

Introduction and Acknowledgements

This module was originally developed at SPL (<http://www.spl.harvard.edu/>) by Wenyao Zhang (visiting scholar from School of Computer Science, Beijing Institute of Technology, China) and Lauren O'Donnell (Laboratory of Mathematics in Imaging at Harvard Medical School).

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Module Description

This module is initially designed to visualize fiber bundles generated by the UKF-based tractography method where the two-tensor model is used. Now, it can in fact handle data produced with one-tensor model or two tensor model, even with the free water model. Data of fibers that can be visualized include fiber lines, fiber tensors, and fiber point scale properties such freewater, estimated uncertainties, traces, FAs, etc.

The easy to use interface provides flexible control over the visualization of fiber bundles. For more information, please refer to the following tutorials.

Installation

It is a loadable script module written in Python. Its running depends on PyOpenGL and an extended interface between Slicer and PyOpenGL. The later is included in the package of this module.

So before downloading the ZIP file of this module from <https://github.com/WYZ-BIT/TwoTensorModelViz>, you should first install PyOpenGL successfully. After downloading and unzipping the module package to a local folder, to load and run the module, please add the local folder

path of the module into the "Additional module path" list in the application settings of Slicer.

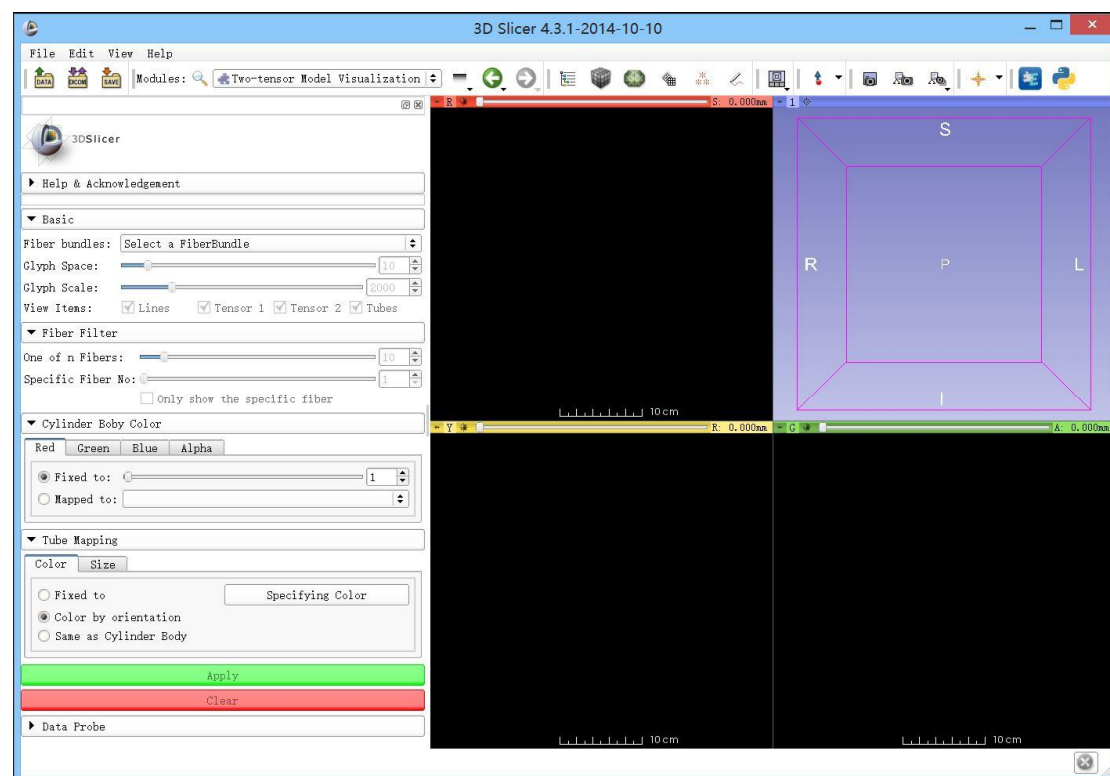
If PyOpenGL is installed, and this module is also loaded successfully, the following similar information would show in the window of Slicer Python Interactor:

```
Python 2.7.3 (default, Jan 21 2015, 14:38:22) [MSC v.1500 64 bit (AMD64)] on win32
>>> PyOpenGL and vtkPyOpenGLActor have been enabled!
```

