

Preface

The thesis comprises of five chapters including an introductory chapter which primarily attempts to offer broad foreground to study our problem by providing the fundamentals of wavelet transform and the literature survey relevant to the proposed problems. The rest of the thesis is divided into two parts. In the first part (chapter 2), some results related to multidimensional wavelet transforms have been presented, while the second part (chapter 3, 4 and 5) is focused on construction of signal-dependent wavelets (matched wavelets) with their applications in some engineering problems.

The work presented in chapter 2 generalizes the conventional approach to the multidimensional wavelet transform with positive scales to the case of both positive and negative scales with respect to its inversion. We propose and prove a wavelet inversion formula for $f \in L^2(\mathbb{R}^n)$. It is shown that the dilation parameter a can be chosen to be in \mathbb{R}^n with none of the components a_j vanishing in contrast to the approach chosen by Daubechies and Meyer who restricted a to be in \mathbb{R}^+ . Further, we prove that if f and $\psi_{a,b}$ are continuous in \mathbb{R}^n , then the convergence, besides being in $L^2(\mathbb{R}^n)$, is also pointwise in \mathbb{R}^n . We have also shown that when f and ψ both belong to $L^2(\mathbb{R}^n)$ then the convergence of the wavelet inversion formula is pointwise at all points of continuity of f . This result significantly enhances the applicability of the wavelet inversion formula to the area of image processing.

In Chapter 3, need of signal-dependent wavelets (matched wavelets) is discussed. We also review the algorithm proposed by Chapa *et al.* (2000) for designing a wavelet matching to a specified signal and further modify it towards establishing application in some engineering problems.

Chapter 4 presents a method for inrush and fault detection for differential protection of power transformer. Matched wavelets have been constructed for both the inrush and the fault waveforms and further used as the mother wavelets in wavelet transform

technique to analyse the output from a power transformer for distinguishing the inrush currents and fault currents. The simulated results show that the proposed technique facilitates good discrimination between magnetizing inrush and fault currents in transformer protection.

In chapter 5, a wavelet transform based method for compression of ECG signal has been presented. A wavelet matched to a cycle of an ECG signal in least squares sense has been constructed and further employed for compression using discrete wavelet transform. For performance measure, Percent Root Mean Square Difference (PRD) and Compression ratio (CR) results are obtained and presented. The results of ECG signal compression show better compression performance with matched wavelet compared to other mother wavelets.