# Perceptual Coloring and 2D Sketching for Segmentation of Neural Pathways

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SIGGRAPH2006

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## Motivations

This project is motivated by the desire to help doctors in understanding white matter structure within human brain for studying diseases such as HIV.

- Visualize the geometric disparity between white matter tracts obtained from DT-MRI (Diffusion Tensor Magnetic Resonance Images)
- Allow expert users to select regions interactively with a 2D based sketching mechanism
- Better Reflects the uncertainty in forming scientific model from geometric information
- Avoid rigid, possibly inaccurate, segmentation from automatic clustering of tracts
- 2D sketching interface exploits neuroscientists' expertise with sectional anatomy




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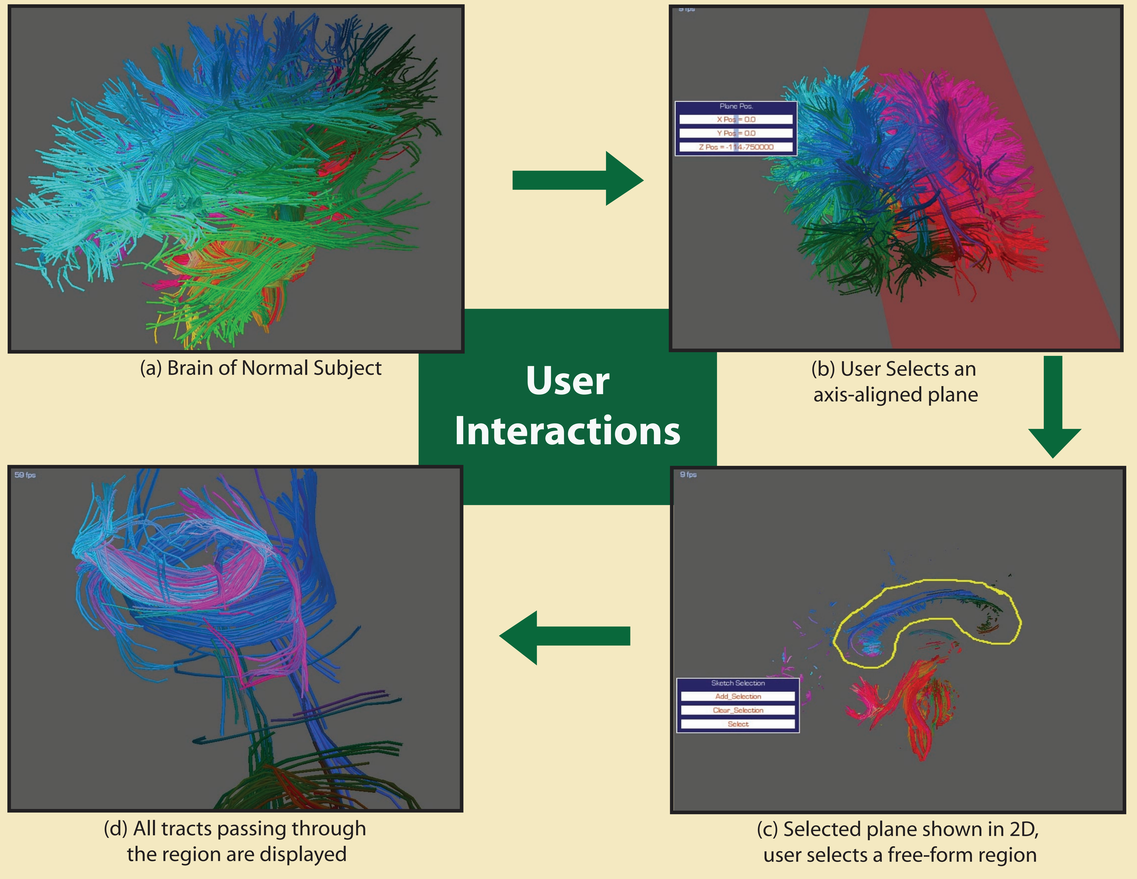


## Methods

### Color Embedding

- Compute streamtubes that represent white matter paths from DT-MRI data
- Compute adjacency matrix of distances between every pair of streamtubes in the brain
- Using spectral embedding method, assign colors to every streamtube such that differences in colors correspond to the distances in the matrix
- Convert these colors from perceptually uniform color space to RGB for display

### Expert User Interactions

- View the generated streamtubes in BrainApp, an interactive tool for visualizing DT-MRI data
- Select axis-aligned planes in 3D, then view as a 2D view, the colors of streamtubes intersecting that slice
- Makes a free-form closed curve, the streamtubes that pass through this region are selected
- Selected streamtubes will be displayed and allows interactions

## Expert Feedback

We performed two informal evaluations with an expert visualizing a normal and an HIV-possitive brain dataset. Our expert reported:

- High anatomic specificity
- Hemispheric color differences easily gave context when navigating in 3D views
- Smooth coloring was more compatible with uncertainty of tractography

## Conclusions

- Our evaluation suggests that visualizing the geometric disparity between white matter tracts using perceptual color embedding is a promising approach
- Our visualization methods shows relavant anatomic structure without imposing a rigid segmentation
- The axis-aligned view and selection method exploits the training neuroscientists have received viewing aligned 2D images of the brain

### Comparison of Generated Streamtubes