SCIENTIFIC COMPUTING AND IMAGING
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DT-MRI Inspection and Visualization

Gordon Kindlmann

Scientific Computing and Imaging Institute,
School of Computing,
University of Utah

UNIVERSITY OF UTAH

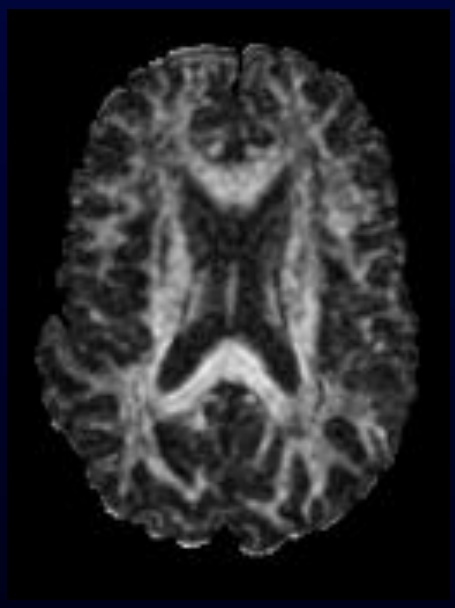
Gordon Kindlmann

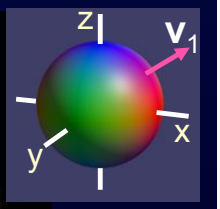
PhD (finishing) Computer Science, University of Utah

Interested in methods for "looking at" DT-MRI data and visually communicating its structure

Idea: two aspects of what's called "visualization"

- Acquisition: get the data
- Inspection: "Show me the data"
  verify data integrity, coordinates, and layout
- Visualization: "Show me the structures"
  depict the form and character of features in the data
- Analysis: extract and quantify features

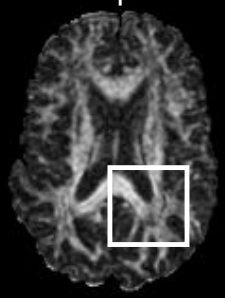




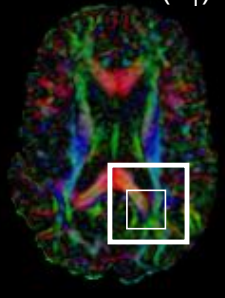
R=| v_1.x |
G=| v_1.y |
B=| v_1.z |

Fractional anisotropy (FA) RGB(1st eigenvector v_1)

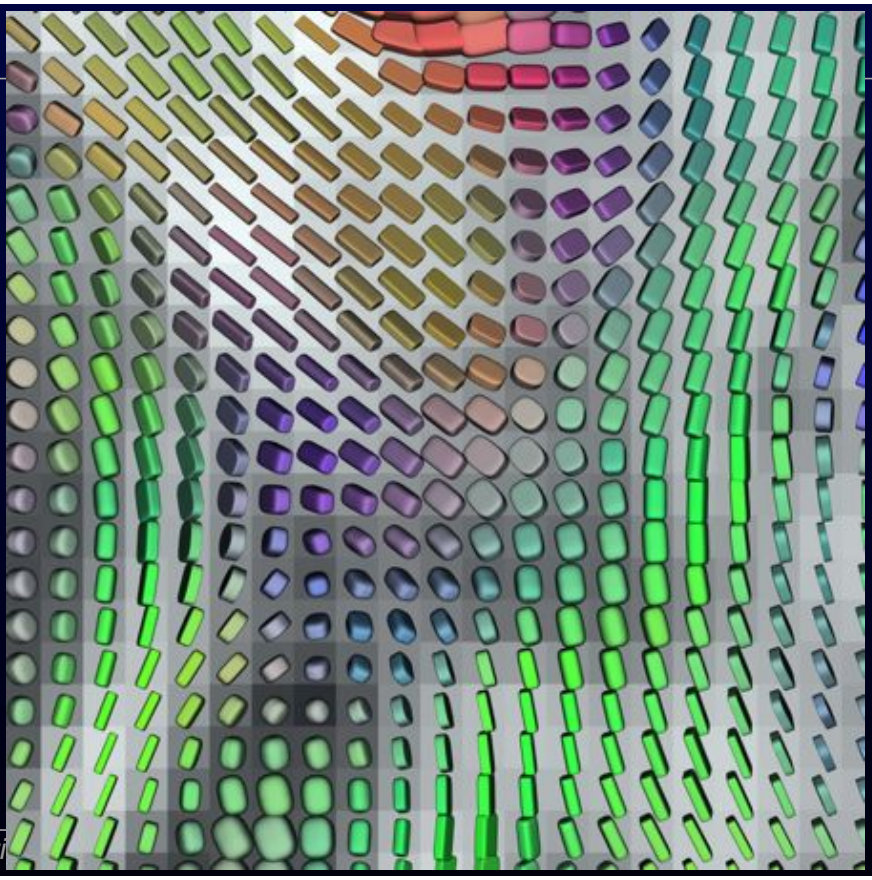
Backdrop: FA

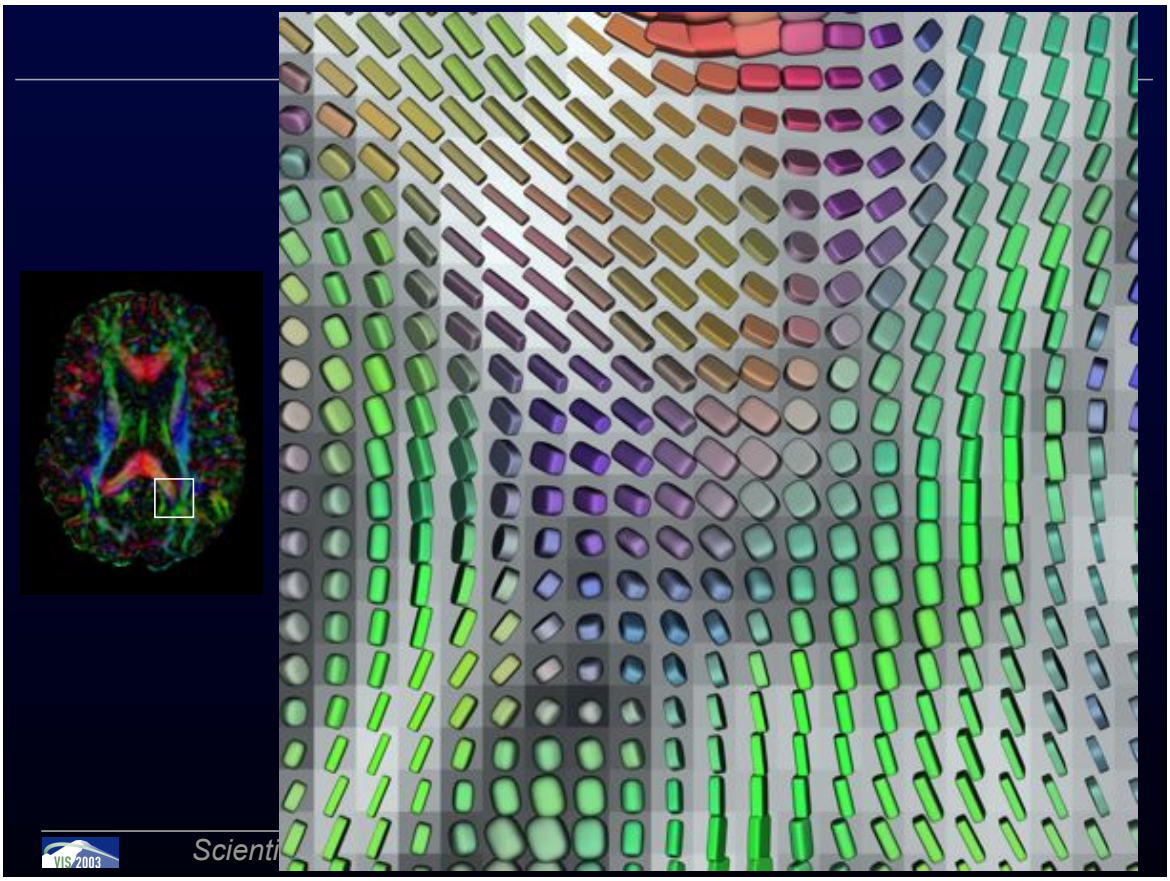


Color: RGB(v_1)



