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## Book Reviews

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### **1 Applied Stochastic Processes and Control for Jump-Diffusions, Modelling, Analysis, and Computation**

**by: F.B. Hanson**

**Published 2007**

**by SIAM Society for Industrial and Applied Mathematics**

**3600 Market Street, 6th Floor, Philadelphia,**

**PA 19104-2688, USA, 443pp**

**ISBN: 978-0-898716-33-7**

The book is intended to be accessible to graduate students and to be a research monograph useful to researchers in applied mathematics, computational science, and engineering. In fact, a number of colleagues have said that they would like to learn about stochastic processes but have found it difficult to learn from the existing literature. Also, the book may be useful for practitioners of financial engineering who need fast and efficient answers to stochastic financial problems. Hence, the exposition is based upon integrated basic principles of applied mathematics, applied probability, and computational science. The target audience includes mathematical modellers and students in many areas of science and engineering seeking to construct models for scientific applications subject to uncertain environments. The prime focus of the text is on modelling and problem solving. The utility of the exposition, based upon systematic derivations along with essential proofs in the spirit of classical applied mathematics, is related more to setting up a stochastic model of an application than to abstract theory.

The book contains issues given in following chapters: Stochastic jump and diffusion processes: Introduction, Stochastic integration for diffusions, Stochastic integration for jumps, Stochastic calculus for jump-diffusions: elementary SDEs, Stochastic calculus for general Markov SDEs: Space-time Poisson, state-dependent noise, and multidimensions, Stochastic optimal control: Stochastic dynamic programming, Kolmogorov forward and backward equations and their applications, Computational stochastic control methods, Stochastic simulations, Applications in financial engineering, applications in mathematical biology and medicine, Applied guide to abstract theory of stochastic processes.

Online Appendix A covers deterministic optimal control and analysis, and Online Appendix B presents background preliminaries in probability and analysis. A third Online Appendix C contains example MATLAB programs that were used to generate many of the figures.

This book is written for graduate students in science and engineering who seek to construct models for scientific applications subject to uncertain environments. Mathematical modellers and researchers in applied mathematics, computational science,

and engineering will also find it useful, as will practitioners of financial engineering who need fast and efficient solutions to stochastic problems.

## **2 Numerical Computing with Simulink, Volume I, Creating Simulations**

**by: R.J. Gran**

**Published 2007**

**by SIAM Society for Industrial and Applied Mathematics**

**3600 Market Street, 6th Floor,**

**Philadelphia, PA 19104-2688, USA, 306pp**

**ISBN: 978-0-898716-37-5**

A digital simulation of the environment that a system ‘lives’ in is crucial in this modern simulation-based design process. The accurate representation of this environment allows the designer to see how well the system being designed performs. It allows the designer to verify that the design meets all of the performance specifications. Moreover, as the simulation develops, the designer always can see how the performance specifications. Moreover, as the simulation develops, the designer always can see how the performance requirements pass through to the various subsystems in the design. This refinement of the specification allows the model to, in essence, become the specification. The simulation environment can also allow the designer of embedded digital signal processing and control algorithms to test the code directly as it is developed to ensure that it satisfies the specification. The last, and newest, step in this process is the ability to use the simulation model automatically or generate the computer code for computers in the system.

That book will take you on a tour of the Simulink environment, showing you how to develop a system model and then how to execute the design steps to make the model into a functioning design laboratory. Along the way, you will be introduced to the mathematics of systems, including difference equations and z-transforms, ordinary differential equations, Laplace transforms, numerical methods for solving differential equations, and methods for simulating complex systems from several different disciplines.

The mathematics of simulation is not complete without a discussion of random variables and random processes for doing Monte Carlo simulations. Toward this end, they introduce and develop the techniques for modelling random processes with predetermined statistical properties. The mathematics for this type of simulation begins with ‘white noise’, which is a very difficult entity to pin down.

The author introduces other tools, in addition to Simulink, from The Math Works. Each of the tools is an expansion into a different ‘domain of knowledge’. The first tool is the signal processing blockset that extends Simulink into the domain of signal processing (both analogue and digital). The second tool, Stateflow<sup>®</sup>, expands Simulink to include state charts and signal flow for modelling event driven system (i.e., systems where the actions start at time that are asynchronous with the computers clock).

The third tool, SimPowerSystems, extends Simulink into the realm of physical modelling and in particular into the realm of electrical circuits including power systems, motor drives, power generation equipment including power electronics, and three-phase power transmission lines.

The last tool, SimMechanics, is also a physical modelling tool. It develops models of mechanical systems such as robots, linkages, etc. These tools can all work together in the common Simulink environment, but they all have their own method for displaying a picture of the underlying system.

