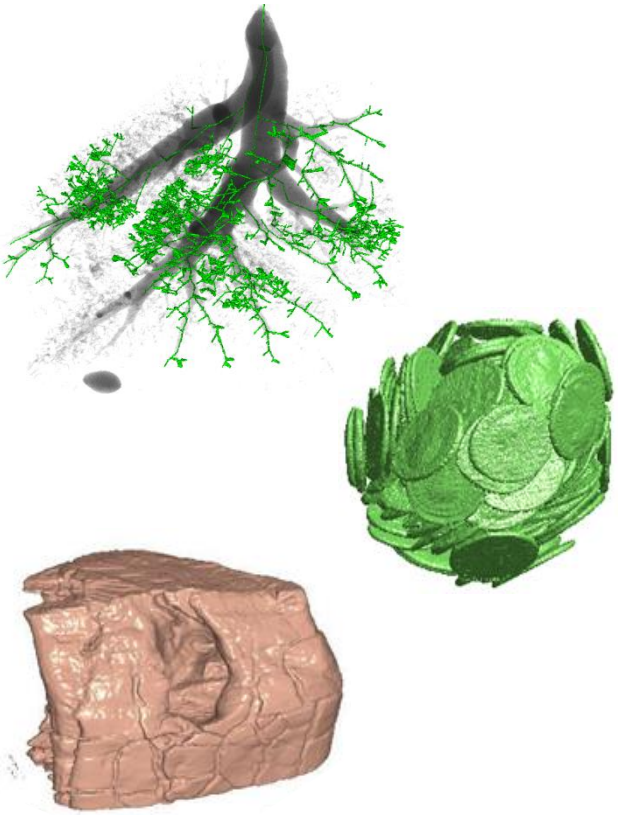
Automated Volumetric Image Analysis

at the μ-VIS centre



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EPSRC
Engineering and Physical Sciences Research Council

MRC Medical Research Council

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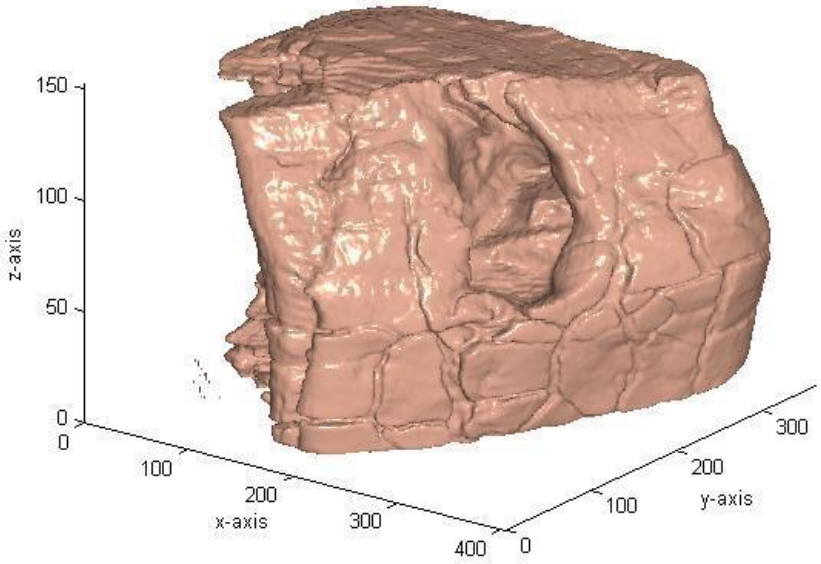
Matching Jaw Fragments