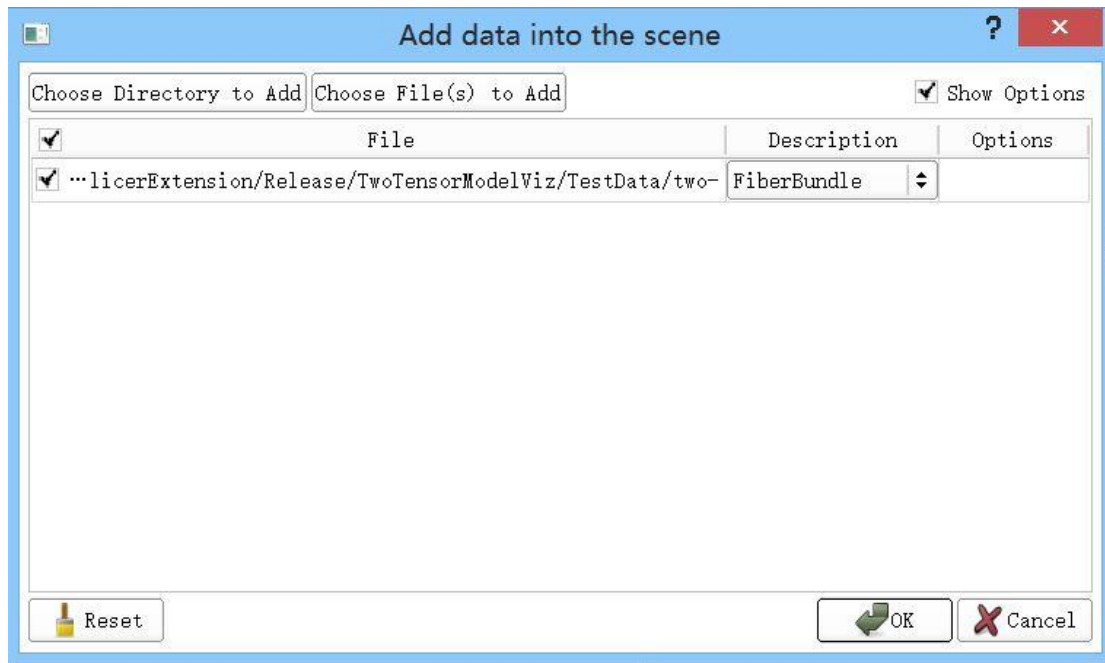
Notes: The module has only been successfully tested on Windows 8.1 with Slicer 4.3.1. If it does not work with your Slicer version, you maybe need to download the source code of Slicer from <https://github.com/WYZ-BIT/Slicer> and compile it to get the Slicer application. This specific version of Slicer includes the source code of the interface to PyOpenGL, and has passed through the test with this module.

Tutorials

Step 1. Start the "Two-tensor Model Visualization" module in Slicer.



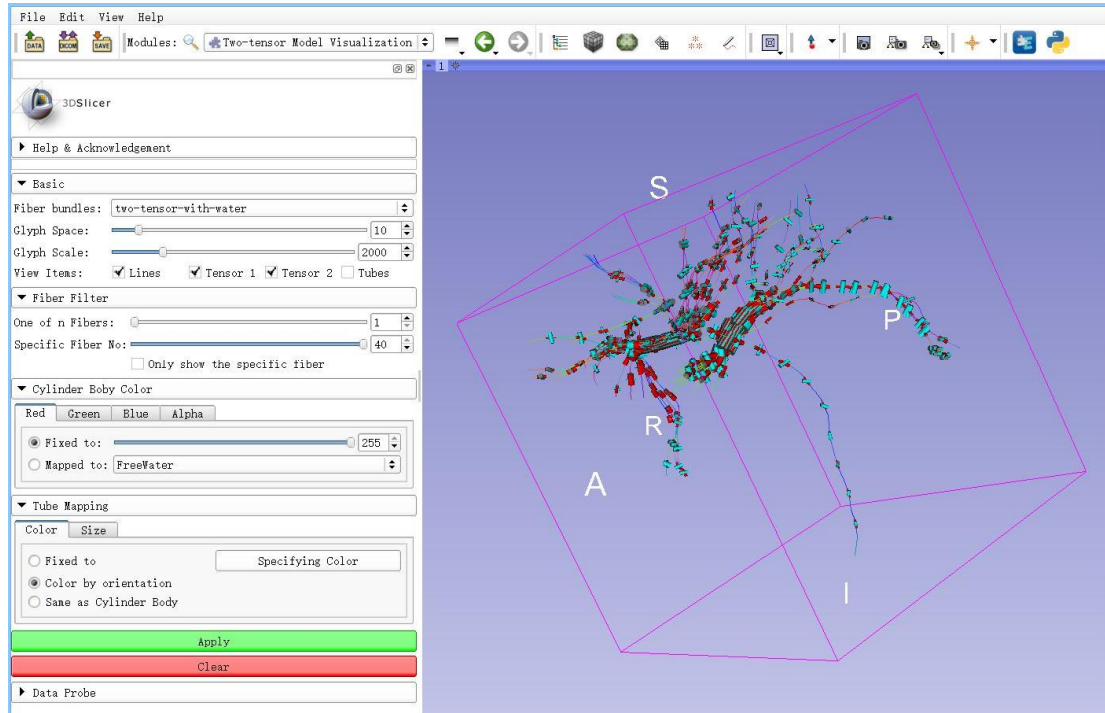
Step 2. Add fiber bundles using the "Add Data" in "File" menu. Here, "FiberBundle" should be specified in the "Description", as shown below. Note: the module package includes the data file that is used here as an example.



