Nested Graph Cut for Automatic Segmentation of Nested Objects and Application to Mouse Embryo Segmentation

We propose a novel, fully-automatic, segmentation method called nested graph cut (NGC) to segment images (2D or 3D) that contain multiple objects with a nested structure. Compared to the multi-object graph cut proposed by Delong and Boykov, our method can work well for nested objects without requiring manual selection of initial seeds, even if different objects have similar intensity distributions and some object boundaries are missing. Promising results were obtained for separating the brain ventricles (BV), head, and uterus regions in the mouse-embryo head images obtained using high frequency ultrasound (HFU) imaging. The proposed method achieved mean Dice similarity coefficients of 88.5±0.04% and 92±0.04% for segmenting BVs and the head, respectively, compared to manual segmentation results by experienced imaging scientist on 40 embryos over 5 mid-gestational stages.