Rectum Segmentation in MR-guided Gynecologic Brachytherapy Data

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Background

Among all cancer types, gynecological malignancies - including endometrial, vaginal/vulvar and cervical cancers - belong to the 4th most frequent type of cancer among women [1]. Besides chemotherapy and external beam radiation, brachytherapy is the standard procedure for the treatment of these malignancies. In the progress of treatment planning, segmentation of the tumor as the target volume as well as segmentation of adjacent organs of risks is crucial to accomplish an optimal radiation distribution to the tumor while simultaneously preserve healthy tissue. This contribution presents the initial results of contouring the rectum with a novel interactive graph-based segmentation method based on a user-defined template.

Methods

The proposed method uses a graph-based segmentation scheme [2] and extends it to an interactive approach (named *Interactive-Cut*) with a user-defined template. In summary, the scheme creates a directed 2D graph, followed by the minimal cost closed set computation on the graph [3], resulting in an optimal outlining of the rectum. Thereby, the graph's center can be interactively dragged to compute a further segmentation and optimize the result. Figure 1 demonstrates the interactive segmentation process: original dataset (A), interactive moving of the graph's center (B-E) with *real-time* feedback of the rectum contour (red) and resulting segmentation (F) after a satisficing outline of the rectum has been achieved.

Results

Six intraoperative T2-weighted magnetic resonance imaging (MRI) datasets acquired with a Siemens 3T scanner at the Brigham and Women's Hospital (BWH) have been used for this initial study [4, 5]. Segmentation of the rectum could successfully be performed in all cases. For visual side-by-side inspection Figure 2 presents three manual segmentations (A, C and E, blue) and the corresponding interactive segmentations (B, D and F, red). For all segmentations the same template has been used (blue dots in the right images) and no parameter definitions were required from the user. However, a satisficing rectum contour could always be found within seconds for every plane.

Conclusion

In this contribution, we tested a novel interactive graph-based approach – called *Interactive-Cut* – to segment the rectum with a user-defined template. Our long-term objective is to support the time-consuming process of manual rectum outlining for gynecologic brachytherapy and our initial 2D results show already promising results. Areas of future work include a comprehensive evaluation via the Dice Similarity Coefficient (DSC) and an extension of the algorithm to 3D.

