

# Preface

Transforms occupy an important compartment of an engineer's tool kit for solving signal processing and polynomial computation problems efficiently. By resolving a time-varying signal into sinusoidal components, engineers transform a problem from that of studying time domain phenomena to that of evaluating frequency domain properties. These properties often lead to simple explanations of otherwise complicated occurrences. Further, polynomial arithmetic can be implemented efficiently in the transform domain.

In contrast to the Fourier transform based approaches where a fixed window is used uniformly for a spread of frequencies, the wavelet transform uses short windows at high frequencies and long windows at low frequencies. In this way, the characteristics of non-stationary disturbances can be more closely monitored. In other words, both time and frequency information can be obtained by wavelet transform. Instead of transforming a pure *time description* into a pure *frequency description*, the wavelet transform finds a good promise in a *time-frequency* description.

Due to its inherent timescale locality characteristics, the discrete wavelet transform (DWT) has received considerable attention in digital signal processing (speech and image processing), communication, computer science, and mathematics. Wavelet transforms are known to have excellent energy compaction characteristics and are able to provide perfect reconstruction. Therefore, they are ideal for signal/image processing. The shifting (or translation) and scaling (or dilation) are unique to wavelets. Orthogonality of wavelets with respect to dilations leads to multi-grid representation.

The nature of wavelet computation forces us to carefully examine the implementation methodologies. As the computation of DWT involves filtering, an efficient filtering process is essential in DWT hardware implementation. In the multistage DWT, coefficients are calculated recursively, and in addition to the wavelet decomposition stage, extra space is required to store the intermediate coefficients. Hence, the overall performance depends significantly on the precision of the intermediate DWT coefficients.

The book presents new sequential and parallel implementation techniques of DWT that are efficient. Efficiency of proposed techniques is in terms of computation requirement, storage requirement, and reconstructed signal with better signal-to-noise ratio. Applications to signal denoising power quality prediction are discussed.

Efficient Algorithms for Discrete Wavelet Transform  
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Systems

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