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Book Review

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Dynamics and Control

G. Leitmann, F. E. Udwadia, and A. V. Kryazhimskii (eds.), Gordon and Breach, 1999, 220 pp., $90.00, ISBN 90-5699-172-8

This book is the ninth volume of the series "Stability and Control: Theory, Methods, and Applications." The series publishes books and monographs on dynamical systems theory and control and is edited by A. A. Martynyuk from the Institute of Mechanics, Kiev, Ukraine and V. Lakshmikantham, Florida Institute of Technology. The purpose of the series is to promote further cross-fertilization between the two sister disciplines, namely dynamics and control. Indeed these two disciplines share the same roots and advances in either of these have an immediate impact on the other. The series also emphasizes reporting results from eastern European countries, a commendable but, unfortunately, rather rare practice.

The particular volume *Dynamics and Control*, contains a collection of nineteen articles presented at the Eighth Workshop on Dynamics and Control which was held in Sopron, Hungary 16–20 July 1995. The papers included in the book are divided into three major parts.

The first part, Control Methodology, consists of eight papers dealing with the development of control methods. The main theme of all these papers is the use of Lyapunov-based analysis and control design techniques. At least a couple of these papers emphasize the so-called min-max controllers developed by G. Leitmann and his students during the late 1980s. Such (by now well-established) controllers achieve disturbance rejection for highly uncertain systems. The major novelty of this approach has been the deterministic rather than stochastic point of view for the uncertainty. The disturbance rejection problem is formulated as a two-person, zero-sum differential game with nature commanding the uncertainty/disturbance strategies. Such a (rather pessimistic) formulation of the disturbance rejection problem leads naturally to "worst case" designs that have been popularized in the now ubiquitous $\mathcal{H}_\infty$ control theory. The connection of min-max controllers with the differential game framework is a recurring theme in the book and several papers pay tribute to the original problem formulation by G. Leitmann. An exception are the last two papers, the first by R. R. Mohler and A. Y. Khapalov ("On Global Controllability of Time-Invariant Nonhomogeneous Bilinear Systems") and the second by B. Mordukhovich and K. Zhang ("Robust Suboptimal Control of Constrained Parabolic Systems Under Uncertainty Conditions").

The second part of the book, Dynamical Systems, includes six papers. The title of this part is rather misleading because it gives the impression that the focus will be solely on purely dynamical systems issues. In fact, most of the papers in this part also deal with control (mainly analysis) problems. There is only one paper on population growth models ("Qualitative Analysis with Respect to Two Measures for Population Growth Models of Kolmogorov Type") by A. A. Martynyuk that could qualify as a problem in "standard" dynamical systems theory. Nonetheless, all papers in this part are worth reading and both dynamicists and control theorists will find something to their liking.

The third part of the book is perhaps the most enjoyable one, with interesting case studies on law enforcement and crime prevention strategies, environmental and behavioral issues, and even sociopolitical ("Electing the Directorial Council" by L. A. Petrosjan). Of particular current interest are the two chapters on "Optimal Control of Law Enforcement" by G. Feichtinger (chapter 15) and "The Climate Change Problem and Dynamical Systems: Virtual Biospheres Concept" by Y. M. Svirezhev and W. von Bloh (chapter 16). Three additional self-contained articles provide nonstandard application-oriented examples of dynamics and controls. If nothing else, the papers in this part of the book give a refreshing new look at applications and provide a convincing answer to the question, "What is dynamical systems theory and control good for?" If nothing else, just for this last part, this book could be a valuable addition to one's library.

In summary, this book offers a very good idea about the state of the art in the diverse area of dynamics and control. Most readers will find several papers of interest and at least one paper introducing a nice technique for analysis or control design that they were not aware of. On the downside, since this book is a collection of contributions by many authors, there is no introduction or notation/terminology chapter that could serve as a guidemap to the reader, although the editors have done a good job summarizing each paper at the preface. Familiarity with several nontrivial mathematical concepts is therefore assumed from the outset (Borel measurable function, viability kernels and functions, etc.) and the unprepared reader will quickly find themself looking at the provided references for help. Nonetheless, a reader with a good grasp of Lyapunov stability theory and/or differential games could easily delve into the relevant chapters and appreciate the results stated therein. In any case, this book is not intended for the novice.

This book is part of a series of monographs that intends to increase the awareness in the west of the current research taking place in eastern Europe, in particular, at the Russian school. Taking into consideration the great tradition and past contributions of this school (Lyapunov, Pontryagin, Tsypkin, Yakubovic, Arnold, and Kolmogorov, just to name a few) it is not surprising that western researchers should be interested in recent advances coming from eastern-European countries. What is surprising, however, is that there is not a larger number of published monographs introducing to the west the exciting work done by our colleagues at the "eastern front." More such publications would be indeed very welcome.

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