Automated Segmentation of the Pulmonary Vascular Tree in Spiral CT Angiography for Computerized Detection of Pulmonary Embolism

Spiral CT-Angiography (CTA) is increasingly used for the diagnosis of pulmonary embolism. However, radiologists must view more than 50 images in order to detect thrombi in the arteries and distinguish them from artifacts caused by partial volume, heart motion, etc. In this study, we present a new method for automated segmentation of the pulmonary vascular tree in spiral CTA data sets for 3D visualization and computerized detection of pulmonary embolism. Our segmentation method is based on the combination of several 3D operations. First, the lung volume is segmented by thresholding and math-morphological operations. Next, large vascular structures such as lobar branches are extracted using a hysteresis thresholding technique and connectivity analysis. Finally, region-growing is performed in the segmented lung volume using extracted major vascular structures as a seed. Three-dimensional visualization is using the marching-cube algorithm. Automated segmentation was successfully performed on several clinical cases by adjusting a few parameters. In comparison with simple thresholding methods, our technique significantly improved the visualization quality of the pulmonary vessels as a result of the automated removal of bone structures and extraneous soft tissues. Segmented volumes are about 3-4 percent of the total volume data. Therefore, our segmentation method makes the subsequent analysis for detection of pulmonary embolism extremely efficient obviating the need for searching the entire data. Method for detection of the pulmonary embolism using the segmented volume are currently being developed.