**Introduction**

**Motivation**

- Direct application for improved medical treatments of neurological disorders
  - Alzheimer’s, Parkinson’s, Autism
- Critical knowledge for tissue engineering
- Improved diagnosis for
  - Abnormal vascular structures (tumors)
  - Stroke conditions
- More effective methods of blocking angiogenesis of tumors

**Objective**

- Models of the vascular system of the brain can be created by designing fractal structures. These mathematical models can then be used to solve the hemodynamics of the brain vasculature.

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**Vasculature**

**Fractals**

Fractals – A complex geometric figure that is made of identical repeated shapes on all scales. This creates self-similarity throughout the figure. Fractals in nature are called random fractals and have a finite range of invariance.

**MATLAB generated fractal structures**

**Fractal Models**

- **Mathematical Approach**
  - (1) Isolate branched vessel from Scanning Electron Microscope (SEM) image.
  - (2) Mark position of vessels with computer pixels.
  - (3) Connect pixel points to create skeletal structure.
  - (4) Model is created that represents original vessel. This begins to appear as a fractal tree structure.

- **Physiological Approach**
  - Scanning Electron Microscope image
  - Fractal Skeleton from SEM image

**Conclusion**

Using fractal structures created from SEM images of the brain vasculature, equations can be generated to solve the hemodynamics of the vessels including flux (in/out), pressure, and distension.

**Teaching Module Plan**

**Brain Model**

- Students will be able to design and construct a model of the human brain including the cerebrum, cerebellum, and brain stem as well as cerebral arteries.

**Communications in Science**

- Students will develop formal and informal communication skills to share scientific knowledge and understanding.

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