Optimal Graph Search Segmentation Using Arc-weighted Graph for Simultaneous Surface Detection of Bladder and Prostate

Abstract: We present a novel method for globally optimal surface segmentation of multiple mutually interacting objects, incorporating both edge and shape knowledge in a 3-D graph-theoretic approach. Hard surface interacting constraints are enforced in the interacting regions, preserving the geometric relationship of those partially interacting surfaces. The soft smoothness *a priori* shape compliance is
introduced into the energy functional to provide shape guidance. The globally optimal surfaces can be simultaneously achieved by solving a maximum flow problem based on an arc-weighted graph representation. Representing the segmentation problem in an arc-weighted graph, one can incorporate a wider spectrum of constraints into the formulation, thus increasing segmentation accuracy and robustness in volumetric image data. To the best of our knowledge, our method is the first attempt to introduce the arc-weighted graph representation into the graph-searching approach for simultaneous segmentation of multiple partially interacting objects, which admits a globally optimal solution in a low-order polynomial time. Our new approach was applied to the simultaneous surface detection of bladder and prostate. The result was quite encouraging in spite of the low saliency of the bladder and prostate in CT images.