Thesis outline

Chapter 1: Introduction

- 1.1 Motivation
- 1.2 Aim
- 1.3 Thesis overview

Chapter 2: Background

2.1 Introduction of IPF

- 2.1.1 Definition
- 2.1.2 Disease classification

2.2 Epidemiology, etiology, pathogenesis

- 2.2.1 Epidemiology
- 2.2.2 Etiology and pathogenesis

2.3 Diagnosis

- 2.3.1 Clinical presentations
- 2.3.2 Radiographic features
- 2.3.3 Histopathology
- 2.3.4 Diagnosis criteria

2.4 Natural prognosis

- 2.4.1 Stable or slowly progressive course
- 2.4.2 Acute exacerbations of IPF

2.5 Complications and comorbidities

- 2.5.1 IPF and emphysema
- 2.5.2 IPF and pulmonary hypertension

2.6 physiological changes

- 2.6.1 Alterations in the mechanical properties of the lung
- 2.6.2 Alternations in pulmonary gas exchange

Chapter 3: Automatic pulmonary lobar segmentation from CT scans

2.1 Background

- 2.1.1 Aim of pulmonary lobar segmentation
- 2.1.2 Challenges of automatic pulmonary lobar segmentation from CT scans

2.2 Review of current published methods of pulmonary lobar segmentation

- 2.2.1 Lung segmentation
- 2.2.2 Fissure detection

2.3 Automatic statistical shape model based lobar segmentation method

- 2.3.1 Lung segmentation
- 2.3.2 Statistical finite element models of lung and fissure shape
- 2.3.3 Initial prediction of lobar location in an individual

- 2.3.4 Multiscale Hessian-based fissure detection
- 2.3.5 Interactive user control interface

2.4 Experiments

- 2.4.1 Testing CT dataset
- 2.4.2 Experiments and results
- 2.5 Discussion

Chapter4: Quantitative analysis of idiopathic pulmonary fibrosis

abnormalities from CT scans

4.1 Background

- 4.1.1 Challenges of IPF diagnosis
- 4.1.2 Advantages of quantitative analysis from HRCT

4.2 Review of current published methods of quantitative analysis of lung abnormalities

4.3 Methods: quantitative analysis of IPF lungs

4.3.1 Tissue classification of IPF lungs

Imageing and clinical data

Pulmonary parenchymal classification

Normalization of classified data

4.3.2 Tissue quantification of IPF lungs

Density analysis

Spatial distribution analysis

The change of tissue pattern over time

4.3.3 Volume analysis of IPF lungs

The change of whole lung volume over time

The change of tissue volume over time

Lobe volume difference between old normal lungs and IPF lungs

4.3.4 SSM based shape analysis of IPF lungs

Shape difference between IPF lungs and old normal lungs

Relationship between lung lobe shape and fibrosis extent

- 4.4 Discussion
- 4.5 Summary

Chapter5: Computational modeling of IPF lung function

- 5.1 Respiratory system in old people
- 5.2 Patient-specific modeling of IPF
 - 5.2.1 Geometry of lung shapes

Relationship between lung function and lung shape

SSM based shape prediction of old normal lungs

Geometry of IPF lungs

5.2.2 Geometry of airway and vessel trees

Upper airway and vessel tree digitizing Upper airway and vessel tree mapping Full airway and vessel tree generation

- 5.2.3 Labeling of disease regions
- 5.2.4 Modeling parameterization
- 5.2.5 Simulation of ventilation

Deep breath

Normal breath

- 5.2.6 Simulation of perfusion
- 5.2.7 Simulation of gas transfer

PaO2

MIGET

5.3 Discussion

Chapter6: Conclusions