- Target: Pliosaur jaw automatically, from fragments
- Strategy: interest points



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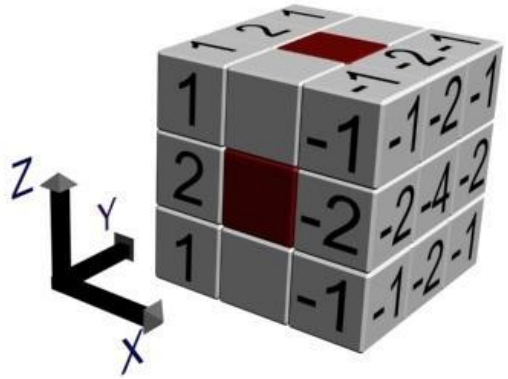
Problem

- Interest point strategies exist only in 2D.
- Extend to 3D: need 3D edge detection



$$M_{y,x,z} = \sqrt{Mx^2 + My^2 + Mz^2}$$

and curvature

$$\kappa_{3D} = \frac{\partial \alpha}{\partial j} + \frac{\partial \beta}{\partial k} + \frac{\partial \gamma}{\partial l}$$

$$\frac{\partial \gamma}{\partial l} = \frac{1}{\left(M_y^2 + M_z^2\right)^{\frac{3}{2}}} \left(M_y^2 \frac{\partial M_z}{\partial y} - M_y M_z \frac{\partial M_y}{\partial y} + M_y M_z \frac{\partial M_z}{\partial z} - M_z^2 \frac{\partial M_y}{\partial z} \right)$$

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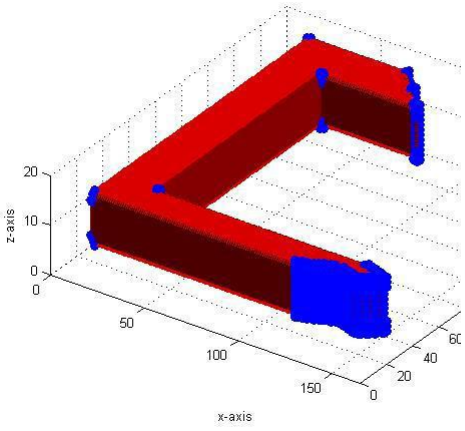
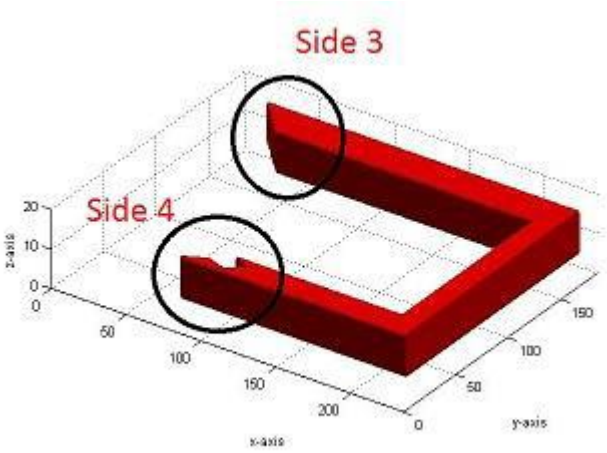
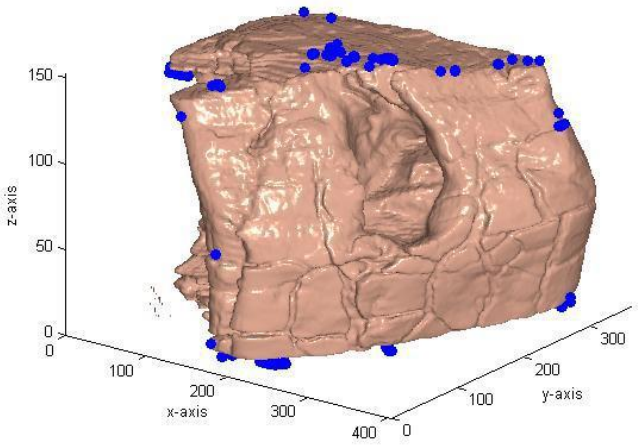
Results

- Worked well for synthetic shape, but
- Erosion on real shape distorted features
- No match possible on real data







