



## Random Differential Equation in Technical Problems

**Random Differential Equations in Science and Engineering.**  
By T. T. Soong. Academic Press, New York and London. 1973.  
327 pp. \$19.50.

REVIEWED BY J. L. BOGDANOFF<sup>1</sup>

The author is to be congratulated on providing a readable and useful book on the mathematical tools needed by engineers in their effective use of random differential equations in technical problems.

Random vibration and random processes began entering the engineering mechanics profession as a significant subject around 20 years ago. Since that time, the subject has grown and developed in a number of ways. Material which first appeared in research papers now is presented in books. Most engineering schools have one or more courses in random vibration; some have courses in random processes. Probabilistic concepts have entered codes in military specifications, nuclear power plant specifications, building codes in areas of high seismic risk, etc. Thus the subject has achieved a position of importance in the profession.

The initial books on the subject were either over the heads of engineers mathematically (and ignored) or on an insecure basis mathematically. As a result, unsound and/or confused conclusions were occasionally put forward in the literature. Soong's excellent book indicates that the profession is now sure of the importance of the subject and expects its members to know the mathematical tools needed to pursue the subject in a competent manner.

According to the author, the primary objective of the book is to give the reader a working knowledge of random differential equations . . . and it is also hoped that the contents will bridge the gap between introductory material on stochastic processes and advanced topics in science and technology involving probabilistic methods.

The contents are as follows. Chapter 1 is an introduction. Chapter 2 briefly reviews some of the concepts of probability needed in succeeding chapters. Chapters 3 and 4 introduce the concept of a random process, classify random processes, and develop the mean square calculus. Chapters 5-8 concentrate on differential equations with stochastic elements including random initial conditions, random nonhomogeneous elements, and random coefficients. Chapter 9 considers stochastic stability. There are two Appendices—one on sample treatment of random differential equations and the other on some useful properties of the solution processes. At the end of each chapter there are references and good problems.

Concepts of probability theory and random processes are carefully defined and illustrated. Significant and useful results in the mean square calculus are presented as theorems and corollaries. Random differential equations are also given deliberate and careful treatment. Illustrations in the text and references are taken from the fields of dynamics, guidance control, physics, and structures. Stochastic stability is treated in the same careful manner, but coverage of this important topic is limited. The author has had to be selective in the topics presented in order to keep the size of

the book reasonable. The reviewer feels that the selection made will satisfy most engineers.

A minor point of criticism in the reviewer's opinion is the lack of illustrations of sample functions of various types of random processes.

The book is ideally suited as a text in a second course in random vibration and continuous time continuous state random processes. It will also be a useful reference book at a fairly advanced level.

The author has admirably met his objective. The reviewer heartily recommends this book to all interested in acquiring the tools needed to understand the subject.

## Moiré Methods for Strain Analysis

**Moiré Fringes in Strain Analysis.** By P. S. Theocaris. Pergamon Press, Headington Hill Hall, Oxford 4 and 5 Fitzroy, Square, London W1. 1969. Pages vii-426. Hard Cover 3.00 pounds; Flexi-cover 2.50 pounds.

REVIEWED BY FU-PEN CHIANG<sup>2</sup>

This book is one of only two books dealing exclusively with moiré methods for strain analysis. It is a comprehensive book containing most of the methods available up to 1968. One of its most important contributions is the listing of some 287 papers and 11 books relevant to the subject matter.

Roughly the contents of the book can be grouped into the following categories: The general theory (Chapter 1), the analysis and application of the in-plane moiré methods for measuring two-dimensional displacement components (Chapters 2, 3, and 4, Sections 7.2 and 7.3), the analysis and application of the out-of-plane moiré methods for measuring either the deflection or partial slope of plates and shells or the change of thickness of plane-stressed models (Chapters 5, 6, and 8 and Section 7.1), moiré extensometer (Chapter 9), and experimental errors and laboratory techniques (Chapters 10 and 11). Chapter 12 gives an evaluation of the moiré methods.

The general theory of moiré fringes follows the approach of Pirard, in which the indicial notation is introduced to relate grating line and fringe to grating pitch, fringe spacing, and fringe orientation. The analysis of the in-plane moiré methods includes not only line grating but also circular, radial, and zone gratings. The basic approach of the (line grating) in-plane moiré method follows the classic displacement concept of Dantu, flanked by a variety of special techniques such as "the linear differential (mismatch) method," "direct tracing of isoentatics," "the angular disparity method," and "the grid-analyzer method." The sections on fractional fringes, however, seem to be a bit lengthy and equation (2.88) (p. 79) is in error. It should read  $D = D_0 + \gamma(\log It - \log E_0)$  where the parameters are as customarily defined for the characteristic curve of photographic film.

In the second group the methods described consist of "the shadow moiré method," "Ligtenberg's photoreflexive moiré method," "the Salet-Ikeda (nonmoiré) method," "the reflected image moiré method," and several other methods developed by the author for measuring the slope and curvature "contours of the sum of principal stresses" of models under plane stress. The development of some of the methods, however, is not very clear to the reviewer

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