Chapter 1 describes the part of the central nervous system that controls movement. In the first part, the authors discuss the morphology and physiology of the smallest basic unit, the neuron; in the second part, they describe the spectrum of functional motions that humans can master during their lifetime. Xerograms help the reader follow the discussion.

In Chapter 2, the authors address the modeling of the main components involved in postural and movement control. The main component in movement is the central pattern generator—a neuronal network capable of controlling and activating individual muscles and the movements involved in walking, feeding, respiration, and so on. Furthermore, these movements can be characterized by certain kinematic features such as hand paths and velocity profiles. The authors go on to show the application of optimization theory to human reaching movements; the concepts of minimum energy, minimum torque, and minimum acceleration cost functions are discussed.

Chapter 3 describes the pathology of sensory-motor systems and the assessment of disability, considering a number of injuries and diseases that can be treated with neurorehabilitation and neuroprostheses. State-of-the-art systems for data acquisition and analysis of movement are also discussed; examples include interrupted light photography, infrared camera systems, and 3-D noncontact motion measurement systems that track small infrared markers on the patient. The trend is toward less or noninvasive techniques, such as goniometers using wireless communication to allow free movement.

Chapter 4 deals with restoring movement by neuroregeneration or neurorehabilitation. State-of-the-art technologies for the latter include robotic “smart exercise partners” that can be used to move or guide the impaired arm. Neuroprosthesis is based on functional electrical stimulation principles. This technique consists of a number of cutaneous and subcutaneous methods used to activate motor nerve fibers, including electronic implantable stimulators. The chapter culminates with a description of various passive and electrically powered prostheses.

Chapter 5 covers external control of movement, starting with an overview of the components of closed-loop control systems for movement. The state variables in these systems are the trajectories, the plant is the musculoskeletal system, and the disturbances are spasms and fatiguing of muscles. For those interested in intelligent control and nonparametric modeling of dynamic systems, the last part of this chapter describes the latest developments in hybrid control systems. Examples include rule-based control systems, inductive learning, artificial neural networks, fuzzy-logic networks, and wavelet networks. The authors describe how these techniques are being used to control neuroprostheses for grasping, reaching, and the movement of extremities.

Finally, in Chapter 6 the authors provide their insights on the future of neuroregeneration, neurorehabilitation, and neural engineering. Intelligent control and micromachining technology will make it possible for implantable devices to interface directly with the central and peripheral nervous systems!

This text is a good reference for those interested in the nervous system and control of movement, particularly the second part, which deals with tracking of movement and control. The volume incorporates more than 30 pages of references and is enriched with many illustrations.


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This unique text combines undergraduate-level control system theory with industrial control system practice. An engineer who begins working in the “real world” after graduation encounters many technical issues and
problems that the university did not address. This transition from theory to practice is often unexpected and difficult. The successful engineer will overcome and master these issues via brain power, trial and error, and the advice of more experienced mentors. Less successful engineers will flounder in this “school of hard knocks,” finding it even more difficult than the university. This book assists with the transition from control system theory to practice.

A glance through the table of contents would give the impression that the book covers much of the same material as other undergraduate controls texts, but this is not the case. A closer look reveals the book’s practical emphasis: entire chapters on the topics of tuning, filters in control systems, and delay in digital controllers (not only sample-and-hold delay, but also calculation delay). The book is light on theory and heavy on practice, assuming that the student already has industrial experience or has already gained the requisite theoretical background in a traditional controls course. It offers a seven-step method for developing a system model that can be used for analysis and design. The latter third of the book is dedicated to motion control, with chapters on encoders, motors, drives, and the use of all these elements in position/velocity loops for motion control. The appendices cover several useful topics, such as analog implementation of controller components, a review of basic matrix algebra, and Runge-Kutta-based integration of differential equations (including implementations in both Basic and C).

Although the author does not provide end-of-chapter problems, he does present numerous practical examples, all based on his free ModelQ software, a PC-based control system simulator. The emphasis on computer-aided analysis and design is reflected in the book’s subtitle: “Using your computer to understand and diagnose feedback controllers.” A Web page devoted to the book and the software is available at www.qxdesign.com. The book bridges the gap between control system theory and application by emphasizing practical approaches and issues (such as troubleshooting, tuning, and design trade-off issues) throughout the text. Industrial engineers find themselves faced with many control system design options and choices, as well as with having to troubleshoot existing control systems. This book addresses both issues and is peppered with discussions, examples, and simulations that explore the advantages, disadvantages, and trade-offs associated with various control system designs. The author provides insights during these discussions that reveal a broad-based experience in the controls industry.

