

Two methods commonly used in radiotherapy for inter-modality image registration are chamfer matching and mutual information (MI). Chamfer matching, though fast (order of seconds) and robust (in terms of convergence), requires user defined or computer generated edges, and is susceptible to noise, which can occur with computer generated edges. MI, though completely automatic, is relatively slow (order of minutes on 800 MHz PC), and convergence is dependent on the initial guess and the optimization method. Here we present a point matching method for inter-modality registration utilizing the Hausdorff measure, which removes outliers based on noise estimation. Our method uses the geometric branch-and-bound approach presented by DM Mount et al. ["Efficient algorithms for robust feature matching", Pattern Recognition, 32(1):17-38, 1999], except that we utilize a novel node processing algorithm that leads to substantially faster search times, which is essential for practical implementation. Given a user specified accuracy and transformation group, this method is guaranteed to either produce a solution within that accuracy, or stop at the nearest candidate if none is available. We tested this method using both rigid and affine transformations, but it can be applied to any group of continuous transformations. For cranial radiotherapy, an automatic feature extraction is used to generate the points (Canny edge detection for portal images, and Laplacian of Gaussian edge detection for radiographs). The advantages of this technique include robustness to noise and local minima, guaranteed convergence, and computational speeds <1 minute for subpixel accuracy using 1200 point pairs with positioning shifts <7.5mm and <7.5°.