Multiscale Computational Modelling of Human Lung: Unsteady CFD and Beyond

Dr Yongmann Chung

School of Engineering and Centre for Scientific Computing
University of Warwick, United Kingdom

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Contents

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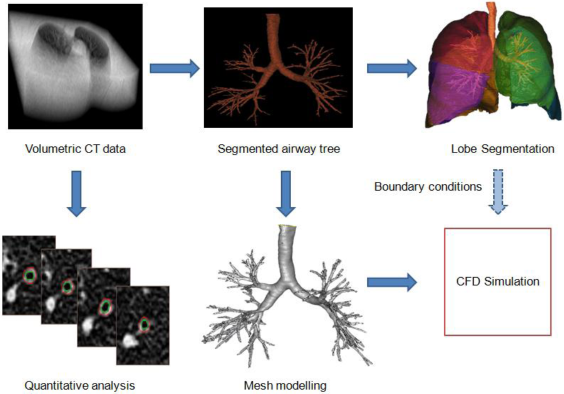
CT Image analysis and processing

- 3D segmented airway tree, lobar anatomy, and volume mesh generation
- Geometry and simulation parameters



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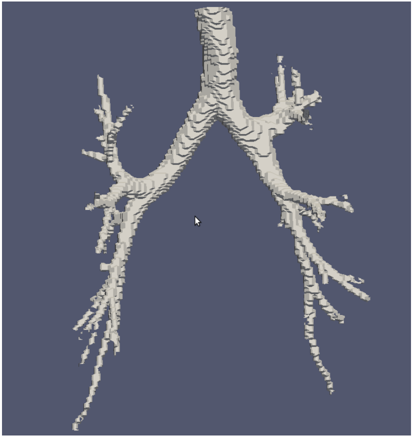
CT Image analysis and processing

Voxel data from CT image

- Not suitable for CFD - resolution of $0{,}5mm^3$
- Good geometry or novel numerical method



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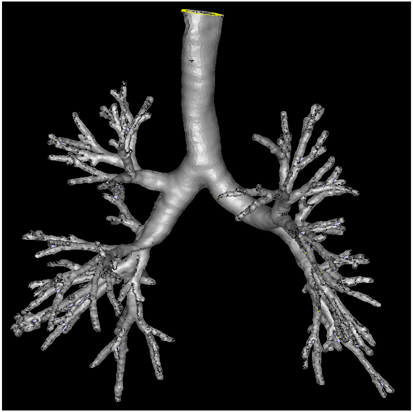
Patient-Specific Airway Model

CFD Geometry

- Volume mesh model of the segmented airway tree
- Modelling up to 6-8 generations of airways



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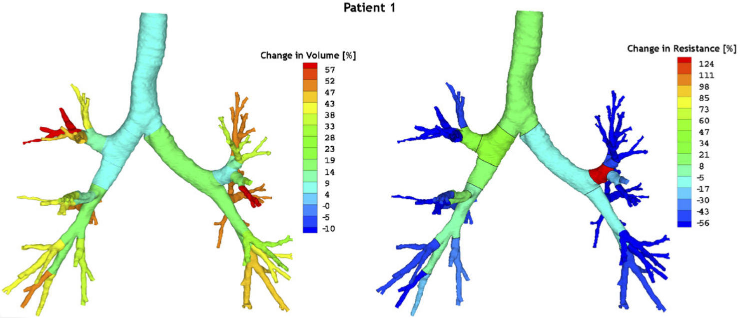
Airway CFD

CFD Results

- Changes after treatment
- Volume — Resistance



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Challenges

CFD capability

- Flexible wall effect
- Variable airway diameter
- Breathing cycle - change in lung volume
- Boundary condition - upper airways modelling

Multiscale modelling

- Currently, only modelling up to 6-8 generations of airways
- Imaging data for lower airways is generally not attainable
- Gas transfer in alveoli - acinar flow modelling

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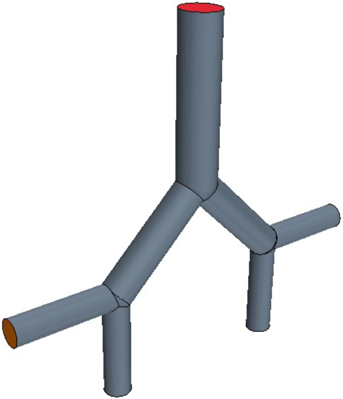
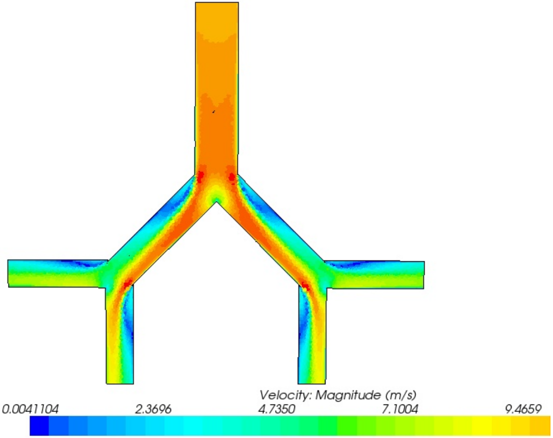
Simple 3D Airway Model

- Simple 3D Weibel model up to 11 generations
- 1D airway tree centrelines and 2D surface mesh



Simple 3D Airway Model

- 3D flow field



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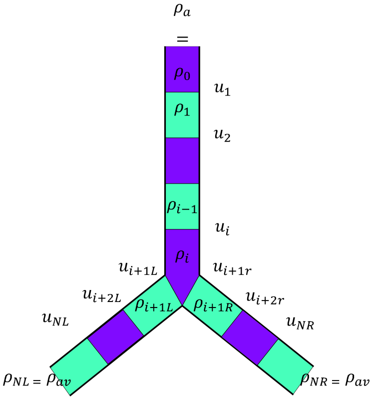
1D Airway Model

- 1D volume-filling model for higher generations



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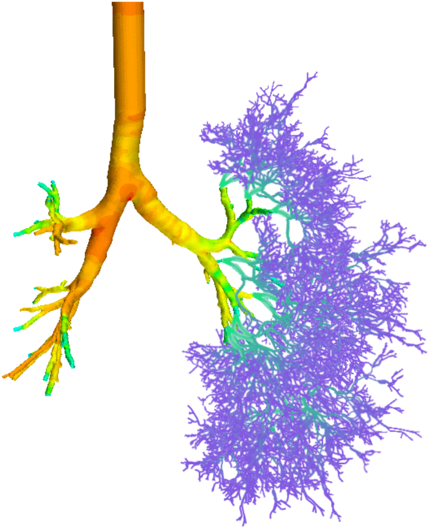
Patient-Specific 3D/1D Airway Model

- Patient specific CT scan + 3D simple model + 1D Weibel model



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The End

Thank You!

Collaboration with:
Professor Chris Brightling (Institute for Lung Health, UK),
Dr Jan De Backer (FluidDA, Belgium),
Dr James Jewkes (Curtin University of Technology, Australia),

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