ABSTRACT

Image Denoising is an important pre-processing task before further processing of image like segmentation, feature extraction, texture analysis etc. The purpose of denoising is to remove the noise while retaining the edges and other detailed features as much as possible. This noise gets introduced during acquisition, transmission & reception and storage & retrieval processes. As a result, there is degradation in visual quality of image. The noises considered in this thesis are Additive White Gaussian Noise (AWGN) and Impulsive Noise.

Wavelets play a major role in image compression and image denoising due to the property of sparsity and multiresolution structure. Wavelet Thresholding is another important technique in wavelet domain filtering. Some spatial-domain and transform-domain image filtering algorithms and wavelet thresholding algorithm have been developed in this thesis to suppress Additive White Gaussian noise (AWGN) and Impulse noise.

In literature, many efficient image filters are found that perform well under low noise conditions. But their performance is not so good under moderate and high noise conditions. Thus, it is felt that there is sufficient scope to investigate and develop quite efficient but simple algorithms to suppress moderate and high power noise in images.

The present research work is focused on *developing efficient filtering and -thresholding algorithm based on wavelet to suppress AWGN and Impulse Noise under moderate and high noise level quite effectively without yielding much distortion and blurring. The performances of the developed algorithms/methods are compared with the existing methods in terms of Peak Signal to Noise Ratio (PSNR) and Execution Time (TE).*

The thesis comprises the research contribution for denoising standard images namely

1. Improved wavelet domain algorithm- Neighbourhood Pixel Filter Algorithm (NPFA)
2. Enhancing performance-Adaptive Sub-band Thresholding (AST) Technique
3. Modified switching median filter-Switching Weighted Adaptive Median (SWAM) Filtering Algorithm
4. Hybrid technique- Filtering and Thresholding Algorithm (FTA)-MRI (Brain Image)

The approaches adopted and the novel algorithms designed are summarized here as follows:

A filter called Neighbourhood Pixel Filter (NPF) is developed to suppress the Gaussian noise effectively. This filter behaves like a low pass filter in smooth region by decreasing noise variance effectively and giving similar weights to all its neighbouring pixels. This in turn cuts off only high frequency noise signal instead of all noisy signals. After implementing NPFA, it is observed that this method out performs the other wavelet

method under moderate and high noise level with an average PSNR value of 46.87 dB and minimum execution time TE 0.1196 ms operating on Lena image under various noise conditions.

An Adaptive Subband Thresholding (AST) technique is developed based on wavelet coefficients in order to overcome the spatial adaptivity which is not well suited near object edges, where the variance field is not smoothly varied by producing effective results. From simulation and results it is observed that AST technique outperforms the other existing wavelet domain methods under moderate and high noise level by possessing average PSNR value of 27.06 dB and minimum execution time TE 0.206 ms operating on Lena image under various noise conditions.

A new filter called Switching Weighted Adaptive Median Filter (SWAM) is developed for effective suppression of Impulse Noise. This filter is designed by determining the appropriate window length initially based on the width of the Impulse Noise present in the input signal and on the amount of corrupted pixels. Due to this the unwanted filtering of uncorrupted pixels and blurring are reduced even at high density noise.

A hybrid method for MRI-Brain Image restoration is developed by combining AST technique based on wavelet coefficient along with NPFA called Filtering and Thresholding Algorithm (FTA).