### **3 Introduction to Surface Chemistry and Catalysis, Second Edition**

**by: G.A. Somorjai and Y. Li**

**Published 2010**

**by John Wiley & Sons, Inc. Publications, Hoboken,**

**New Jersey, USA, 772pp**

**ISBN: 978-0-470-50823-7**

The chemistry of surfaces and interfaces plays dominating roles in our lives. The challenge of modern physical chemistry is to understand macroscopic surface phenomena on the molecular level. This book, the second edition of Introduction to Surface Chemistry and Catalysis, first published in 1994, aims to update our rapid progress in these fields. In the interim period, surface science has emerged as the frontier area of molecular physical chemistry on a broad front, ranging from nanoparticle structures to biointerfaces and selective catalysis of stereo specific molecules and reactions, and to chemical energy conversion. Many applications of the newly acquired knowledge of molecular surface chemistry is used in innovative technologies relying on metal, semiconductor, and polymer surfaces in order to achieve controlled chemical bonding, adhesion, friction, electron and atom transport, solar energy conversion, and selective catalysis.

Since the publication of the first edition of this book, molecular surface chemistry and catalysis science have developed rapidly and expanded into fields where atomic scale and molecular information were previously not available. This revised edition reflects this increase of information in virtually every chapter. It emphasises the modern concepts of surface chemistry and catalysis uncovered by breakthroughs in molecular-level studies of surfaces over the past three decades while serving as a reference source for data and concepts related to properties of surfaces and interfaces.

In this book, the following chapters are included: Introduction, Surfaces: An introduction, The structure of surfaces, Thermodynamics of surfaces, Dynamics at surfaces, Electrical properties of surfaces, Surface chemical bond, Mechanical properties of surfaces, Polymer surfaces and bio interfaces, Catalysis by surfaces.

### **4 Handbook of Metrology, Volume I**

**by: M. Gläser and M. Kochsiek**

**Published 2010**

**by WILEY-VCH Verlag GmbH & Co. KGaA,**

**Weinheim, Germany, 408pp**

**ISBN: 978-3-527-40666-1**

Metrology is the science and technology of measurement. It is as old as human culture, because measurements were necessary even in ancient times for manufacturing tools, even if they were simple like axes, lances, and plows, or for construction of houses.

The contributions of the first part are summarised as follows:

- ‘Units’ presents not only the SI but also units outside the SI, writing rules, and international topics of this field.
- ‘Fundamental constants’ first points out their role and importance in physics, particularly for the Josephson and quantum Hall effects in the quantum electrodynamics, QED.
- ‘Fundamentals of material measurement and testing’ describes the types of materials and the methods to characterise their properties, for example, their elemental and chemical composition, their microstructure, and essential physical properties.
- ‘Measurement of mass and density’ is devoted to two basic quantities in mechanics and their measurements, which are not independent from each other, to some extent.
- ‘Measurement and instrumentation of flow’ first starts with Bernoulli’s differential flow equation, and then presents the various principles and instruments of flow measurement and discusses their advantages and disadvantages.
- ‘Ultrasonic’s’ first develops the theories at conditions in boundless and bounded media and those in solids and liquids. Attenuation and wave dispersion models are discussed next. Finally the methods of ultrasonic generation, measurement techniques, and applications of ultrasound are dealt with.
- ‘Measurement of basic electromagnetic quantities’ first discusses about realising the units farad, ohm, volt, and watt and continues with presenting working standards of voltage and resistance, for example, those that make use of the conventionally adopted constants  $R_k$  and  $K_j$ .
- ‘Quantum electrical standards’ deals with the presentation of the quantised Hall resistance standard and the Josephson voltage standard and an outlook for a new quantum standard for current, based on Coulomb blockade.
- ‘Metrology of time and frequency’ first discusses the principles of characterising clocks and oscillators, and then describes quartz crystal and atomic frequency standards, measurement of time and frequency, and comparisons between remote sites.
- ‘Temperature measurement’ first introduces the concept of temperature from basic laws of thermodynamics, and provides the definition of the Kelvin and the envisaged future redefinition based on a fixed value of the Boltzmann constant. Various kinds of physical thermometry concepts follow, such as primary gas thermometry, thermometry based on noise, Doppler broadening, total radiation, and spectral radiation.
- ‘Metrology in medicine’ is characterised by procedures that measure physical or chemical quantities tracing them to standards known not only from the other fields of metrology but also by other reference measurement procedures that refer to well-accepted physiological test signals in medical diagnostics.

The readers of the *Handbook of Metrology* will find the information contained herein new and useful.

**5 Handbook of Metrology, Volume II**  
**by: M. Gläser and M. Kochsiek**  
**Published 2010**  
**by WILEY-VCH Verlag GmbH & Co. KGaA,**  
**Weinheim, Germany, 411–726pp**  
**ISBN: 978-3-527-40666-1**

Metrology is the science of measurement. It includes all theoretical and practical aspects of measurement and may be divided into three subfields:

Scientific or fundamental metrology concerns the establishment of measurement units, unit systems, development of new measurement methods, realisation of measurement standards and the transfer of traceability from these standards to users in society.