In a university curriculum, this text could be best used for a secondary undergraduate controls course that emphasizes the practical implementation of the primary controls course. In any case, the book is a unique and valuable contribution to present control system literature. Practicing control engineers and technicians will find it an indispensable reference.

This monograph proposes that a new approach to feedback control is needed and attempts to develop the relevant theory. Part I of the book is essentially an overview of the existing control literature, conveniently presented to highlight certain drawbacks of conventional techniques. In the second part, the authors develop their new theory.

The main theme of the book is the stabilization problem. In the preface, the authors suggest their preference for an evolutionary approach to the development of control theory. In a manner reminiscent of the recent debate on fuzzy control, they propose that the general mechanisms of generating control action are more important than the knowledge of specific synthesis methods.

Part I of the book consists of two chapters. Chapter 1 is devoted entirely to linear systems design, whereas Chapter 2 describes the synthesis of nonlinear controllers, namely, sliding-mode and variable-structure systems. Both presentations are at an advanced undergraduate level. These two chapters focus on robustness issues (naturally, given the theme of the book) and summarize the limitations and drawbacks of high-gain theory (for linear systems) and VSS theory (for nonlinear systems).
The problems raised in Part I are tackled in Part II, which includes eight chapters. The general problem is simply stated: given a context where uncertainty in the plant is too great, performance specifications are too stringent, and so on, new approaches must be sought to the synthesis of feedback. Naturally, readers may ask: "If a new approach is to be sought, why feedback again? Why not some alternative?" But the authors go on to justify that feedback remains indispensable. Their basic premise (called the "generation principle") is to synthesize an algorithm that generates the feedback operation, not just the operator itself. This premise raises several important questions, and the monograph is an attempt to answer them.

Chapter 3 provides the basic concepts. According to the notation introduced here, we may refer to conventional feedback as "coordinate" feedback. The new types of feedback introduced are: 1) coordinate-operator feedback, 2) operator-coordinate feedback, and 3) operator feedback. Oscillator circuits serve to exemplify these approaches. Chapters 4 through 10 are then devoted to a study of the stabilization problem in light of the proposed feedback objects. The discussion automatically turns to nonlinear systems.

On the whole, the monograph is interesting reading and a good introduction to recent Russian work in this field. The book would have benefited, however, from better proofreading and closer attention to producing figures in standard international form; furthermore, a theorem-proof style might have been more fitting to the subject matter. Nevertheless, the book is an excellent text at the advanced undergraduate/graduate level.

Books for Review

The following books are available for review. Anyone interested should contact the Associate Editor for Book Reviews.


Calendar

(Continued from page 102)

△ 7th International Workshop on Variable Structure Systems 17-19 July, Sarajevo, Bosnia and Herzegovina General Chair: Asif Sabanovic, asif@sabanciuniv.edu

International Symposium on Active Control of Sound and Vibration (ACTIVE 2002) 15-17 July, Southampton University, U.K. General Chair: Professor Stephen J. Elliott, Institute of Sound and Vibration Research, Southampton University, University Road, Highfield, Southampton SO17 1BJ, U.K., fax: +44 23 8059 3190, sje@isvr.soton.ac.uk http://www.isvr.ac.uk/ACTIVE2002

September

△ IEEE Conference on Control Applications (CCA) and

December

△ IEEE Conference on Decision and Control 10-13 December 2002, Las Vegas, Nevada, U.S.A. General Chair: Ümit Özgüner, Ohio State University, 2015 Neil Ave., Columbus, OH 43210, U.S.A., +1 614 292 5940, fax: +1 614 292 7695, ozguner.1@osu.edu http://www.eecs.tulane.edu/cdc02/

June 2003

△ 2003 American Control Conference 4-6 June, Denver, Colorado, U.S.A. Gen. Chair: B. Wayne Bequette, Department of Chemical Engineering, Rensselaer Polytechnic Institute, Troy, NY 12180-3590, U.S.A., bequette@rpi.edu

△ 11th Mediterranean Conference on Control and Automation (MED2003) 18-20 June, Rhodes, Greece General Chair: Frank L. Lewis, Automation and Robotics Research Institute, University of Texas, 7300 Jack Newell Blvd. S., Ft. Worth, TX 76118-7115, U.S.A., fax: +1 817 272 5889, flewis@controls.uta.edu