

# IMBL USER CASE STUDY:

## An end to end overview of lamb lung data

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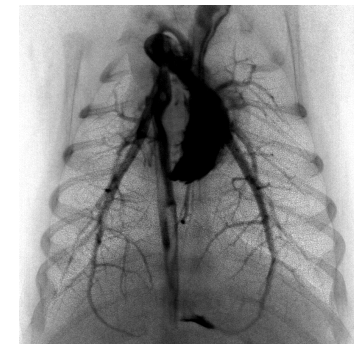
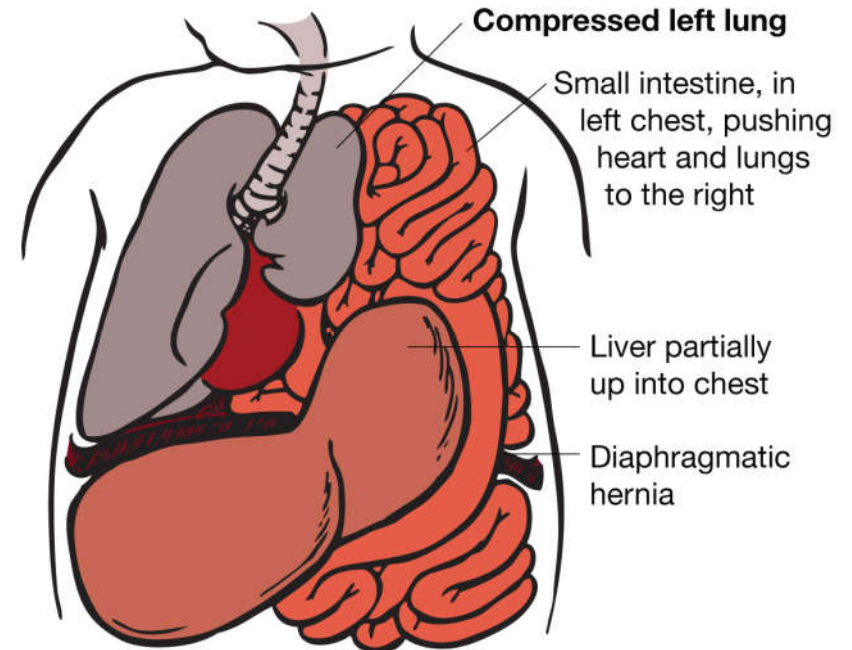
Prof Stuart Hooper  
Dr Ryan Hodges\*  
Dr Kelly Crossley  
Dr Philip DeKoninick  
Dr Erin McGillick  
Dr Marta Thio-Lluch\*  
Dr Shigeo Yamaoka  
Alison Moxham\*  
Karyn Rodgers\*  
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\* not pictured



Dr Marcus Kitchen  
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Katie Lee

