Purpose: In the era of image-guided radiotherapy, there has been increased use of multimodality imaging to accurately define target volumes. However, current methods to define the overall target volume based on multimodality imaging are restricted to manual contouring using visual judgment and limited by lack of semi- or automated segmentation algorithms that can handle multiple images at the same time. Moreover, the problem is compounded by the fact that images from different modalities are typically misaligned. Therefore, in this work we investigate and contrast the performance of sequential registration/segmentation with joint registration/segmentation for optimal target definition from multimodality images.

Methods: For demonstration of the proposed multimodality framework for target definition, we will consider the challenging case of prostate cancer target definition by combining MRI with CT images. The multimodality framework is based on active deformable models with mutual information using a geometric level set objective function with segmentation and registration terms.

Results: Our preliminary results indicate that multimodality image definition of the prostate target volume is improved by using MRI/CT compared to individual definition by either modality. Moreover, joint registration/segmentation produced improved correspondence and agreement with manual contouring compared to sequential registration followed by segmentation. It is also noticed that in this framework the registration correspondence improves weak boundary definition during segmentation while segmentation improves region matching during registration.

Conclusions: This work demonstrates the potential of joint registration/segmentation using deformable active contours for target definition in radiotherapy treatment planning from multimodality imaging.