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# Book reviews - Probability and Stochastic Processes for Engineers

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# Book Reviews

## Fast Transforms, Algorithms, Analysis and Applications

D. F. Elliott & K. R. Rao
New York: Academic Press, 1982.

Andrew G. Tescher, *Reviewer*

This book provides a comprehensive discussion on the field of fast transforms. It consists of 11 chapters plus several appendices. The book is well organized and each chapter provides a set of problems that test the reader's understanding of the previous material. Approximately two-thirds of the book cover primarily Fourier techniques. Consequently, this material well complements other textbooks on signal processing, Fourier techniques, and spectral estimation.

Chapter 1 is an introduction to the material to be presented. It provides basic definitions and discusses the structure of the book. Chapters 2 and 3 review principles of Fourier techniques. In these two chapters, the basic concepts, such as Fourier integral and transforms followed by the discrete Fourier transforms, are discussed. Chapters 4 and 5 provide the primary "fast" in the book. Here, the various techniques of "fast" Fourier transform algorithms are discussed.

Chapters 6 and 7 provide the applications part of the book; however, these applications (such as filtering and spectral analysis) are exclusively based on Fourier techniques. The remaining chapters, 8–11, comprising the last third of the book, provide a review of other transforms and their implementations. The Walsh-Hadamard transform is discussed in chapter 8. Chapter 9 discusses the generalized transform, followed by the discrete orthogonal transforms in chapter 10 and, finally, chapter 11 provides a discussion of the number theoretic transforms.

In addition to the 11 chapters, several appendices provide additional material to the basic text. The references are quite extensive although somewhat awkward to use. The references are listed in alphabetical order only according to the first letter of the principal author's name. However, within each group they are no longer in alphabetical order. Although the authors heavily depend on abbreviations, and there are many of them by judicious use of the list of acronyms given at the beginning of the text, one can overcome the heavy dependence on the large number of abbreviations. Similarly, the short section on notation is very helpful and necessary. In general, I find the book well written and comprehensive. The emphasis is primarily on Fourier techniques; however, considering their importance in signal processing, this emphasis in the discussion is not unreasonable. The material on the other transforms is basically a good tutorial. Unlike that on Fourier techniques, only limited discussion is provided on applications for this material. Although the treatment of the fast Fourier transforms is extensive, no actual algorithm is provided, which might have been a useful addition.

I believe the referenced book is an excellent addition to anyone's library on digital signal processing. It can be useful as a complementary text for a signal processing course or as the primary text for a course on fast transforms.

## Probability and Stochastic Processes for Engineers

Carl W. Helstrom
Macmillan, 1984.

R. Viswanathan, *Reviewer*

Many engineering schools offer an introductory course on probability and random processes based on the popular textbook [1]. Now, this textbook comes as an alternative, especially if one is interested in covering the subject in one semester. Inclusion of many worked-out examples and problems at the end of the chapters make this a good choice for a one-semester course. It will also be useful for a practicing engineer if one is prepared for a concentrated self-study effort. In contrast to [1], the author of this book has chosen to treat stochastic processes rather lightly in order to keep the size small.

The book has five chapters. Chapter 1 discusses probability from classical and axiomatic-definitions points of view. The topic is treated at an elementary level, without the use of measure theory. There is a nice presentation of various interpretations of probability. Bayes theorem and conditional probability are introduced. Chapter 2 deals with continuous and discrete random variables. Instances are shown where one might come across a mixed-type variable. Conditional random variables and failure rate distributions are also discussed. Among the standard distributions, the exponential distribution is not mentioned; it could have at least been mentioned as a special case of Gamma, because of its relation to life-time statistics and Poisson distribution. Chapter 3 discusses the problems of two random variables. The joint CDF and the joint density functions are defined. Possibility of a line mass in the joint density is mentioned. An excellent treatment of conditional distribution for the case of 1) nonnumerical conditioning attributes, and 2) numerical conditioning events then follows. Bivariate Gaussian, covariance of two variables, functions of two random variables, and conditional expectations are also included in this chapter.

Chapter 4 deals with multiple random variables, basically an extension of the concepts from the previous chapter. Though the concept is simple, only specialized problems could be solved to get a final answer, as mentioned by the author. Multivariate Gaussian and multidimensional characteristic functions are introduced. Uncorrelating a set of random variables by means of linear transformation is also mentioned. The chapter concludes with a discussion on central limit theorem and random sums. The final chapter is about stochastic processes. The process is introduced as a result of an assignment of a function to each outcome in the probability space. Then the discussion of mean, correlation, and power-spectral density follows. Many examples of random processes are illustrated. There is a discussion of linear systems excited by random noise, thermal noise, and noise figure, and finally, a brief treatment of spectral estimation. Of notable omission is any discussion on a sequence of random variables, convergence, and stochastic continuity. A discussion of histograms and empirical CDF could have been included in chapter 4.

The introduction of hypothesis testing at an early stage in the discussion of probability should be welcome. This also enables the author to introduce a digital communications example. However, examples 1.21 and 1.22 could have been eliminated at this point. They are treated later in terms of random variables. The moment generating function, which has been defined in a problem in chapter 4 in order to evaluate the density of a sum of iid random variables, could have been replaced by asking the reader to use the characteristic function itself. (Of course, one would need Fourier Transform tables, instead of Laplace tables.) This would have added more examples to a single Poisson case

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considered in the text. Finally, the author chose to make the transistors fail in many examples to illustrate the concepts. In some cases, a light bulb would be a better choice, at least from the viewpoint that each one of us had observed the failure of bulbs over a period of time.

There is a bibliography on the foundations of probability. A short list of references from engineering and statistics disciplines for materials in the other chapters has been provided. However, a table of standard density functions with their means, variances, and characteristic functions could have been included.

A collection of well-graded problems at the end of the chapters closely follows the material discussed in the chapter. The presentation of the book is excellent, making the reader interested in the material. Very few typing errors have been noticed. There is one logical error in example 3.19, which is due to the incorrect simplification of $w\sqrt{z/w}$ as $\sqrt{zw}$, when both $z$ and $w$ are negative. This resulted in equation (3.75) being wrong.

The book will serve as a very good textbook for an introductory course on probability and stochastic processes.

### Typing Errors

1) Page 9, bottom paragraph, "subtelities" mispelled.
2) Page 35, 7th line from the bottom: We assume the trials [are] statistically independent; [are]—missing.
3) Page 78, the CDF of the arc-sine distribution should be shown to remain constant at 1, for $x$ greater than 1.

### Reference

[1] A. Papoulis, *Probability, Random Variables, and Stochastic Processes*, New York: McGraw Hill, 1965.

**R. Viswanathan** received the B.E. (Hons.) degree in Electronics and Communication Engineering from the University of Madras in 1975; the M.E. degree with distinction in Electrical Communication Engineering from the Indian Institute of Science, Bangalore, India in 1977; and the Ph.D. degree in Electrical Engineering from Southern Methodist University, Dallas, TX in 1983.

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