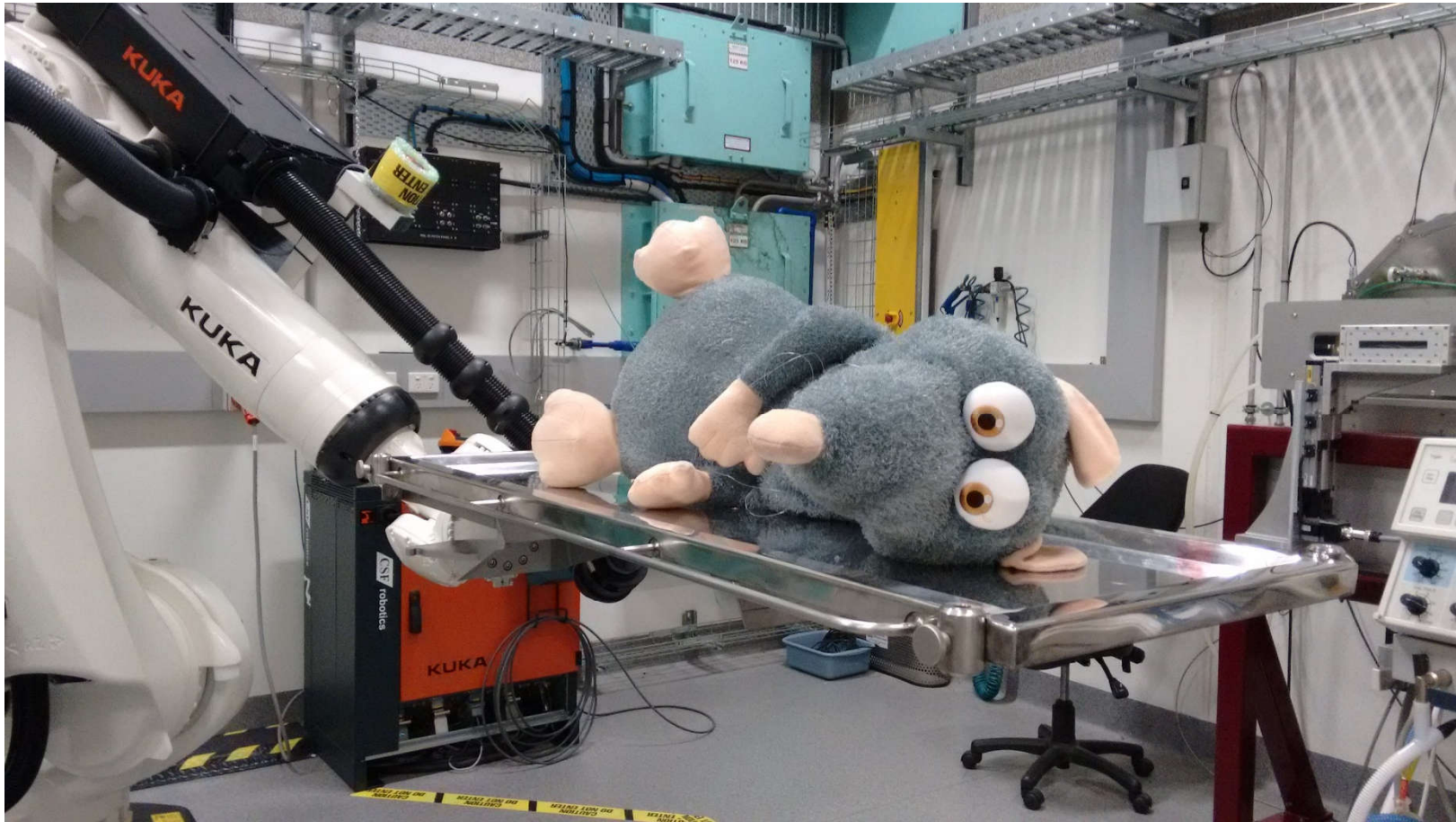
Dr Mitzi Klein  
Dr Chris Hall  
Dr Andrew Stevenson\*  
Dr Anton Maksimenko\*

- Newborn lambs
- Hernia model
  - underdeveloped lungs
  - high blood pressure
- Testing the effect of sildenafil
  - shown to work in small animals
  - unknown in large animals
- X-rat CT of excised lungs
  - MICROFIL<sup>®</sup> contrast agent in the blood vessels to make them look black



