**Fully Automated Extraction of Airways from CT Scans Based on Self-Adapting Region Growing**

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### Introduction

A fast and reliable extraction of the airway tree is of fundamental importance for many clinical applications like a noninvasive 3D measurement and quantification of airway geometry, computer-assisted bronchoscopy or emphysema quantification. Low dose CT scans and ultra low dose scans are increasingly utilized in lung screening studies. Lowering the radiation exposure increases the amount of noise in the CT images, hence it increases the demands on fast and reliable airway extraction methods. So far, there have been no perfect extraction techniques, however events like EXACT09 are important for comparing and improving different airway extraction methods. We present a method for fully automated extraction of airways from volumetric computed tomography (CT) images based on a self-adapting region growing process. Former versions of our method have been used extensively in many clinical studies.

### Results

The images used in this challenge were volumetric chest CT scans acquired at different sites using several different scanners, scanning protocols, and reconstruction parameters. The images were divided into two sets: a training set (CASE01-CASE20) and a testing set (CASE21-CASE40). We used the training set in order to slightly modify our existing method so that it was able to cope with the exact data. The datasets range from clinical close to ultra low dose scans, from healthy volunteers to patients with severe lung disease, and from full inspiration to full expiration. Table 1 documents the results achieved with our method for the 20 cases in the testing set. An average number of 130.1 branches were detected in the datasets (mean value for all participating teams: 124.0). The mean value for the leakage volume was the mean value for all teams: 769.5 ± 390.4 mm³. The average runtime on a PC (Intel Xeon CPU, 2.83 GHz, 4GB RAM) per case of the testing set was 183.3 ± 39.3 s for Step 1 and 2 and 44.4 ± 8.0 s for Step 3. Fig. 6(c) shows CASE22, where the greatest number of branches were determined. Fig. 6(c) shows CASE22, where the greatest leakage volume was measured.

### Conclusion

We presented a method for fully automated extraction of airways from CT Scans. Our proposed method was able to extract the bronchial tree fully automatic in all 40 datasets. Our implemented leakage detection is just based on the number of added voxels by a single region growing process - this simple rule should be improved, shape features can be used for this purpose. This should allow the segmentation of more peripheral bronchi. The rules for the detection of smaller airways in step 3 should be reworked and additionally more than the 3 main cutting planes (axial, sagittal, coronal) should be used for the decision-making process. Furthermore, 2D airway detection should be applied to a dataset and the results connected to the 3D segmentation. This can help to detect airway stenoses. Our method worked well on the challenging datasets of EXACT09, nevertheless we have gathered valuable information for our future work. Generating a common database covering a wide range of possible CT scans is an important step for improving and comparing different airway extraction methods.

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**Literature**


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**Further Information**

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