

Spatial error from brain volume registration with the internal landmark matching technique, ILM, is investigated. The ILM technique uses Procrustes analysis with manually selected homologous point pairs for registering single photon emission computed tomography (SPECT) and magnetic resonance (MR) brain volumes. The registration errors are studied with landmark point set distribution simulations to control the dependence of the translation and rotation errors on different factors. These factors include: the number of point pairs, the error in point pair homology modeled by the full width at half maximum of a 3-D Gaussian error envelope, and the geometry of the configuration of the landmark point sets as they depend on their radius from their centroid. The results of this study are used to interpret the results from studies based on a 3-D brain phantom fitted with external fiducials to provide a basis for true registrations. It is shown from the simulations that the translation and rotation errors are dependent on the number of point pairs and the level of point set homology. The spatial distribution of the rotation error is not homogeneous because of dependence on the radial dispersion of the point set configurations from their centroid coupled with the varying dimensions of the brain in the three cardinal planes.