Step 3. Click the green "Apply" button, and get the following 3D display with all default settings.

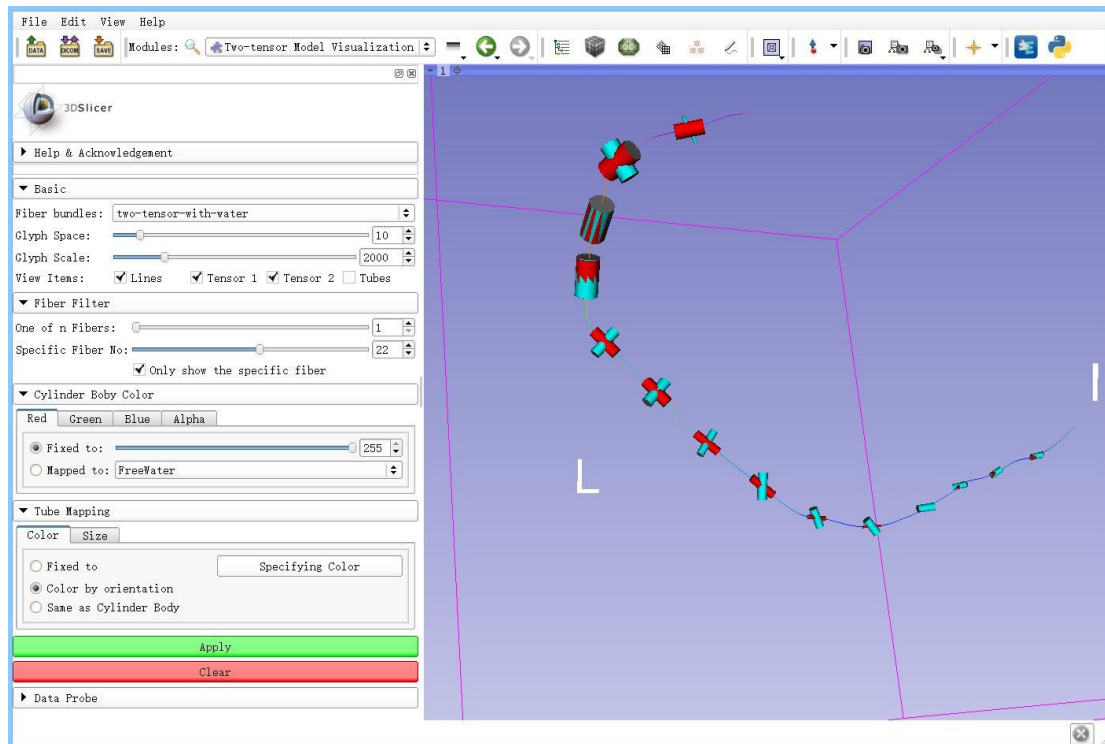
In this picture, cylinder glyphs are used to present tensors. And cylinder size is used to code eigenvalues of tensors. Each tensor is supposed to have two equal eigenvalues, according to the two-tensor model used in the UKF-based tractography. Fiber lines are colored with orientation, while cylinder body color is customized by the setting in the Section "Cylinder Body Color". Note: The colors of tensor 1 and tensor 2 are set to be complementary.

Moreover, we can change the fiber bundle in the "Basic" section, change the scale and space of glyphs, and select the items to be viewed.