This handbook contains articles that are also published in the Encyclopedia of Applied Physics (Wiley-VCH) and it is divided into two parts. It contains articles dealing with general topics of measurement and articles on particular subjects in mechanics and acoustics, electricity, optics, temperature, time and frequency, chemistry, medicine and particles. The contributions of the second part are summarised as follows:

- The authors start with basic concepts like the probability density function (PDF), Baye's theorem, modelling and the use of Taylor series, then describes the propagation of PDFs or uncertainties, the standard procedure of the guide to the expression of uncertainty in measurements (GUM), the Monte Carlo method, and finally selected advanced topics in uncertainty evaluation.
- 'Laser spectroscopy' deals with the analysis of atomic or molecular structure by using laser radiation. After a historical introduction, the width and broadening mechanism of spectral lines are discussed, aspects those are crucial for spectral resolution.
- 'Chemical analysis metrology' first explains what metrology means in chemical analysis and the key role of validation, and lists related terms used in chemical analysis.

The following sections deal with standards, sampling, sampling preparation, the signal and noise detection limits, the working concentration limits, and propagation of uncertainty.

- 'Chemical analysis' presents a comprehensive review on methods for specifying the elemental and molecular composition of materials. A tabulated overview on the methods and general rules for assessing measurement results is followed by descriptions for the various chemical and physical assay methods.
- 'Photoacoustic spectroscopy' first explains the method as an indirect technique measuring an effect of light absorption rather than light absorption itself and its advantages compared with regular spectroscopy.
- 'Radiation detectors' starts with a view on the historical development of radiation detectors and mentions the application fields of such instruments.

- ‘X-ray spectrometry’ are introduced as instruments that measure wavelengths or equivalent energies and fluxes of radiations with wavelengths in the range between ultraviolet and gamma radiation with equivalent photon energies between about 100 eV and 100 keV.
- ‘Calorimetric particle detectors’ first points out their properties and advantages as energy detectors for charged and neutral particles compared with momentum and velocity detectors, which are appropriate only for charged particles.

The readers of the *Handbook of Metrology* will find the information contained herein new and useful.

**6 Handbook on the Knowledge Economy**  
**by: D. Rooney, G. Hearn and A. Ninan**  
**Published 2005**  
**by Edward Elgar Publishing Limited**  
**Glensanda House, Montpellier Parade,**  
**Cheltenham, Glos GL50 1UA, UK, 290pp**  
**ISBN: 1-84376-795-2**

The central motivation for assembling the contributions in this *Handbook on the Knowledge Economy* derives from the observation that many in government and business seem to have taken up the challenge of putting in place whatever is needed for a knowledge-based economy of a knowledge-based organisation but very few appear to be included to explain what knowledge is or how it works socially, organisationally or economically. While there are good reasons for this situation, not knowing what knowledge is or how it works in any detail is problematic for those who are charged with managing or facilitating it. Policymakers would not consider constructing monetary policy without the input of some detailed knowledge of economics. Managers would not implement an information system without detailed input from knowledgeable information systems experts.

This handbook also demonstrates that an understanding of what knowledge entails raises other important issues such as values, power, culture, communication, risk perceptions and ethics that are central to effective knowledge systems. It seems disappointing to us that so little is said in the dominant knowledge discourse about these issues.

This handbook has pulled together many leading researchers from a range of knowledge studies disciplines in one convenient volume.

The book contains issues given in chapters:

- Part I-Concepts: The material, mental, historical and social character of knowledge, Wisdom, ethics and the postmodern organisation, risk and knowledge, social epistemology: preserving the integrity of knowledge about knowledge, knowledge and social capital.
- Part II-Policy: Knowledge and cultural capital, the organisation of creativity in knowledge economies: exploring strategic issues, analysing policy values in a

knowledge economy, knowledge issues and policy in the operation of industrial clusters, intellectual property rights in the knowledge economy.

- Part III-Implementation: Information sharing, collaboration and the network form of organisation in the new knowledge-based economy, exploring the information space: a strategic perspective on information systems, tacit knowledge versus explicit knowledge approaches to knowledge management practice, knowledge and social identity, managing creativity in the knowledge economy, inexperience and inefficiency in information transactions: making the most of management consultants, the knowledge worker: a metaphor in search of a meaning, how to be productive in the knowledge economy: the case of ICTs, digital rights management (DRM): managing digital rights for open access.

