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Analyzing the Structural Properties of Pulmonary Arterial Networks

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“Analyzing the Structural Properties of Pulmonary Arterial Networks”

From micro-CT images of the lungs of mice, one can observe that the pulmonary arterial network forms a tree-like structure. In collaboration with Kitware, Inc. we have been able to use 3D Slicer, an open source image analysis software, to extract the representative graph structures from these images. These graphs include the (x,y,z) coordinates of terminal and bifurcation nodes and edge points, as well as the vessel radii at these points. While it is apparent in these images that the vessels form a branching tree, the exact topological and geometric structure of the networks varies widely due to experimental conditions and parameters set during the segmentation process. In this talk, we explore the various geometric and topological relationships that may hold in the vessel network. Our work is based on Olufsen et al. (2000), which hypothesizes that the arteries form a self-similar “structured tree”, whose pattern is generated by quantifying certain geometric parameters of the vessels, such as scaling factors for radii and length to radius ratios. Moreover, Olufsen et al. assumes that the structured tree parameters remain constant throughout the network; in this talk we examine the validity of these hypotheses. We also aim to use the structured tree model parameters to distinguish between control and hypertensive networks.