Figure 1

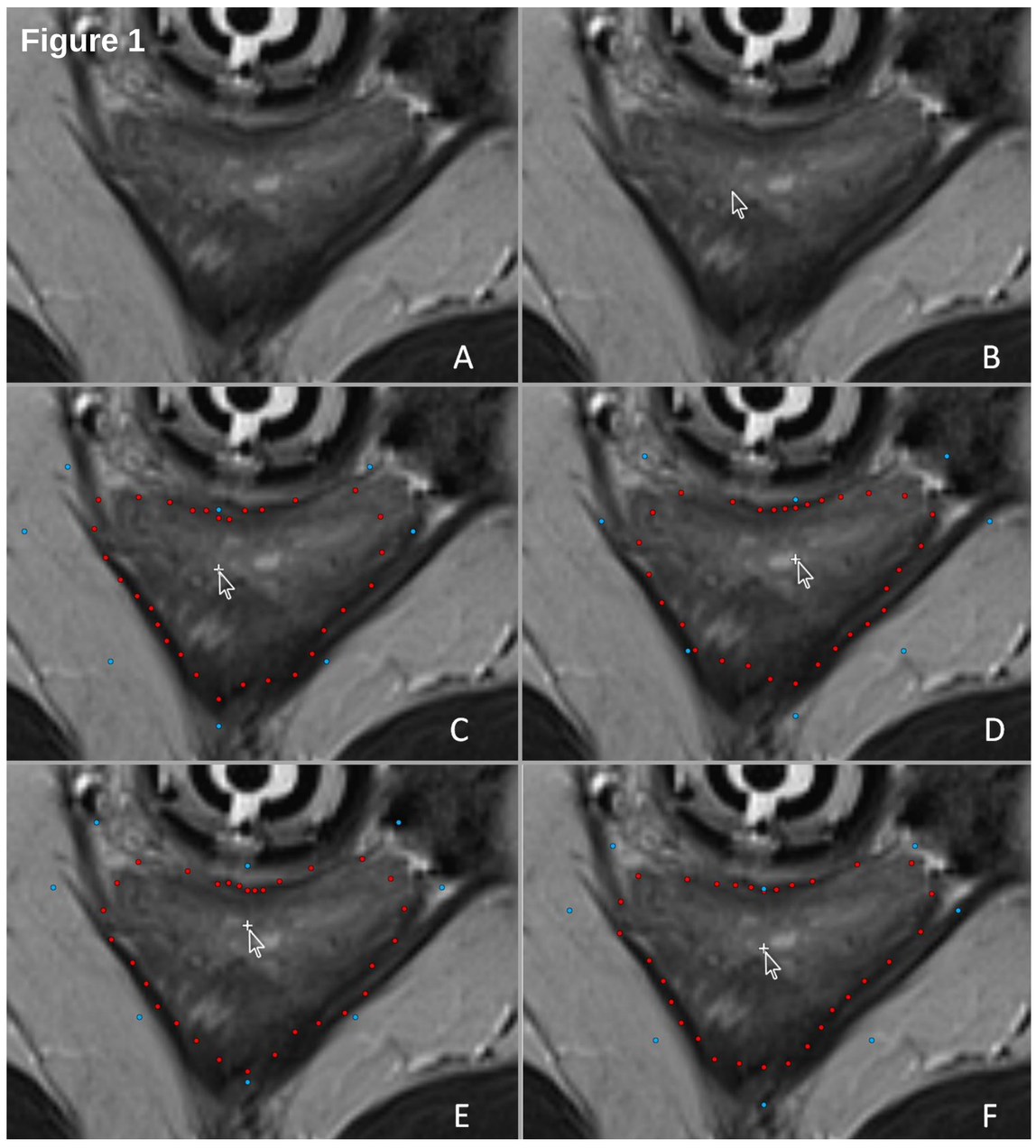
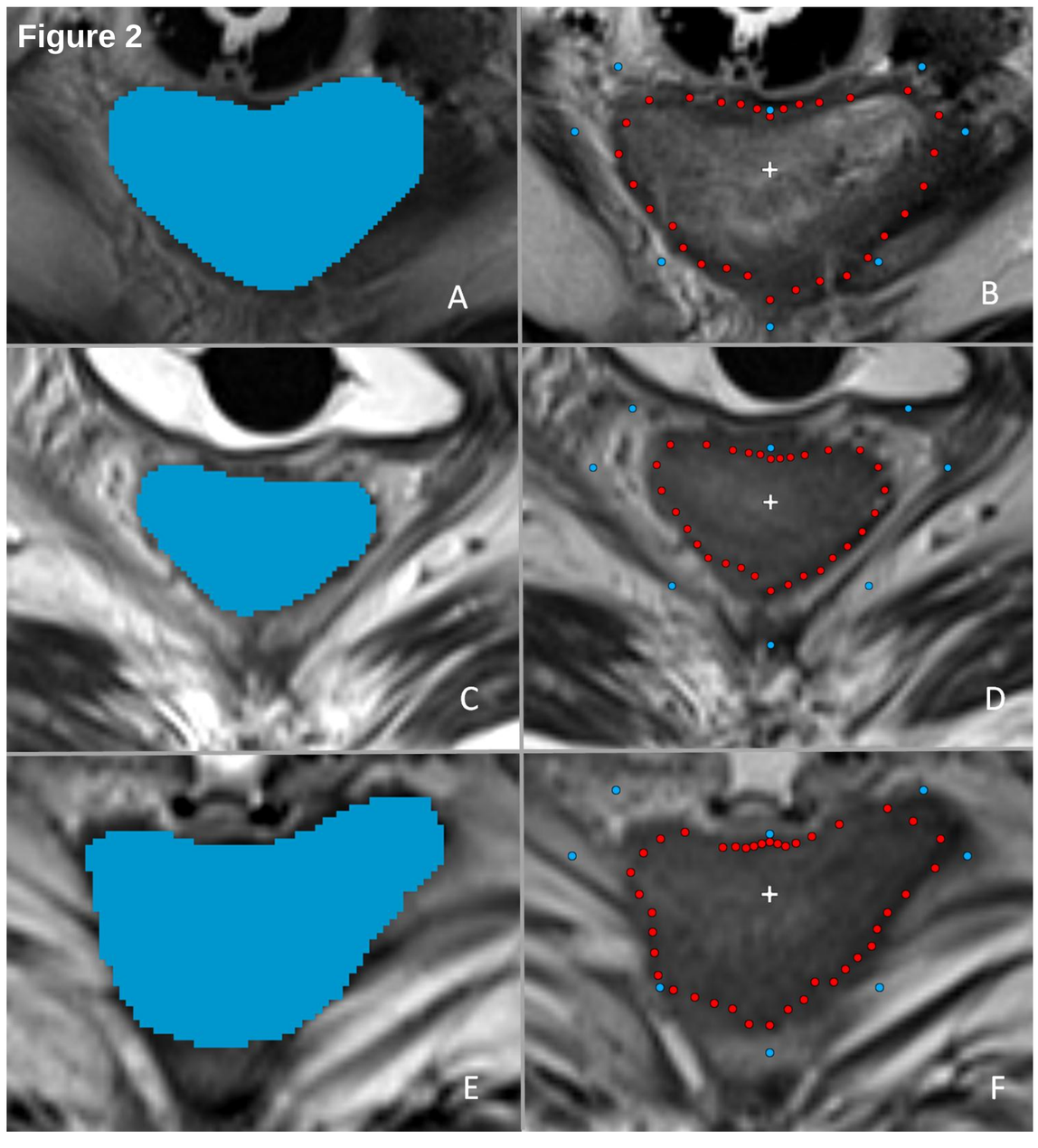


Figure 2



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