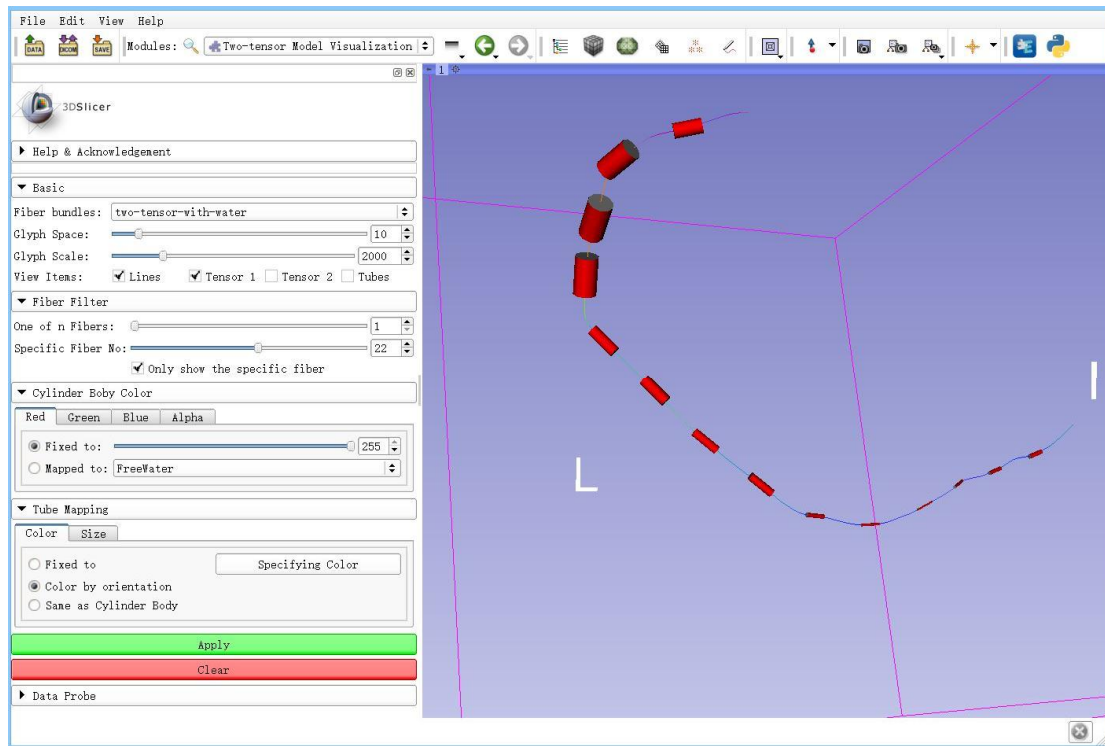


Step 4. View one fiber.

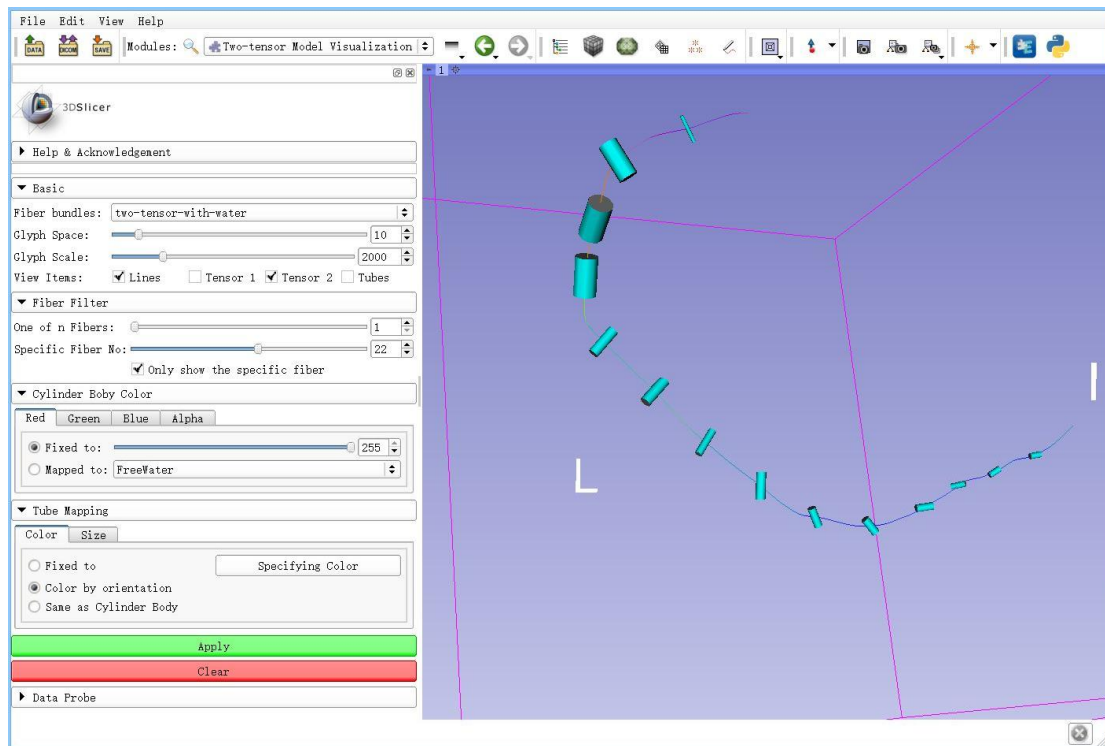
In the "Fiber Filter" section, check the option "Only show the specific fiber", and specify a number using the above slider, we can view fibers one by one. Setting according to the left part, we can get the right 3D display as shown in the following picture, where relationships of tensors are disclosed clearly.



