Purpose: To present a novel joint segmentation/registration for multimodality image-guided and adaptive radiotherapy. A major challenge to this framework is the sensitivity of many segmentation or registration algorithms to noise. Presented is a level set active contour based on the Jensen-Rényi (JR) divergence to achieve improved noise robustness in a multi-modality imaging space.

Method and Materials: The partial differential equation for evolving a level set function was solved using a finite difference scheme incorporating the JR divergence as an energy functional. To reduce processing time the algorithm was implemented on a graphical processing unit. In order to facilitate multiple modalities, joint non-parametric probability estimation was used with a Gaussian kernel. The algorithm was tested under a number of noise conditions and compared to using the mutual information (MI) metric. We evaluated the new algorithm for segmenting the prostate using MR and CT images.

Results: It was found that JR divergence when used for segmentation has an improved robustness to noise compared to using mutual information, or other entropy-based metrics. The MI metric failed at around 2/3 the noise power than the JR divergence.

Conclusion: The JR divergence metric is useful for the task of joint segmentation/registration of multimodality images and shows improved results compared entropy based metric. The algorithm can be easily modified to incorporate non-intensity based images, which would allow applications into multi-modality and texture analysis.