6.1 SUMMARY OF THE THESIS

Image registration plays a major role in medical applications. Image registration optimizes the parameters that describe a spatial transformation between the original and transformed images. Medical image registration that are useful in simulation, modeling, and in planning surgical procedures is used to match images from same subject but may be with same or different modalities. The behavior of a similarity measure is influenced powerfully by the imaging modality, image content and differences in image content, geometric transformation, partial image overlap, implementation details and image degradations, such as noise, intensity inhomogeneities and geometrical distortions. Knowing the global behavior of similarity measures under unusual situations is significant as it may help to choose the most excellent similarity measure for a given application and type of images and to forecast the effect of the registration.

To obtain valuable information on the quality of rigid registrations, similarity measures for the analysis of these algorithms have been devised. Three affine registration algorithms based on control points are evaluated using the five similarity measures that are formulated. As such, the quality of the given image registration models are tested by enabling the evaluation of the similarity measures.
The feasibility of the proposed models were demonstrated for five similarity measures on a pair of simulated MRI - T1, MRI - T2 and CT images of three views, frontal, sagittal and / or transaxial images of the brain.

The thesis shows improvements in the existing brain image registration algorithms with various transforms, by performing certain modifications to enhance the registration quality of brain images with WT, APT and AMC techniques. Fast transforms are employed to make the algorithms computationally accurate and robust and also to improve the data alignment. Also application of Genetic Algorithm (GA) for the optimized selection of translation, rotation and scaling values to improve the similarity measures is performed.

6.1.1 Image Registration Algorithm using Fast Walsh Hadamard Transform

The existing brain image registration algorithm (George Lazaridis and Maria Petrou 2006) using Walsh Transform is enhanced by introducing Fast Walsh Hadamard Transform. The brain image registration algorithm using FWHT is compared with existing brain image registration algorithm using WT based on accuracy and robustness. Simulations are implemented by evaluating the quality of registration using the similarity measures like MI, CC, CTR, NSSD and RIU to validate the improvement in registration. Based on the comparative results it is noted that the performance of image registration shows overall improvement during registration of brain images using base 10 FWHT than Base 2, Base 5 and Base 8 FWHT.
6.1.2 **Image Registration Algorithm using Modified Adaptive Polar Transform**

The image registration algorithm (Rittavee Matungka et al 2009) using Adaptive Polar Transform that uses Fast Fourier Transform is modified in this thesis, to enhance registration by introducing Modified Adaptive Polar Transform that uses Short Time Fourier Transform. The algorithm using MAPT is compared with APT based on accuracy and robustness. The effectiveness of registration using MAPT is investigated by observing the similarity measures. Compared to APT, Modified APT shows improvement in performance.

6.1.3 **Image Registration Algorithm using Wang Landau Monte Carlo Technique**

The image registration algorithm (Alexander Wong 2010) using Monte Carlo technique is modified to enhance the registration by introducing Wang Landau Monte Carlo (WLAMC) technique. The brain image registration using WLAMC technique is compared with existing AMC technique. Simulations are implemented by evaluating the quality of registration using the similarity measures to validate the improvement in registration. Based on the comparative results it is noted that the performance of image registration shows overall improvement during registration of brain images using WLAMC than AMC.

6.1.4 **Genetic Algorithm based Fast Walsh Hadamard Transform**

In the techniques presented above, the metrics are evaluated based on values of translational parameters x, y; rotational parameter θ, and scaling parameter s selected on trial and error. The Fast Walsh Hadamard Transform (FWHT) image registration algorithm is optimized to improve
the registration process by initiating Genetic Algorithm technique (Flavio Luiz Seixas et al 2008, Michael Sdika 2008) to provide Optimized FWHT image registration algorithm. Ratio of Image Uniformity (RIU) is resolved to confirm the improvement in registration.

6.2 EVALUATION OF RESULTS

The evaluation of registration results of the monomodal images shows that based on one transformation for translation FWHT, rotation MAPT and scaling WLAMC give good registration results. In case of two combined transformations for translation and rotation FWHT, rotation and scaling MAPT and translation and scaling WLAMC algorithms offer good results and finally for all three combined transformations WLAMC method performs best of all three with respect to accuracy and robustness.

It is observed that multimodal image registration using FWHT Base 8 method is a better transform compared to MAPT and WLAMC method based on accuracy and robustness.

6.3 FUTURE WORK

The following are few suggestions for future work.

- The transformation algorithms used in the research can be extended to small and large size images also. As a future work, the algorithms can be applied for different image formats and performance metrics can be analyzed.

- Image registration techniques discussed in this research study can be applied for other modalities like PET, SPECT, etc,
The techniques may be evaluated by applying additional transformations like shearing and reflection.

The work reported in the thesis could be extended for fusion of brain images.

The techniques may be extended for registration of other objects like heart, kidney, lungs etc.

Genetic Algorithm can also be used to maximize MI for monomodal and multimodal images.

Optimized transformations can also be obtained for MAPT and WLAMC techniques using GA.