

Table of Contents

Notations	ix
Introduction	xiii
Chapter 1. Multiple Model Representation	1
1.1. Introduction	1
1.2. Techniques for obtaining multiple models	2
1.2.1. Construction of multiple models by identification	3
1.2.2. Multiple model construction by linearization	8
1.2.3. Multiple model construction by mathematical transformation	14
1.2.4. Multiple model representation using the neural approach	22
1.3. Analysis and synthesis tools	29
1.3.1. Lyapunov approach	29
1.3.2. Numeric tools: linear matrix inequalities	31
1.3.3. Multiple model control techniques	38
Chapter 2. Stability of Continuous Multiple Models	41
2.1. Introduction	41
2.2. Stability analysis	42
2.2.1. Exponential stability	48
2.3. Relaxed stability	49
2.4. Example	52
2.5. Robust stability	54
2.5.1. Norm-bounded uncertainties	56
2.5.2. Structured parametric uncertainties	57

2.5.3. Analysis of nominal stability	60
2.5.4. Analysis of robust stability	62
2.6. Conclusion	63
Chapter 3. Multiple Model State Estimation	65
3.1. Introduction	65
3.2. Synthesis of multiple observers	67
3.2.1. Linearization	68
3.2.2. Pole placement	70
3.2.3. Application: asynchronous machine	72
3.2.4. Synthesis of multiple observers	75
3.3. Multiple observer for an uncertain multiple model.	77
3.4. Synthesis of unknown input observers.	82
3.4.1. Unknown inputs affecting system state	83
3.4.2. Unknown inputs affecting system state and output.	87
3.4.3. Estimation of unknown inputs	88
3.5. Synthesis of unknown input observers: another approach . .	93
3.5.1. Principle	93
3.5.2. Multiple observers subject to unknown inputs and uncertainties	96
3.6. Conclusion	97
Chapter 4. Stabilization of Multiple Models	99
4.1. Introduction	99
4.2. Full state feedback control.	99
4.2.1. Linearization	101
4.2.2. Specific case.	103
4.2.3. α -stability: decay rate	106
4.3. Observer-based controller	113
4.3.1. Unmeasurable decision variables.	115
4.4. Static output feedback control	119
4.4.1. Pole placement	122
4.5. Conclusion	126
Chapter 5. Robust Stabilization of Multiple Models	127
5.1. Introduction	127
5.2. State feedback control.	129
5.2.1. Norm-bounded uncertainties.	129
5.2.2. Interval uncertainties	131
5.3. Output feedback control	137
5.3.1. Norm-bounded uncertainties.	137

5.3.2. Interval uncertainties	147
5.4. Observer-based control	150
5.5. Conclusion	156
Conclusion	157
APPENDICES	159
Appendix 1: LMI Regions	161
A1.1. Definition of an LMI region	161
A1.2. Interesting LMI region examples	162
A1.2.1. Open left half-plane.	163
A1.2.2. α -stability.	163
A1.2.3. Vertical band	163
A1.2.4. Horizontal band	164
A1.2.5. Disk of radius R, centered at $(q,0)$	164
A1.2.6. Conical sector.	165
Appendix 2: Properties of M-Matrices	167
Appendix 3: Stability and Comparison Systems	169
A3.1. Vector norms and overvaluing systems	169
A3.1.1. Definition of a vector norm	169
A3.1.2. Definition of a system overvalued from a continuous process.	170
A3.1.3. Application	172
A3.2. Vector norms and the principle of comparison.	173
A3.3. Application to stability analysis	174
Bibliography	175
Index	185