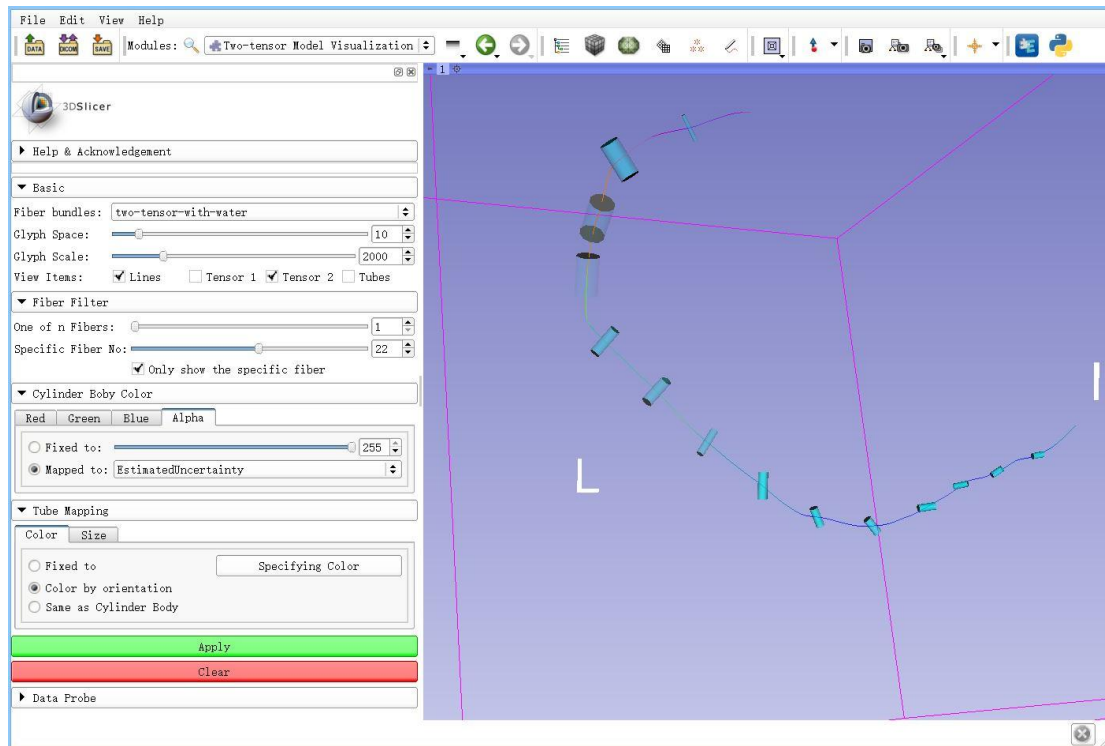
Uncheck the option "Tensor 2", we get this:



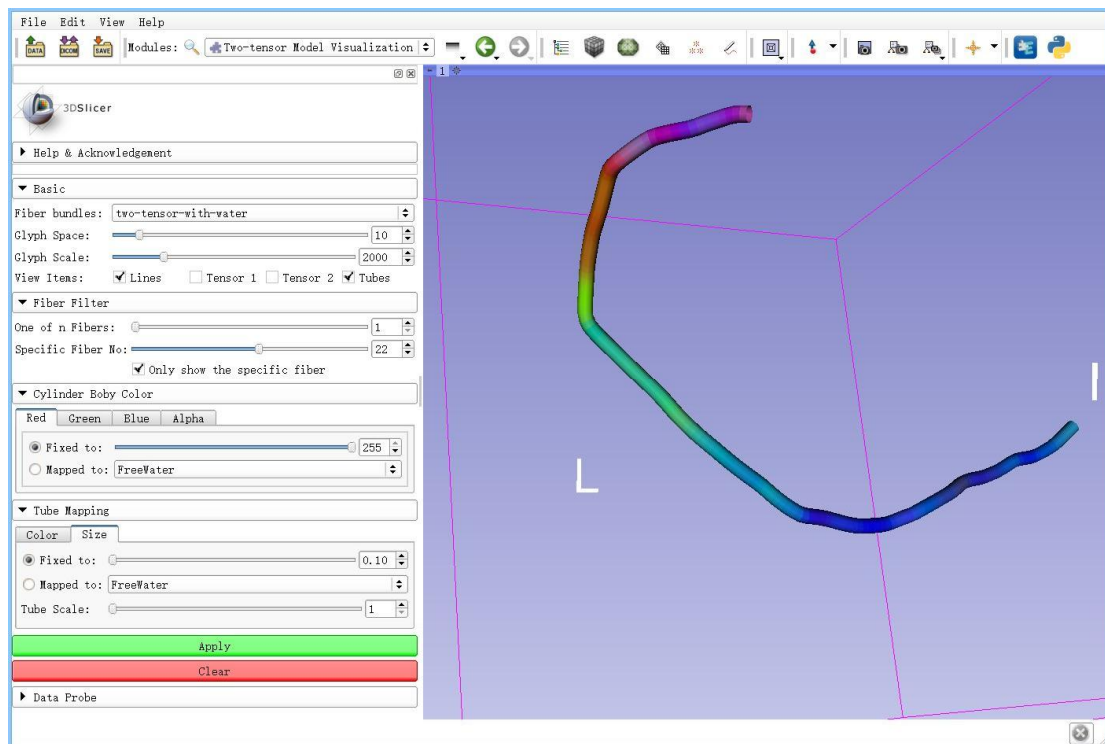
Uncheck the option "Tensor 1", we get that:



