Vertebral Body Segmentation with Prior Shape Constraints for Accurate BMD Measurements

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Abstract:

We propose a novel vertebral body segmentation approach, which is based on the graph cuts technique with shape constraints. The proposed approach depends on both image appearance and shape information. Shape information is gathered from a set of training shapes. Then we estimate the shape variations using a new distance probabilistic model which approximates the marginal densities of the vertebral body and its background in the variability region using a Poisson distribution refined by positive and negative Gaussian components. To segment a vertebral body, we align its 3D shape with the training 3D shape so we can use the distance probabilistic model. Then its gray level is approximated with a Linear Combination of Gaussians (LCG) with sign-alternate components. The spatial interaction between the neighboring voxels is identified using a new analytical approach. Finally, we formulate an energy function using both appearance models and shape constraints. This function is globally minimized using s/t graph cuts to get the optimal segmentation. Experimental results show that the proposed technique gives promising results compared to other alternatives. Applications on Bone Mineral Density (BMD) measurements of vertebral body are given to illustrate the accuracy of the proposed segmentation approach.

Keywords:

VB; BMD; Segmentation; Shape; GC

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