Residual Generation and Evaluation (RGE) 47
5.5.2 Residual Generation, Padding and Evaluation (RGPE) 47
5.6 NN and EKF Input/Output Structure 50
5.7 Sensor Fault Types 52
5.8 SFDA Application to UAV Model 53
5.8.1 NN Training 53
5.8.2 SFDA Test Outline 54
5.8.3 SFDA Performance Indicators 57
Results 58
Discussion 61
Conclusions 80

6 SFDIA-Multiple Sensor Faults 83
6.1 General SFDIA Outline and Terminologies 84
6.2 NNs Input/Output Structure 86
6.3 Sensor Fault Types 86
6.4 SFDIA Application to UAV Model 87
6.4.1 NN Training 87
6.4.2 SFDIA Test Outline 88
6.4.3 SFDIA Performance Indicators 90
6.5 Results 90
Discussion 92
Conclusions 107

7 FADS System Applied to a MAV 109
7.1 The Mini Air Vehicle (MAV) 109
7.2 CFD Simulations (2D) 111
7.2.1 Background and Terminologies 111
7.2.2 Results 113
7.3 Location of the Matrix of Pressure Orifices (MPO) 118
7.4 CFD Simulations (3D) 120
7.5 Wind Tunnel and Instrumentation 125
7.6 Wind Tunnel Test Procedure 128
7.7 Wind Tunnel Data 128
7.8 FADS System Results 133
7.8.1 Static Tests 133
7.8.2 Fault Accommodation 135
7.8.3 CFD vs. Wind Tunnel 138
7.8.4 Dynamic Tests 139
7.8.5 FADS System via LUTs 143
Conclusions 156

8 Conclusions and Future Work 159

References 165