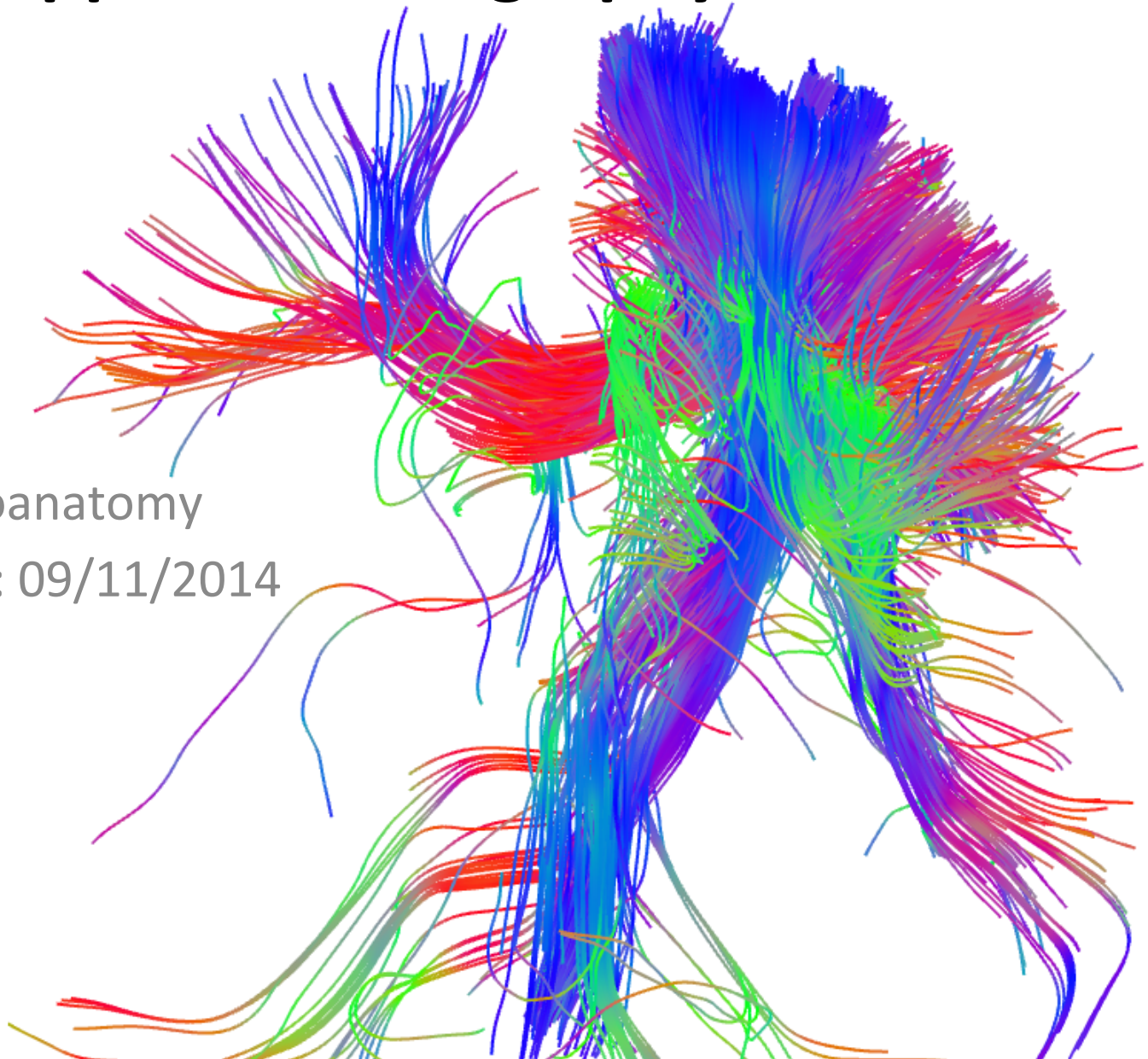# Applied Tractography – Part 2

Virtual Neuroanatomy

Lecture Date: 09/11/2014
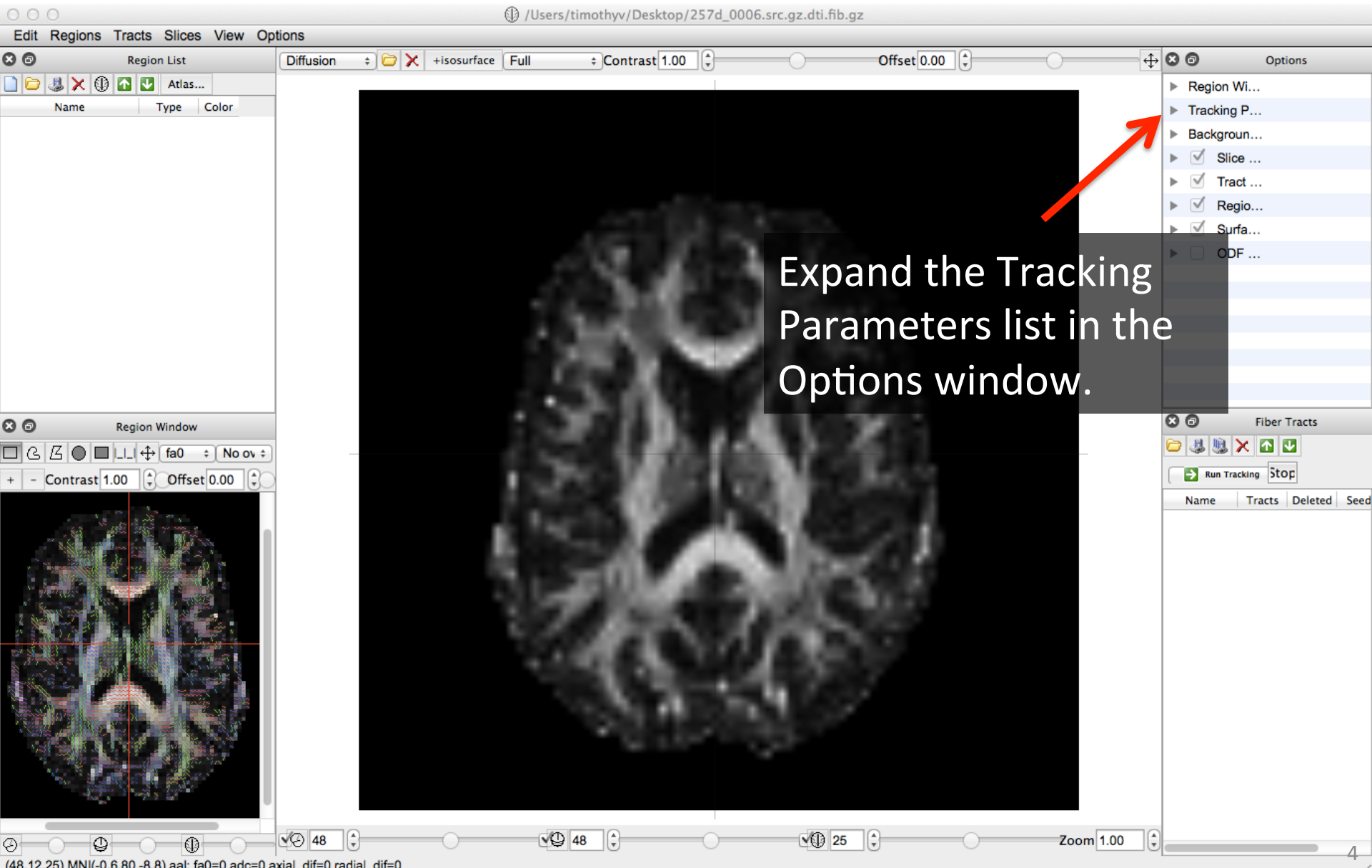
Goals

A.   Compare how different tractography parameters influence the final tractography output.

Picking up from last class

1. Compared three different reconstruction approaches on recovering the centrum semiovale:

   a. Diffusion Tensor Imaging

   b. QBI

   c. GQI

Tractography

Expand the Tracking Parameters list in the Options window.

The tracking options

Tractography Parameters

Parameter	Function
Termination Criteria	FA: Fractional anisotropy; QA: Quantitative Anisotropy.
Threshold	Identify gray matter. Stop when algorithm jumps into voxel with QA/FA lower than this value.
Max Angle	Minimize sharp turns. Stop when algorithm requires a turn greater than this angle.
Step Size	How big are the jumps in the algorithm.
Smoothing	How much the previous jump direction is incorporated in the current angle estimation: $A_{t+1} = S*A_{t-1} + (1-S)*A_t$
Length	Minimum and maximum lengths of fibers allowed to be included in the final set.
Initial Direction	At the start of each seed attempt, what direction to you start moving?
Seed Position	Start in center of whole voxel or work in the interpolated voxel.
Direction Interpolation	How to interpolate between steps of the algorithm.
Tracking Algorithm	What type of decision algorithm to us?
Terminate if	Finish running algorithm after either so many seed attempts (Seeds) or after so many streamlines have been collected (Tracks).

Seeds vs. Tracks

