

AbstractID: 1763 Title: Mutual information based brain MR registration algorithm with simulated annealing for repeat trigeminal neuralgia Gamma Knife radiosurgery

Studies suggest that clinical outcomes are improved in repeat trigeminal neuralgia (TN) Gamma Knife radiosurgery by shifting the second treatment volume relative to the first. To get the projection of the dose distribution of first treatment onto the second magnetic resonance (MR) image set, we propose a fully automatic and robust method and compare our method to a conventional automatic whole brain MR-MR 3-D rigid registration approach. The latter uses Powell's method to optimize the mutual information (MI) objective function. Our method also uses mutual information, but it applies a simulated annealing (SA) technique to obtain the global maximum. Forty-one patients were examined in this study. Our method obtains successful registration results for all 41 cases. Powell's method fails to provide satisfactory registration results for 11 patients (27%). We define the overlapping volume ratio (OVR) as the fraction of the anatomically overlapping volume of two MR images to second MR image volume. Statistical results from a logistic regression procedure demonstrated that the probability of success of Powell's method tends to decrease as the OVR decreases. The rigid registration with Powell's method is not suitable for our TN radiosurgery, where the OVR is likely to be low since only 28 MR slices were used for each patient. This makes Powell's method more likely to trap into local maxima. Compared with Powell's method, the optimization process with SA technique is more robust and more accurate.