1 glyph = 1 mm^3

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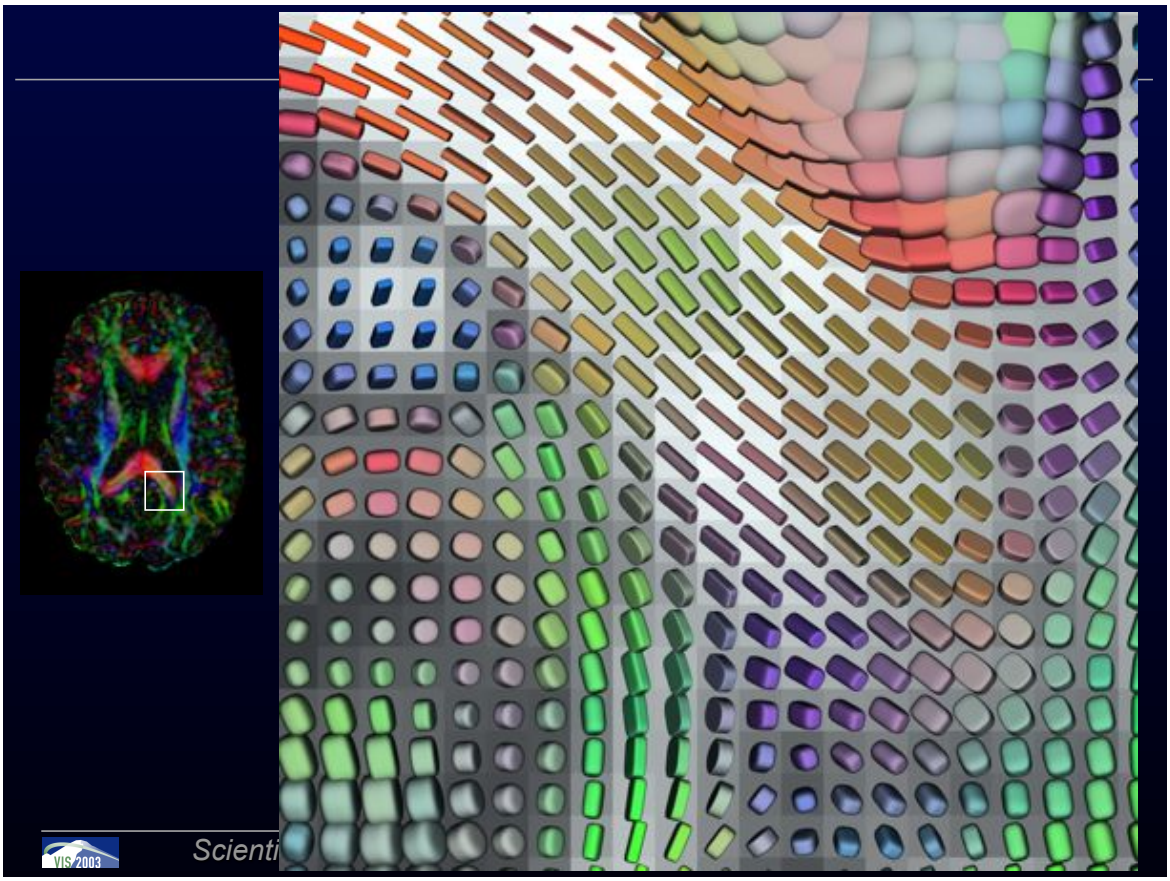
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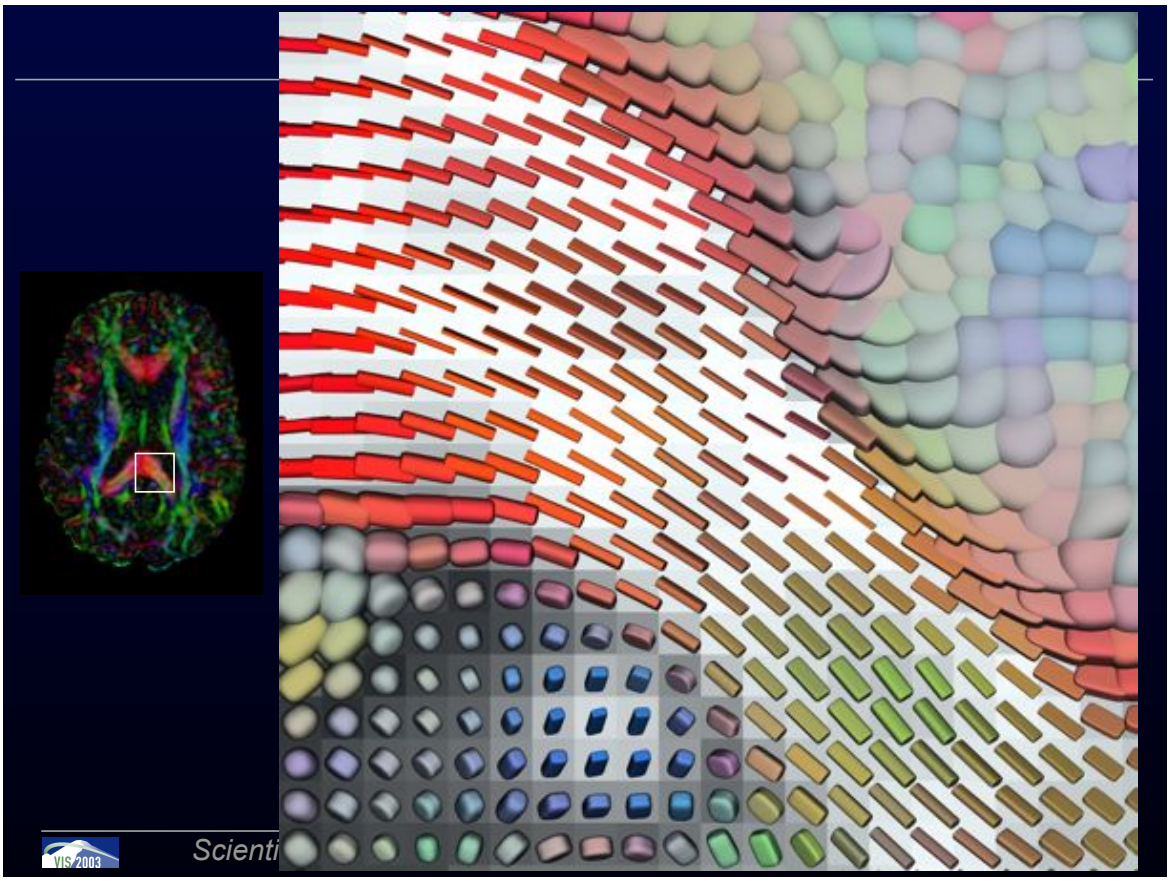
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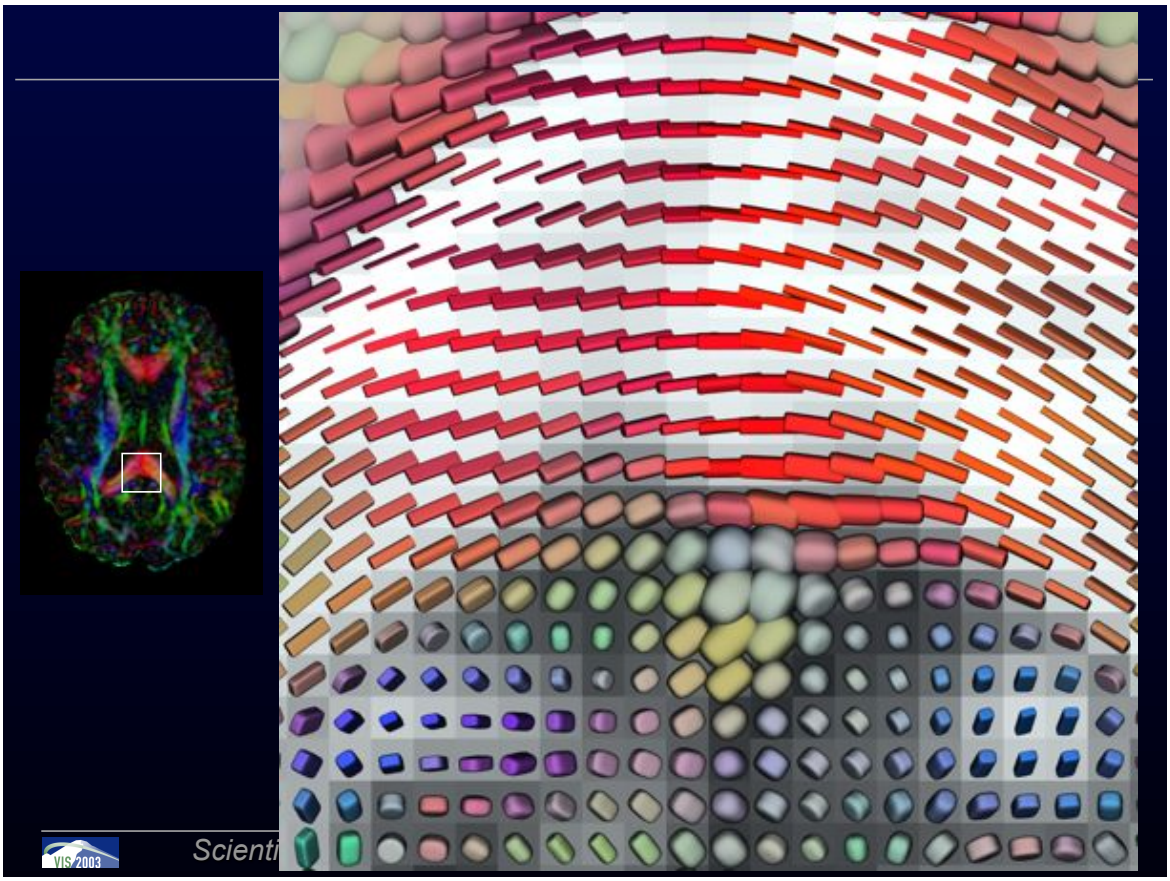
