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AN IMPROVED METHOD FOR ESTIMATING THE DOMAIN OF ATTRACTION OF UNCERTAIN RATIONAL NONLINEAR SYSTEMS BY USING LMI STABILITY CONDITIONS

Péter Polcz¹, Gábor Szederkényi^{1,2}, and Tamás Péni²

¹Faculty of Information Technology and Bionics, Pázmány Péter Catholic
University, Práter u. 50/a, H-1083 Budapest, Hungary

²Systems and Control Laboratory, Institute for Computer Science and
Control (MTA SZTAKI), Hungarian Academy of Sciences, Kende u. 13-17,
H-1111 Budapest, Hungary

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Abstract

An optimization based method is proposed in this report for the computation of Lyapunov functions and regions of attractions for uncertain nonlinear systems containing polynomial and rational terms. The Lyapunov function is given in a special quadratic form, and the negativity of its derivative is ensured using appropriate LMI conditions. The starting point of the method is an approach taken from the literature, in which the conservatism of the solution is reduced by utilizing Finsler's lemma. The improvements and new contributions can be summarized as follows: 1) The model transformation to the required form for optimization is done automatically. At the same time, the number of monomials and rational terms in the computational problem is kept as low as possible using linear fractional transformation (LFT) and further automatic model simplification steps. This technique results in the dimension reduction of the problem compared to known solutions in the literature. 2) An algorithm was given for the generation of appropriate annihilators, which appear in Finsler's lemma. 3) An improved method was proposed for determining the possible largest invariant set for the dynamics using the computed Lyapunov function. 4) In comparison with the technique taken from the literature, a generalized and simplified formula was given. The operation of the method is illustrated on a few examples taken from the literature.