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BOOK REVIEW

Signals and Systems, by A.V. Oppenheim, A.S. Willsky, and I.T. Young. Prentice-Hall, Englewood Cliffs, New Jersey, 1983, 796 pages, hardbound, $37.95.

Signals and Systems is designed as a textbook for an intermediate level undergraduate course within an engineering curriculum. It serves this purpose well, providing an excellent introduction to the techniques used in analyzing and synthesizing both continuous-time and discrete-time signals and systems. The first chapters provide background material and introduce the concept of linear, time-invariant systems. Basic tools for describing and interpreting such systems are discussed. Subsequent chapters develop techniques of Fourier analysis for both continuous-time and discrete-time systems. They offer the reader a thorough understanding of Fourier series representation and Fourier transforms and present the techniques for continuous-time and discrete-time systems in a parallel fashion, allowing the reader to compare the two types of systems.

In the next section of the book, some of the most important applications associated with Fourier analysis are introduced: filtering, modulation, and sampling. They provide the reader with some insight into how the techniques are applied, in areas with which every student is well acquainted.

The final chapters extend the basic techniques of Fourier analysis to the more generalized Laplace and "z" transformations for continuous-time and discrete-time signals, respectively. The last chapter discusses the concept of linear feedback systems and techniques for their design and analysis using Laplace and z-transforms.

Signals and Systems is clearly written and provides abundant examples and illustrations. Numerous homework problems are included, both to provide practice for the student as well as to provide some insight into how the material presented can be applied. The authors state that solutions to the homework problems may be obtained from the publisher. A self-study course consisting of video-tapes and a study guide is promised. An extensive bibliography at the end of the book refers the reader to other texts on the methods and applications of signals and systems.

Readers of *Cytometry* will find that *Signals and Systems* does provide an excellent means by which to learn the basic techniques of Fourier series representation and Fourier transforms. The chapters on filtering, modulation, and sampling are aimed at providing any engineer or scientist a taste for some applications of the techniques introduced in this book. Unfortunately, the text only provides a limited discussion of these applications. In general, we would have liked to see more examples of applications in which these techniques are currently being used.

Readers interested in image analysis should note that the authors limit their discussion to one-dimensional systems. These readers may be disappointed that the complicated realities of two-dimensional analysis are not treated. Indeed, the application of Fourier analysis to two-dimensional systems is not as clear as in the one-dimensional case. Hence, practical applications are more difficult to describe and interpret. There is, of course, an obvious and necessary gap between the level of any introductory undergraduate text and the level at which most readers of *Cytometry* are working. This reality makes *Signals and Systems* less useful as a reference book for this audience.

In our opinion, *Signals and Systems* is very well suited as a textbook for an introductory undergraduate course in signals and systems. It provides a sound, logical basis for the development of the commonly used techniques of analysis and synthesis that are found today in many scientific and engineering disciplines. We would encourage teachers using this or any other introductory text to supplement the material from the start with additional specific applications of these basic techniques. We would also encourage the teacher to discuss the concepts of two-dimensional systems and the complications they provide, even at the introductory level.

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