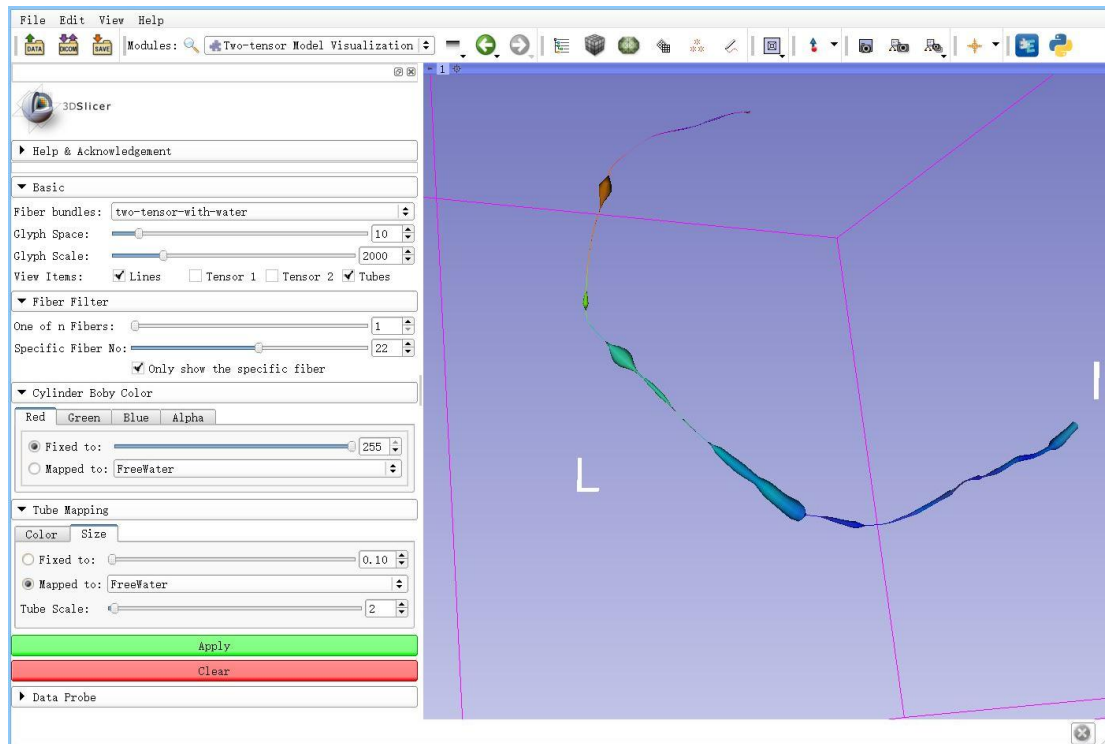
On this basis, change the alpha channel of cylinder color to the option "Mapped to EstimatedUncertainty", we can get the result where cylinders' transparency indicates the estimated uncertainties at each sample position.



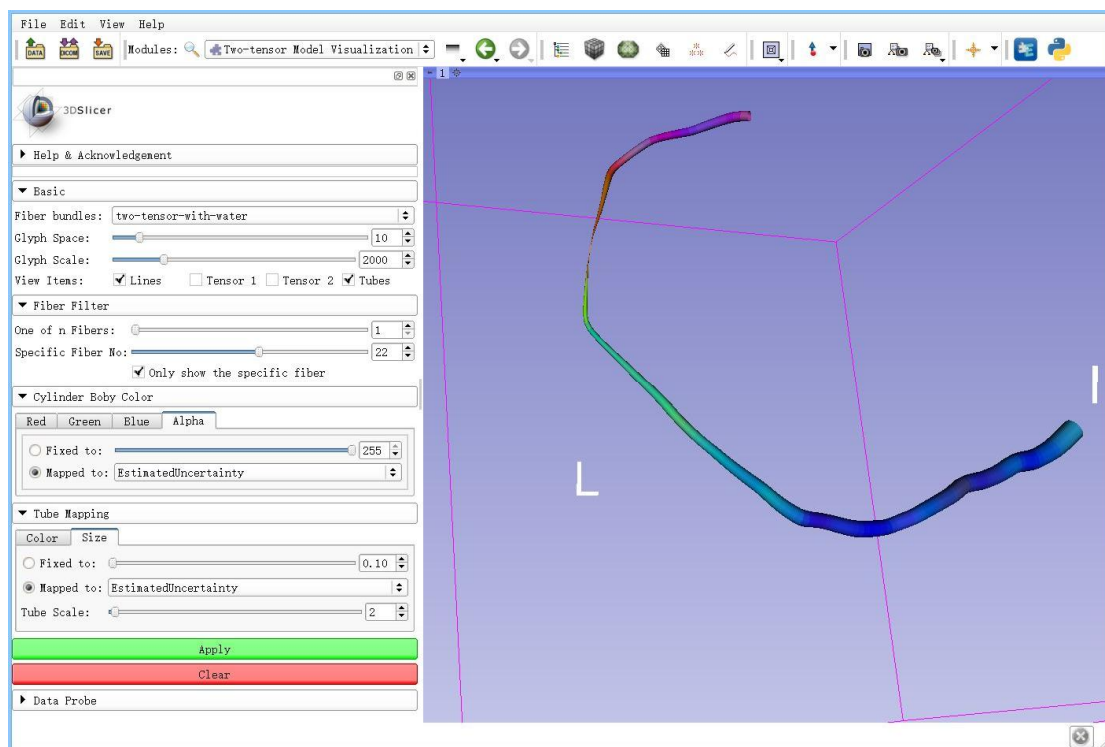
Step 5. View one fiber as a tube using the settings below.



