variety of industries, as well as workers in fluid mechanics, turbulence, including direct simulations of turbulent flows, rheology, both polymer and suspension, polymer processing, colloid science, reaction engineering, transport and polymer reactors.

Reviewing edited books is treacherous since there is always some unavoidable convergence toward the mean. Attention has to be paid to the whole but, generic comments, loosely interpreted in an average sense, might punish good chapters while at the same time appearing to needlessly encourage. However, in reading the book I could not avoid thinking which one of the chapters could possibly have been published as reviews in this journal. When viewed in this light the picture is not encouraging. Neither is the global picture, I am afraid.

The book consists of 17 chapters (one less than in the first edition) ranging in length from a well-used 17 pages (mixing in single-phase chemical reactors) to a rather long 43 pages (mechanical aspects of mixing); the average chapter is about 24 pages. The cast of authors is slightly different than in the first edition, with nine authors being common to both. The first edition had a total of 11 different authors, the new one two more. Of the 13, six are academics and the rest from industry. When counted by chapter there are 12 academic authors and 11 industrialists. This makes for balance, if only in a numerical sense. The only U.S.-based author is now deceased. The rest, with the exception of a lone chapter from Switzerland, are from the U.K. By whatever definition I could imagine, except the tautological one of who is doing really applied mixing work in the U.K., I could hardly call it representative of academic U.K.-based work.

The preface of this edition states: "We think and hope that this *highly-revised second edition* satisfies the demand by industry and academia." This might be a bit of both an overstatement and wishful thinking. The words in italics are the only change in the preface of this second edition and the overall updating is very light. Only 13% of the references are 1985-on, and four chapters have none. Let us further state that the whole thing does not begin on a foundation of greatness. Even in this second edition the whole thing looks a bit rushed and nonuniform; some chapters have end of chapter notations, others not. Not a few chapters look a bit myopic as well. I could not avoid thinking that the contents could have been improved, had some of the authors examined literature in the immediate vicinity of their interests. Obvious references, even in the interest of providing a global picture, are missing; I could not find any reference to Tatterson's work in Chapter 8 (Mixing of Liquids in Stirred Tanks); the references to rheological work in p. 23 are a strange lot. Some chapters look decidedly old-fashioned: Chapter 11 (Laminar Flow and Distributive Mixing) could have been in the early 70s without being revolutionary, and Chapter 14 (Dynamics of Emulsification), while by far not the worst, could probably have been much better if more modern material had been considered. I estimate that between a third and a half of the chapters are in areas where I consider myself knowledgeable; the majority of these are either out of date, some by about a decade or so, or are hopelessly naive. It is nevertheless a good thing that all this material is under one roof, since, for better or for worse, this paints a picture of what is currently being used in a practical sense.

It is conceivable that this is what industry demands and needs. It is also conceivable that some industrial researchers might find ready-made answers here although I hope that some ideas are not taken too literally. I can speak with more authority regarding academic wants and needs. If you want an overview of what gets consumed by industry or if you seek topics and ideas for research proposals, then you should consult this book. If you want insight and understanding, then you should look elsewhere.

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Applied Digital Control, Theory, Design & Implementation

By J. R. Leigh, Prentice-Hall International, United Kingdom, Ltd., 1992, 524 pp.

As the title suggests, the author of this book tries to give a balanced treatment of theory and practice of digital control. The scope is kept wide to cover many topics of interest. In doing so, however, certain areas naturally lack depth. In my opinion, what distinguishes this book from others is its increased emphasis on practical issues regarding computer control implementation. In comparison with the first edition, the major changes include a more detailed discussion on available distributed control systems, seven additional case histories of industrial applications and a chapter on adaptive and robust control with its separate list of references. The book is probably most useful as a reference book for engineering students and practitioners. It can be used as a textbook both at the undergraduate and graduate (MS) levels. Background required is classical feedback control and a working knowledge of mathematics and computing.

The chapters can be categorized as follows:

1. Mathematical foundations (Chapters 2–4 and 8)
2. Design-oriented topics (Chapter 5)
3. Hardware implementation (Chapters 6 and 10)
4. Industrial applications, survey of commercial DCS systems (Chapters 7 and 11)
5. More survey-type chapters which are still in research stage (Chapters 9 and 12)

Chapters 6, 7, 10 and 11 particularly distinguish this book from others.

