Automatic Lung Segmentation Improvement using a Registration Framework

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I. Introduction

In this work, we presented a method to improve the conventional lung segmentation on cases with severe pathologies automatically by taking advantage of lung shape and anatomic information. True lung boundaries from the conventional results are detected and a registration method is employed to match the feature points to a template/lung atlas.

II. Methods

A. Conventional Lung Segmentation and Error Detection

The conventional lung segmentation method proposed by Pu et al. is applied as a first step. The conventional method can obtain good results on normal cases, thus no further improvement is required for these cases. The purpose of error detection is to find if the conventional lung segmentation is correct.

B. Landmarks and Feature Points Detection

Though the conventional lung segmentation methods may fail to obtain the correct lung volume, they might get some parts of the lung boundaries correctly. We aim to find these boundary locations as more as we can and regard the boundary points as feature points for further registration procedure.

B.1 Rib Segmentation. Ribs are stable landmarks in CT examinations. The detected “lung boundaries” are believed to be true lung boundaries if they are near to ribs.

B.2 Lung Bottom Lines Detection. A normal lung bottom is a smooth curved plane in space. On the coronal view and sagittal view, a normal lung bottom can be regarded as a smooth curved line.

B.3 Boundaries near the other lung. If the boundaries between left lung and right lung are close enough they can be regarded as true lung boundaries. For each boundary voxel in right lung, if we can find a left lung boundary voxel close to it we add both voxels to the feature point set.

C Registration

An elastic registration method is employed to match the above detected feature points to the boundary of a predefined template.

1. J. Pu, J. Roos, C. A. Yi, S. Napel, G. D. Rubin, and D. S. Paik, “Adaptive border marching algorithm: Automatic lung segmentation on chest CT images,” Atmos. Technol. 32(6), 452–462 2008.