Name of Scholar: **Kashif Khan**

Name of Supervisor: **Prof. Khalil Ahmad**

Department: **Mathematics**

Title of the Thesis: **"Applications of Wavelets in Signal Processing"**

Keywords: *wavelet transform, wavelet packet transform, thresholding, speech signal, local contrast, adaptive mean.*

The discovery of wavelets (small waves) was a result to search a function, which generates the space of square integrable functions over the real line. They have advantages over traditional Fourier methods in analysing physical situations where the signal contains discontinuities and sharp spikes. Wavelets were developed independently in the fields of mathematics, quantum physics, electrical engineering and seismic geology. Interchanges between these fields during the few last years have led to many new wavelet applications such as speech denoising, image denoising, image compression, turbulence, human vision, radar and earthquake prediction.

In the present thesis we have carried out a systematic study of wavelets, wavelet packets and their applications in speech and image processing. The thesis as such has been classified into five chapters. Chapter-0 gives a brief survey of speech and image processing, which motivate us for the applications in speech denoising and image denoising.

Wavelet functions provide a new class of orthogonal expansions in $L^2(\mathbb{R})$, comprise a family of building block functions, localised in time and offer more flexibility than Fourier transform in representing different types of signals. In Chapter-1, in order to choose appropriate threshold value we have applied median threshold estimator in wavelet packet domain. To find the optimal threshold value we have considered the threshold value of the detailed wavelet coefficients at each decomposition level and then taking the average of these values, which retain maximum possible signal coefficients and remove much more noisy

coefficients. Experimental results show the performance of the proposed method.

In Chapter-2, we propose an image denoising algorithm based on local contrast and adaptive mean in wavelet transform domain. To evaluate the threshold value, we have applied the concept of local contrast and ∂-neighbourhood which we call it adaptive mean at different level of decompositions. Daubechies wavelet with five vanishing moments (Db5) is used as a mother wavelet to decompose the image into four levels. To evaluate the performance of the proposed algorithm peak signal to noise ratio at different standard deviation is computed. The result obtained is compared with existing methods and it is found that proposed algorithm gives better result. Also, it reduces the computational time.

In Chapter-3, an image denoising technique based on wavelet decomposition of image signal is proposed. An optimum threshold value is estimated by computing the minimum error between detailed coefficients of noisy image and denoised image. The present technique can effectively remove the noise. To evaluate the denoising performance of the present technique, mean square error (MSE) is computed at different noise levels. The simulation is done using MATLAB 7.0 version.

In Chapter-4, an image denoisigng method based on wavelet packets decomposition is proposed. To choose optimal threshold value we have considered a basic assumption. Since noise in the image signal is additive white Gaussian noise that has a constant power spectral density (psd) for all frequencies. Hence, the fixed global threshold is employed when noisy image is analysed in each scale. A very popular wavelet proposed by Daubechies (db4) is used as mother wavelet. To evaluate the performance of the proposed method mean square error is computed for different values of SNR. The result obtained is compared with Anjum Khan’s method and it is found that the proposed method gives better result.