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Book Review: *Nonlinear Stochastic Systems in Physics and Mechanics*

Nonlinear Stochastic Systems in Physics and Mechanics. Nicola Bellomo and Riccardo Riganti, World Scientific, Singapore, 1987, 244 pp.

This book deals with methods of solution of systems described by differential equations with random parameters and/or random initial conditions. The randomness is not a function of the independent variable (e.g., time); rather, each member of the ensemble of systems has constant fixed parameters and initial conditions, but these fixed values change from one member of the ensemble to another. Of necessity, the solutions must usually be approximate, and the authors discuss a variety of such approximations for the calculation of the dynamic response and of the probability density. The purpose of the book is to provide practical recipes for these calculations (as opposed to new theories), and so it provides a collection of such algorithms. Each method of solution is developed and justified sufficiently for the reader to understand the steps that have to be taken. Each type of equation and method of solution is illustrated via examples taken from physics and mechanics. It should be noted that the systems dealt with do not exhibit singular or nonanalytic behavior: the methods used rely mostly on perturbative series and other series that require analytic behavior of the solutions.

The book consists of six chapters and an appendix, the latter containing basic definitions of random variables, stochastic processes, distributions, various specific distributions, and a number of examples in an effort to make the book self-contained. The first chapter sets the stage by stating and classifying the random differential equations to be dealt with in subsequent chapters. Chapter 2 deals with perturbative solutions of stochastic ordinary differential equations around a "zeroth-order" system chosen to be one that can be solved analytically in closed form (for many systems this is, of course, not possible). Chapter 3 deals with the "decomposition method," a method of solution that presumes a certain power series form that is then truncated at a finite order. Both of these chapters

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deal with transient solutions that cannot be carried beyond a finite time, and in both the solution consists of the direct calculation of the dynamic response. In Chapter 4 the probability density (rather than the dynamic response) is the focus of attention, and in Chapter 5 the authors deal with asymptotic periodic solutions of random differential equations using both perturbative techniques and the decomposition approach. Finally, in Chapter 6 the discussion centers on the extension of these methods to random partial differential equations.

Katja Lindenberg
Department of Chemistry
Univesity of California at San Diego
La Jolla, California