

AUTOMATIC LUNG SEGMENTATION

We are looking for motivated student(s) for a **Master Thesis or IDP project** in automated lung segmentation from abdominal CT-scans. The project is held between the Image-based Biomedical Modeling group at the TUM Institute of Medical Engineering (IMETUM) and the Institute for Computational Mechanics from the Mechanical Engineering Department.

MOTIVATION

Acute respiratory distress syndrome (ARDS) is type of respiratory failure characterized by rapid onset of widespread inflammation in the lungs. The primary treatment involves mechanical ventilation together with treatments directed at the underlying cause [1]. In current clinical practice, the ventilation mechanism is tuned manually, however the optimal conditions for given patient are not known.

The Institute for Computational mechanics is developing elaborate computational models to predict optimal mechanical ventilation designed for patient individual conditions. These models depend on patient-specific lung anatomy extracted from the CT-scans. For clinical application, the segmentation methods must be robust and automated.

In the past several lung segmentations methods were designed. A recent review [1] provides a summary of the existing methods. However, these methods are designed either for healthy lungs or lungs affected by diseases that do not significantly alternate the lung appearance. In contrast, lungs afflicted with ARDS exhibit significant variations due to collapsed lung regions (atelectasis, cf. Figure 1, red arrow) or presence of liquid inside the lungs. In such cases, standard, intensity-based segmentation methods cannot be applied.

The goal of this project is the development and investigation of different approaches for automatic lung segmentation from CT-scans as a first step towards a robust segmentation pipeline to be applied in clinics.

PROJECT OBJECTIVES

- Create data-set to evaluate performance of various image segmentation approaches in patients with ARDS
- Investigate performance of existing segmentation method, e.g. shape-based machine learning method as well as deep learning approaches
- Update existing methods to account for ARDS
- Evaluation of different developed approaches

REQUIREMENTS

- Good programming skills: Python, Unix
- Knowledge of image processing
- Experience with machine learning
- Experience with deep learning (TensorFlow, PyTorch)
- Desire to learn

REFERENCES

- [1] *Acute Respiratory Distress Syndrome: Advances in Diagnosis and Treatment*. Eddy Fan, Daniel Brodie and Arthur S. Slutsky, JAMA, (2018)
- [2] *Overview of current lung imaging in acute respiratory distress syndrome*
Maurizio Zompatori, Federica Ciccarese, Luca Fasano, European Respiratory Review, 2014, 23 (134) 519-530;
- [3] *Segmentation and image analysis of abnormal lungs at CT: current approaches, challenges, and future trends*, Awais Mansoor, Ulas Bagciand Foster, Brent Foster et al, RadioGraphics 2015.

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