Segmentation of Pelvic Structures for Gynecologic Brachytherapy

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Purpose – Gynecological cancers, which consist of cervical, endometrial, and vaginal/vulvar cancers, remain the 4th largest cause of death in women in the US since 2010, with reports of 88,750 (5.6% increase) new cases and 29,520 deaths per year in 2012 (6.5% increase) [1]. The standard treatment protocol for these malignancies consists of concurrent chemotherapy and external beam radiation directly followed by brachytherapy. Contouring the cancerous tissue, as well as adjacent organs at risk (OAR), is a routine clinical step. In this contribution, we report on the results of semi-automatic contouring of tumor, the bladder, and the rectosigmoid using the free and open source software package *3D Slicer* (http://www.slicer.org).

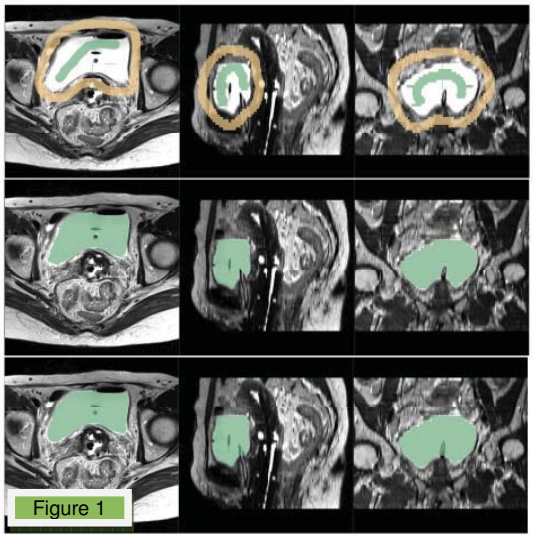

Figure 1

Methods – In this study we used six T2-weighted magnetic resonance imaging (MRI) datasets from a Siemens 3T scanner. A physician carefully manually segmented the tumor, the bladder, and the rectosigmoid in each dataset for reference. We used the *GrowCut* [2] algorithm in *3D Slicer* [3] which is an interactive segmentation algorithm based on the idea of cellular automata to segment each of the structures. In each case, the initialization of *GrowCut* was performed on sagittal, axial, and coronal cross-sections. In this initialization step, parts of the structure to be segmented and parts of the background are marked on the image with the Slicer brush tool (a typical initialization for a bladder is shown in three upper images of Figure 1). The algorithm then automatically computed the contours for the structure.

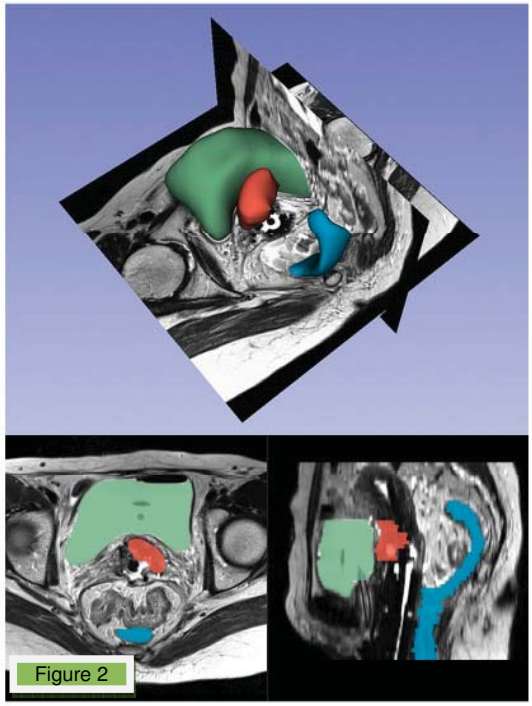

Figure 2

Results – Segmentation of the bladder was successfully performed in all cases, with a Dice Score of 91.94±5.4 compared to expert manual segmentation (second row of Figure 1 shows *GrowCut*, and third row shows manual refinement segmentation). However, *GrowCut* was not able to achieve satisfactory segmentation results for the tumor and the rectosigmoid. Figure 2 shows the results of *GrowCut* segmentation of the bladder rendered together with the tumor and sigmoid from manual segmentation. This is attributable to the heterogeneity in appearance of these structures.

Conclusions – In this contribution, we studied the segmentation of pelvic structures to support the process of automated contouring for gynecologic brachytherapy. Contouring of the bladder was achieved accurately using the *GrowCut* algorithm in *3D Slicer*. However, manual contouring was needed to achieve segmentation results for the tumor and the rectosigmoid. Future work will include the application of additional methods from the literature for these structures [4, 5].

Acknowledgements

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