

Visualizing Neural Tissue from MR data

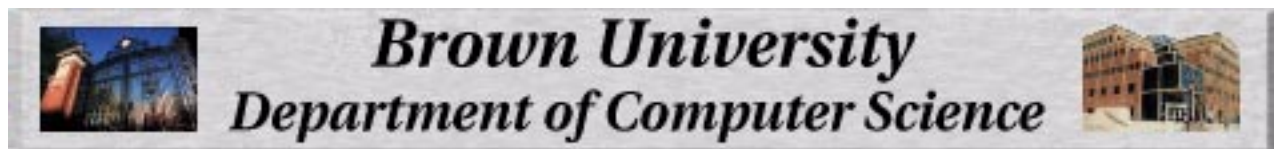
Research Comp Proposal

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Introduction

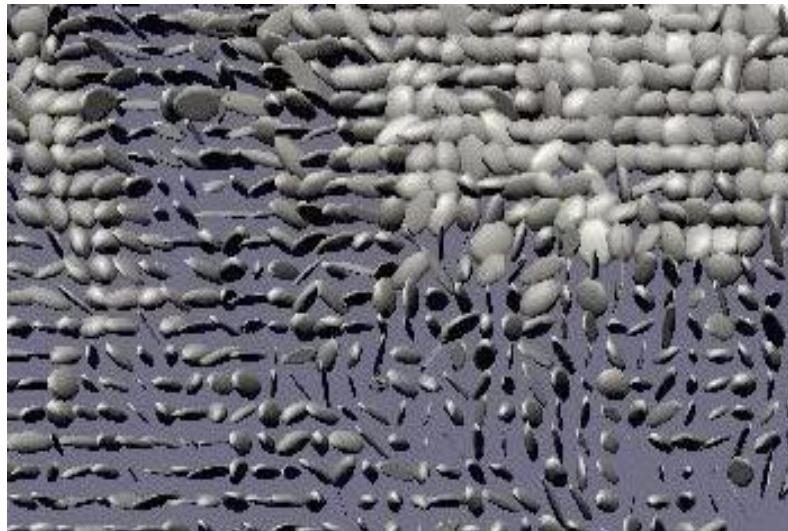
- From MR data, we can get directionally dependent diffusion rate, which can help us visualize anisotropic neural tissues such as white matter of spinal cord.
- Diffusion rate images calculated from MRI measurements are second-order tensor fields. Our goal is to visualize the structure of the neural tissue from these tensor fields.

Visualizing diffusion rate tensor fields is difficult

- Totally 7 dependent values at each spatial location
- Information conveyed through visualization should be rich and clear at the same time
- Volumetric visualization is even harder

Possible Method 1

- Ellipsoid as point icon.
- Using ellipsoid to present anisotropy at a certain point.
- Previous work: Visualizing 2D slices of 3D tensor field.

