Chapter 9
Surface Segmentation: The Case of Bronchus Anatomical Structure

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ABSTRACT

Segmentation is a powerful procedure that could be used to extract relevant information of the images based on advanced techniques (like active contours, region growing, Markov random fields, and medical atlas analysis). For the procedures, the main task is the contour, or volume or surface representation of specific parts of the organs that could be used for the benefit of the patients under doctor evaluation. So, in real cases, the proposed process must be quick, accurate and easy to implement. The segmentation of the organ is another problem that must be considered. More complicated, more demanding the segmentation process. In our case (bronchus segmentation) a quick, effective and easy to implement procedure is proposed based on the combination of boundary tracking and region growing techniques.

INTRODUCTION

Image segmentation is the process of splitting a digital image into one or more regions of interest based on their organ structure (Punam, 2011). Cases where noise, unclear regions, and poor contrast make difficult the process, a human eye must be included.

Segmentation, especially in medical images, is important because based on the resulting reconstruction, the shape of the organ could be used for the measurements of the image classifications. In biomedical image segmentation, there is great interest segmenting three-dimensional anatomical structures from CT, MRI and PET data. General purpose segmentation, on the other hand, is typically a two-dimensional problem. Time complexity and storage complexity are two main problems with the implementation of the process.

From the viewpoint of the diagnosis of the chest, the bronchus is a very important organ, since a lung disease such as a tumor is often concerned with the bronchus. The bronchus has a tree structure

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for sending air to the lungs. It starts from the trachea as the root of a tree. The trachea bifurcates the left and the right main bronchus, which enters the left and the right lung. Bronchial branches are repeatedly split toward the peripheral of the lungs and, finally, connect with alveolus, where gas exchange takes place (Netter, 1997).

Many studies on automatically extracting bronchus regions from 3D chest X-ray CT images have been reported (Mori *et al*., 1995; Sonka *et al*., 1996; Iseki *et al*., 1997; Tsui and Heng, 2000; Schlathoelter *et al*., 2002). Conventional approaches are mostly based on a region-growing method. This work is an extended work of the spinal cord segmentation analysis (Zimeras, 2012).

BACKGROUND

Based on the bronchus morphology, the segmentation procedure includes linear interpolation or B-splines between gap contour reconstructions. The common procedure is the linear interpolation where in the plane of slice i, the surface created between slice pairs 1 - i and I will usually not agree in the normal surface with the surface created between slices i and 1 + i. To avoid discontinuities in the normal surface, more than just two slices, at a given time, must be considered.

Assume that we begin with k sets of constraints, one set for each 2D data slice. Instead of considering the contours in pairs, we place the constraints for all of the k slices into 3D simultaneously. Specifically, the constraints of slices i are placed in the plane z = si, where s is the spacing between planes. Once the constraints from all slices have been placed in 3D, we invoke the implicit function interpolation once to create a single implicit function in 3D for the complete set of contours (Karangelis, 2004).

Figure 1. Implicit surface interpolation