Chapter 1 summarizes the elements of a digital control loop and prompts the reader to question the issues to be addressed during design and implementation. Chapter 2 covers the classical material on discrete-time signals, sampling and reconstruction. Loss of information during sampling of continuous signals and aliasing are discussed together with Shannon's sampling theorem. This material which can be found in other texts is clearly presented, but there is no significant discussion on filtering. Z-transform techniques are introduced in Chapter 3 along with pulse transfer functions and difference equations. The treatment is again quite classical and clear. Some proofs are not as detailed as one might like to see. The rest of the mathematical exposition includes inverse Z-transforms, solution of difference equations, transformations between z- and s-planes and analysis of time response for different pole locations in the z-plane.

Chapter 4 discusses some of the traditional methods of analysis and design. Different methods of discretization (such as backward, forward and trapezoidal)

are clearly illustrated. This is followed by root locus diagram and frequency response analysis for discrete-time systems, both of which can be used for controller design. Bilinear transformation is used to facilitate the construction of frequency response plots (Bode or Nyquist). The chapter concludes with some classical stability tests (such as Jury's test and via bilinear transformation). There are ample examples and exercises.

Certain parts of Chapter 5, Digital Control Algorithms, need better focus and organization. The author starts by giving alternate routes toward design (such as design in continuous time followed by discretization or discrete all the way). It also discusses transformation of the transfer function $G(s)$ into z-domain followed by digital controller design. The design method chosen is direct synthesis (although he does not call it as such), in which the designer chooses the desired closed-loop transfer function and calculates the realizable controller to achieve it. Reason for the choise of this method is not explained. The section contains too many subtopics which distracts the reader. Dead beat and Dahlin's controllers are briefly discussed. Internal model control (IMC), which is the unifying framework, is not mentioned. The problem of ringing is mentioned, but the reason for its occurrence is not made clear. Examples which compare output and control input responses of the discussed controllers would have been useful. No reference is given for Kalman's algorithm. Position and velocity PID algorithms are given. It also outlines other design approaches including the use of Bode plots. Structures for digital cascade and feedforward control systems are given, but there is not enough discussion on design and implementation. Comparative study of different control systems on a physical example would be quite instructive. The chapter contains practical tips on the selection of sampling time.

Chapter 6 deals with practical aspects of hardware and its implementation. Typical sensor, actuator types are given; basics of A/D, D/A conversion, multiplexing and interfacing are covered. It is clearly written and offers practical value.

Chapter 7, Tutorial Case Studies, demonstrates the design techniques and the implementation issues on two physical systems: temperature control in an oven and thickness and flatness control in metal rolling. The latter study is more interesting and challenging. However, certain points need clarification such as: How are the process transfer functions determined?; How are the three control inputs defined?; Are the three models truly decoupled?; Why does one choose the same closed-loop performance for all three?; and Any data on controller performance?

Chapter 8 is mathematically oriented as it summarizes the classical state space concepts. Concept of state, state equations, their solutions, stability, controllability and related issues are included. I recommend a separate section on the development of discrete time models from their continuous counterparts. As multivariable design methods, decoupling, pole placement, optimal control and finally state estimation are briefly described.

Chapter 9 tries to motivate control of large-scale systems and presents multilayer-multilevel hierarchical control as an approach. The material on decomposition and coordination comes from the Polish School. No physical examples and insights are given to support the practical value of this material, and in its present form, it does not fit into a book of this kind.

I found Chapters 10 (control system implementation and integration) and 11 [commercially available distributed control systems (DCS) and their industrial application] informative and useful, though some of the material will need to be updated as new technology emerges. Criteria for selection of distributed control systems, survey of commercial systems and several industrial case histories provide valuable information.

The last chapter is devoted to adaptive and robust control which is new to the second edition. Admittedly these topics are very significant, but they cannot be presented in any useful detail within the space provided. The author thus tries to overcome this by providing a separate bibliography. In this chapter one can also find one-page discussion on dynamic matrix control. Excluding model-predictive control, which achieved its industrial success, is a weakness.

In summary, the book tries to cover many topics under theory, design and implementation of digital control. Despite its shortcomings, it does provide valuable contributions, especially on the practical side.

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