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Airway Segmentation in CT Scans

ABSTRACT - Masterthesis

Lung diseases and other lung related disorders are becoming increasingly common in western societies. Such diseases include influenza, pneumonia, tuberculosis, lung cancer and many other breathing disorders. To diagnose such diseases, a bronchoscopy may be performed, where the surgeon examines the airway (bronchi) tree. To plan such a bronchoscopy, a virtual bronchoscopy (in which the bronchoscopy is virtually conducted) is often performed. These virtual bronchoscopies require a segmentation of the airway tree for path planning, rendering and quantitative analysis. Airways are observed in CT data as circular objects with a low intensity center region, and a higher intensity wall. The contrast between wall, lung volume and the low intensity center are strongly dependent on the X-ray dose used for the acquisition of the data.

In this thesis we detect airways by employing a circle fitting procedure applied to a diffused gradient field. This results in an airway tree skeleton from which the volume is reconstructed by using an inverse gradient vector flow tracking tube segmentation algorithm as proposed in [18]. We manually determine the optimal parameter sets for this algorithm, by employing reference segmentations, which were available for a sub-set of the data.

Since the performance of such an algorithm depends heavily on the data presented to it, we characterize the data in terms of its quality by employing blind image quality assessment procedures.

In the final stage we establish a coupling between the optimal algorithm parameter set and the image quality characterizing parameters, aiming at an optimal adaptation by employing image quality characterizing features.

Our results show that such a coupling exists, but that further research is necessary to enhance the procedure.

[18] Bauer C., Bischof H., Beichel R. "Segmentation of the airways based on gradient vector flow", in: Proc. of Second International Workshop on Pulmonary Image Analysis, 2009