
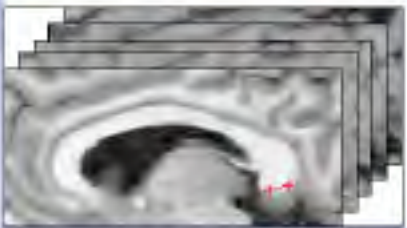


Segmentation

- Process of identifying structure in 2D & 3D images
- Output may be
 - Labeled pixels or voxels
 - Boundary representation of organs
- Many different techniques and methods
 - Manual (still very common)
 - Automated (much research, some practice)
- We don't have time to cover this in any detail



 **Manual Segmentation
(Outlining)**



- Extremely time-consuming (~6 hours per case)
- 3D Imagery – Performed slice at a time
- Some structures near impossible (blood vessels)

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Credit: Eric Grimson

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Automated Methods

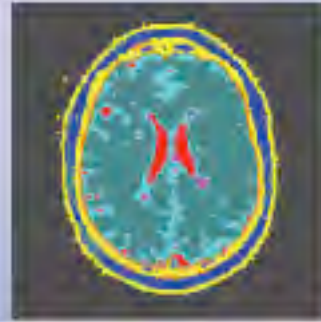
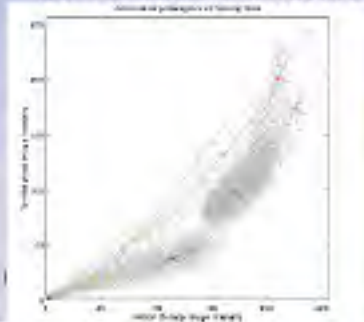
- Pixel-based
 - Thresholding
 - Region growing
- Edge/Boundary based
 - Deformable surfaces
 - Implicit surfaces / level sets
- Emerging themes
 - Incorporation of prior knowledge of anatomy
 - Statistical learning methods
 - Validation still difficult





Segment statistically

- Measure distribution of intensities at known tissue locations
- Use nearest neighbor style classifiers for all other voxels



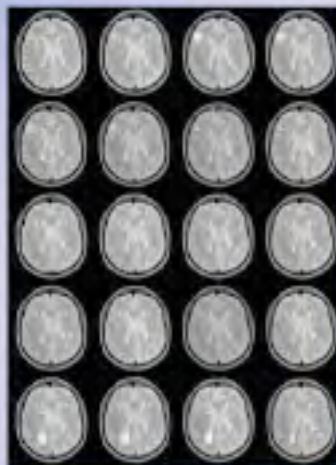
Credit: Eric Grimson

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Standard Scans




19/10/07

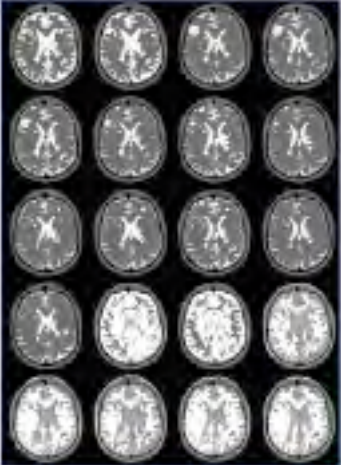
3/79

Credit: Eric Grimson

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 **Statistical segmentation**



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Credit: Eric Grimson

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 **EM-Segmentation [Wells 1994]**

E-Step

Compute tissue posteriors using current intensity correction.

Estimate intensity correction using residuals based on current posteriors.

