ABSTRACT

Today, successful applications of image processing concepts can be found in many fields like astronomy, biology, defence, medicine, nuclear science and satellite imaging etc. In all these fields scientists are mainly faced with problem of recovering original images from incomplete and noisy images. Many spatial filtering techniques were developed to retrieve the original image from noisy observations. During the last decade, the Wavelet transform has proven to be a valuable tool in image denoising and enhancement. This thesis deals with the application of Wavelet transform in image denoising and enhancement.

Image denoising is a process to improve the quality of an image corrupted by noise. The objective of noise removal is to remove or suppress the noise while preserving the integrity of the edges. A good and effective denoising technique should not smooth the edges of an original image. But in practice, removal of noise without blurring the image edges is a difficult task. The Wavelet transform is an important tool for this problem due to its energy compaction property.

The Wavelet transform divides an image into many subbands. Many thresholding techniques like Hard Thresholding, Soft Thresholding and Semi-soft Thresholding were developed to threshold the wavelet coefficients in the subbands to remove coefficients due to noise. The effectiveness of these thresholding techniques mainly based on the threshold value. Many methods were found in literature to find an optimum threshold value. This thesis discusses about an optimum threshold value used to remove Additive White Gaussian Noise (random noise), based on the
analysis of statistical parameters like Arithmetic Mean, Geometric Mean and Median Average Deviation of the subband coefficients. Since many such statistical parameters are used, the threshold value is adaptive to subband coefficients, level of decomposition and nature of the image. This threshold value is used in Soft Thresholding technique to remove Additive White Gaussian noise. The performance of this threshold estimation process is tested with different types of Wavelet transforms like Discrete Wavelet Transform, Double Density Wavelet Transform and Dual Tree Complex Wavelet Transform.

One more Wavelet based method is also developed to remove speckle noise which is a major problem in images obtained through Synthetic Aperture Radar (SAR). SAR is an active microwave sensor that transmits microwave and detects the wave that is reflected back by the objects. Since SAR is completely different from passive optical sensors, it is not affected by cloud cover and variations in solar illumination. The coherent microwave illumination, however, generates a multiplicative Speckle noise that corrupts the images. A Stationary Wavelet Transform based shrinkage function is developed to remove this Speckle noise from SAR images.

Moreover Wavelet transform is experimented in enhancing medical images like Computed Tomography (CT), Magnetic Resonance (MR), X-Ray and Mammogram images. A Stationary Wavelet Transform based edge enhancement technique is developed, which combines with Tegear’s operator and High Boost filtering technique. This method is tested with poor contrast MR and CT images to enhance the hidden information, which is important for proper diagnosis. One more
method for enhancing the overall gray scale of the medical images like X-Ray and Mammogram is framed. It is found that this method improves the overall visual perception of the image by enhancing the contrast, brightness and sharpness of the image.