- **Seed**: A random draw to start the tractography algorithm. Usually drawn uniformly across voxels in a seed mask (default is a whole-brain mask)

- **Track**: A completed run of the tractography algorithm.

Tractography Tests

- Open the GQI reconstruction from the example subject.

- Reload the sphere ROI mask you used last class to find the semiovale streamlines.

- Set sphere mask to being a "ROI" for tractography purposes.

- Start with the default parameters shown here.

Parameter	Value
Termination Criteria	QA
Threshold	0.05
Max Angle	75 Degrees
Step Size	1 mm
Smoothing	0.70
Length	10-200 mm
Initial Direction	Random
Seed Position	Subvoxel
Interpolation	Trilinear
Tracking Algorithm	Streamline
Termination	20000 Seeds

Tractography Tests

How do manipulations of the different parameters influence the final tractography output?

- **Test 1**: Recollect a semiovale with default parameters.
- **Test 2**: Change the termination threshold value to 0.025 and then to 0.1.
- **Test 3**: Set maximum turning angle to 20, 60, and 85 degrees.
- **Test 4**: Set turning angle to 75 degrees and then change smoothing to 0, 0.5, and 0.9.
- **Test 5**: Reduce maximum fiber length to 10, 50, then a minimum of 0 (max 200).
- **Test 6**: Change termination set criteria to Tracks.
- **Test 7:** Change the "ROI" mask to a "Seed" mask, then to a "ROA" mask.

Homework

In a word document, show the screenshots from today's tests and give a 1-2 sentence description of how each parameter tested affected the final tractography results.

Due at the beginning of class on Thursday (9/16)

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