M-Step

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Credit: Eric Grimson

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CSAIL

Gain Corrected Scans

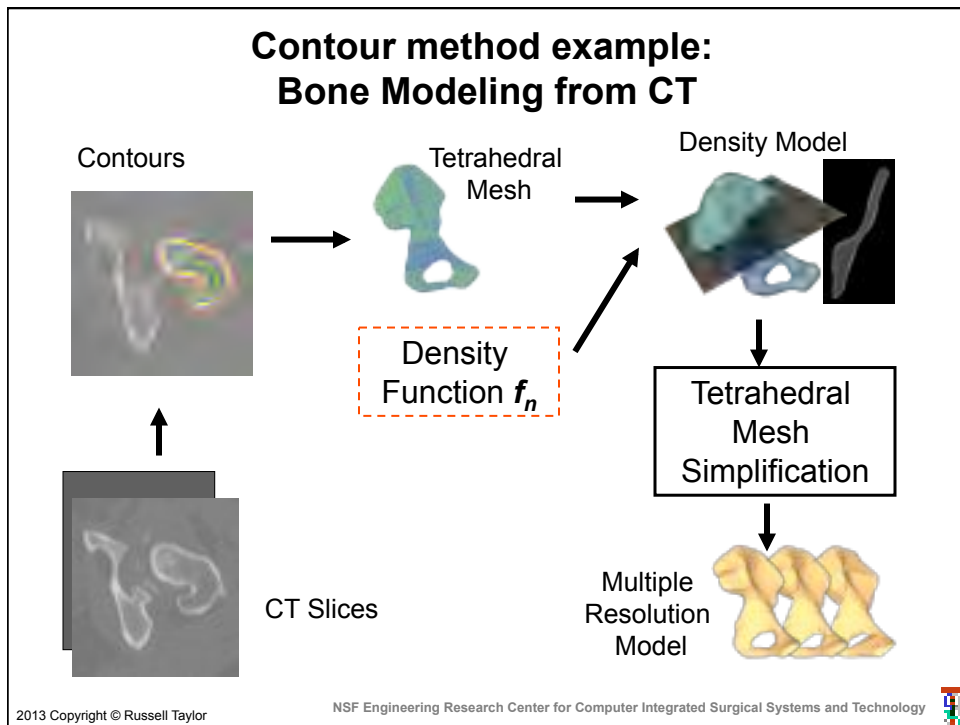
10/19/07

10/19

Credit: Eric Grimson

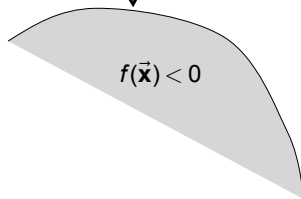
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Level Set Methods

$$f(\vec{x}) = 0 \quad f(\vec{x}) > 0$$



Basic idea: "insideness" function $f(\vec{x})$ such that

$f(\vec{x}) > 0$ if \vec{x} is outside structure

$f(\vec{x}) = 0$ if \vec{x} is on surface of structure

$f(\vec{x}) < 0$ if \vec{x} is inside structure

Assign values for $f(\vec{x})$ to points \vec{x} near possible surface and iteratively adjust the values so that "inside" and "outside" correspond more closely with the image data.



Many detailed variations on this basic idea

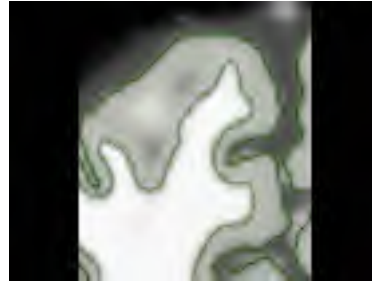
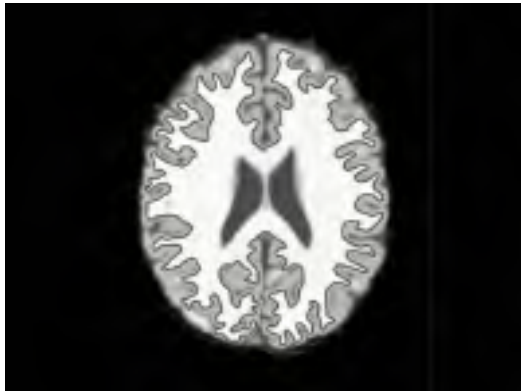
Video: Blake Lucas

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Deformable Surfaces & Level Sets



Example of current research:

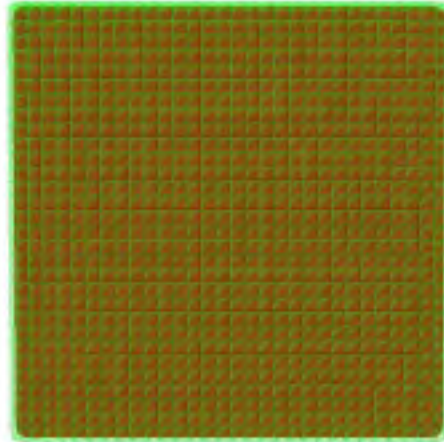
- New data structure ("Springs") and associated algorithmic formulation combining aspects of level sets and meshes
- Blake Lucas, October 2010

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Pelvis



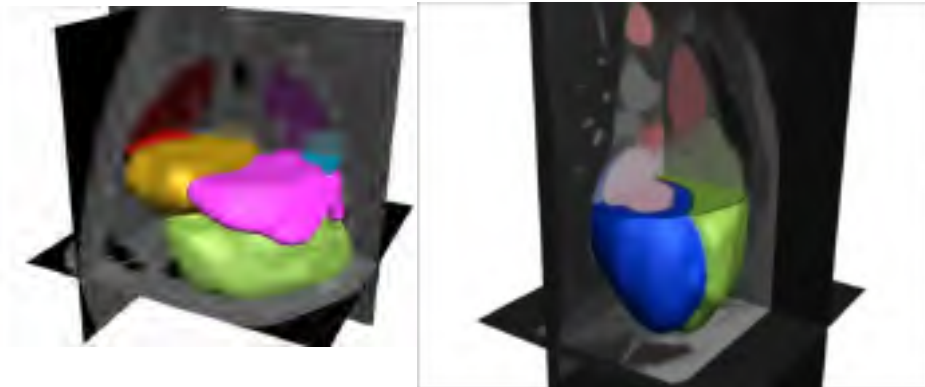
Video: Blake Lucas

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Other examples



Video: Blake Lucas

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