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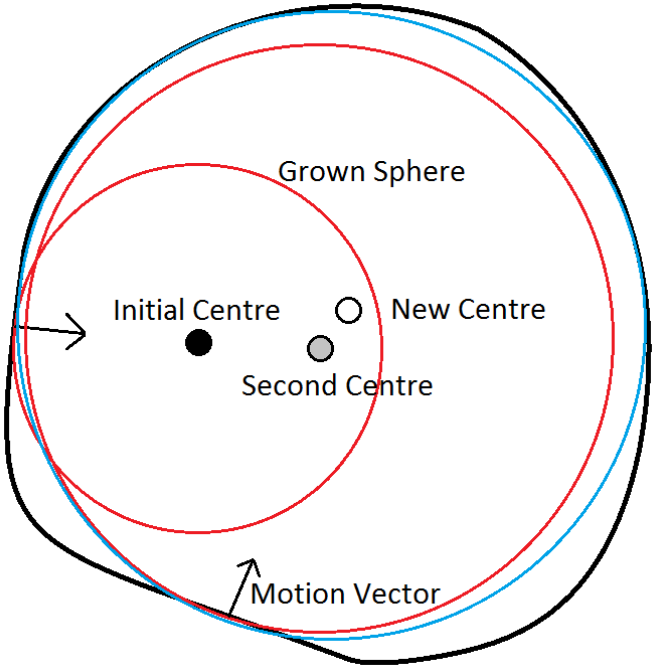
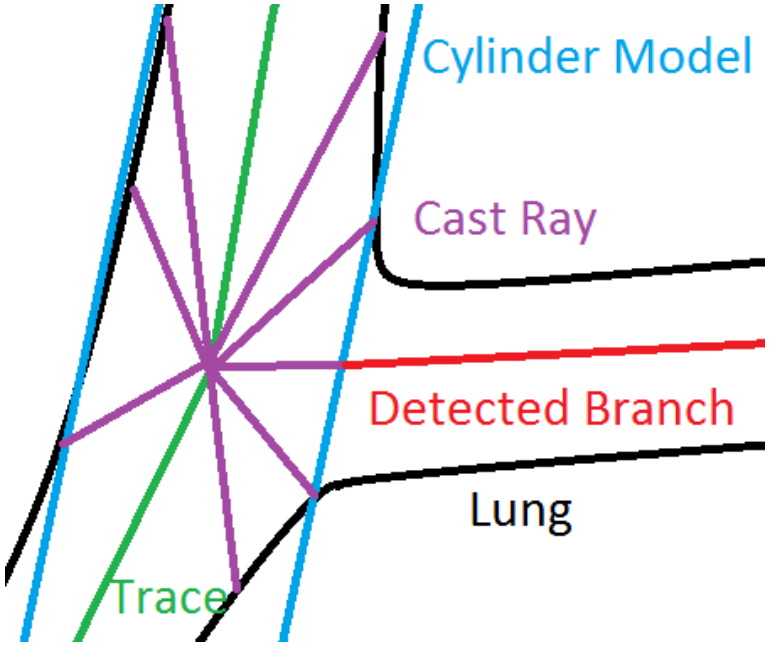
3D Lung Analysis

