Efficient 3D Neuron Object Segmentation exploiting Level Set Speed Images with High Local Iso-surface Curvature Seeds

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Abstract

The microstructure of dendritic spine of 3D neuron object have great significant in brain cognitive functions[1]. Biologists have been studying the biochemical pathways by examining the morphological and statistical changes of the dendritic spines at the intracellular level. The automatic segmentation is core technology for dendritic spines detection, identification and reconstruction. This paper proposes a novel level set segmentation method for neuron object in 3D fluorescence confocal image. The first step uses the min-max curvature flow filter to smooth and enhance 3D image. In the second step, the critical seeds of neuron object, which correspond to the local ridge or valley points on neuron object, are computed automatically from the local iso-surface curvature extrema. Then in the third step, the fast marching method is used to produce the initial level set speed images with these ridge or valley points. In the last step, the initial level set speed images are passed as input to the shape detection based level set algorithm[2-3] to compute the final 3D neuron object. With the local ridge or valley points on neuron object, our method decreases the computation time by minimizing level set propagation, which converges at the optimal object within a fixed iteration number. Experimental results are demonstrated on 3D fluorescence confocal images and our method is shown to be effective and efficient.

Reference

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