

# Abstract

*Registration is the determination of a geometrical transformation that aligns points in one view of an object with their corresponding points in another view of that object or another object. It has a diverse range of field in the research community including science, engineering, robotics, computer vision, and image processing. Within these major fields of registration, it has some specific applications in the areas such as stereo vision, remote sensing, image stabilization, video/image compression and coding, tracking, video microscopy, pattern recognition and of course medical imaging. Accurate image registration enhances diagnoses of patients, accounts for changes in morphology of structures over time, and even combines images from different modalities. Our goal is to create a robust, real time, registration solution that may be used on many modalities. To tackle such a computationally intensive and multifaceted problem, at the different levels of the algorithm parallelism has been explored to improve the performance and it has been implemented in the hardware. Hardware based solution for image processing applications is required for high speed portable multimedia devices.*

*To speed up the image registration process, the sub-processes: (parameter computation, transformation, and similarity measure) are needed to speed up. These sub-processes occur iteratively during image registration process. A new method for parameter computation has been developed. The proposed method for computing parameters addresses the issue of the oversampling problem near the image center that occurs during the computation of angular and radial projections which affect the speed of the image registration process. The proposed method computes angular projection considering samples adaptively without converting images in polar coordinate. A LUT based high speed Affine transform algorithm is proposed and its parallel and pipelined architecture implementation is described. This algorithm can rotate the image by any angle. It traverses only one fourth of pixel locations of the image to obtain the transformation of complete image. Computation of MI, required for similarity measurement, has also been sped up by accelerating histogram computation. An efficient non-rigid registration algorithm based on Demons approach is also presented in this thesis addressing the issue of aperture and occlusion problems which limit the accuracy of the registered image. An Affine transform based motion estimation algorithm has been proposed which reduces complexity for computing the Affine parameters by taking a constant matrix during computation of the Affine parameters.*

**Key Words:** Hardware, FPGA, Parallel Processing, Image Registration, Angular Projection, Radial Projection, Demons Algorithm, Affine Transformation.