- Problem domain: asthma
- Research area: 3D branching structures





Udell, Thurner et al, *ASB CMBBE* 2013, *MIUA* 2013

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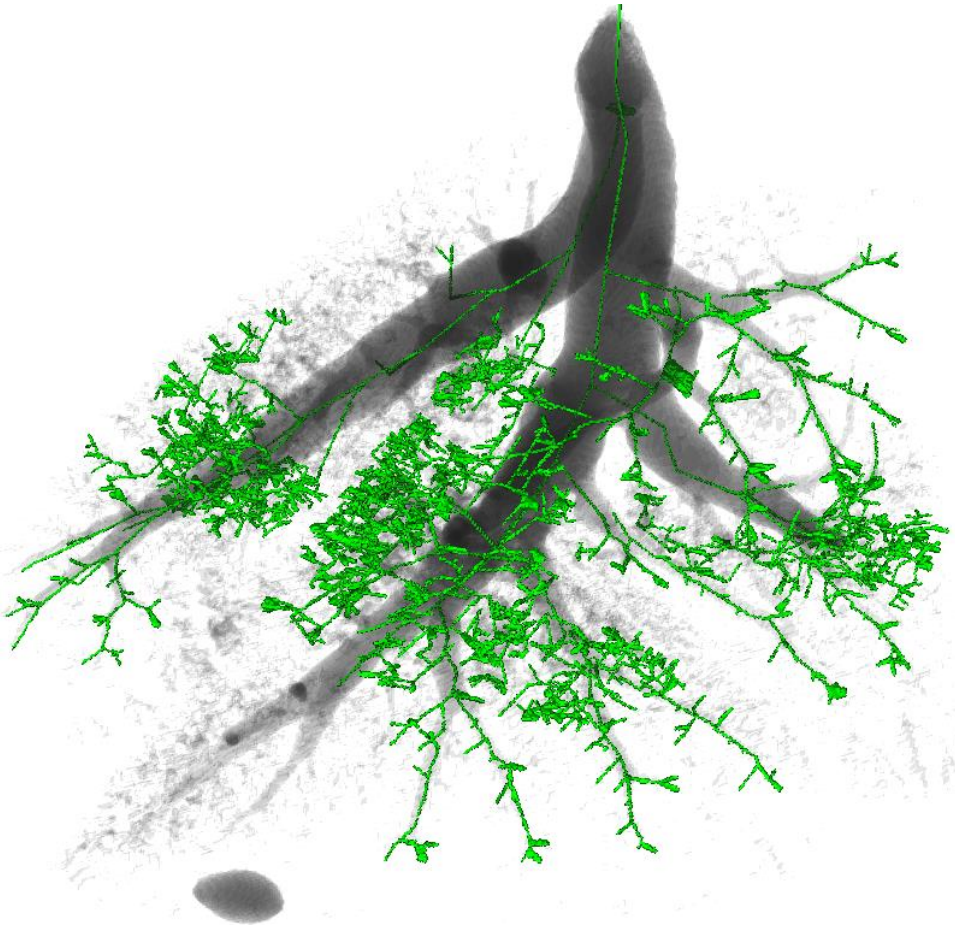
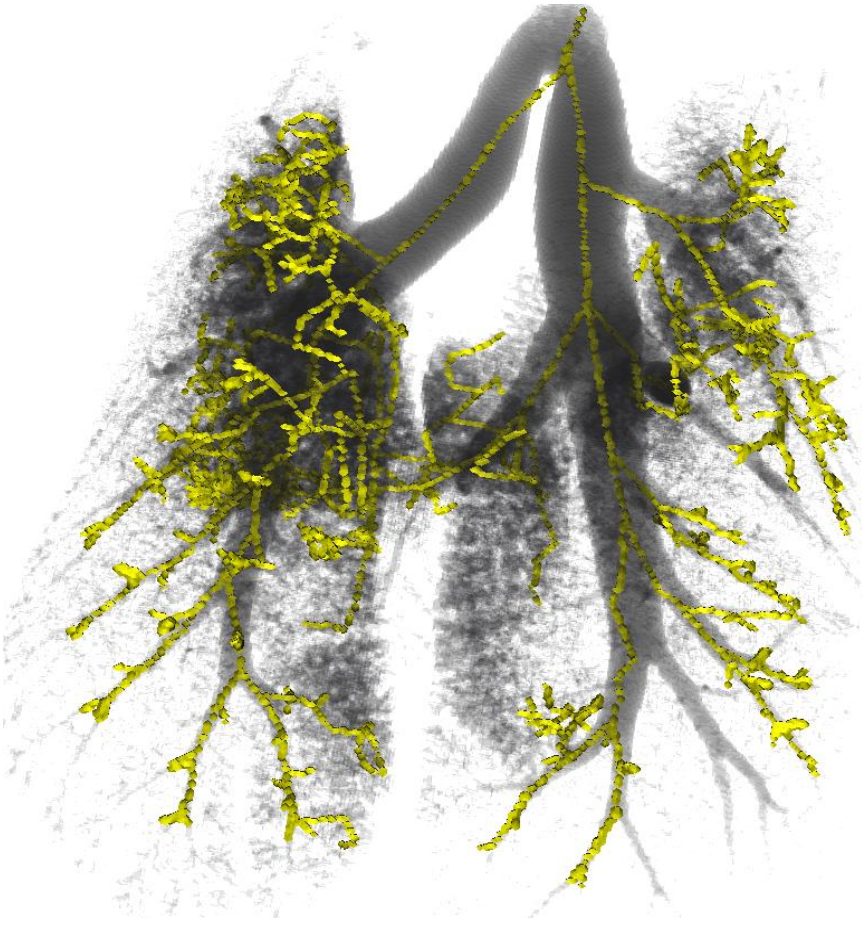
Murine Airway Morphology (Mouse Lungs)