An iodine based  
contrast agent

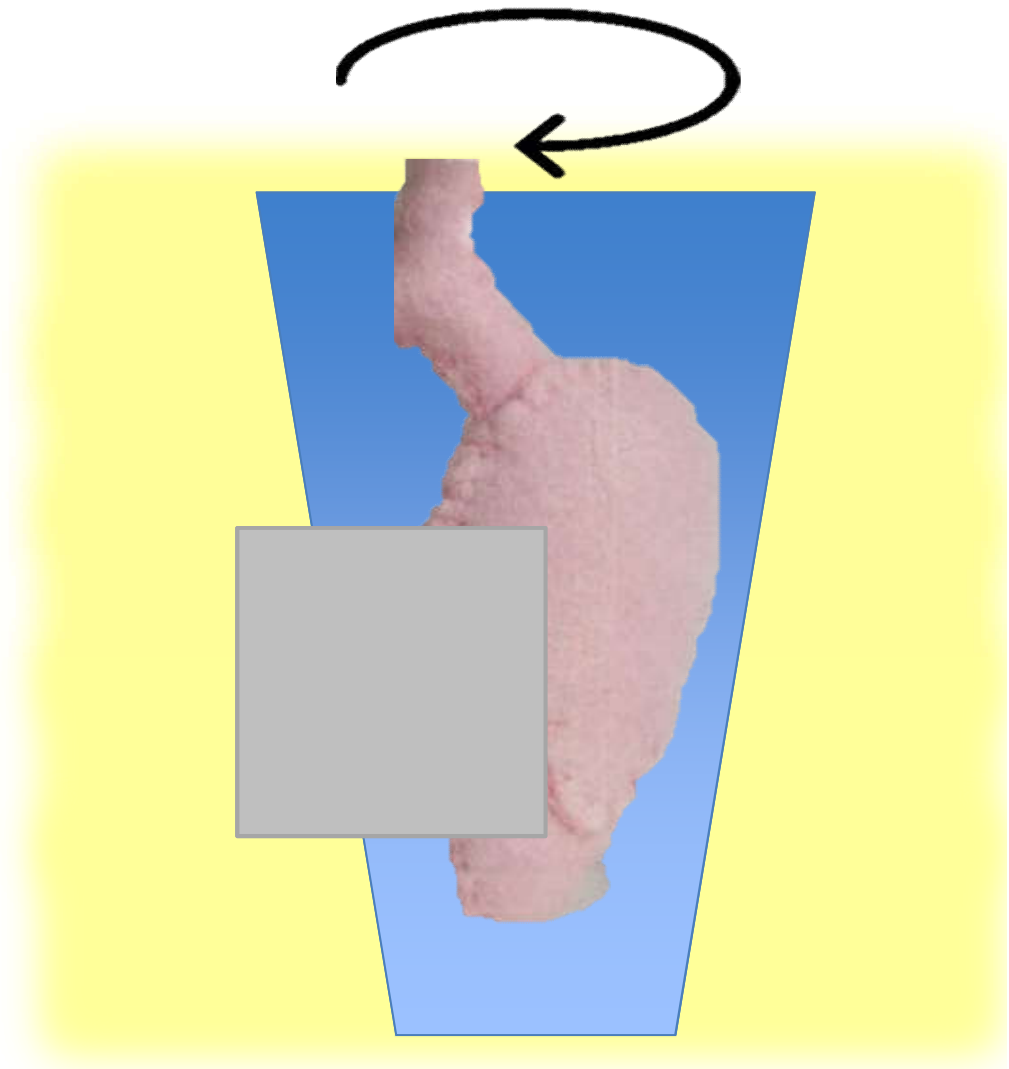
# AQUIRING THE IMAGES



Featuring Ratatouille (the unofficial IMBL mascot) in Hutch 3B.

## OK, REALLY: ACQUIRING THE IMAGES

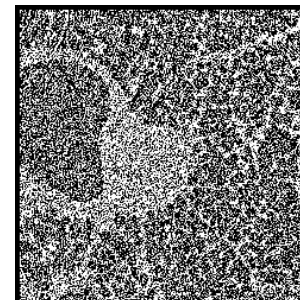
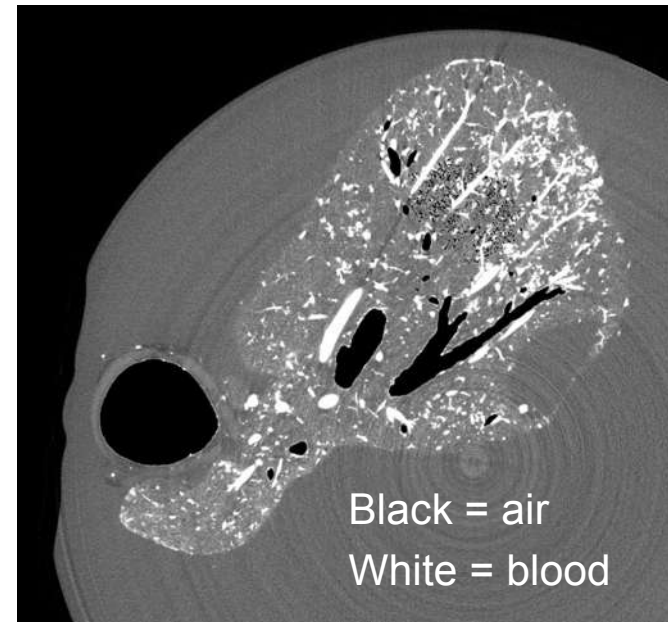
- Hutch 3B, 135 metres from the source
- Beam width  $\sim 300$  mm
- **Beam height  $\sim 30$  mm**
  - we'll need to do 5 CT scans
- **Detector field of view is not wide enough**
  - we'll need a  $360^\circ$  rotation
  - with some of Anton's trickery!



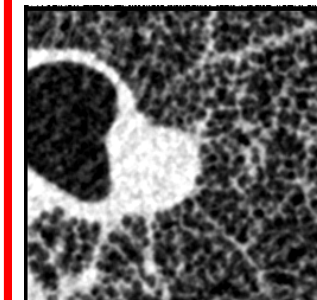
Now you could take your data and go home.  
But you'd be missing out!

