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Optimizing Flow in Branching Lymphatic Vessels

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BAMM Abstract Submission

Optimizing Flow in Branching Lymphatic Vessels:

Understanding lymphatic development is clinically relevant in applications from the viability of embryos, to chronic inflammation, to cancer metastasis. I specifically address the branching of developing lymphatic vessels, and flow through these vessels. While branching in arterial development is understood to consistently follow Murray's Law, I have found that an optimization law for lymphatic vessels is less straightforward. Several of the assumptions necessary for Murray's Law do not hold, and Murray's Law itself does not hold. Rather, the relationship between the parent and daughter vessels is upheld through a strictly additive rule, and the parent vessels are larger than would be predicted by a radius-cubed law. The variability in vessel diameter and potential for backflow suggest a different optimization strategy based on the geometry and function of the system. Future work will consist of examining other models based on branching structure, flow, pressure, shear, vorticity, or efficiency, using the immersed boundary method.