The tube size can be fixed to a value or mapped to a scale property of samples. In the following image, the tube size is mapped to FreeWater. Obviously, free water varies along the line.

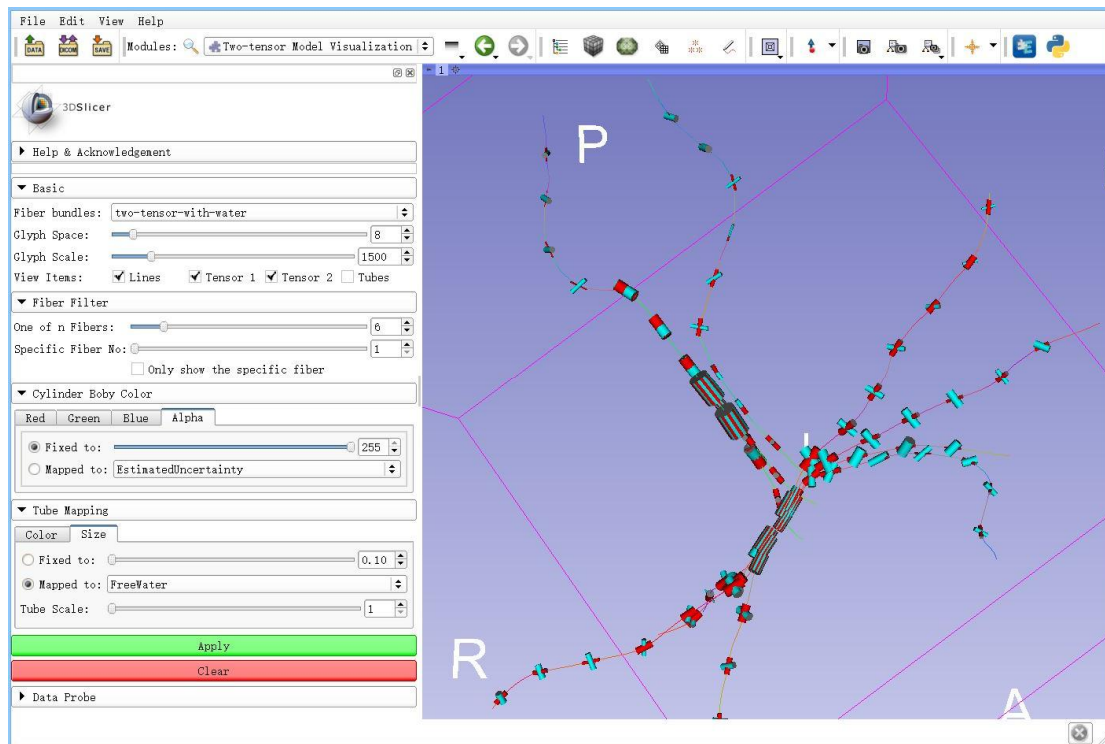


Similarly, we can observe the estimated uncertainty along the line.

