

Contents

Abstract	iii
1 Introduction	1
1.1 Motivation and background	1
1.2 Objectives	6
1.3 Structure of the thesis	7
I State of the Art	9
2 Lyapunov stability and linear matrix inequalities	11
2.1 Lyapunov stability	11
2.2 Linear matrix inequalities	17
3 Takagi-Sugeno models	25
3.1 Takagi-Sugeno modelling	25
3.2 Quadratic Lyapunov function	29
3.3 Parameter-dependent Lyapunov functions	39
3.4 Line-integral Lyapunov functions	43
3.5 Piecewise Lyapunov function	44
4 Convex-polynomial models	51
4.1 Introduction	51
4.2 Sum-of-square decomposition	53
4.3 Convex-polynomial modelling	57
4.4 Stability analysis via SOS	64
4.5 Stabilisation via SOS	67
4.6 Polynomial parameter-dependent Lyapunov function	71

II Contributions	75
5 Piecewise Lyapunov function	77
5.1 Introduction	77
5.2 Preliminaries	80
5.3 Main Results	88
5.4 Asymptotical exactness	107
5.5 Conclusion	112
6 Parameter-dependent Lyapunov function	113
6.1 Introduction	114
6.2 Preliminaries	115
6.3 Main Results	120
6.4 Examples	131
6.5 Conclusion	135
7 Polynomial-Integral Lyapunov Function	137
7.1 Introduction	138
7.2 Preliminaries and problem statement	140
7.3 Main Result	147
7.4 Examples	152
7.5 Discussion	156
7.6 Conclusion	157
8 Conclusions	159
Publications authored or co-authored	163
Bibliography	167