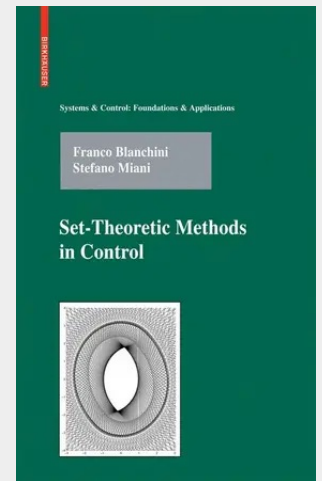


Set-Theoretic Methods in Control

This self-contained monograph describes basic set-theoretic methods and provides a discussion of their links to fundamental problems in control. The work presents several established and potentially new applications, along with numerical examples and case studies. Mathematical language is kept to a minimum necessary for the adequate formulation and statement of main concepts. Numerical algorithms in MATLAB and C++ are available online.

Set-Theoretic Methods in Control is accessible to readers familiar with the basics of systems and control theory. The text provides a solid foundation of mathematical techniques and applications and also features avenues for further theoretical study. Aimed primarily at graduate students and researchers in applied mathematics and engineering, the book will also appeal to practitioners since it contains extensive references to the literature and supplies many recipes for solving significant control problems.

Many control problems can be naturally formulated, analyzed, and solved in a set-theoretic context. Sets appear naturally when three aspects, which are crucial in control systems design, are considered: constraints, uncertainties, and designs specifications. Furthermore, sets are the most appropriate language to specify several system performances, for instance when we are interested in determining the domain of attraction, in measuring the effect of a persistent noise in a feedback loop or in bounding the error of an estimation algorithm. From a conceptual point of view, the peculiarity of the material presented in this book lies in the fact that sets are not only terms of the formulation, but they play an active role in the solution of the problems as well. Generally speaking, in the control theory context, all the techniques which are theoretically based on some properties of subsets of the state-space could be referred to as set-theoretic methods. The most popular and clear link is that with Lyapunov theory and positive invariance. Lyapunov functions are positive definite energy-type functions of the state variables, which have the property of being decreasing in time and are fundamental tools to guarantee stability. Besides, their sublevel sets are positively invariant and thus their shape is quite meaningful to characterize the system dynamics, a key point which will be enlightened in the present book. The invariance property will be shown to be fundamental in dealing with problems such as saturating control, noise suppression, model-predictive control, and many others.



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