Udell, Thurner et al, *ASB* *CMBBE* 2013, *MIUA* 2013

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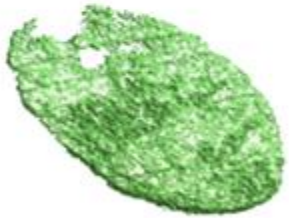
Roman Hoard

Object 6

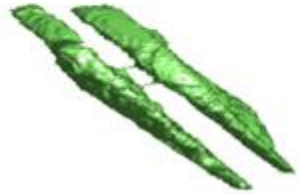
Object 10

Object 16



Object 30

Object 42



Object 45

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Object Separation using Pressure Analogy

Touching objects (synthetic)

$\mathbf{V}_{x,y,2}$

$\mathbf{V}_{x,y,4}$

$\mathbf{V}_{x,y,6}$

$\mathbf{V}_{x,y,8}$

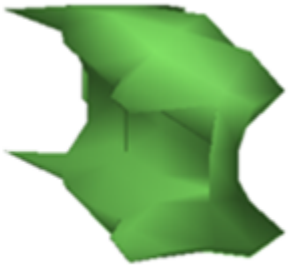
Creating a pressure mask

$\mathbf{P}_{x,y,2}$

$\mathbf{P}_{x,y,4}$

$\mathbf{P}_{x,y,6}$

$\mathbf{P}_{x,y,8}$



Alatheri and Nixon, *submitted*

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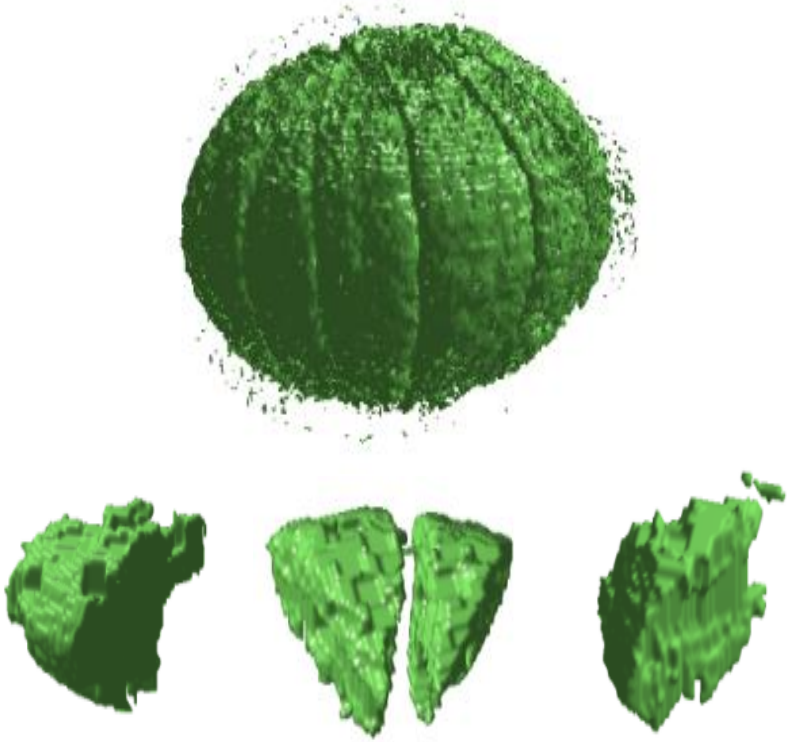
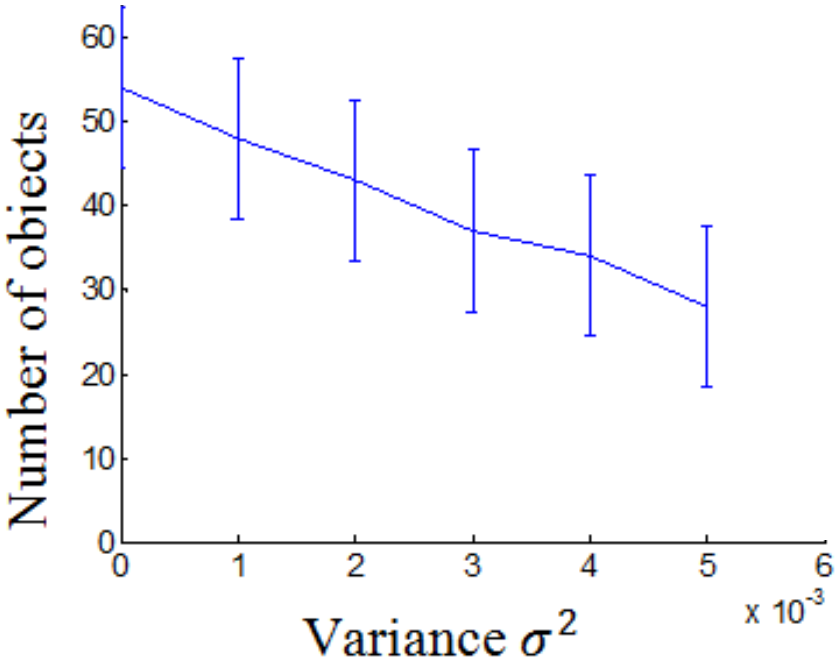
More performance: density and noise



Variation in density



Coin performance

Alatheri and Nixon, *submitted*

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Conclusions

- Rich variety of technique available for feature extraction in 2D computer vision
- Techniques have yet to migrate to books and packages
- Need extensions for 3D
- Interesting and topical area

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Papers

1. N. Udell, M.S. Nixon et al. Classification and Quantification of Murine Lungs as 3D Branching Structures, Proc. *British Assoc. of Lung Research* UK 2012
2. N. Udell, P Thurner et al, The determination of murine airway morphology from microfocus computer assisted tomography data using tracing, Proc. *19th Congress of the European Society of Biomechanics,* Greece 2013
3. N. Udell, I Sinclair et al, Sphere-growth based centreline extraction of murine airways from microfocus X-ray computer assisted tomography, *MIUA* UK 2013
4. N. Udell, I Sinclair et al, Tracing as a tool for determining murine airway morphology from microfocus computer assisted tomography data, *11th ASB Computer Methods in Biomechanics and Biomedical Engineering*, Utah 2013
5. A. Abuzaina, T. S. Alatheri and M. S. Nixon , Detecting moving spheres in 3D point clouds via the 3D velocity Hough transform, *IEEE IVMSP,* Korea 2013
6. T. S. Alatheri and M. S. Nixon, Using Pressure to Segment Volumetric Images, submitted

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