

Image registration is fundamental in image analysis and has a wide variety of applications. Patient registration, a major concern in traditional radiation therapy, is of even greater importance in tomotherapy where positioning error of less than 2 mm is desired.

A new technique for 3-D image/patient registration is proposed. This technique provides image/patient registration directly from standard tomographic projection files. When dealing with image files, the projections are generated slice by slice by a 2-D Radon transform. The registration in projection space is performed by calculating a Fourier Invariant (FI) descriptor for each one-dimensional projection and then registering the FI descriptor by the Fourier Phase-Matching method.

The performance of the technique developed is the same as or better than that of image-based methods when dealing with translated, rotated, and/or uniformly scaled 2-D image registration. Some preliminary result for the case of 3-D registration is presented. The significant advantages of the new method are as follows: (i) by performing image registration in projection space, the new technique is insensitive to the image noise. (ii) By obtaining patient registration directly from projection data, the image reconstruction is not needed in the therapy setup verification. (iii) By reducing the 2-D or 3-D registration problem to a set of 1-D projections, a shorter computation time is required. (iv) The new technique is an accurate and efficient method for general 3-D image/patient registration.