## **7 The Technology Imperative**

**by: G. Tasse**

**Published 2007**

**by Edward Elgar Publishing Limited**

**Glensanda House, Montpellier Parade,**

**Cheltenham, Glos GL50 1UA, UK, 329pp**

**ISBN: 978-1-84542-912-6**

Today, the world's economy is much more dependent on science as a precursor to the creation of technology. Globalisation of industries and markets, the steadily growing complexity of technology, emerging organisational forms for conducting research and development (R&D), and multiple government policy institutions and economic growth strategies are major trends confronting all nations – current leaders and emerging economies alike.

In particular, US economic performance, which has been the envy of the rest of the global economy for most of the post-World War II period, is struggling with two fundamental problems that portend serious constraints on future economic growth. First, the US economy has lost its perspective on what drives growth. Excessive consumption fuelled by accumulation of enormous debt precludes sufficient aggregate investment. Second, what investment is occurring suffers from serious compositional inadequacies, in particular, inadequate rates of investment in technology, especially breakthrough technologies – the ones that create new industries and thereby provide a large number of high-paying jobs.

The second problem continues to befuddle many who fall into the trap of looking backward at the dominant R&D investment profile of the US economy for most of the post-war period. However, the amount of R&D investment is only meaningful when considered relative to the size of the economy it is trying to support and when compared to similar ratios among other nations.

The phenomena of technological and economic convergence have been repeated throughout economic history. However, every technology life cycle has some distinguishing characteristics, which defy extrapolation of successful strategies from one cycle to the next. In the current process of global convergence, the unique factor is the diminished impact of the original version of the law of comparative advantage.

This situation will continue until it is realised that the complexity of the technology-based economy demands institutionalised technology assessment and economic analysis to supported and they are organisationally structured to ensure segmentation and thereby dysfunction. The science and technology policy community focuses largely on the input side, that is, on funds for investment in R&D. In contrast, conventional economic growth policy implicitly assumes that technology magically appears (the black-box model) and is then combined with the traditional inputs of capital and labour to produce desired goods and services.

The book contains the following chapters:

- Part I-The economics of decline: Globalisation of technology, indicators of decline.
- Part II-R&D in the modern economy: The technology paradigm, the public-private growth model, underinvestment in R&D, strategic shifts in the economy, the technology life cycle, the role of technical infrastructure.
- Part III-Technology-based political economy: Assessing the government role, elements of STID policy, to compete or not to compete.

## **8 Methods in Bioengineering, Microdevices in Biology and Medicine**

**by: Y. Nahmias and S.N. Bhatia**

**Published 2009**

**by Artec House**

**685 Canton Street, Norwood, MA 02760, USA, 260pp**

**ISBN 13: 978-1-59693-404-7**

Micro fabrication technology has already changed the world around us. Hiding under the shiny coat of our cars, iPods, cellular phones, laptops, and televisions, the integrated circuit and silicon microchip have changed the way we live forever. Features a thousand times smaller than a single millimetre enable an unparalleled control over electrical signals resulting in nearly magical computational, communication, and memory powers. At the dawn of the 21st century, a similar revolution is changing the study of biology and the practice of medicine. Micro scale patterns, three-dimensional features, and the physics of small places offer to radically change our ability to screen thousands of conditions, control the cellular microenvironment, and provide innovative tools for the diagnosis and treatment of disease. Notably, micro devices that have already researched the market are gaining increasing popularity.

The success of these early micro devices has brought us to realise the need for a methods-based book that will provide timely insight into the technology of newly developed bio-MEMS devices. *Methods in bioengineering: Micro devices in biology and medicine* is intended for students and scientists who wish to apply these tools for basic science or clinical diagnostics and for clinicians who wish to familiarise themselves with the science of this emerging technology. As part of the Artec House methods in bioengineering series, this book presents the science behind micro scale device design as well as the engineering of its fabrication. Each chapter includes a detailed, step-by-step methodology as well as a troubleshooting table designed to enable the rapid dissemination of micro fabrication technology.



The book contains the following chapters: Immunoaffinity capture of cells from whole blood, Dynamic gene-expression analysis in a microfluidic living cell array (mLCA), Micromechanical control of cell-cell interactions, Mechanotransduction and the study of cellular forces, A microfluidic tool for immobilising *c.elegans*, Osmolality control for microfluidic embryo cell culture using hybrid polydimethylsiloxane (PDMS)-parylene membranes, Image-based cell sorting using microscale electrical and optical actuation, Pharmacokinetic-pharmacodynamic models on a chip, Lab-on-a-chip impedance detection of microbial and cellular activity, Controlling the cellular microenvironment, Subtractive methods for forming microfluidic gels of extracellular matrix proteins.

Readers will gain a unique perspective on the challenges and emerging opportunities in developing microdevices for cell capture from whole blood, study of transcriptional dynamics in living cells, temporal control of cell-cell interactions, nanoscale measurements of cellular forces, immobilisation of living organisms, optical and electrical on-chip cell sorting, human-on-chip models of drug metabolism, microreactors for tissue engineering, and 3D control of the cellular microenvironment.