Bladder Wall Segmentation in MR Images

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Bladder wall thickness is an important measure for diagnosing conditions such as bladder tumors and endometriosis. To acquire this information, a 3D model of the bladder wall is needed, which requires the segmentation of the inner and outer boundaries of the wall. The bladder wall has distinct appearances under different imaging environment. Currently, MR imaging of bladder and pelvis is preferred in many cases because of its safeness and multi-planar visualization with high imaging quality. In T2-weighted MR images, the low-signal-intensity bladder wall has large contrast to the high-signal-intensity urine and perivesical fat, and therefore can be well identified. In this work, we propose two deformable models to segment the inner and outer bladder wall boundaries in MR images.

Since the tissues around the bladder form a complex image background, the outer bladder boundary is harder to be segmented than the inner boundary; hence, we choose the order to first segment the inner boundary. Due to the influence of noise, results by normal segmentation algorithms may contain unwanted inner boundaries or leak outside. We propose a modified geodesic active contour to handle this problem. The algorithm uses the statistical information of the bladder lumen and allows normal intensity variance of the bladder lumen. To segment the outer bladder wall, a region of interest (ROI) that includes the bladder wall is defined according to the location of the inner bladder wall boundary. In the ROI, the appearance difference between the bladder wall and the perivesical fat is used, and a shape guided vector field is built, based on the shape of the inner bladder boundary and the assumption of minimum bladder wall thickness. A modified Chan-Vese model is then proposed, by which the obtained contour will not overlap with the inner boundary when the bladder wall is blurred.

The bladder wall can be successfully segmented by the proposed models. To test their performance, segmentation examples will be presented and analyzed both qualitatively and quantitatively. Implementation issues and future work will also be addressed.

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