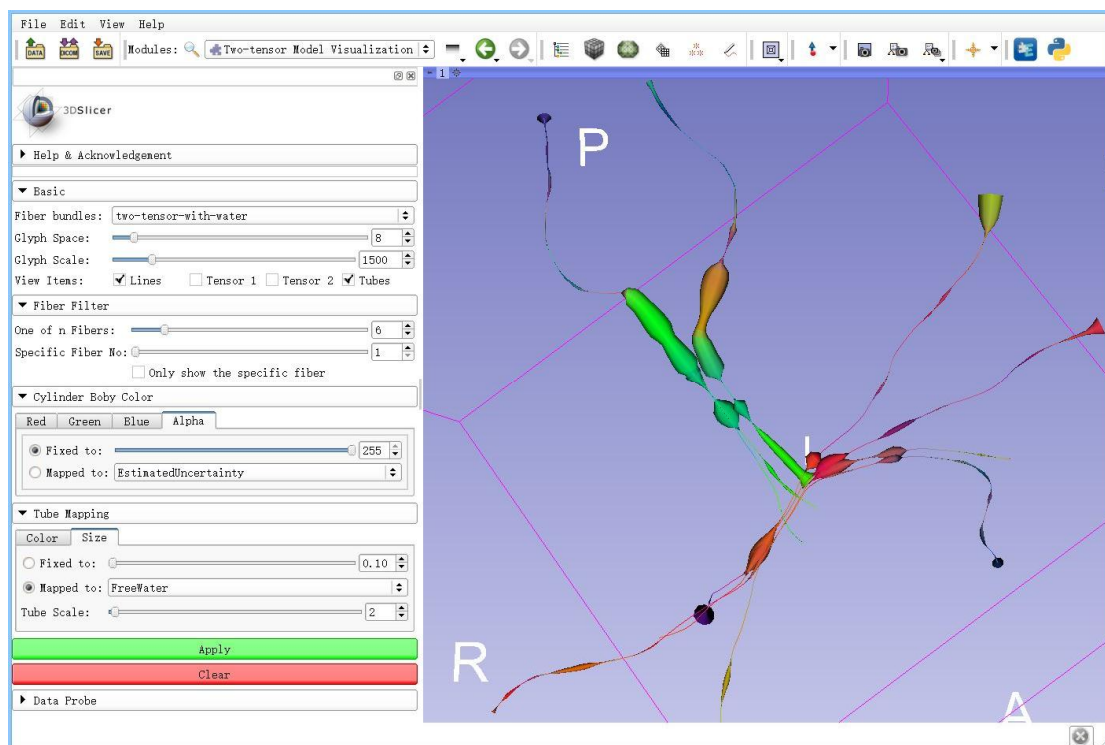


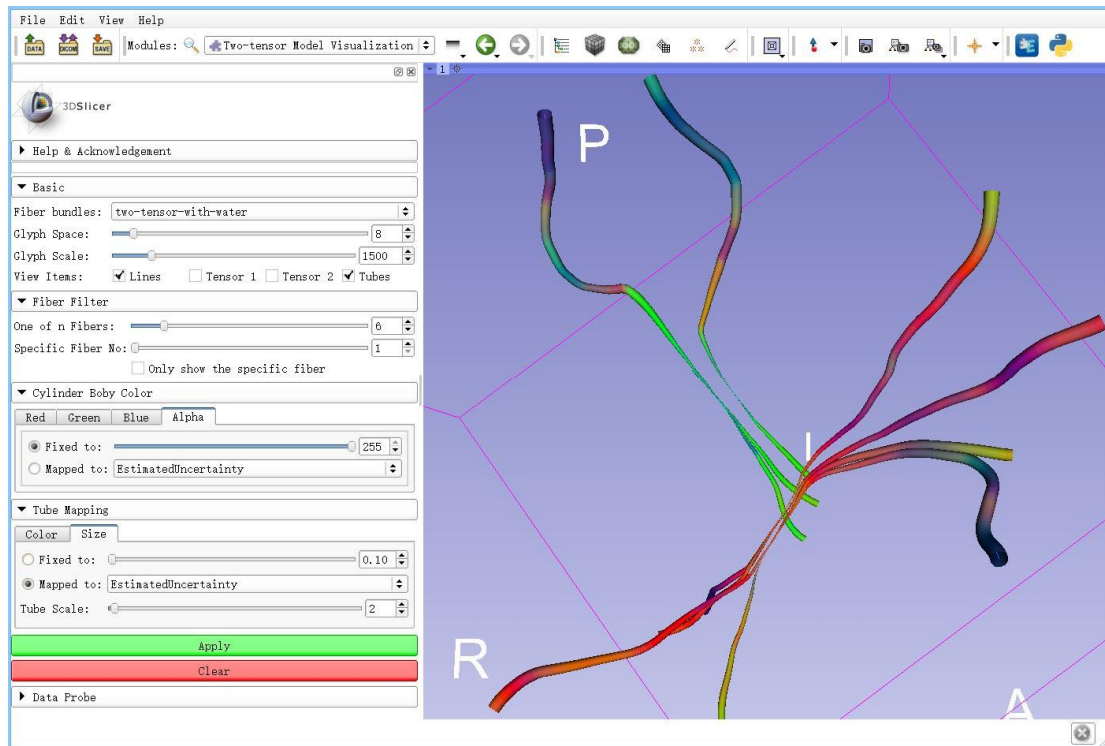
Step 6. View multiple fibers.

This module provides a way to filter fibers by selecting one fiber from each n fibers. If n is set to one, then all fibers are selected. In the following picture, the parameter n is set to 5. To use this mode, please make sure the option "Only show the specific fiber" unchecked.



Similar to the one fiber case, other options and settings can be combined with this model to get the desired visualization, such as the following images.





References

Reference for the two-tensor UKF tractography:

- Malcolm J, Shenton ME, Rathi Y. Filtered multitensor tractography. IEEE Trans Medical Imaging 2010;29:1664-1675.

Information for Developers

N/A

Version Information

The current version of this module is Version 1.0.

(Last updated August, 2015.)