- **MASSIVE** supercomputer
  - has a huge amount of processing power
- **Fiji/ImageJ**
  - can automate your drudge work with scripts
- **X-TRACT**
  - for CT reconstruction
  - improve signal to noise with phase retrieval
- **Powerful visualization software (Avizo, Drishti)**
  - quantitative analysis tools
  - create animations for presentations

- ImageMagick scripts to flip and stitch projection images together (thanks Anton!)
- CT reconstruction using X-TRACT on MASSIVE
  - lots of artefact correction options available
- Finally, vertically join each of the 5 CT scans to get the whole 3D lung volume
- Phase retrieval algorithms (X-TRACT) can dramatically improve soft tissue contrast!



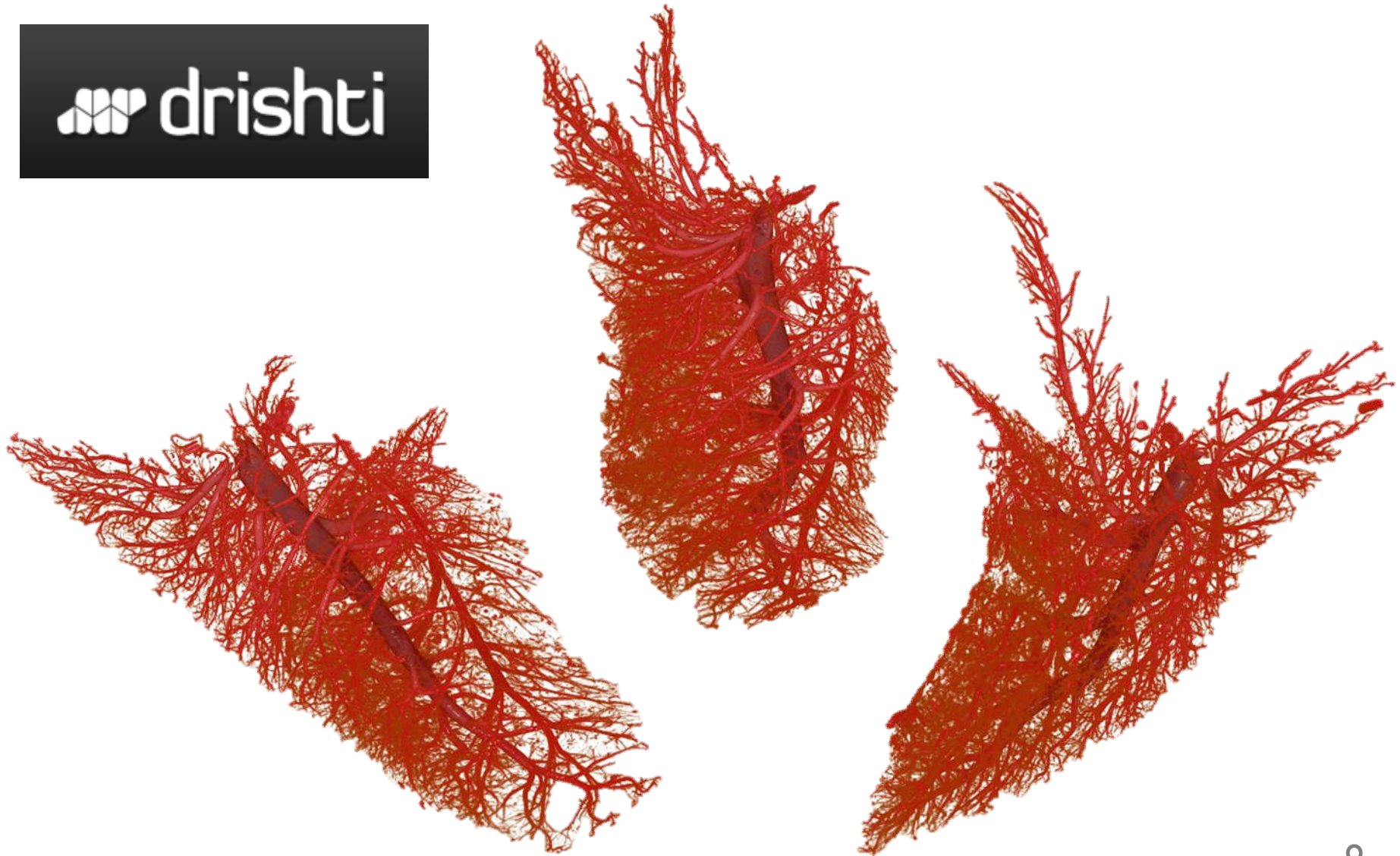
Original



Phase retrieved

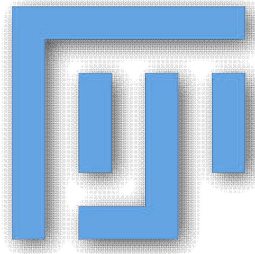
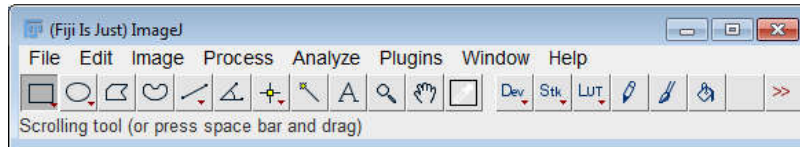
# VISUALIZATIONS WITH DRISHTI

 drishti

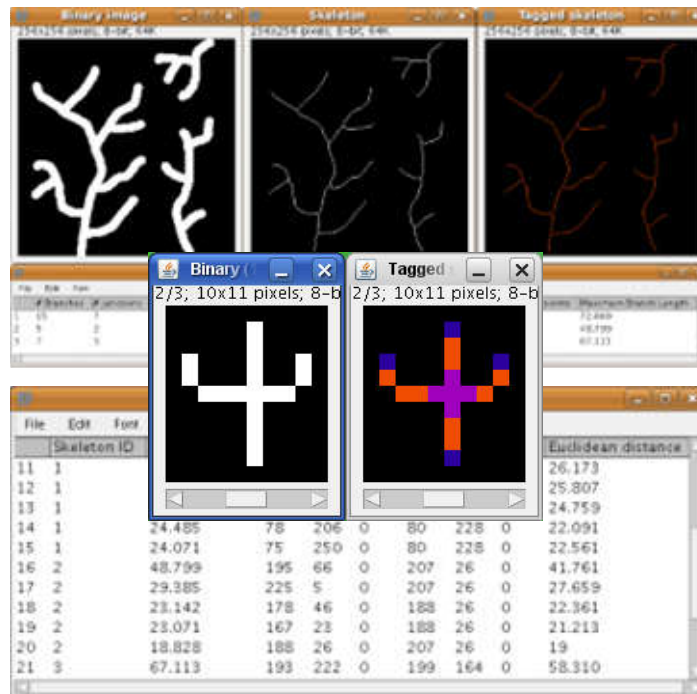


- It's pretty, but what can we do with it?
