in metals processing operations, and the computer simulation of solidification.

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Advances in Nuclear Science and Technology—Vol. 14, Sensitivity and Uncertainty Analysis of Reactor Performance Parameters

Editors	Jeffery Lewins and Martin Becker
Publisher	Plenum Publishing Corporation (1982)
Pages	372
Price	$49.50
Reviewer	Raymond L. Murray

This book is refreshing for its frankness in pointing out deficiencies in our methods of using basic data to calculate reactors. It notes, for example, that by depending on computers we have tended to lose the ability to interpret the physical meaning of trends. Experimenters are chided for failing to document their uncertainties adequately. The parameter evaluator is also urged not to introduce improper bias. The book is appealing because of the occasional philosophical commentary. The authors suggest, for example, that the urge to improve methods causes a bewildering proliferation that competes with the desire for standardization.

On a technical basis, the authors provide an orderly and logically structured discussion of several important connected aspects of uncertainties in the process of reactor design. The principal chapter topics reflect the sequence: nuclear data calculation methods, integral experiments, sensitivity functions, and the combination of all information. These chapters were obviously well planned and are well executed. The authors use as simple a language as is appropriate to a reader who has a good background in reactor physics but wants to understand sensitivity methods. For example, the treatment of two independent measurements with their separate uncertainties precedes the analysis of a general matrix representation of many data. Nume ical illustrations are used liberally to give substance to the theoretical and calculational methods described. However, to fully appreciate the book, the reader should be familiar with matrix algebra, basic statistical analysis, and neutron transport theory.

In the beginning chapter on uncertainty, the important concept of covariance is explained clearly. In contrast to the variance as an expected value of the error in a quantity, the covariance is the expected value in the product of errors in two quantities. It is straightforward to generalize to an array of quantities, in which a covariant matrix represents the interactive effect of errors. This chapter reviews least-squares methods, pointing out both virtues and pitfalls. The matrix theory is displayed for initial evaluations of data and incremental improvements. The problems that exist in the resonance region are stressed, and the status of the covariance uncertainty files for ENDF/B-V is discussed.

The chapter on sensitivity functions describes the perturbation theory that uses ordinary fluxes and adjoint fluxes from the Boltzmann equation. Application is made to performance parameters of various types, including reactivity, reactivity worth ratios, cross sections for capture, fission, and scattering, neutron production data, neutron group representations, and breeding ratios.

The large chapter on calculation of reactor design and performance parameters covers cross sections, with special attention to resonances and Doppler effect, group constant formation, diffusion theory, transport theory, burnup programs, and mesh effects. Emphasis is placed on uncertainties, of course.

The chapter on integral experiments is restricted to data on fast reactors. It gives a survey of facilities and measurement techniques for critical experiments and describes the methods of interpreting critical masses and reaction rates, ending with an expression of need for new data. This plea is now particularly apt because operating critical facilities are unfortunately being abandoned.

One important chapter explains how differential and integral data are combined using least-squares methods and covariances. The description of the basic process is followed by the treatment of uncertainties. Special attention is given to the "k-reset" concept, in which results for a case with multiplication factor not equal to unity are treated.

The book ends with a challenging chapter entitled "New Developments in Sensitivity Theory," in which a generalized theory is presented, applicable to the transient neutronics, thermal-hydraulics, and fuel performance aspects of the reactor. The science and engineering of nuclear reactors would clearly be advanced if the suggested ambitious treatment could be fully implemented.

The book differs from many in this familiar series. Rather than providing a smattering of isolated new developments, it concentrates on one subject, seeking to provide a unified review. Its format, using typewritten pages, is easy to read. There are relatively few typographical errors. Each chapter contains a large but not excessive number of references, going back as far as Bayes (1763), up through Gauss (1821), and Laplace (1886), but leaping into the 1970s for the relevant material on what is obviously a new subject. Casual inspection indicates that the right references are present. Although written by experts, the book seeks to meet tutorial needs.

To this reviewer, one disappointing aspect of the book is its preoccupation with fast reactors. The reader continues to ask the question: "Does this all apply to thermal reactors?" This defect might have been resolved by inclusion of a special chapter that discussed differences between the approaches for fast and thermal reactors. Also, the reader may find it difficult to ascertain the degree of conformity of actual and expected values of multiplication of systems designed using sensitivity methodology. In spite of these

concerns, the writer recommends the book to all reactor physicists and reactor engineers concerned with the reliability of data and calculation methods. The authors are to be congratulated on having adeptly encapsulated a large and rapidly changing subject within the covers of a single book.

