ABSTRACT

Image processing methods possibly able to visualize objects inside the human body, are of special interest. Advances in computer science have led to reliable and efficient image processing methods useful in medical diagnosis, treatment planning and medical research. In clinical diagnosis using medical images, segmentation of objects is a critical task due to noise and multi-resolution of objects. The better segmentation can be performed by the integration of useful data obtained from separate images. The images need to be geometrically aligned for better observation. This procedure of mapping points from one image to corresponding points in another image is called **Image Registration**. It is a spatial transform. It is used in computer vision, medical imaging, military automatic target recognition and compiling and analyzing images and data from satellites.

In this dissertation work “**Image Registration**” is used for the segmentation of brain tumors. Currently, cancer is one of the important diseases in the world; both developed and developing nations are suffering due to different causes. In human body, brain is an important organ, controls the function of all other organs. In medical images once object is segmented, the diagnosis and treatment planning can be easily performed by the doctors based on the nature and growth rate of tumors. In this work, active contour segmentation of brain tumors is performed with the aid of registration.
Image registration uses two images. The reference and the sensed image could be different because they are taken at different times (multi temporal), using different devices like Magnetic Resonance Imaging (MRI), Computer Tomography (CT), Positron Emission Tomography (PET), Single Proton Emission Tomography (SPECT) etc. (multi modal) and from different angles (multi-view) in order to have 2D or 3D perspective. **Image registration** is the process of transforming different sets of data into one coordinate system. Registration is necessary in order to be able to compare or integrate the data obtained from these different measurements.

Image registration is performed based on different criteria. Based on the control points, registration can be divided as area based methods and feature based methods. Based on the nature of images they can be classified as rigid (global) and non-rigid (local) methods. In this work, area based automatic rigid and DRLSE (Distance Regularized Level Set Evolution) based non-rigid methods implemented and their performance is compared with the existing similarity metrics.

Registration process is validated using similarity metrics Correlation Coefficient (CC), Sum of Squared Distances (SSD) and Mutual Information (MI). In this work, statistical metric MI is used for the registration of both mono and multi-modal registrations. Further, optimization of registration process is performed using optimization techniques like Gauss-Newton, Simplex and Quasi-Newton etc. The interpolation is performed with bi-cubic method.
The DRLSE based simultaneous segmentation and registration is performed using CT, MRI and PET scans and their performance is compared with the existing energy based variational method. It is observed that DRLSE is outperforming in terms of uses, computational time and maintains more similarity (more MI) than the existing methods.