

AbstractID: 1955 Title: Receiver Operating Characteristic (ROC) Based Evaluation of Registration Algorithms

Evaluation of image registration results is essential for implementation of automated image registration software as part of the clinical decision making process in medicine. Historically this has typically involved image superimposition, difference images, cross-correlation coefficients where appropriate, computing attractor profiles, etc. Robustness and accuracy of algorithms have been evaluated using “first-try success rate” and comparison with phantom or fiducial markers. Registration errors can occur due to imaging artifacts, out-of-plane shifts (in 2D), anatomical deformations, and optimization trapping in local maxima/ minima. Here we present a novel technique, *registration quality evaluator* (RQE), to quantitatively evaluate registration results. RQE, a decision curve based on an adaptive pattern classifier, is uniquely generated using a reference image and a target image, and is imaging modality, detector and anatomical site specific. A methodology to estimate the performance of RQE using receiver operating characteristic (ROC) analysis is presented. ROC analysis is an effective method for selecting the similarity measure which has good discriminatory ability. RQE uses a cost function to set the optimal sensitivity / specificity based on clinical criteria. This methodology is applied to the case of 2D registration of portal electronic portal imaging with reconstructed radiographs from CT data sets. RQE is used for determining the accuracy of a registration for patient positioning in radiotherapy. It is also used to study the feasibility of using mutual information and cross-correlation similarity measures in intra-modality and multimodality registrations. This methodology can be generalized to 3D imaging and assessment of image fusion.