

Table of Contents

Abstract	xi
Deutsche Kurzfassung	xiii
1 Introduction	1
1.1 Motivation	1
1.2 Related work	4
1.3 Contributions and outline	10
2 Background	15
2.1 Nonlinear dynamical systems	15
2.2 Dissipativity	16
2.3 Integral quadratic constraints	21
2.4 Nonlinearity measures	23
2.5 Sum-of-squares relaxation	27
2.6 Summary	29
3 Data-based system analysis of polynomial systems	31
3.1 Problem setting	32
3.2 Set-membership system characterization	34
3.3 Dissipativity verification	50
3.4 Determining optimal IQCs and NLMs	63
3.5 Summary	78
4 Data-driven control of nonlinear systems by polynomial approximation	81
4.1 Problem setting	82
4.2 A polynomial system representation for nonlinear systems	84
4.3 Dissipativity verification	101
4.4 Verification of incremental dissipativity	114
4.5 State-feedback synthesis	121
4.6 Summary	135

5 Conclusions	139
5.1 Summary	139
5.2 Discussion	141
5.3 Outlook	144
A Appendix	147
A.1 Equivalence of soft and hard IQCs for NLMs	147
A.2 Proof of Lemma 3.2	148
A.3 Proof of Theorem 3.3	151
A.4 Global asymptotic stability of polynomial discrete-time systems	153
A.5 Proof of Theorem 3.8	154
A.6 Proof of Proposition 4.2	156
A.7 Proof of Corollary 4.1	157
A.8 Proof of Theorem 4.4	158
Bibliography	161