Automated Volumetric Image Analysis

at the $\mu$-VIS centre

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Matching Jaw Fragments

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

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

\[ \frac{\partial y}{\partial l} = \frac{1}{\left( M_y^2 + M_z^2 \right)^{3/2}} \left( M_y^2 \frac{\partial M_z}{\partial y} - M_y M_z \frac{\partial M_y}{\partial y} + M_y M_z \frac{\partial M_z}{\partial z} - M_z^2 \frac{\partial M_y}{\partial z} \right) \]
Results

- Worked well for *synthetic* shape, but
- **Erosion** on real shape distorted features
- **No match** possible on real data
3D Lung Analysis

- Problem domain: asthma
- Research area: 3D branching structures
Murine Airway Morphology (Mouse Lungs)
Roman Hoard

Object 6
Object 10
Object 16
Object 30
Object 42
Object 45

Alatheri and Nixon, submitted
Object Separation using Pressure Analogy

Touching objects (synthetic)

Creating a pressure mask

Alatheri and Nixon, submitted
More performance: density and noise

Variation in density

Coin performance

Alatheri and Nixon, \textit{submitted}
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
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