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# A Numerical Model for Simulation of Blood Flow in Vascular Networks

**Authors :** Houman Tamaddon, Mehrdad Behnia, Masud Behnia

**Abstract :** An accurate study of blood flow is associated with an accurate vascular pattern and geometrical properties of the organ of interest. Due to the complexity of vascular networks and poor accessibility in vivo, it is challenging to reconstruct the entire vasculature of any organ experimentally. The objective of this study is to introduce an innovative approach for the reconstruction of a full vascular tree from available morphometric data. Our method consists of implementing morphometric data on those parts of the vascular tree that are smaller than the resolution of medical imaging methods. This technique reconstructs the entire arterial tree down to the capillaries. Vessels greater than 2 mm are obtained from direct volume and surface analysis using contrast enhanced computed tomography (CT). Vessels smaller than 2mm are reconstructed from available morphometric and distensibility data and rearranged by applying Murray’s Laws. Implementation of morphometric data to reconstruct the branching pattern and applying Murray’s Laws to every vessel bifurcation simultaneously, lead to an accurate vascular tree reconstruction. The reconstruction algorithm generates full arterial tree topography down to the first capillary bifurcation. Geometry of each order of the vascular tree is generated separately to minimize the construction and simulation time. The node-to-node connectivity along with the diameter and length of every vessel segment is established and order numbers, according to the diameter-defined Strahler system, are assigned. During the simulation, we used the averaged flow rate for each order to predict the pressure drop and once the pressure drop is predicted, the flow rate is corrected to match the computed pressure drop for each vessel. The final results for 3 cardiac cycles is presented and compared to the clinical data.

**Keywords :** blood flow, morphometric data, vascular tree, Strahler ordering system
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