



Discrete Fourier Analysis and Wavelets: Applications to Signal and Image Processing

S. Allen Broughton, Kurt M. Bryan

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A thorough guide to the classical and contemporary mathematical methods of modern signal and image processing

Discrete Fourier Analysis and Wavelets presents a thorough introduction to the mathematical foundations of signal and image processing. Key concepts and applications are addressed in a thought-provoking manner and are implemented using vector, matrix, and linear algebra methods. With a balanced focus on mathematical theory and computational techniques, this self-contained book equips readers with the essential knowledge needed to transition smoothly from mathematical models to practical digital data applications.

The book first establishes a complete vector space and matrix framework for analyzing signals and images. Classical methods such as the discrete Fourier transform, the discrete cosine transform, and their application to JPEG compression are outlined followed by coverage of the Fourier series and the general theory of inner product spaces and orthogonal bases. The book then addresses convolution, filtering, and windowing techniques for signals and images. Finally, modern approaches are introduced, including wavelets and the theory of filter banks as a means of understanding the multiscale localized analysis underlying the JPEG 2000 compression standard.

Throughout the book, examples using image compression demonstrate how mathematical theory translates into application. Additional applications such as progressive transmission of images, image denoising, spectrographic analysis, and edge detection are discussed. Each chapter provides a series of exercises as well as a MATLAB project that allows readers to apply mathematical concepts to solving real problems. Additional MATLAB routines are available via the book's related Web site.

With its insightful treatment of the underlying mathematics in image compression and signal processing, *Discrete Fourier Analysis and Wavelets* is an ideal book for mathematics, engineering, and computer science courses at the upper-undergraduate and beginning graduate levels. It is also a valuable resource for mathematicians, engineers, and other practitioners who would like to learn more about the relevance of mathematics in digital data processing.

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