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LUNG LOBAR SEGMENTATION USING TUBULAR TISSUE DENSITY FROM MULTIDETECTOR-ROW CT IMAGES

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Abstract. *In evaluating thoracic function, it is effective to segment the five lung lobes from multidetector-row computed tomography (MDCT) images. Almost all of the conventional methods are based on extracting the lobar fissures; however, some parts of the fissures may not be observed from MDCT images due to CT artifacts and/or adhesions between the lung lobes. This article proposes an alternative method for segmenting the lung lobes. It is based on tubular tissue density, and is not based on lobar fissure extraction. The tubular tissues are the peripheral blood vessels and peripheral bronchi. Because tubular tissues do not exist on the boundary between the lung lobes, our method determines the boundary by finding a continuous three-dimensional space in which tubular tissues are absent. The boundary determination process is automatically performed using fuzzy control. The proposed method was applied to five normal subjects, one patient with chronic obstructive pulmonary disease, and one patient with emphysema. The absolute mean error of detecting lobar boundaries was 3.4 mm and that the volumetric accuracy for the proposed method was an absolute ratio of 3.8 and 5.9% for inspiration and expiration, respectively. The proposed method is also applicable to MDCT images in which the lobar fissures cannot be distinguished.*

Keywords: Lung lobes, Image segmentation, Multidetector-row computed tomography, Fuzzy control

1. **Introduction.** The human lung is composed of five lobes. The right lung is segmented into three lobes, while the left lung is segmented into two lobes. There are important differences among the individual lung lobes with respect to structure and function [1], especially for the purpose of assisting preoperative planning of living-donor lobar lung transplantation (LDLLT), in which the lung lobes of two living donors are transplanted into a recipient, and for which the measurement of the individual lung lobe volumes is an important factor in selecting suitable donors [2,3]. Therefore, segmenting the lung lobes on chest multidetector-row computed tomography (MDCT) images can provide useful information in terms of describing lung structure and function. In addition, segmenting the lung lobes will help locating lung cancers, for example, detected by [4].

Almost all of the conventional methods employed in segmenting lung lobes based on CT images extract lobar fissures to determine a boundary between the lung lobes [5-8]. The lobar fissure exists on the boundary between lung lobes and has a thin surface structure. The lobar fissures are generally observed on chest MDCT images as thin curved surfaces that have slightly higher CT values than the surrounding parenchyma; it is therefore difficult to extract the lobar fissure on MDCT images using a simple image-processing