AbstractID: 2968 Title: Registration of Prostate MRI/MRSI and CT Studies Using the Narrow Band Approach

Purpose: High-field MR techniques makes possible to obtain high quality MRI metabolic images of the prostate to accurately identify the intra-prostatic lesion(s). However, the use of rigid endorectal probe deforms the shape of the prostate gland and the images so obtained are not directly usable in radiation therapy planning. This work applies a narrow band deformable registration model to faithfully map the MRI information onto treatment planning CT images.

Method and Materials: The narrow band is a hybrid method combining the advantages of pixel-based and distance-based registration techniques, since the calculation is restricted to those points contained in a region around user-delineated structures. The narrow band method is inherently efficient because of the use of a priori information of the meaningful contour data. The deformable mapping is described by the B-spline model. The limited memory algorithm (L-BFGS) was implemented to optimize a normalized cross correlation metric function. It's convergence behavior was studied by comparing final metrics obtained in 100 registrations self-registering an MR image starting from 100 randomly initiated positions. The spatial performance of the algorithm was assessed by intentionally distorting an MRI image and an attempt was then made to register the distorted image with the original one. The MRI-CT mapping was carried out for two clinical cases.

Results: The convergence analysis showed absence of local minima. The technique can restore an MR image from the intentionally introduced deformations with an accuracy of ~2 mm. On clinical cases the method was capable of producing clinically sensible mapping. The whole registration procedure for a complete 3D study took less than 15 minutes on a standard PC.

Conclusion: Both hypothetical tests and patient studies have indicated that narrow-band based registration is reliable and provides a valuable tool to integrate the ER-based MRI/MRSI information to guide prostate radiation therapy treatment.