Chapter 7

Conclusion and Outlook for Future

Over the last two decades image registration has been a very successful topic with variety of applications. Fast and convenient access of data is now possible due to development in digital data archiving and communication. This provides platform for registration of multimodal images in various disciplines. But registration is often a component of an image processing analysis package. Various methods are reported in literature to register images which are in same band.

- The method combining image features with correlation method have many advantageous properties of both feature-based and intensity based. It overcomes the limitation of intensity based method.

- Contour based methods do not use the gray values for matching and hence overcomes the limitations of spatial methods.

- In frequency based method accuracy is more but if we extract image features and then apply Fourier Transform accuracy further increases and hence this method can be effectively used for monomodal image registration.

Image registration is difficult when images are obtained through different sensor types. The novel method based on Radon Fourier approach is proposed for multimodal image registration for correcting rotation, translation and scale. The method has been tested with success on different datasets. Application to the real world data yielded plausible results.

- In multimodal registration, MI technique is a standard reference. However being an area based technique, the MI has principle limitation.

- Combination of MI with Wavelet and RTFT method gain higher robustness and reliability.

Multi-sensor image fusion is a technique to combine the registered images to increase the spatial resolution of acquired low detail multi-sensor images and preserving their spectral information. Various approaches are proposed for different applications. Image quality assessment plays an important role in all applications. Image quality metrics are used to benchmark different image processing algorithm by comparing the objective metrics. In the application of medical image fusion it is observed that, in the methods namely Radon, Fourier, PCA, Laplacian and SIDWT the contents like tissues are clearly enhanced. Other useful information like brain boundaries and shape are almost perfect. These techniques are able to retain edge information without significant ringing artefacts in all applications. These methods are also good at faithfully retaining textures from input images.
• Based on subjective and objective analysis of fused images it is observed that some of the best methods those could be used in all type of applications are SIDWT pyramid, PCA method, Laplacian pyramid, Radon and Fourier method.

• In treatment planning, multimodality image correction offers advantages in terms of tumor delineation, discrimination between necrosis and recurrent disease and evaluation of treatment effect. Therefore, image fusion has become an essential tool for clinical use. Combining morphological (CT, MRI) and functional (PET and SPECT) data improves the possibilities of interpreting 3-D data for medical dosimetry treatment planning. The complexity of image fusion and image registration process requires a solid and consistent algorithm to ensure the accuracy and safety of radiation treatments to the patient. Although complex, the most important message is that the image fusion process is advantageous for patient with cancer and their long term survival.

7.1 Outlook for Future

Image registration is one of the most important tasks when integrating and analyzing information from various sources. It is a key stage in image fusion, change detection, super-resolution imaging, and in building image information systems, among others. Although a lot of work has been done, automatic image registration still remains an open problem. Registration of images with complex nonlinear and local distortions, multimodal registration, and registration of N-D images (where N > 2) belong to the most challenging tasks at this moment. A major challenge in the current literature is to perform population registration on large collections of data sets. Currently available tools pre selects a reference dataset that is template and registers in a pair wise fashion. The computational complexity and accuracy of this approach can be eliminated by performing a simultaneous registration on the whole population. The methods, explored in this thesis have desirable computational speed for achieving population registration. An immediate next step would be to investigate this open problem that may lead to a significant contribution. The functional alignment of the human cerebral cortex is a very promising research area. We consider this area as an important direction for future research. In the future, the idea of an ultimate registration method, able to recognize the type of given task and to decide by itself about the most appropriate solution, can motivate the development of expert systems. They will be based on the combination of various approaches, looking for consensus of particular results.