

Computational Mechanics of Probabilistic and Reliability Analysis, by W. K. Liu and T. B. Belytschko. Elmepress International, Lausanne, 1989. 622 pages. Price: \$70.00.

REVIEWED BY P. SPANOS¹

This book consists of a collection of 27 articles dealing with the subject of probabilistic engineering mechanics with special emphasis on the ensuing computational issues.

The book has two parts. The first part is meant as a tutorial on the basic aspects of probabilistic mechanics, whereas the second part is an overview of some of the applications that rely on probabilistic concepts for their treatment. The tutorial part starts with two expository chapters covering both basic and advanced concepts of structural reliability theory. Chapter 2, in particular, gives a clear and concise presentation of the first-order and second-order reliability methods, (FORM/SORM), as well as a thorough exposition of the various Monte Carlo simulation schemes that have proven to be useful in the context of structural reliability analysis. Chapters 3 and 4 present certain computational aspects associated with the analysis of structural systems with uncertain parameters. Chapter 3 deals with the dynamic analysis of such systems, whereas Chapter 4 treats them in the context of a perturbation-based stochastic finite element method. Chapter 5 is an attempt to couple the boundary element with a perturbation expansion for applying it to uncertain systems. In Chapter 6, a Neumann expansion is used to obtain statistics of the amplitude and frequency of uncertain vibratory systems. Useful truncation and convergence criteria associated with the expansion are also presented. The advanced mean value method for efficient estimation of the CDF is presented in Chapter 7. The NESSUS probabilistic finite element program is also reviewed in this chapter. The perturbation approach is again demonstrated in Chapter 8 through its application to the transient analysis of structures with uncertain damping. An improved perturbation approach is presented in Chapter 9. Here, an iterative perturbation scheme is reviewed that aims at improving the efficiency of the perturbation approach for the analysis of uncertain systems. Brief and sketchy presentations of directional simulation and importance sampling are presented in Chapter 10. The efficacy of these two methods in the reliability analysis of structural systems is indicated. Chapter 11 presents the coupling of the perturbation approach with the response surface approach for the reliability analysis of structural systems. The response surface approach is presented in Chapter 12 where it is applied to the analysis to uncertain nonlinear continua. A central composite design for the response surface is

used for the computational experiments. In Chapter 13, the finite element implementation of the FORM and SORM methodologies is presented. The basic difficulties associated with such an implementation are pointed out, as well as various means of addressing them. A sketchy review of the representation of random fields is also presented. The first part of the book ends with a discussion of nonlinearity and randomness in mechanics based on the Adomian decomposition method.

The second part of the book presents a number of applications of probabilistic mechanics concepts in the context of computational mechanics. Six chapters, 15 through 20, address the problem of stochastic fracture mechanics and fatigue crack growth. State-of-the-art research in this important topic is presented. Random vibration analysis using Hermite moments is discussed in Chapter 21, and the first passage problem associated with stochastic structural dynamics is addressed in Chapter 22. Chapter 23 deals with hysteretic structural systems with special emphasis on the seismic reliability aspects of the problem. Chapters 24 and 25 feature more applications including the analysis of fluid-shell systems with random imperfections and the reliability analysis of the settlement of raft foundations. An algorithmic formulation is presented in Chapter 26 for the synthesis of linear two-phase uncertain systems. The Monte Carlo simulation method is used to simulate the system parameters. The last chapter of the book, Chapter 27, deals with the optimization of the performance reliability of manufacturing processes. A generalized reduced gradient method is implemented to maximize the system reliability.

In conclusion, the book attests to the timeliness of the rapidly evolving area of computational probabilistic mechanics. The choice of its material is somewhat misleading since it exclusively presents methods that are based on the FORM/SORM and the perturbation approaches for the analysis of uncertain structural systems. This choice leaves out a number of research contributions that are within the scope of the book. Still, this book is valuable to researchers and practitioners in the field of probabilistic mechanics.

Non-Destructive Testing, by B. Hull and V. John. Springer Verlag, New York, 1987. 144 pages.

REVIEWED BY TOSHIO MURA²

This is a thin (144 pages) introductory text which covers the underlying principles and some major applications of nondestructive inspection methods, liquid penetrant inspection, magnetic particle inspection, electrical testing, ultrasonic testing,

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