system structure and desired performance as well. A simulation study of near-optimal compressor operation by means of slope seeking is also conducted, indicating that slope seeking can recover system performance in the presence of disturbances.

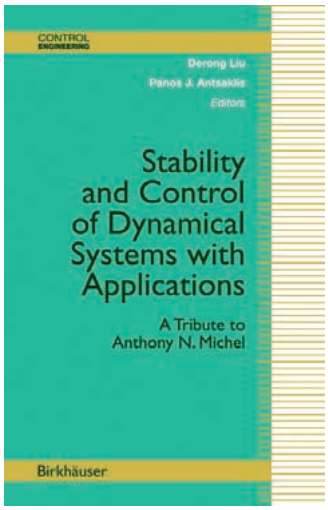
These applications are clearly presented and technically convincing. Most of the applications are sophisticated in both system modeling and control design. Their success proves that extremum seeking is a powerful technique for significant engineering applications. These examples are also representative of additional systems for which extremum seeking may be effective, such as power system and magnetic bearing system applications.

In summary, *Real-Time Optimization by Extremum-Seeking Control* is a well-written and authoritative book on this technically important subject. It has unique demonstrations of important stability concepts such as bifurcation, as well as analysis tools such as singular perturbations and averaging. The book is an excellent technical reference or an advanced textbook for graduate students, researchers, and engineers. For those who are interested in dynamic systems and control, I strongly recommend this book as an essential resource for learning about extremum-seeking control and for motivating further developments in this subject area.

Stability and Control of Dynamical Systems with Applications: A Tribute to Anthony N. Michel, by D. Liu and P.J. Antsaklis, Birkhäuser, 2003, 430 pp, US$89.95, ISBN 0817632336. *Reviewed by Huaguang Zhang.*

This book is an extensive compilation of papers presented at a workshop held at the University of Notre Dame on 5 April 2003. It presents recent important research results on stability and control of dynamical systems by 41 researchers.

The book is organized into three



major parts incorporating 21 chapters. The first part of the book contains seven chapters on stability analysis of dynamical systems. Chapter 1 expands wave digital concepts and relativity theory through some modifications to Newton's laws. Chapter 2 studies the notion of time and establishes a consistent Lyapunov methodology for nonlinear systems. Moreover, the extended concept of the vector Lyapunov function is introduced. Chapter 3 develops a mathematical model for a multibody attitude system that exposes the dynamic coupling between the rotational degrees of freedom of the base body and the deformation or shape degrees of freedom of the elastic subsystems. Furthermore, results that guarantee asymptotic stability of this multibody attitude system are obtained. Chapter 4 discusses robust control of uncertain hybrid systems affected by both parameter variations and exterior disturbances, and it provides a method for checking attainability. Chapter 5 overviews stability properties of swarms, and it analyzes swarm cohesion under very noisy measurements using Lyapunov stability theory. Chapter 6 presents a necessary and sufficient asymptotic stability condition for discrete-time, time-varying, uncertain delay systems, and it applies the result to control problems of a communication network. Chapter 7 investigates stability and L2 gain properties for switched symmetric systems. The key idea is to establish a common Lyapunov function for all of the subsystems in the switched systems.

Comprising six chapters, the second part of the book is concerned with neural networks and signal processing. Chapter 8 investigates the approximation capabilities of Gaussian radial basis functions and the concept of locally compact metric spaces. Chapter 9 provides a generalized state-space formulation and learning algorithms for blind source recovery based on the theory of multivariable optimization. Chapter 10 discusses the theme of approximate dynamic programming. Furthermore, it presents a method of direct neural-dynamic programming and its application to helicopter command tracking. Chapter 11 studies online approximator-based aircraft state estimation. Chapter12 proposes and analyzes a novel dynamic multiobjective evolutionary algorithm. Chapter 13 introduces set membership adaptive filtering and its novel feature of data-dependent selective update of parameter estimates.

The final part of the book covers power systems and control systems (Chapters 14–21). Chapter 14 is concerned with trajectory sensitivity theory and its practical application to power systems. Chapter 15 investigates the design of a corrective control strategy after substantial disturbances in large-scale electric power systems. An analytical approach in which the system is separated into smaller islands at a slightly reduced capacity is developed. Chapter 16 expands control methods for maintaining the stability of the electric power generation transmission distribution grid. This chapter also presents a roadmap for the development of new controls for power system stability.

Chapter 17 introduces data fusion

modeling for groundwater system identification based on Kalman filtering methods and a Markov random field representation for spatial variations. Chapter 18 provides an introduction to the nominal design problem along with results for feedback synthesis in an algebraic framework. Chapter 19 introduces the adaptive dynamic programming algorithm and gives a detailed proof. Chapter 20 analyzes the reliability of supervisory control and data acquisition systems used in offshore oil and gas platforms. Chapter 21 develops call admission control algorithms, based on signal-to-interference ratio, for power-controlled CDMA cellular networks. In particular, call admission control algorithms are developed based on the necessary and sufficient conditions under which the power control algorithm will have a feasible solution.

One welcome feature of the book is that each chapter includes an abstract, a detailed introduction, and a concise conclusion, thereby significantly assisting the readers' comprehension. Each chapter is a helpful guide for anyone engaged in the analysis and control of dynamical systems, offering ample opportunity for further exploration of the approaches covered. Rigid mathematical descriptions and logical derivations are another feature. The main ideas presented are original, and the results stated are advanced and appropriate. The reviewer believes that the book is an excellent reference source for researchers and practitioners in the areas of dynamical systems research and applications. The book is well written and well organized, and it is clear that the authors have made important research contributions in this field.

Conference Report

(continued from p. 95)

the United States, starting from a regional system to a global system, which evolved according to a specific set of established rules of noninterference, which in turn evolved with time.

Oscar Crisalle questioned the name "robust control," and he concluded that this word could be misleading. For example, a robust controller may become fragile if not properly implemented in a finite word-length processor. Tempo agreed that the name robust control could be too narrow, and the use of the terminology uncertain systems would be more appropriate for its broadness. This notion may also reflect the development of methods or algorithms, which are not robust in the classical sense. Khargonekar added that the name "electrical engineering" is a good example of a field that is dynamic and inclusive since it started with power systems and evolved into electronics and now incorporates wireless communication and nanotechnology. Hence, he concluded that control should remain inclusive to embrace very diverse areas.

Başar said that we should periodically introduce new terminology not only to identify specific research groups or subgroups but also for selling our developments to the outside world. The terminology "robust control" was used after the H_∞ developments, and this name later became important for economists who named a field "robust economics." This adoption shows the significance of using the right terminology to market control to researchers working in other areas. Kokotovic mentioned that, after actively working in the control field for about 45 years, he has never before seen so much demand for control expertise required in different disciplines. Although control is extremely popular in many areas, the real question is whether the traditional control community will be able to respond to this demand or whether the demand will be met by specialists in other areas who develop, or redevelop, methods to suit their needs.

Başar finally drew a brief conclusion on the discussions made during the panel, noting that the field is alive and well, and there are lots of opportunities for those who are willing to take the challenge to extend the boundaries of robust control.

—Sergio Bittanti
—Patrizio Colaneri