Dr. Raymond L. Murray received his first degree in science education at the University of Nebraska, where he also received a masters degree in physics. His doctorate was from the University of Tennessee. In World War II, he contributed to the uranium isotope separation research and production at Berkeley and Oak Ridge. He has been a faculty member at North Carolina State University since 1950, assisting in the establishment of the first nuclear engineering curriculum and the first university nuclear reactor. He served as Burlington Professor of Physics, as head of the nuclear engineering department for 11 years, and currently is professor emeritus. He has published a number of research papers on reactor theory and design analysis, has written textbooks in nuclear engineering and basic physics, and serves as consultant to industry on reactor design and nuclear safety. He has been a member and chairman of the North Carolina Radiation Protection Commission. His current studies involve nuclear reactor analysis related to the Three Mile Island-2 recovery and to uranium resource extension, the application of microcomputers to nuclear problems, and public information on nuclear energy, especially radioactive waste management.

World Energy Supply

Author	Manfred Grathwohl
Publisher	Walter de Gruyter and Company, Hawthorne, New York (1982)
Pages	450
Price	$49.50
Reviewer	Efstathios E. Michaelides

Reading this book by Grathwohl has been a gratifying and rewarding experience. It is a complete treatise on the subject of energy, written with a rare combination of technical expertise and economic competence. Its pages contain a vast amount of information, valuable to the practicing engineer, the research scientist, and even to the nontechnical social scientist.

After a brief introduction, the book presents a short historic background and the basic principles for the conversion of energy (laws of thermodynamics). Then follows a presentation of the primary energy consumption in the world and its connection to national economic and population growths. Here some basic aspects of energy economics are also examined. The third chapter of the book is devoted to the potential of the world's primary energy sources. The sections cover conventional sources, such as coal, oil, and gas as well as more modern sources, such as fuels for nuclear fusion and fission, geothermal, solar, and tidal energy. The lengths of these sections are approximately proportional to the expected impact of the energy source on the world energy supply. The fourth chapter examines the technical aspects of the production of secondary energy forms. The production of electricity from nuclear fission or fusion is given in detail as well as heating from solar energy. Sections include methods for the production of electric power from the wind, waves, ocean currents, biomass photolysis, tides, and geothermal resources. The direct methods for energy conversion (magnetohydrodynamics, thermoelectrics, thermionics, fuel cells, and radionuclides) are also discussed. A lengthy exposition follows on the technical and economic aspects of coal gasification and hydrogen energy. The fifth chapter of this book discusses the environmental and safety considerations of energy production and transportation. The topics covered include the safety of nuclear installations and the waste problem, the environmental impact of new energy sources, the emissions of pollutants, and the climatic changes associated with the release of carbon dioxide and waste heat.

The number of references (close to 800) is an asset for this book. Thus, the interested reader can improve his knowledge of a specific subject by looking at the relevant references. The exposition is complete with lists of abbreviations, units conversion table, and a text of the nuclear proliferation treaty.

The author approaches the subject of energy in a global rather than topical way. Because of this, his book will be of interest to the engineer and the researcher. In general, the book is very accurate and rigorous, although there are occasional mistakes in the translation of certain technical terms from German. The originality of the book lies in the fact that the author has compiled information from diverse fields to produce a unified approach to the solution of the energy problem.

Efstathios E. Michaelides was born in Thessaloniki, Greece, and studied at the University of Oxford, England (BA, engineering science and economics, 1977) and Brown University (MS, 1979, and PhD, 1980, engineering science). Since the summer of 1980, he has been an assistant professor at the University of Delaware in the Department of Mechanical and Aerospace Engineering. His research interests are multiphase flow, energy conversion, geothermal energy applications, and irreversible thermodynamics. He has contributed about 40 papers to scientific and technical literature.

Advances in Non-Destructive Examination for Structural Integrity

Editor	R. W. Nichols
Publisher	Elsevier Science Publishing Co., Inc. (1983)
Pages	447
Price	$90.25
Reviewer	Gerald A. Schlapper

This book is a compilation of papers from the Second International Seminar on Non-Destructive Examination in Relation to Structural Integrity held in Paris, France, during August 1981. The papers presented deal with the nondestructive examination of steel welds in relation to assessment of