CHAPTER 1

INTRODUCTION

1.1 IMPORTANCE OF IMAGE FUSION

Medical image fusion is the process of combining relevant information from several images into one image. The final output image provides more information than any other single images. The use of image fusion techniques has gained significant popularity over the past decade. It is improved with the development of digital image processing and image analysis technology. Further, more information provided by different modalities may be in agreement or in complementary nature. Image fusion combines perfectly registered images from multiple sources to produce a high quality fused image with spatial and spectral information. Its algorithm can be categorized into different levels low, middle, and high or pixel, feature, and symbolic levels. The Pixel Level image fusion is to take the average of the two images pixel by pixel. However, this method usually leads to unwanted side effect such as reduced contrast. The feature level algorithms typically segment the image into contiguous regions and fuse the regions together using their properties. The features used may be calculated separately from each image or they may be obtained by the simultaneous processing of all the images. Decision level Fusion algorithms combine image descriptions to the fused image, such as in the form of a relational graph. The main objective of image fusion is to obtain a better visual understanding of certain phenomena, and to introduce or enhance intelligence and system control functions.
Image fusion consists of putting together information coming from different modality of medical images, but registration consists of computing the geometrical transformation between two data sets. This geometrical transformation is used to resample one image data set to match other. An outstanding registration is set for an outstanding fusion. It integrates complementary information from various modalities based on specific rules to give a better visual picture of a scenario, suitable for processing. This is to recognize the disease and complementary fusion is useful in many Medical applications.

1.2 IMPORTANCE OF IMAGE DENOISING

Image denoising is a fundamental problem in the field of image processing. It is still considered as an interesting but challenging problem in image processing field. Digital images are often affected by random noise arising in the image acquisition process. The image obtained after transmission is often corrupted with noise. The received image needs processing before it is used in applications. In general, noise removal is essential in medical imaging applications in order to enhance and recover fine details that may be hidden in the data.

Noise is commonly present in an image which is undesired information that contaminates the image. In the image denoising process, information about the type of noise which is present in the original image plays a significant role. Noise in imaging systems is usually either additive or multiplicative. Typical images are corrupted with noise modeled either in a Gaussian, uniform, or salt and pepper distribution. Another typical noise is the speckle noise, which is multiplicative in nature.
1.3 NECESSITY FOR IMAGE COMPRESSION

An image comprises pixels of uniform size. Since all pixels have the same dimension, a pixel can be identified by its colour and position. Hence any image can be described by listing the colour and position of its pixels. A common characteristic of most images is that the neighboring pixels are correlated and therefore contain redundant information. If a group of neighboring pixels is of the same colour it is more efficient to use a single description of the region. By replacing such pixels with their average the image can be distorted only slightly, and the representation will be more compact. This is the basic concept of image compression. It reduces the amount of data required to represent a digital image. The reduction process is the removal of redundant data.

Image compression requires considerable amount of storage capacity and transmission bandwidth to transmit multimedia material in compressed form. This makes transmission slow and time consuming. The recent growth of data intensive multimedia based web applications has not only sustained the need for more efficient ways to encode signals and images but has made compression of such signals central to storage and communication technology. There are three main characteristics by which one can judge image compression algorithms. The compression ratio is equal to the size of the original image divided by the size of the compressed image. Compression time and decompression time are defined as the amount of time required forcompressing and decompressing a picture, respectively. Fast compressing time increases the speed with which material can be created. Fast decompression time increase the speed with which the user can display and interact with images. Image quality describes the fidelity with which an image compression scheme recreates the source image data. Some image
compression schemes may be either lossy or lossless, depending upon the quality level preferred by the user.

1.4 NEED FOR CURRENT STUDY

Image fusion is one of the most modern, correct and useful diagnostic techniques in medical imaging today. The new technology has made a clear difference in patient care by compressing the time between diagnosis and treatment. The scope of image fusion is to integrate complementary information from multimodality images so that, the new images are more suitable for the purpose of human visual observation and computer processing. Therefore, the task of image fusion is to make many salient features in the new image such as regions and their boundaries. Image fusion is important in many different image processing fields such as satellite imaging, remote sensing and medical imaging. The wavelet fusion algorithm also succeeded in both satellite and medical image fusion applications.

Image denoising is a procedure in digital image processing aiming at the removal of noise, which may damage an image during its acquisition or transmission, while retaining its quality. Thus, the necessary of denoising is the first step to be taken before the data is analyzed. It is necessary to apply an efficient denoising technique to compensate for such data corruption. Here the different transform was used for denoising problem.

Uncompressed multimedia (graphics, audio and video) data requires considerable storage capacity and transmission bandwidth. Despite rapid growth in mass storage space, processor speeds, and digital communication systems performance, demand for data storage capacity and data transmission bandwidth continues to outstrip the capabilities of available technologies. Compression is the science of reducing the amount of data used to convey information. It is used for the transmission of the data over today’s
band limited network or for the storage constrained applications. The compression reduces the storage and network costs of the data since the data must be decompressed before it can be processed.

1.5 OBJECTIVES OF THE THESIS

The proposed research work focuses on the following objectives:

- To obtain a high resolution image and to extract more features as possible in a single image for the sake of diagnosis.

- To solve the issue of where there is no single modality provides both anatomical and functional information and to assists physicians in extracting features that may not be normally visible in images produced by different modalities.

- To remove the noise while retaining as much as possible the important signal features.

- To decrease irrelevance and redundancy of the image data in order to store or transmit data in an efficient form.

1.6 ORGANIZATION OF THE THESIS

The thesis is divided into seven chapters. The organization of the thesis is as follows:

Chapter 1 presents an introduction of image processing application like Image Fusion, Image Denoising and Image Compression for medical image analysis.

Chapter 2 deals with the available survey of literature in the existing image fusion, image denoising and image compression techniques
using wavelet, ridgelet, curvelet and contourlet transforms along with wavelet based ridgelet transform, wavelet based curvelet transform and wavelet based contourlet transform.

**Chapter 3** describes image fusion using wavelet, ridgelet, curvelet and contourlet transforms along with wavelet based ridgelet transform, wavelet based curvelet transform and wavelet based contourlet transform and the performance is compared. The algorithm is tested with MedPix database and real time database images.

**Chapter 4** explains image denoising using wavelet, ridgelet, curvelet and contourlet transforms along with wavelet based ridgelet transform, wavelet based curvelet transform and wavelet based contourlet transform and the performance is compared. The algorithm is tested with MedPix database and real time database images.

**Chapter 5** presents with image compression using wavelet, ridgelet, curvelet and contourlet transforms along with wavelet based ridgelet transform, wavelet based curvelet transform and wavelet based contourlet transform and the performance is compared. The algorithm is tested with MedPix database and real time database images.

**Chapter 6** deals with results obtained in various transforms and discussion on the selection of transforms for different applications.

**Chapter 7** summarizes the research work and provides some suggestions for future work and reference.