Domain of Attraction [Analysis and Control via SOS Programming /

Chesi, Graziano

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Monografía

The stability of equilibrium points plays a fundamental role in dynamical systems. For nonlinear dynamical systems, which represent the majority of real plants, an investigation of stability requires the characterization of the domain of attraction (DA) of an equilibrium point, i.e., the set of initial conditions from which the trajectory of the system converges to such a point. It is well-known that estimating the DA, or even more attempting to control it, are very difficult problems because of the complex relationship of this set with the model of the system. The book also offers a concise and simple description of the main features of SOS programming which can be used in research and teaching. In particular, it introduces various classes of SOS polynomials and their characterization via LMIs and addresses typical problems such as establishment of positivity or non-positivity of polynomials and matrix polynomials, determining the minimum of rational functions, and solving systems of polynomial equations, in cases of both unconstrained and constrained variables. The techniques presented in this book are available in the MATLAB® toolbox SMRSOFT, which can be downloaded from http://www.eee. hku.hk/~chesi. Domain of Attraction addresses the estimation and control of the DA of equilibrium points using the novel SOS programming scheme, i.e., optimization techniques that have been recently developed based on polynomials that are sums of squares of polynomials (SOS polynomials) and that amount to solving convex optimization problems with linear matrix inequality (LMI) constraints, also known as semidefinite programs (SDPs). For the first time in the literature, a means of dealing with these issues is presented in a unified framework for various cases depending on the nature of the nonlinear systems considered, including the cases of polynomial systems, uncertain polynomial systems, and nonlinear (possibly uncertain) non-polynomial systems. The methods proposed in this book are illustrated in a variety of real systems and simulated systems with randomly chosen structures and/or coefficients which includes chemical reactors, electric circuits, mechanical devices, and social models. The book also offers a concise and simple description of the main features of SOS programming which can be used in research and teaching. In particular, it introduces various classes of SOS polynomials and their characterization via LMIs and addresses typical problems such as establishment of positivity or non-positivity of polynomials and matrix polynomials, determining the minimum of rational functions, and solving systems of polynomial equations, in cases of both unconstrained and constrained variables. The techniques presented in this book are available in the MATLAB® toolbox SMRSOFT, which can be downloaded from http://www.eee.hku.hk/~chesi

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