Contents

Abbreviations XI

1 Introduction 1
1.1 Introduction of Networked Control Systems 1
1.2 Fundamental Issues with Networked Control Systems 3
1.3 Recent Works on Networked Control Systems 6
1.4 Research Motivation 11
1.5 Contribution of the Book 13
1.6 Book Outline 14

2 Modeling of Networked Control Systems 17
2.1 Formulation of Networked Control Systems 17
2.2 Modeling of Random Network-induced Delays 19

Part I: Linear Uncertain Networked Control Systems

3 State Feedback Control of Uncertain Networked Control Systems 25
3.1 Introduction 25
3.2 Problem Formulation and Preliminaries 26
3.3 Main Result 27
3.4 Numerical Example 32
3.5 Conclusion 33

4 Dynamic Output Feedback Control for Uncertain Networked Control Systems 37
4.1 System Description and Problem Formulation 37
4.2 Main Result 39
4.3 Numerical Example 49
4.4 Conclusion 50

5 Robust Disturbance Attenuation for Uncertain Networked Control Systems 53
5.1 Introduction 53
5.2 System Description and Problem Formulation 54
5.3 Main Result 57
5.4 Numerical Example 60
5.5 Conclusion 63

6 Robust Filter Design for Uncertain Networked Control Systems 65
6.1 Introduction 65
6.2 System Description and Problem Formulation 65
6.3 Main Result 68
6.4 Numerical Example 70
6.5 Conclusion 72

7 Robust Fault Estimator Design for Uncertain Networked Control Systems 73
7.1 Problem Formulation and Preliminaries 74
7.2 Main Result 76
7.3 Numerical Example 80
7.4 Conclusion 82

Part II: Nonlinear Uncertain Networked Control Systems

8 Takagi–Sugeno Fuzzy Control System 87
8.1 Takagi-Sugeno Fuzzy Modeling 88
8.2 Takagi-Sugeno Fuzzy Controller 90

9 State Feedback Control for Uncertain Nonlinear Networked Control Systems 93
9.1 Introduction 93
9.2 Problem Formulation and Preliminaries 93
9.3 Main Result 96
9.4 Numerical Example 102
9.5 Conclusion 104

10 Dynamic Output Feedback Control for Uncertain Nonlinear Networked Control Systems 107
10.1 Problem Formulation and Preliminaries 107
10.2 Main Result 110
10.3 Numerical Example 113
10.4 Conclusion 115

11 Robust Disturbance Attenuation for Uncertain Nonlinear Networked Control Systems ... 117
11.1 Problem Formulation and Preliminaries ... 117
11.2 Main Result ... 120
11.3 Numerical Example ... 123
11.4 Conclusion ... 126

12 Robust Fuzzy Filter Design for Uncertain Nonlinear Networked Control Systems ... 129
12.1 Problem Formulation and Preliminaries ... 129
12.2 Main Result ... 132
12.3 Example ... 135
12.4 Conclusion ... 136

13 Fault Estimation for Uncertain Nonlinear Networked Control Systems ... 137
13.1 Problem Formulation and Preliminaries ... 137
13.2 Main Result ... 140
13.3 Numerical Example ... 142
13.4 Conclusion ... 144

14 Conclusions ... 145
14.1 Summary of the Book ... 145
14.2 Future Research Work ... 146

A Mathematical and Background Knowledge ... 147
A.1 Linear Matrix Inequality ... 147
A.1.1 LMI Problems ... 148
A.1.2 The Schur Complement ... 148
A.2 Continuous-time Markov Process ... 149
A.3 Lemmas ... 150

References ... 151

Index ... 159