

Application of Neural Networks in High Assurance Systems: A Survey	p. 1
Introduction	p. 1
Application Domains	p. 3
Aircraft Control	p. 4
Automotive	p. 4
Power Systems	p. 5
Medical Systems	p. 6
Other Applications	p. 7
Toward V&V of NNs in High Assurance Systems	p. 8
V&V of Software Systems	p. 8
V&V Issues and Gaps for NN-Based Applications	p. 10
V&V Approaches for Neural Networks	p. 11
Conclusions	p. 15
References	p. 16
Robust Adaptive Control Revisited: Semi-global Boundedness and Margins	p. 21
Introduction	p. 21
Problem Statement	p. 22
Adaptive Controller	p. 24
Reference Model	p. 24
Adaptive Controller Design	p. 24
Stability Analysis	p. 25
Delay Margins	p. 25
(1,1) Pade Approximation ($\zeta = \zeta_1 (s)u$)	p. 26
(2,2) Pade Approximation ($\zeta = \zeta_2 (s)u$)	p. 30
Nonlinearity Margins	p. 31
Interpretation of Theorem 3	p. 34
Numerical Model: Hypersonic Vehicle	p. 34
Relation between $e(t_0)$, $\varepsilon(x_p)$, and N	p. 36
References	p. 38
Appendix	p. 39
Network Complexity Analysis of Multilayer Feedforward Artificial Neural Networks	p. 41
Introduction	p. 41
Pruning Algorithms	p. 44
Computer Simulation Results	p. 50
Summary	p. 53
References	p. 53
Design and Flight Test of an Intelligent Flight Control System	p. 57
Introduction	p. 57
IFCS Program	p. 58
IFCS Experiment	p. 59

Controller Architecture	p. 61
Requirements Validation	p. 63
System Stability	p. 64
Aeroservoelastic Margin	p. 64
Handling Qualities	p. 66
Nonlinear Systems Requirements Validation	p. 67
Flight Controls Software and System Verification	p. 70
Flight Test	p. 74
Conclusions	p. 75
References	p. 76
Stability, Convergence, and Verification and Validation Challenges of Neural Net Adaptive Flight Control	p. 77
Introduction	p. 77
Convergence and Stability of Neural Net Direct Adaptive Flight Control	p. 79
Direct Adaptive Control Approach	p. 80
Stability and Convergence	p. 82
Unmodeled Dynamics	p. 90
Potential Improvements	p. 93
Direct Adaptive Control with Recursive Least Squares	p. 93
Hybrid Direct-Indirect Adaptive Control with Recursive Least-Squares	p. 96
Verification and Validation Challenges for Adaptive Systems	p. 99
Simulation of Adaptive Control Systems	p. 99
Approach for Adaptive System V&V	p. 101
Future Research	p. 103
Adaptive Control	p. 103
Verification and Validation	p. 105
Conclusions	p. 107
References	p. 107
Dynamic Allocation in Neural Networks for Adaptive Controllers	p. 111
Introduction	p. 111
Paper Overview	p. 113
Dynamic Allocation in Neural Networks	p. 113
Dynamic Cell Structures	p. 114
Components of DCS Neural Network	p. 114
DCS Algorithm	p. 117
Robustness Analysis of Dynamic Allocation	p. 119
Node Insertion	p. 119
Analysis for UC1 (Undesirable Condition 1)	p. 120
Analysis for UC2 (Undesirable Condition 2)	p. 122
Data-Driven Dynamic Allocation Algorithm	p. 127
Case Study	p. 131

Conclusion	p. 138
References	p. 138
Immune Systems Inspired Approach to Anomaly Detection, Fault Localization and Diagnosis in Automotive Engines	p. 141
Introduction	p. 141
Research Issues in Immune Systems Engineering	p. 143
Anomaly Detection and Fault Localization	p. 146
Fault Diagnosis	p. 148
Automatic Control System Reconfiguration	p. 149
Anomaly Detection, Fault Isolation and Diagnosis in an Automotive Electronic Throttle System	p. 150
Anomaly Detection and Fault Isolation	p. 150
Fault Diagnosis	p. 152
Fever-Like Behavior in the Presence of an Unknown Fault	p. 153
Anomaly Detection and Fault Isolation in Automotive Crankshaft Dynamics	p. 156
Conclusions and Future Work	p. 160
References	p. 161
Pitch-Depth Control of Submarine Operating in Shallow Water via Neuro-adaptive Approach	p. 165
Introduction	p. 165
Dynamics	p. 166
Nonlinear Model	p. 167
Fault Dynamics	p. 168
Control Design	p. 169
Nonlinear Model	p. 169
Stability Analysis	p. 171
Simulation Results	p. 172
Conclusions	p. 177
References	p. 177
Stick-Slip Friction Compensation Using a General Purpose Neuro-adaptive Controller with Guaranteed Stability	p. 179
Introduction	p. 179
The Neural-Network-Based Control Strategy	p. 182
Indirect Adaptive Neuro-Controller	p. 182
Neural Network Scheme	p. 183
Control Oriented On-Line Identification Method	p. 183
Mathematical Description of the Control Scheme	p. 184
Training Multilayer Neural Network (MLP)	p. 186
Back-Propagation through the Model	p. 186
Stability Analysis	p. 187
Implementing the Proposed Adaptive-Neuro Control Method	p. 188
NN Identifier Block	p. 188

NN Controller Block	p. 191
Controller Error Sensitivity Feedback Block	p. 191
Simulation Studies	p. 192
Example 1: A Non-linear System with a Second-Order Difference Equation and Variable Reference Model	p. 192
Example 2: A Non-linear Plant Subjected to Uncertainty	p. 194
Stick-Slip Friction Compensation Using the Introduced Neuro-Control Algorithm	p. 195
Problem Statement	p. 195
Simulation Results	p. 196
Conclusions	p. 200
References	p. 201
Modeling of Crude Oil Blending via Discrete-Time Neural Networks	p. 205
Introduction	p. 205
Crude Oil Blending	p. 206
Modeling of Crude Oil Blending via Discrete-Time Neural Networks	p. 208
Application Study	p. 213
Conclusion	p. 218
References	p. 219
Adaptive Self-Tuning Wavelet Neural Network Controller for a Proton Exchange Membrane Fuel Cell	
Introduction	p. 222
PEMFC System Model	p. 223
Wavelet Neural Network and Identification Algorithm	p. 226
Wavelet Neural Network	p. 226
System Model Identification	p. 228
Proposed Controller Design	p. 230
Neural Network Controller Based on Wavelet	p. 230
PID Neural Network Controller Based on Wavelets	p. 230
Simulation Results	p. 232
Identification of PEMFC	p. 232
Control of PEMFC without Noise	p. 233
Control of PEMFC with Input Noise	p. 236
Control of PEMFC with Output Noise Problem	p. 240
Conclusions	p. 244
References	p. 244

Table of Contents provided by Blackwell's Book Services and R.R. Bowker. Used with permission.