Book Review

Advances in Shannon's Sampling Theory, by Ahmed I. Zayed. Published by CRC Press, Inc., Boca Raton, FL, July 1993

To most shock and vibration engineers, the sampling theorem, usually credited to C.E. Shannon, is that theorem that states the following: if an analog signal is band-limited to a frequency range from 0 to W Hz, then it is completely determined by a series of discrete values spaced ½W seconds apart. It is the basic theorem that dictates the sampling rate needed to accurately convert a measured shock or vibration signal to discrete values for digital data analysis purposes. This book by Zayed shows the implications of sampling theory go far beyond the above simple interpretation and application. Specifically, one of the objectives of the book stated in the Preface is "To provide a moderately concise survey of the present state of knowledge of the subject and to shed some light on the new connections between sampling theory and other branches of mathematical analysis, such as the theory of boundary-value problems, the theory of frames and wavelets and multiresolution analysis of Hilbert spaces." The author achieves this objective very effectively.

The first chapter provides an excellent historic review of the subject, and makes an effort to relate the mathematical terminology used throughout the book to terms more familiar to communication engineers. The second chapter summarizes sampling theory for band-limited signals, including a brief discussion of oversampling. The third chapter presents a series of 28 theorems that provide the foundation for most sampling theory applications. Of particular practical interest in this chapter are the discussions and theorems related to non-uniform sampling, and the various errors associated with sampling, i.e., truncation, aliasing, amplitude, and time-jitter errors. The remaining seven chapters pursue the previously stated objective of the book, and are probably of interest only to applied mathematicians, communication engineers, and analytical engineers concerned with boundary-value problems.

In summary, this book is well written and leaves no doubt that the author is knowledgeable about the subject. Other virtues of the book are (a) the material truly represents the present state of knowledge, as claimed by the author, (b) the author avoids laborious proofs that can be found elsewhere in the literature, and (c) the author is diligent in identifying the origin of various theorems and giving proper credit to their sources. On the other hand, the author is a mathematician, and this fact is strongly reflected in the highly analytical manner in which the material is being presented. Beyond the first three chapters, most shock and vibration engineers will find this book tough reading, and would probably do better with the sampling theory presentations in the more traditional data analysis and signal processing books written by engineers for engineers. Nevertheless, for those engineers with a strong background in applied mathematics and an interest in subjects like the formulation of acceptance functions for shock and vibration prediction purposes, this book might provide some valuable insights into the relation of sampling theory to other analytical problems.

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