- Physiologists want to look at the diameter of the smallest blood vessels – also the most challenging to see clearly!
- Quantitative measures:
  - blood vessel diameters
  - average branch length
  - average branching angle
  - number of generations in tree structure
  - etc.
- Be careful you don't 'drown in data'

# QUANTITATIVE ANALYSIS



Analyze Skeleton  
plugin



- Auto Skeleton
- Centerline Tree

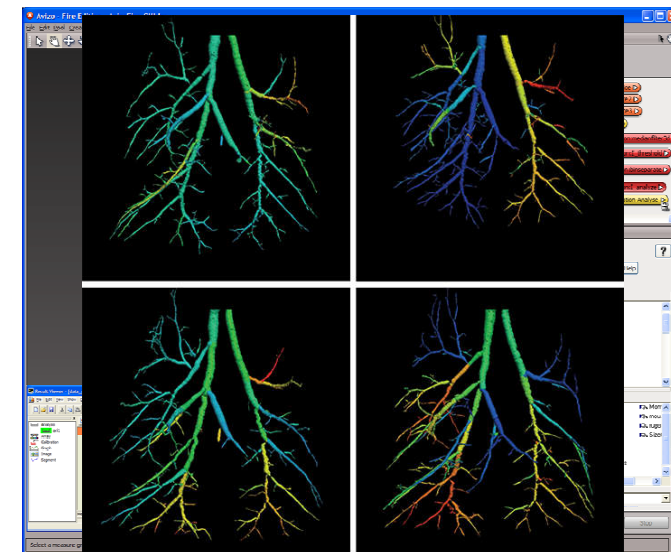


Image credit: Fouras group

- Laboratory for Dynamic Imaging, Monash
- 4Dx, med-tech start-up company

## THINGS TO REMEMBER

- Flexible CT & imaging system
- Talk to the IMBL staff before your experiments
- Take advantage of the MASSIVE supercomputer
  - Quantitative analysis done faster
  - XTRACT for CT reconstructions (and phase retrieval algorithms)
  - Visualisations with Drishti / Avizo
- Use scripts to automate data collection, and data analysis



Animation created with Drishti

Credit: Katie Lee (Monash University) 11



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