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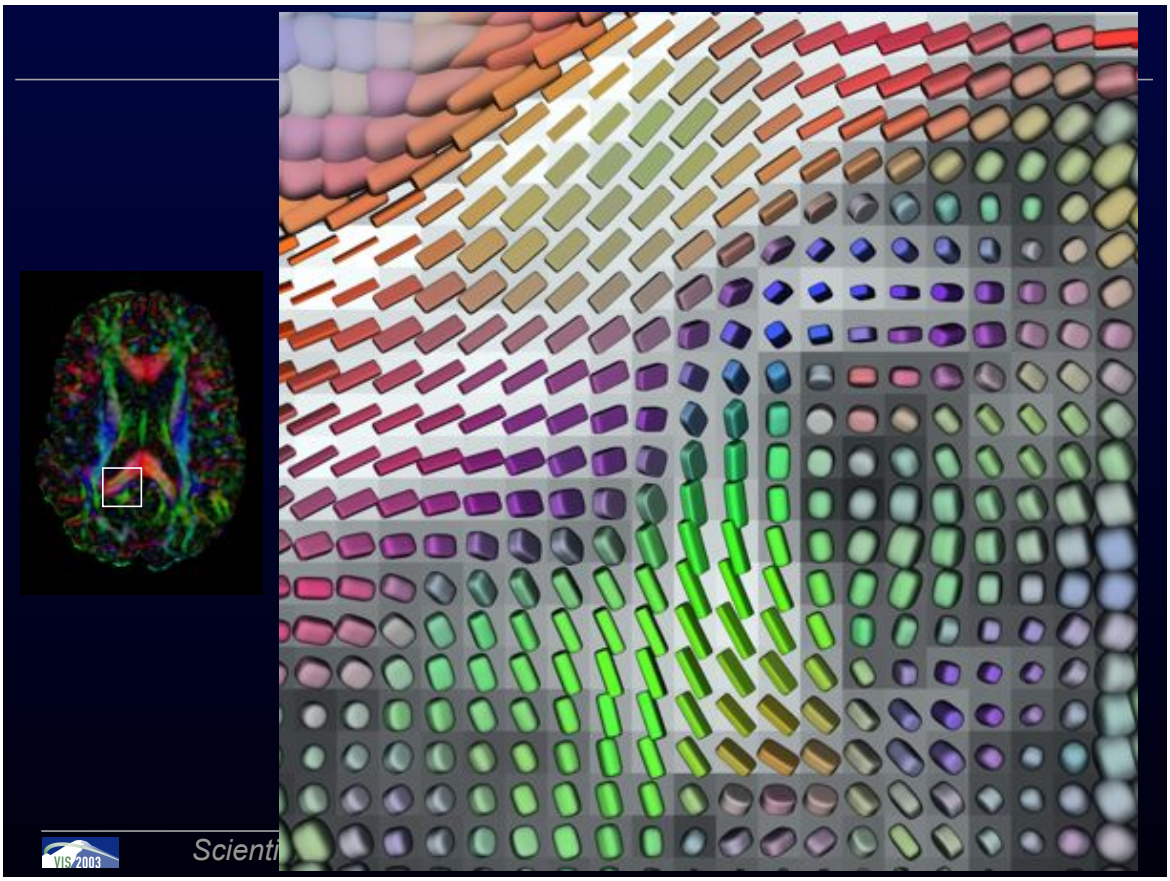
VIS 2003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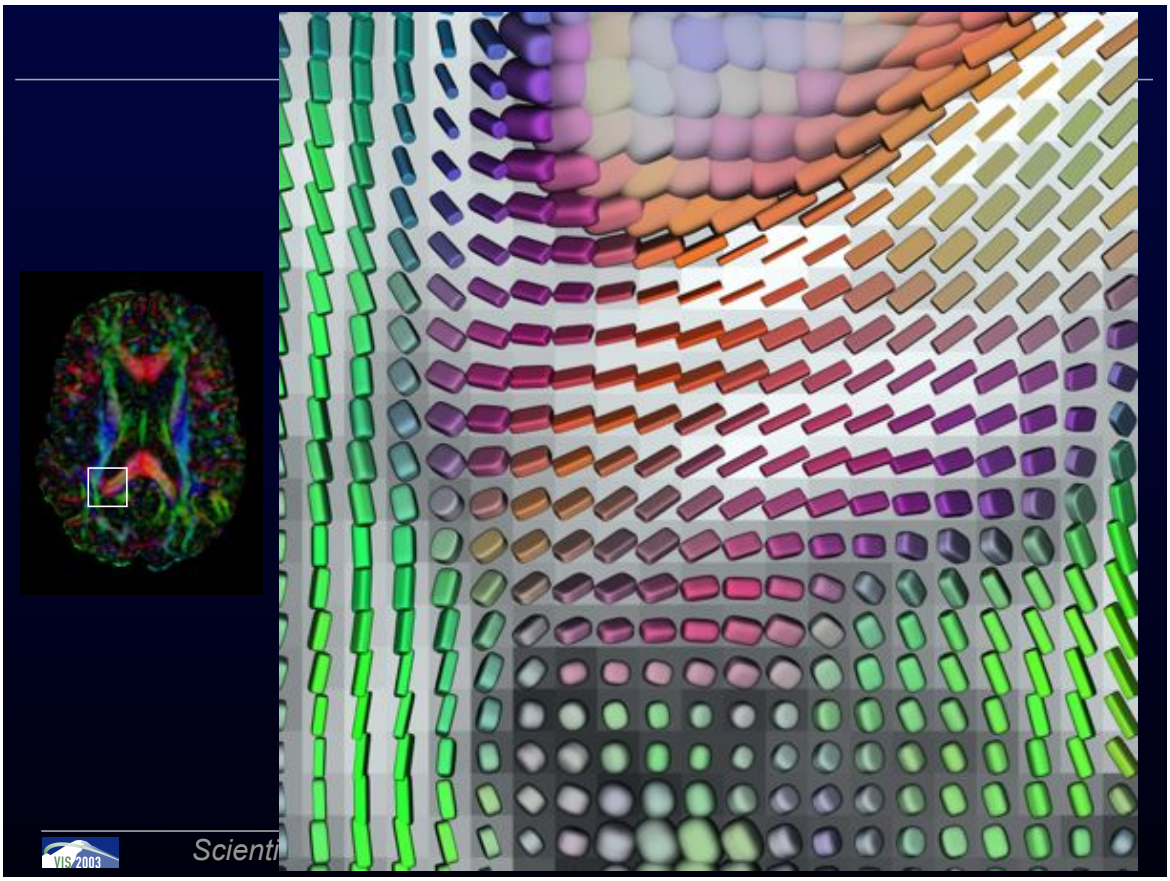
VIS 2003
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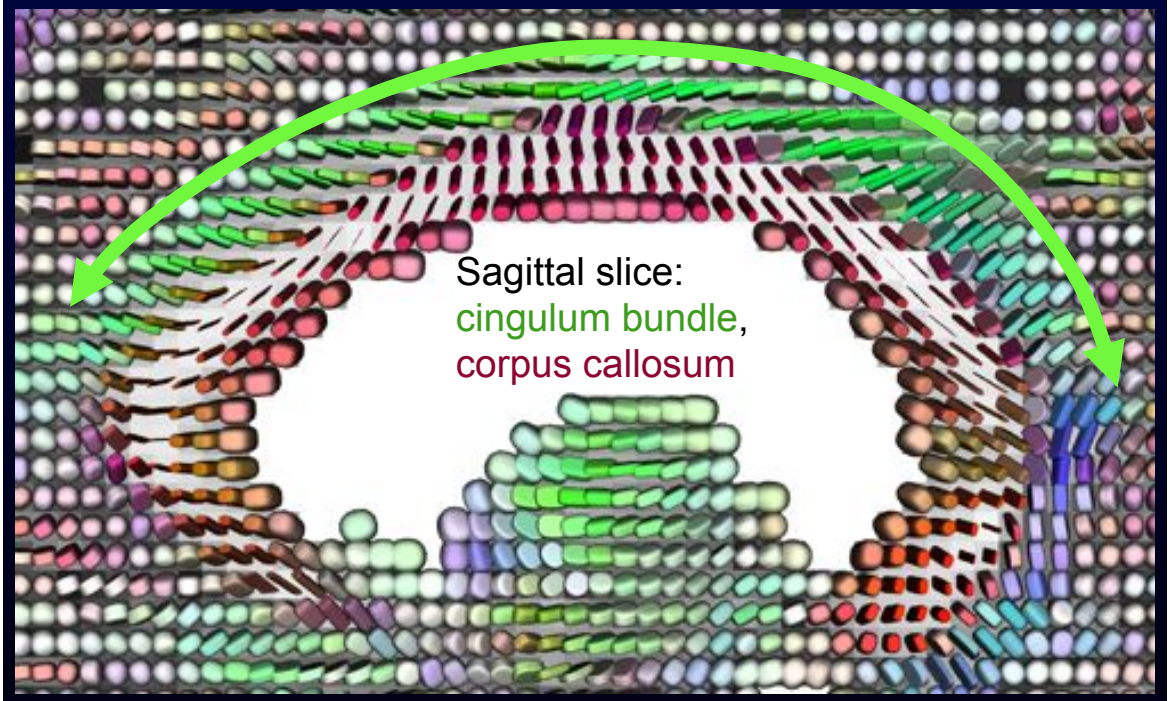
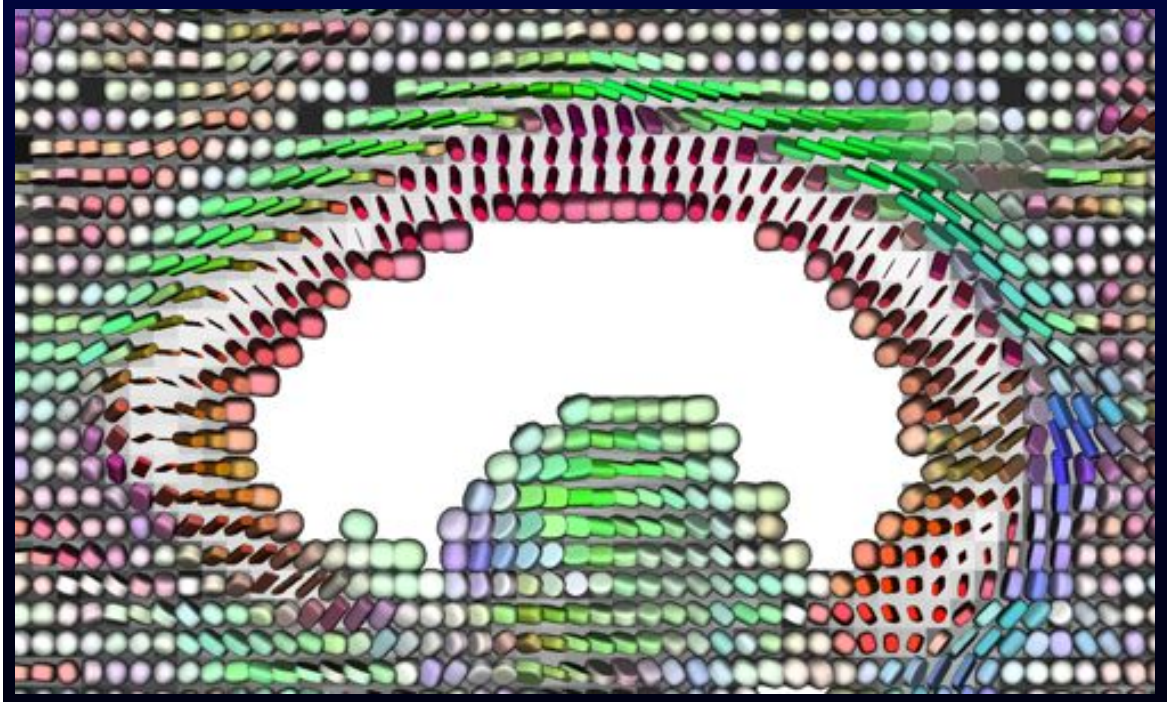
Inspection saves the day



Inspection saves the day



Inspection + Visualization

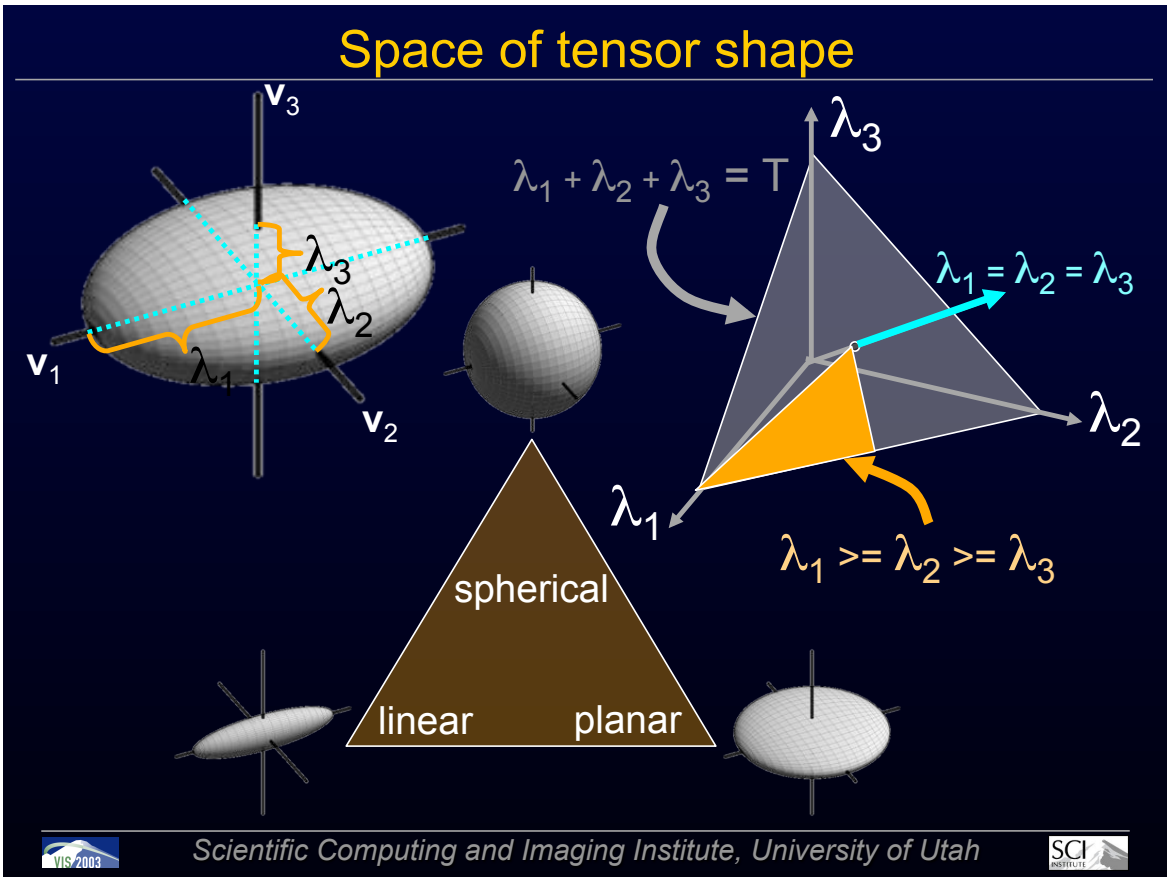
Scalar shape metrics (anisotropy)

- Barycentric shape space

Glyphs

- Boxes, spheres, cylinders, superquads
- Culling based on anisotropy

- Volume visualization
  - Isosurfaces of shape metrics
  - Transfer functions of shape


Space of tensor shape
v3
v1
v2
λ3
λ2
λ1
λ1 + λ2 + λ3 = T
λ3
λ1 = λ2 = λ3
λ2
λ1
λ1 >= λ2 >= λ3
spherical
linear
planar
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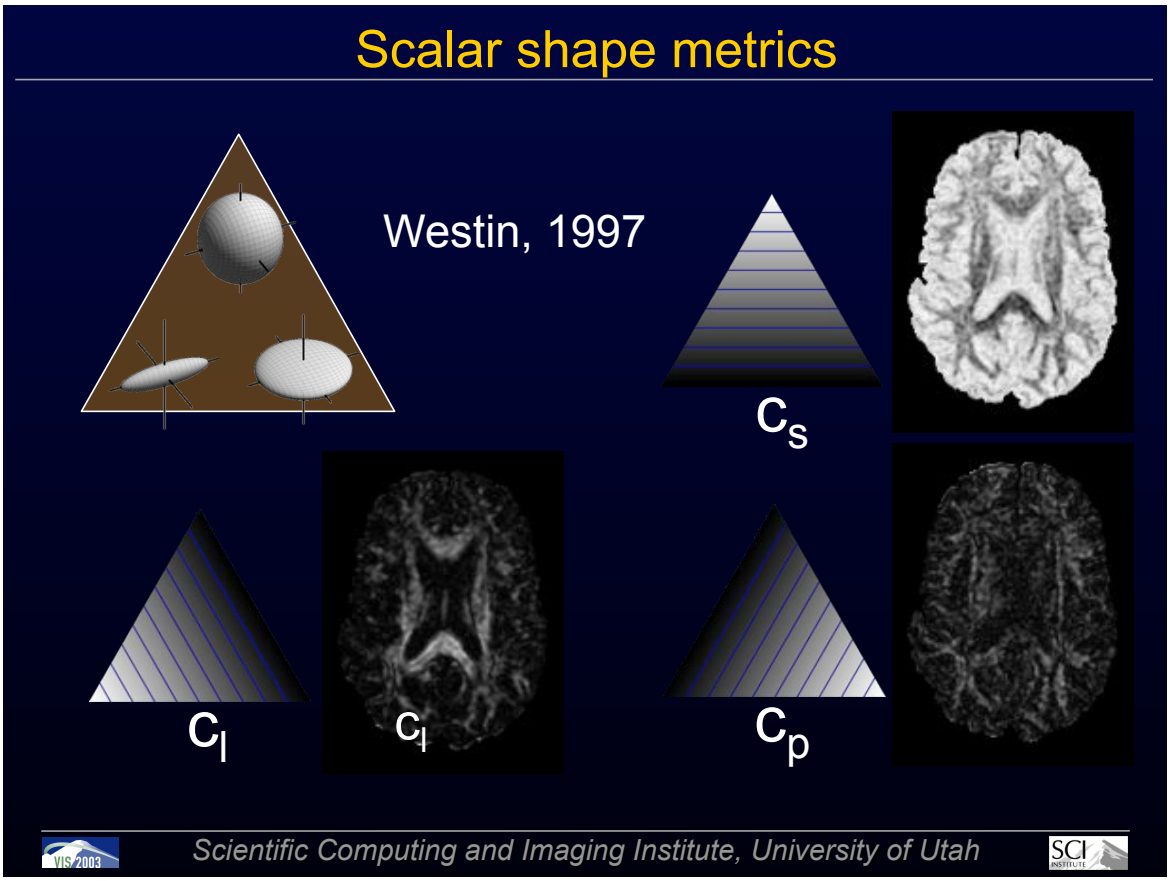
Scalar shape metrics
Westin, 1997
Cs
Cl
cl
Cp
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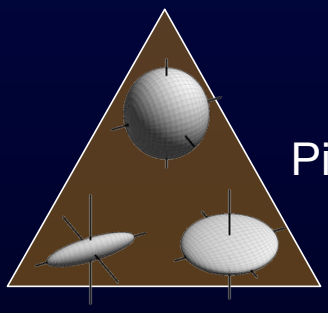
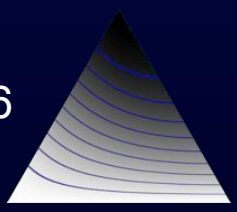
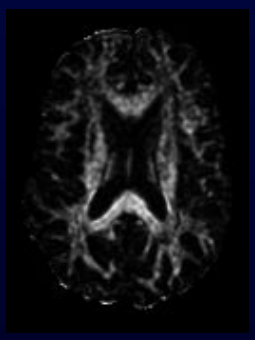
Scalar shape metrics



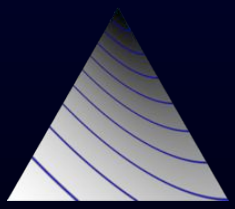
Basser +
Pierpaoli, 1996

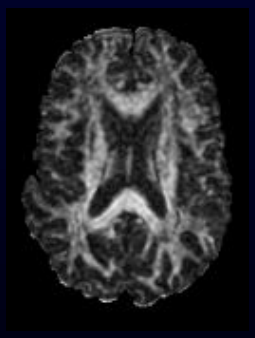




1 - VR

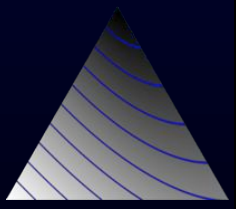
1 - volume ratio

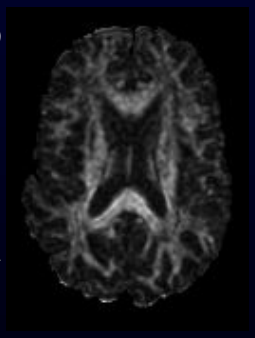




FA

fractional anisotropy

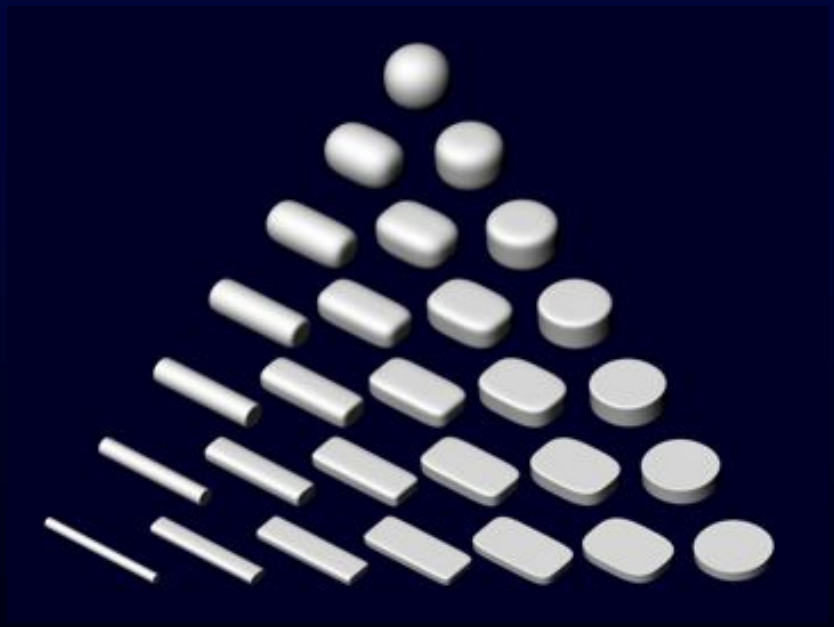


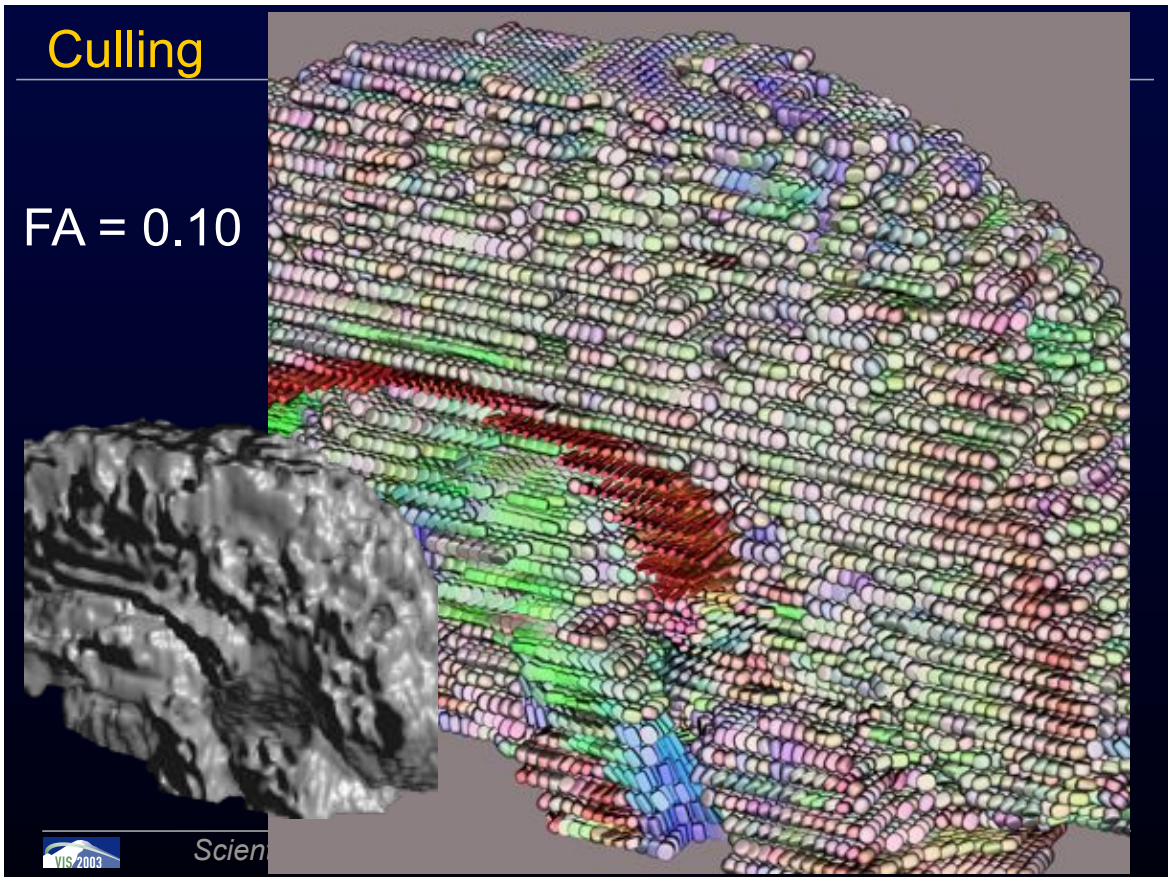


RA

relative anisotropy

Glyph shapes




Culling
FA = 0.10
VIS 2003
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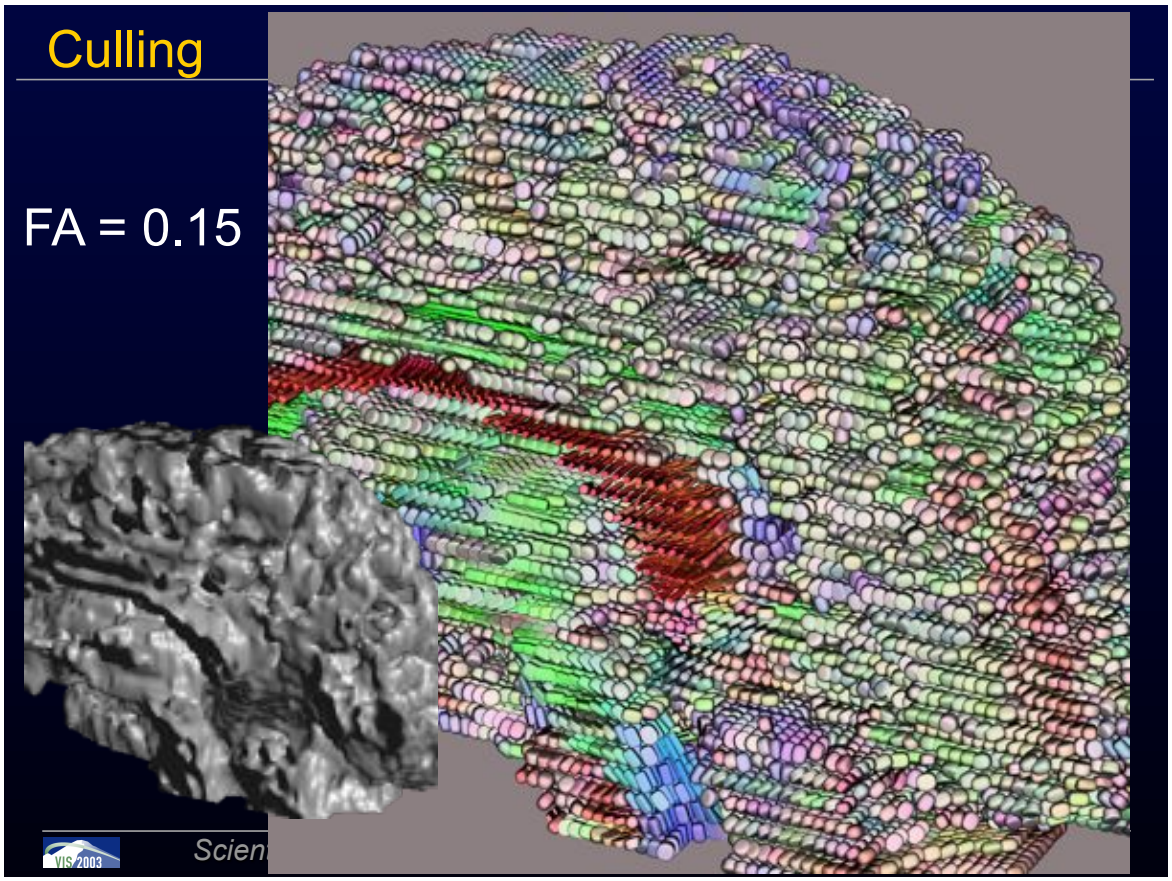
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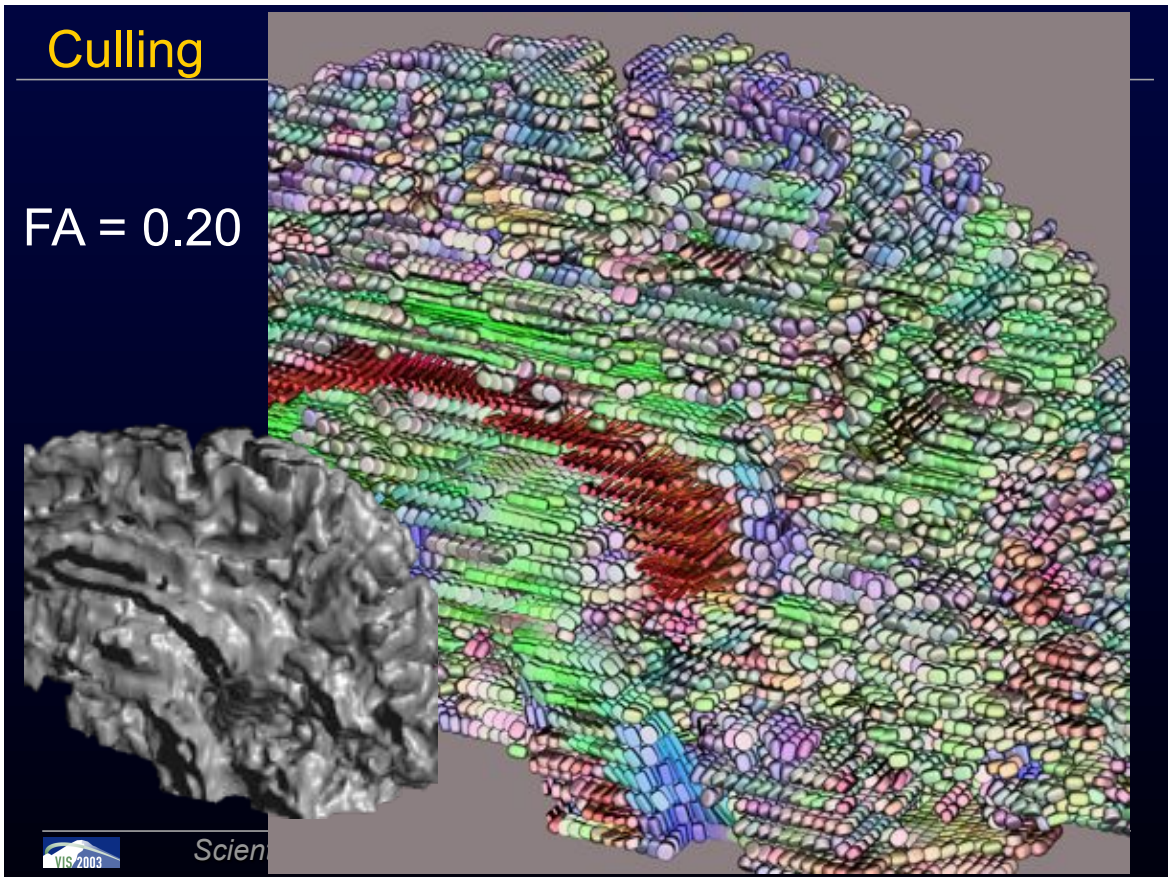
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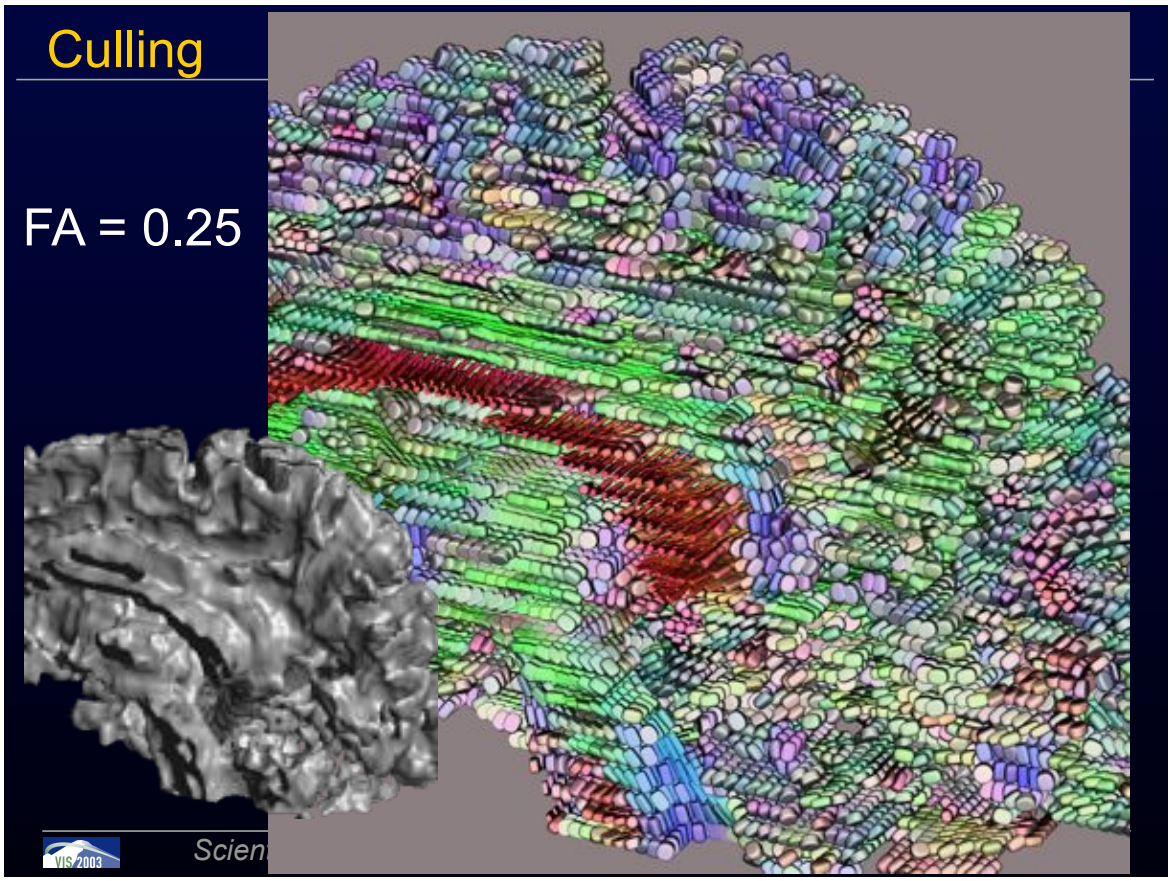
Culling
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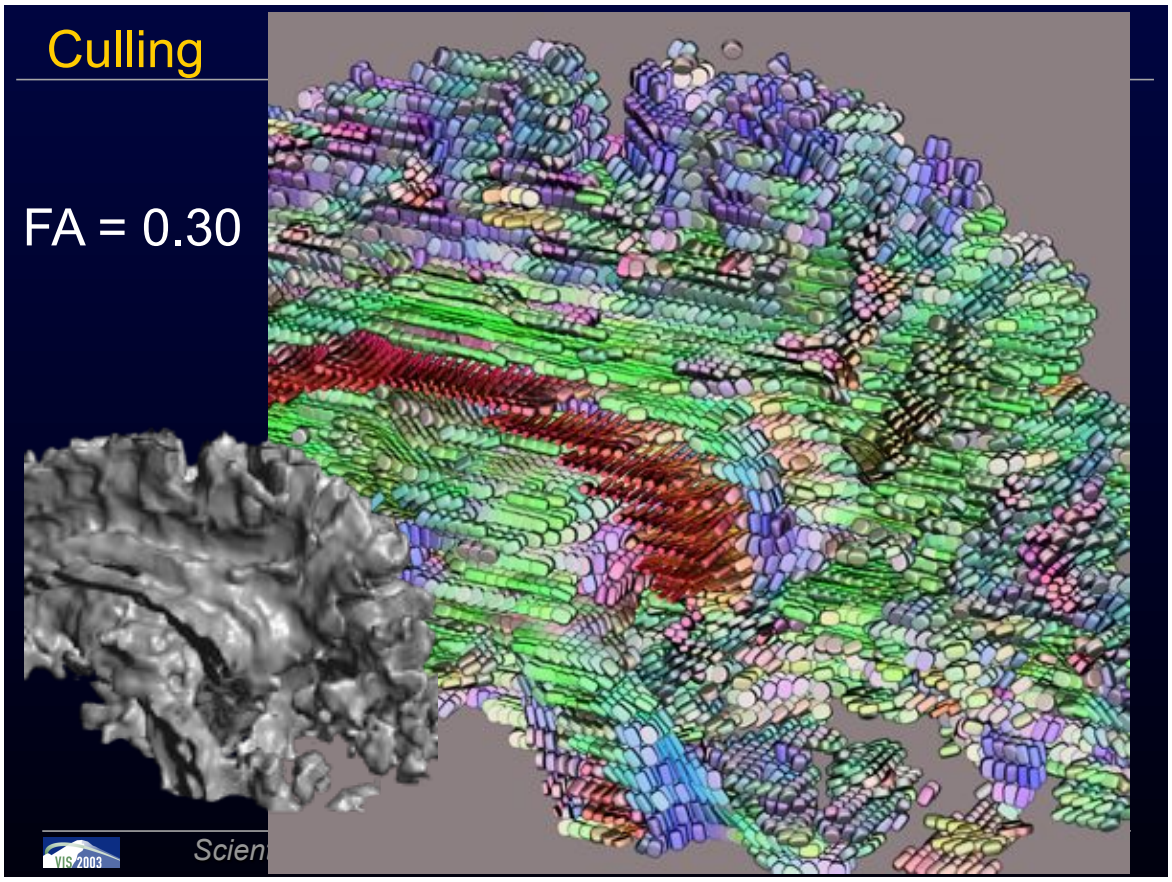
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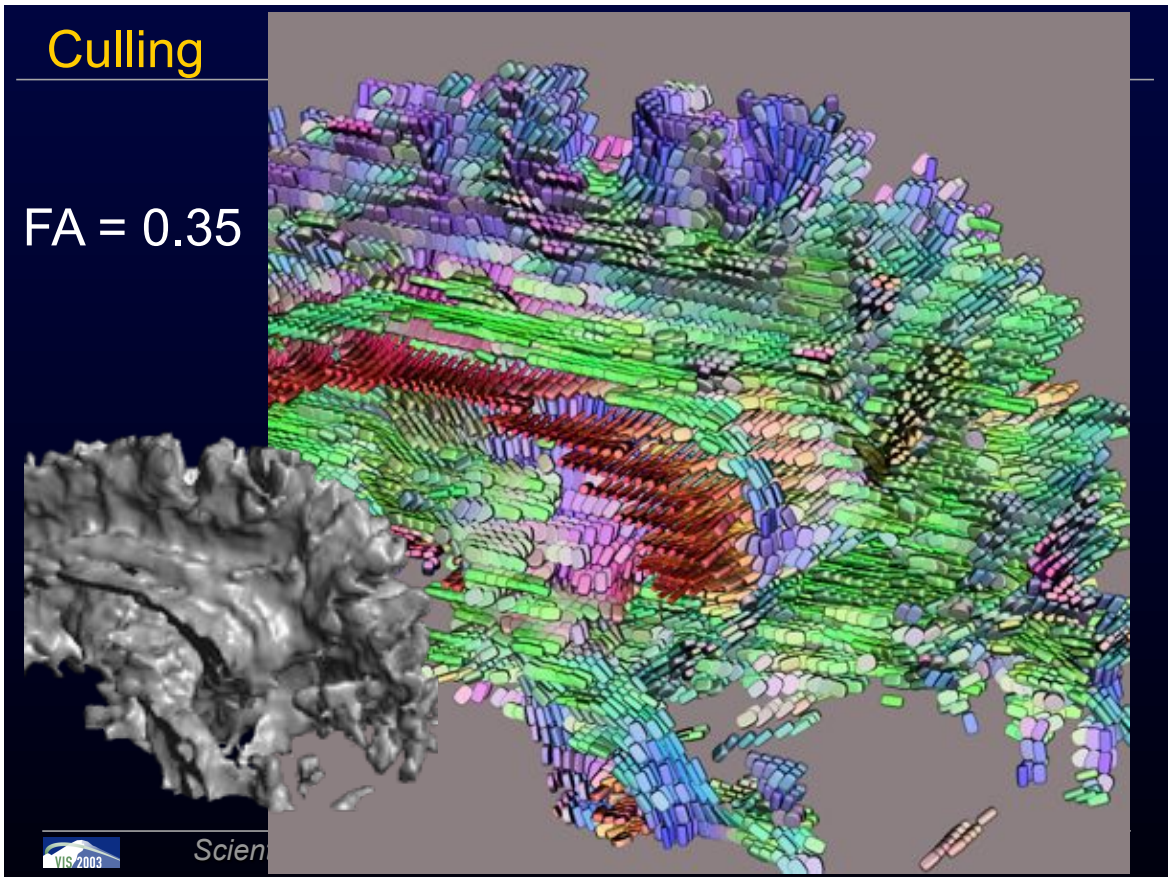
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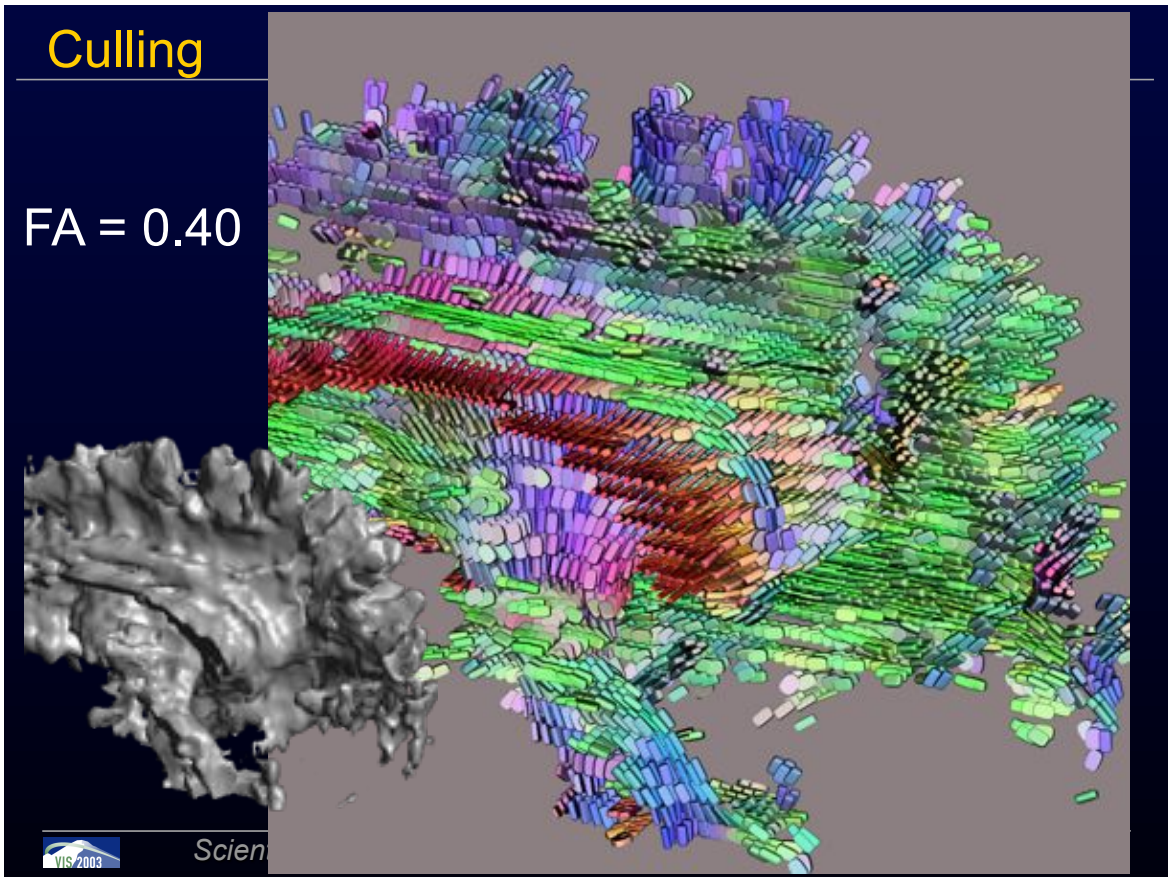
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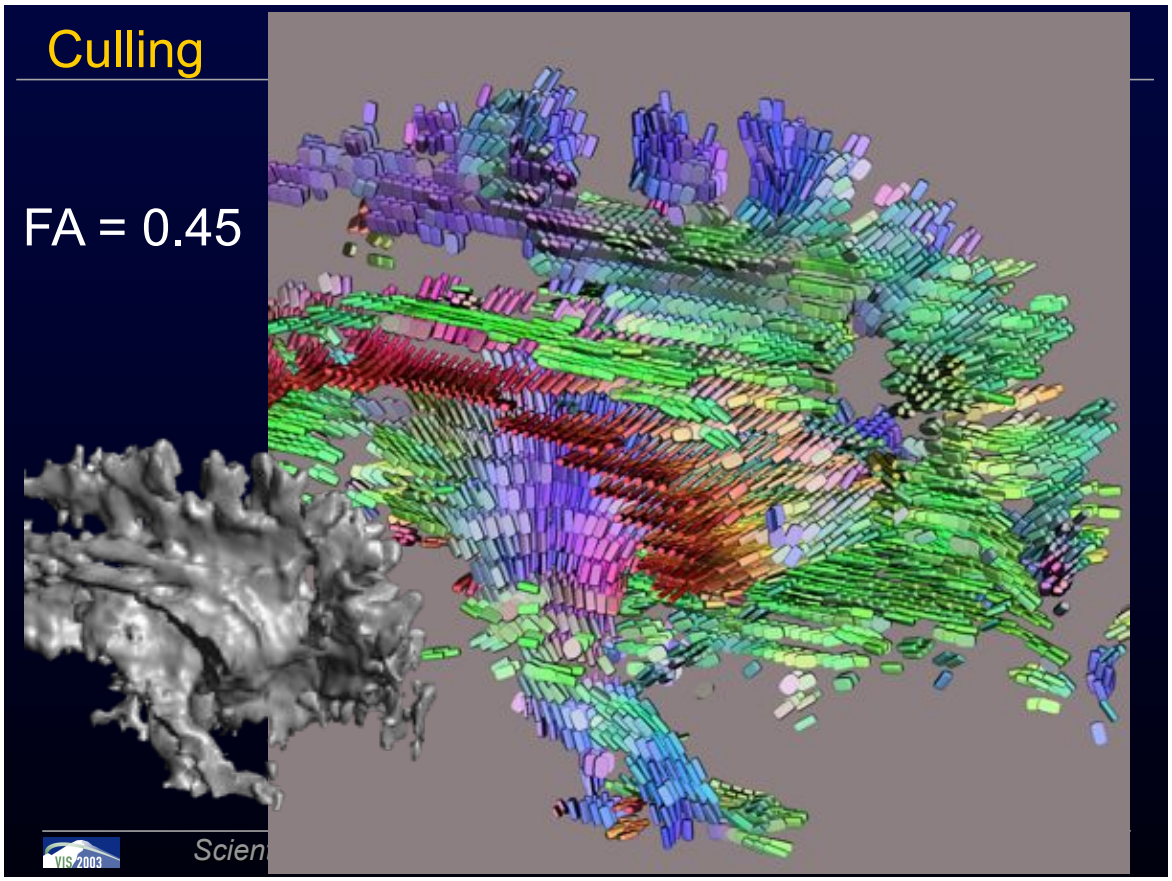
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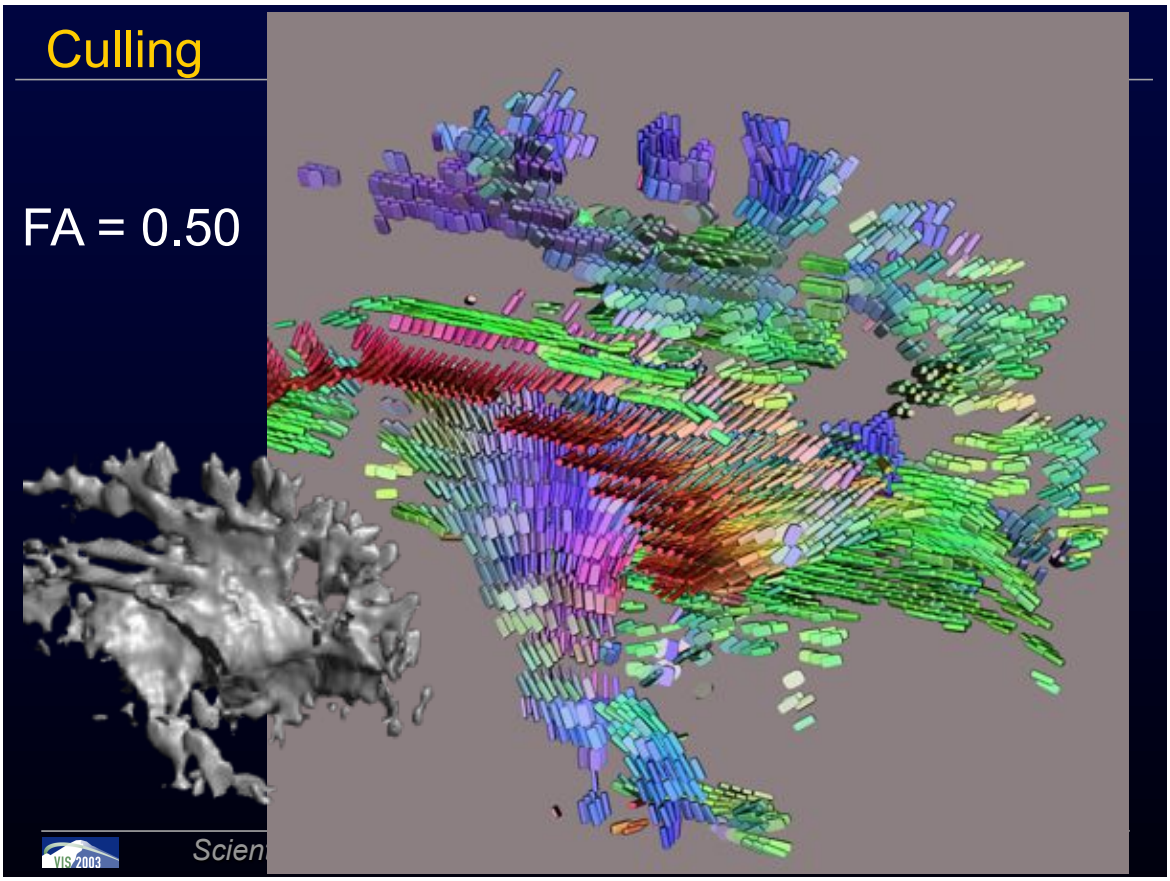
Culling
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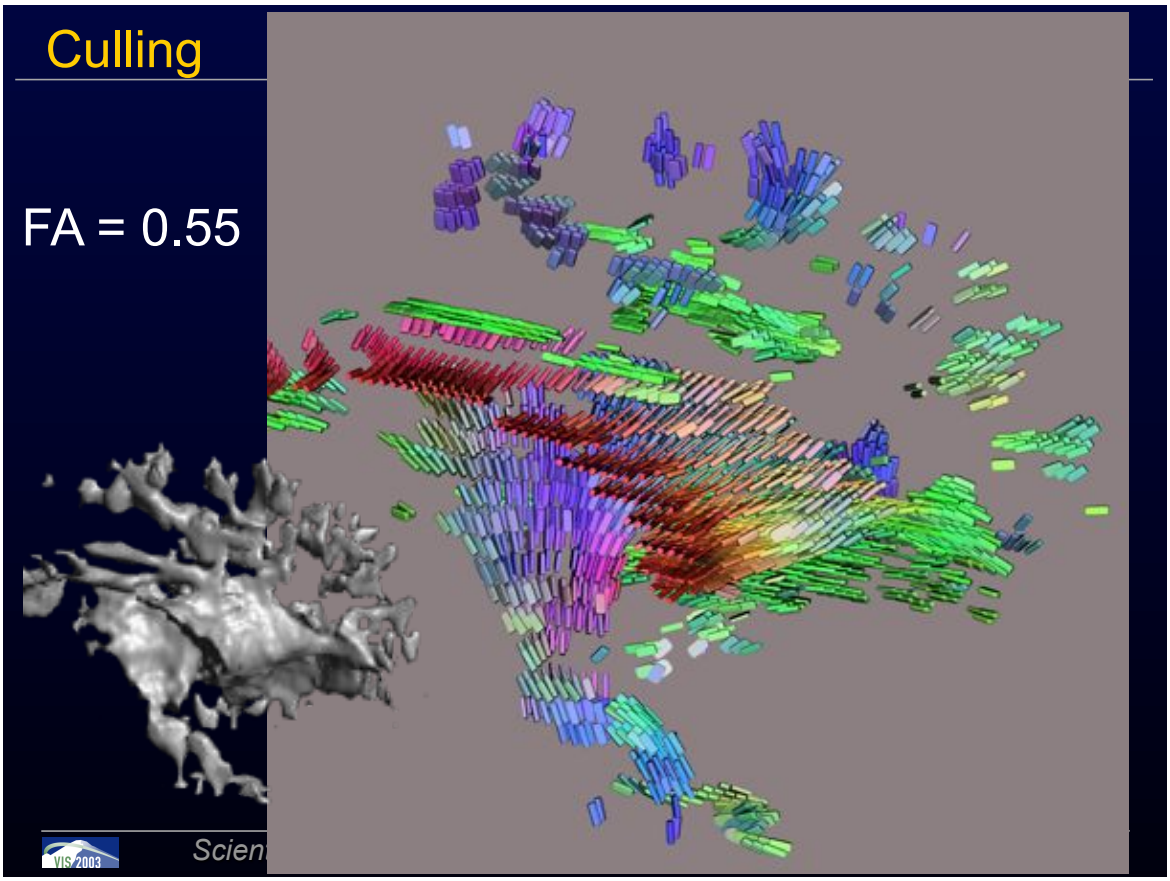
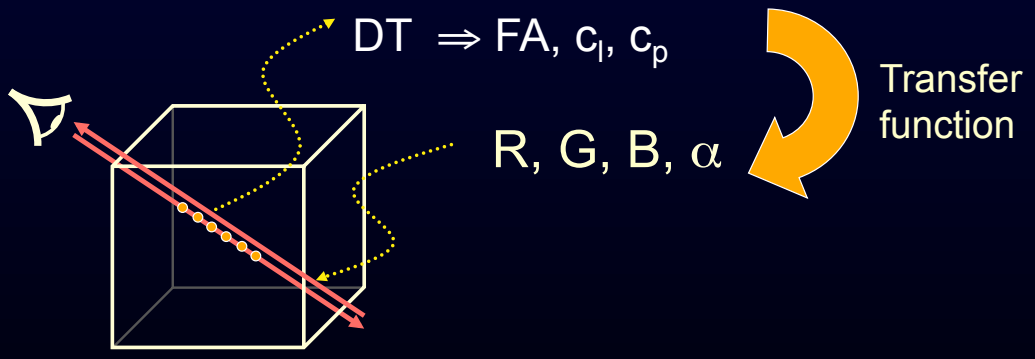
VIS 2003


Culling
FA = 0.55
VIS 2003

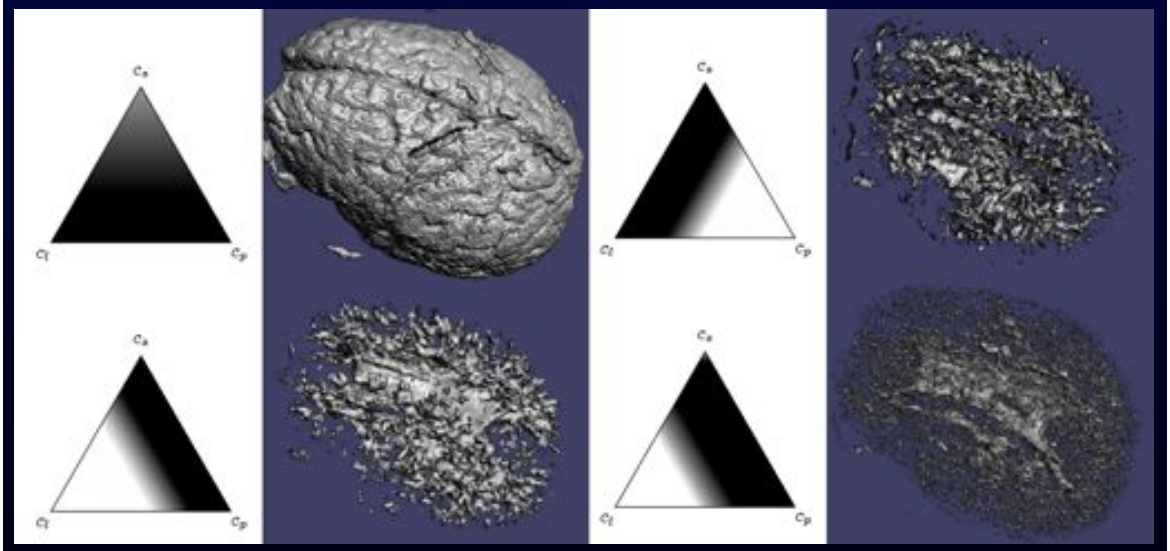
Volume Rendering

Simple algorithm

- Cast rays through volume
- Measure tensor, tensor properties
- Assign colors and opacities
- Composite



Volume Rendering



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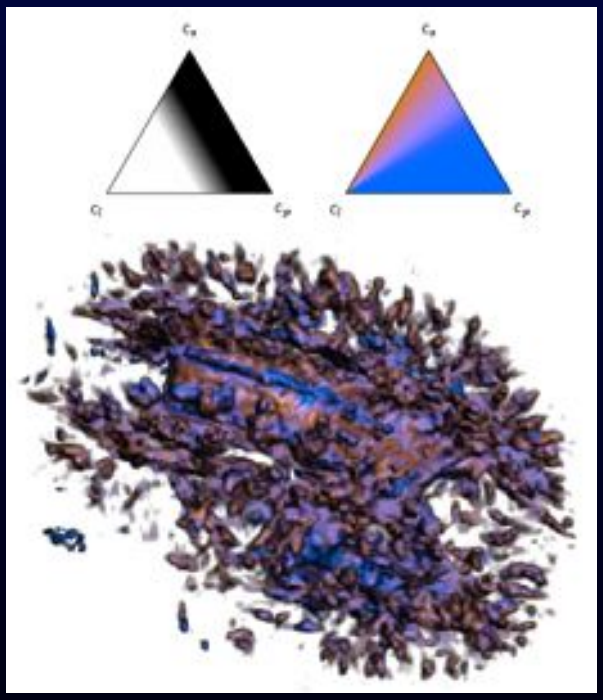

Volume Rendering