

WinFiber3D

User's Manual

Last edited: 3/22/2010

Introduction

WinFiber3D is a custom program that can open and visualize MicroVisu3D (.mv3d) data files. The program was originally developed to quantify vascular networks, but could be used to quantify other types of 3D line segment networks. WinFiber3D can quantify various statistics of line data sets including segment orientation (angle), segment length, vessel length (network length), branch points, etc.

Running WinFiber3D

Open the application.

Open a .mv3d file generated by another program (e.g. AMIRA).

Once the data set has been loaded, there are 6 basic things that can be done.

1. Manipulate the data set in space; rotate, zoom,
2. Crop the data set
3. Change rendering options
4. Remove vessels from data set / size filtering
5. Quantify various statistics
6. Saving the data to a .txt file

NOTE: The original data file is never changed by WinFiber3D. All the save functions are as .txt files and will not over-write the original data.

Manipulating the 3D data set in space

To rotate the data set, left click on the data and drag mouse while holding the left mouse button down. To zoom in and out, click+drag with the right mouse button and move mouse up to zoom in or move down to zoom out.

Cropping the data set

To crop a 3D data set, select **crop** (F6) from the Tools drop-down menu at the upper left. In the crop window that appears, input the new start and end x, y, and z dimensions and press the crop button. As the new values are input, the new bounding box will be displayed in green, and the old bounding box will be in white. Cropping a 3D set cannot be undone, unless the data set is closed and re-opened.

Changing Rendering options

In the lower right corner of the window there is a **render** panel. Using the drop down menus, either a fancy or standard line style may be selected. In the color style drop down menu, all the line segments may be colored red, randomly colored by segment, or entire vessel, or by the segment type. In the latter case, red identify internal segment, green are terminal segments (end point segments), and white are loop segments.

Removing a vessel from the data set

If there is a need to remove a vessel (network) from the data set due to an imaging aberration, etc., a vessel may be removed from the data set as follows. Left-click on the vessel to be removed. It should become highlighted. Properties of the selected vessel, including vessel identification number, length, volume, and branches will appear in the *selection* panel on the right hand side of the window. Left-click on the Delete button to remove the selected vessel. This function cannot be undone, unless the data set is closed and then reopened.

Filtering vessels by length

Vessels can also be removed from the data set based on their length. To only quantify those vessels within a certain length range, input a minimum and maximum vessel length under the

range bar also located on the right side of the window. Left-click on update. This function can be un-done by putting the default values back, and left-clicking on update.

Statistics

The basic statistics for each data set are shown on the upper right hand side of the window. These statistics are self explanatory and will change as vessels are deleted or filtered by length.

- Total number of vessels
- Total number of branch pts.
- Total number of end pts.
- Average number of branch pts. per vessel
- Average number of end pts. per vessel
- Total volume (bounding box volume)
- Vessel volume
- Volume ratio

Some statistics may be examined individually within WinFiber3D as distributions. Selecting **Measure** (F5) under the **tools** drop-down menu on the upper left menu bar will open a new “measure” window. There are 6 different statistics that may be examined using the drop-down menu within this window:

- **Angle (pr(x))** = displays angle distribution of segments relative to the x-axis of the data set. In this case, the segments are first projected into the xy plane first, then the angle relative to the x-axis is calculated. (values from 0-90 degrees)
- **Angle (x)** = displays the angle distribution of segments relative to the x-axis of the data set. (values from 0-90 degrees)
- **Angle (z)** = displays the angle distribution of segments relative to the z-axis of the data set. (values from 0-90 degrees)
- **Average segment diameter** = displays distribution of average segment diameter. First the average diameter for each segment is calculated, then the distribution is calculated.
- **Segment Length** = displays distribution of segment lengths
- **Vessel Length** = displays distribution of vessel lengths

For each of these statistics, the X axis is auto-scaled, however, the number of bins for the distribution may be defined in the Bins input. The y-axis for all the distributions is normalized such that all values are a fraction of the total summing to 1. In addition, the distributions may be weighted according to segment length, by checking the **length weighting** box. This feature essentially multiplies the value for each parameter being measured by the segment length. Therefore, the longer segments have more amplitude in the distributions than shorter programs. Each of these distributions may be saved as a text file for further analysis in other programs. To save the data, left-click on the **save** button located in the lower left-hand corner of the measure window.

Saving Statistics to a .txt file

Basic statistics as well as segment and vessel stats may be saved as a .txt file by selecting **save** (ctrl+s) in the file drop down menu (upper left of window). Browse to a location and type a file name, with the .txt extension. To save the basic statistics, check the box next to **save statistics**. At this time the segment data containing the segment angle, length, and diameter for each segment may also be saved by checking the box next to **segment data**. In addition, the vessel data may be saved by checking the box next to **vessel data**. This data includes vessel ID, length, volume, and number of branches. All of this data saved as a .txt file is listed in a tab delimited output, which then may be opened and analyzed with Excel, Matlab, or other software.

Other Features

Selection history

As different vessels are selected by left clicking on the vessels, a log of the vessels is kept. To view this log, select **selection history** under the **edit** drop down menu located at the upper left of the main window. This will open a new window called selection history. This will display the vessel identification number, length, volume and branch points. This information maybe saved as a text file by left-clicking on the **save** button located in the lower left corner. The list may also be cleared by left-clicking on the **clear** button.

Delete loops

Loops are defined a segments that start and stop at the same point. Since an angle associated with such an object is unusable, loops maybe removed from data sets by selecting **delete loops** in the **tools** drop-down menu located at the upper left of the main window.

MicroVisu3D Data Format

The figure below displays a sample .mv3d file. This is the format data will need to be in if it is to be read properly by WinFiber3D.

```
# MicroVisu3D file
# Number of lines 1427
# Number of points 29903
# Number of inter. 598
#
# No      x      y      z      d
#
0      3057.720215 0.000008 0.000000 8.299848
0      3057.564453 2.490007 0.000000 8.196313
0      3057.020020 4.980010 0.000000 7.833363
0      3055.823486 7.470010 0.000000 6.640000
0      3055.415039 9.960011 0.000000 6.640000
0      3055.285400 12.450007 0.000000 6.640000
0      3055.090820 14.940008 0.000000 6.361691
0      3054.534668 17.430010 0.000000 6.640000
0      3053.334961 19.920010 0.000000 6.640000
0      3052.925293 22.410007 0.000000 6.640000
0
1      151.890015 7.470009 0.000000 2.490000
1      154.224380 9.960011 0.664062 2.490000
1      156.169693 12.450007 1.738281 2.490000
1      157.463333 14.940008 1.765137 2.490000
1      159.389191 17.430010 1.086426 2.490000
```

Headers

Headers in the .mv3d format are designated by the initial character '#.' 6 lines of headers precede the data portion of the file: Title, number of lines, number of points, number of intersections, a line break, column labels, and another line break.

Data

Data is stored in the .mv3d format as the position coordinates of nodes in 3-D. The data is also partitioned by an ID number which runs through 0 to NL – 1, where NL is the number of lines. This ID number designates which nodes connected into a line.

The first data column contains the ID number (for example, all nodes with the ID of '0' connect into a line).

The next three data columns contain the position of the node in the x, y, and z direction respectively.

The final data column contains the diameter of the line segment, which is not displayed in WinFiber3D but can be stored by the program.