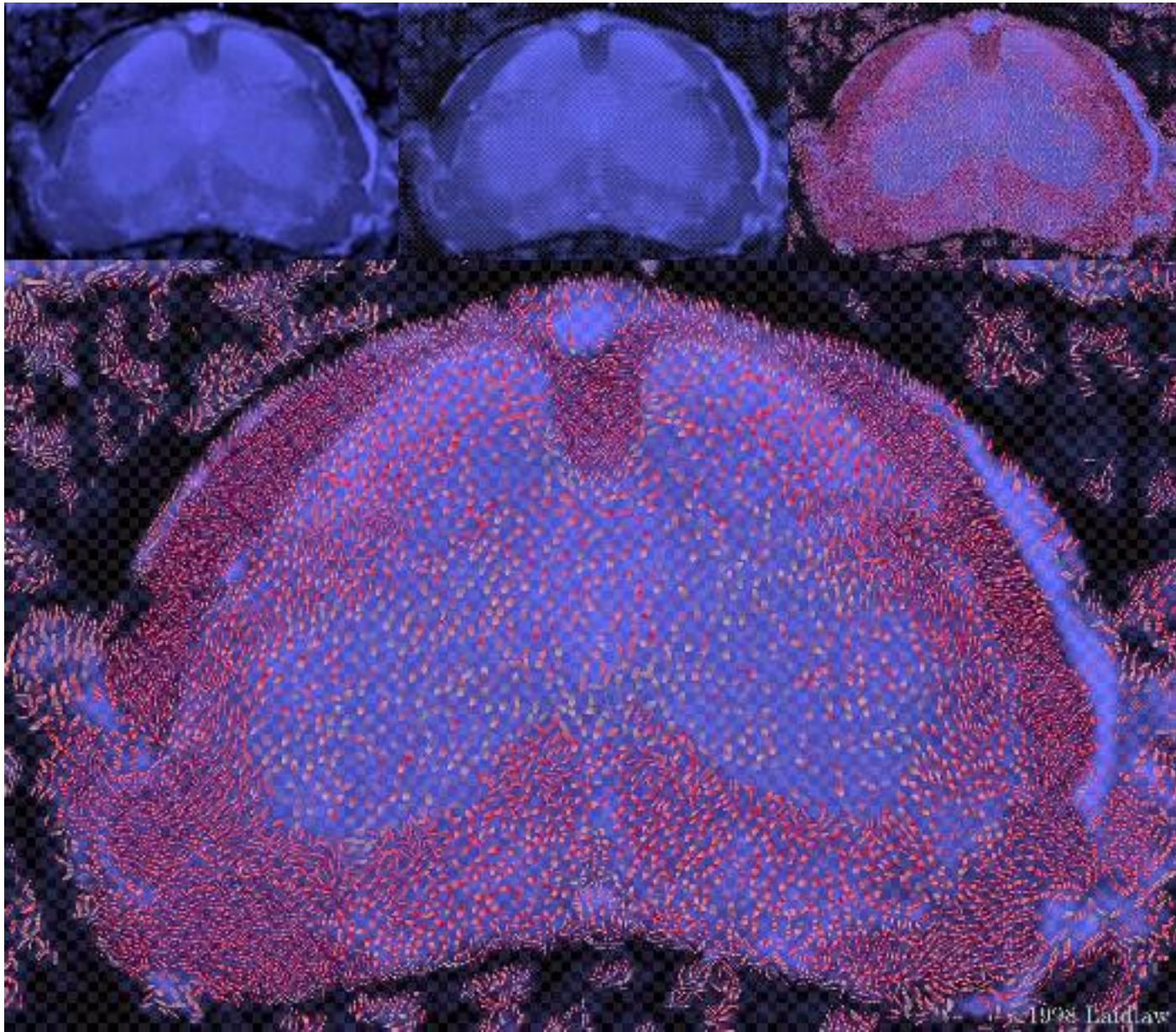


Possible Method 2

- Painting Metaphor
 - Concept borrowed from painting.
 - Using different layers of paint to represent different elements of a scene
 - Varying the many characteristics of brush strokes.
 - Use brush, or ellipse as stroke. It's an extension of previous work, from 2D to 3D.



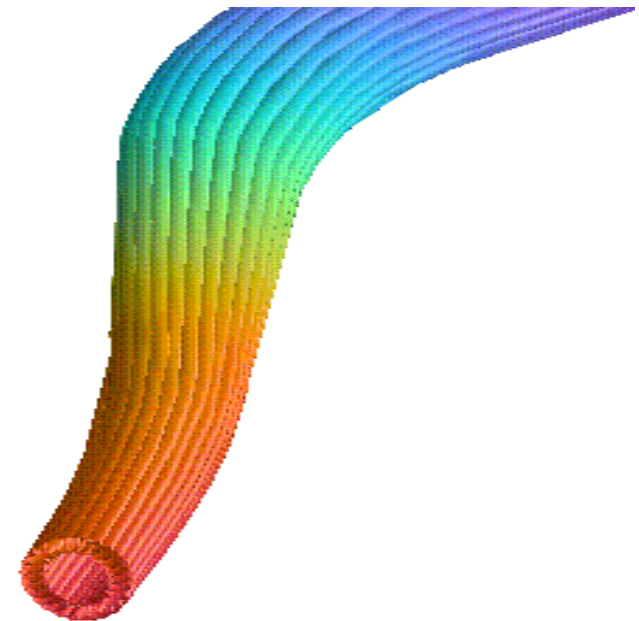
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Possible Method 3

- Hyperstreamline as line icon.
 - Using hyperstreamlines to represent tensor field in 3D space.
 - Variable trajectory, cross section, color scheme.
 - Designed to visualize stress tensor.



Possible Method 4

- Using hairy texture
 - Inspired by “Cellular Texture Generation”
 - Using fiber-like long thin hairs to present structure of the tissue.



Possible Method 5

- Using polygon mesh to represent surface of the tissue

Detect the surface and represent it with polygon mesh. Its primary goal is to detect surface. In order to visualize the structure of the neural tissue, we should use other method in combination with this one.

Possible Method 6

- Computational Diffusion(staining)

Theoretically stain the tissues with dye, and simulate the diffusion process. Then find out the tissue structural information from the distribution of the dye.

Validation

In order to be able to verify the accuracy of our image, we need to construct phantom models. Imaging phantoms with our methods and compared them to the model image.

User survey and Conclusion

User survey will be included in the research process. We will ask people from biological departments to evaluate the pictures. And use the feedback to modify our methods.

Timeline

- 4/15-5/15 Reading and thinking
- 5/15-6/15 Integrate available codes. Play with MR data
- 6/15-8/15 Implement one method.(possibly painting metaphor)
 - Iterate through the steps of
 - Visualization design
 - Coding the algorithm
 - Generating picture
 - Evaluate picture(user survey)
- 8/15-12/15 Implement another method.
- 12/15-2/1 Write the thesis.
- 2/1-4/15 Finish thesis and prepare the presentation.