Abstract Submitted
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Predicting vascular diameter changes to up-regulate highly unsteady blood flow in the brain vasculature by using an adjoint-based inverse model[1] ROBERT EPP, