COLLEGE of CHARLESTON
DEPARTMENT OF PHYSICS AND ASTRONOMY

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Investigation of Pulmonary Vascular Geometries Using 3D Slicer Software

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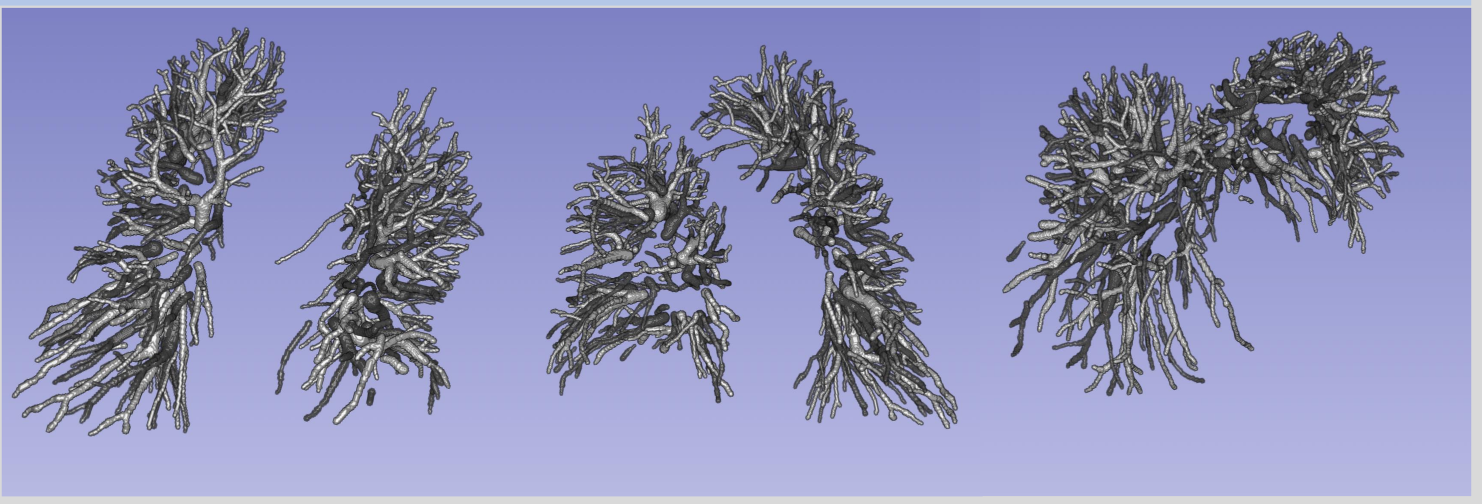
Introduction/Goals

- The geometric properties of vascular systems are indicative of disease presence and physiological function. The purpose of our project was to explore, organize, and analyze the "healthy" control data for future analysis of "diseased" data.

Post Processed CT Scan

- All three images here are the same lung but from different perspectives. The left image is axial view, the middle image is viewing from the coronal, and the third image is from the sagittal view.

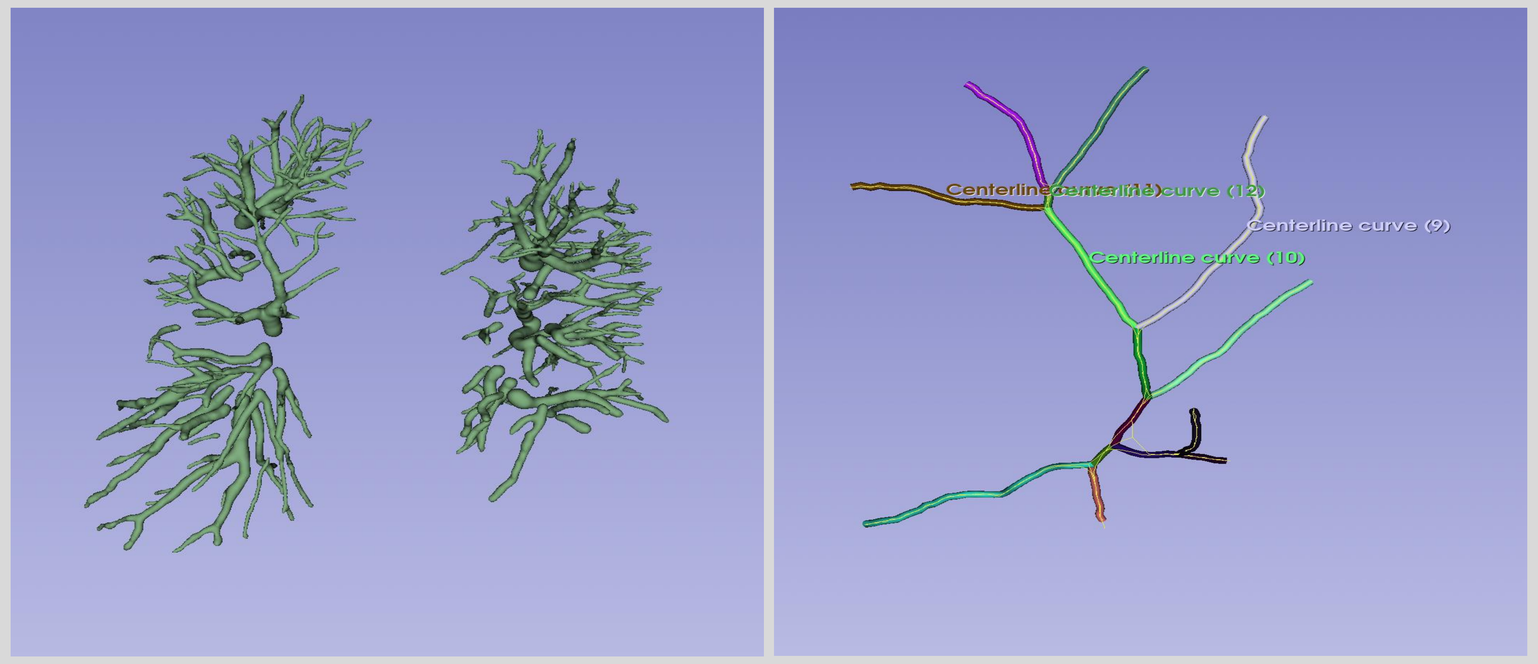
3D Image Generated by 3D Slicer



- 3d image generated from the 2d images above. The first image is viewed from the front, the second image is rotated 180 degrees and viewed from the back, the third image is rotated an additional 30 degrees.

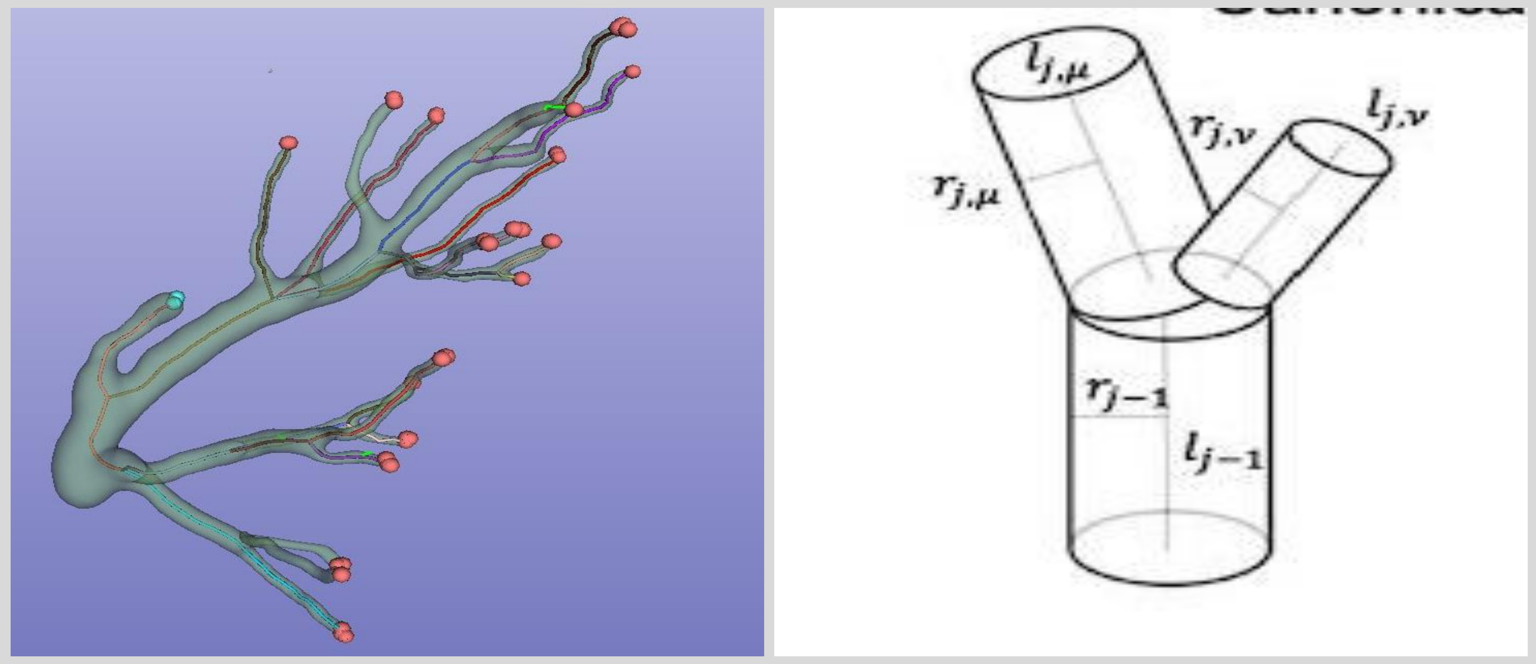
- Scan this QR Code for more information!

Segmentation/Editing within Slicer



- This process includes taking the pixel values of the image. A pixel value of 1 represents an artery while a pixel value of 2 represents a vein. These pixel values are then segmented in order to separate the two to allow easier calculations of geometric properties.

Single Mapped Vessel and Canonical Generation

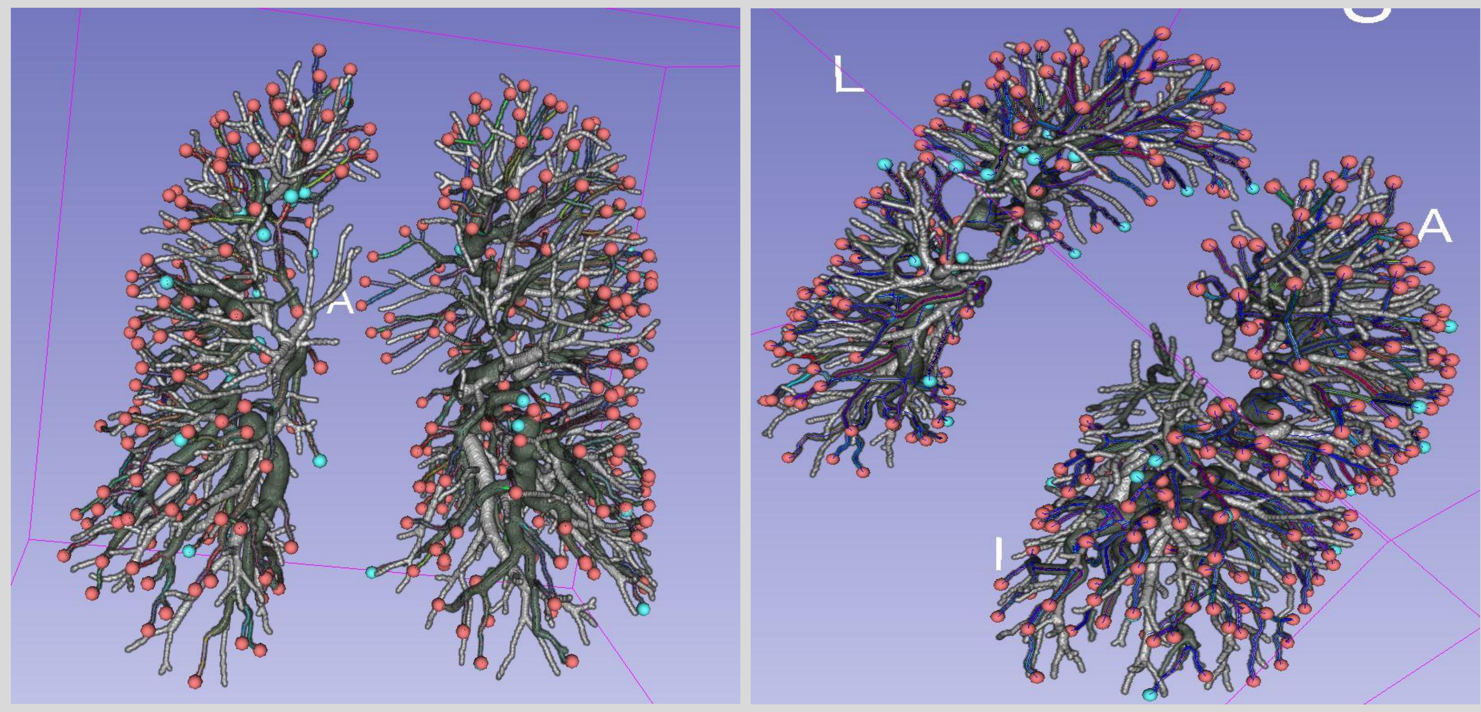


- This section shows how a single vessel is mapped using the 3D Slicer software. The image on the right demonstrates how parts of the vessel are identified as "Parents" or "Child" using canonical generation.

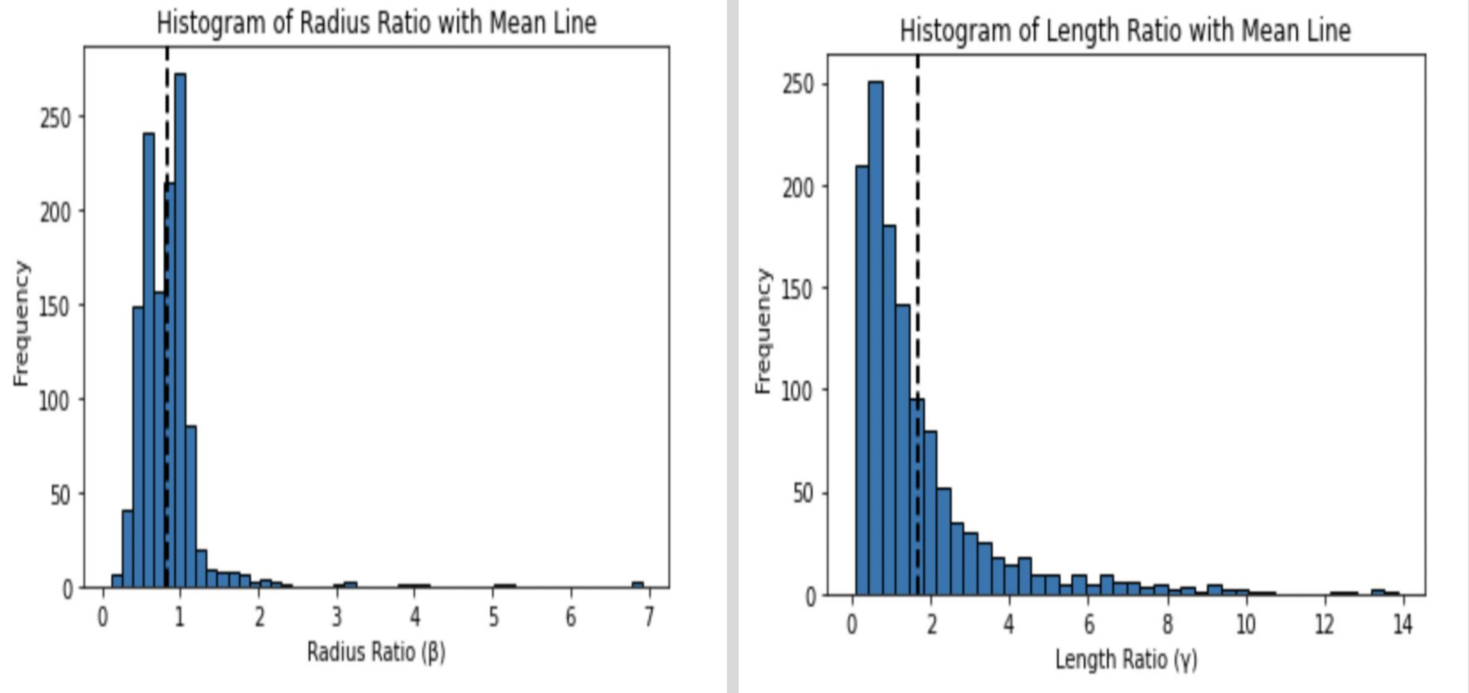
Using Python to Organize Data

- 3D Slicer can give data on each individual branch of a vessel. The application gives measurements such as radius, length and tortuosity of each branch. After extracting this data, we insert it into python to organize and further analyze the data.

Fully Mapped Vascular Trees



Results



$$\beta_j = \frac{r_j}{r_{j-1}} \qquad \gamma_j = \frac{l_j}{l_{j-1}} \qquad r_{j-1}^2 = r_{j,\mu}^2 + r_{j,\nu}^2$$

- Minimizing resistance to fluid flow predicts radial scaling. The mean for the ratios was not our predicted value(0.72). The value obtained was (0.83). The value did fall within one standard deviation(0.28). This could be due to methods of analysis or the fact it was a sample size of 1.

Future Work

- Stafford: To utilize the same procedure in analyzing publicly available data from the Cancer Imaging, for analysis of cancerous pulmonary vascular systems and compare it to the control group.
- Patrick: I will be using this same procedure, in collaboration with MUSC, for analysis of cerebral vasculature of NASA astronauts in low gravity environments.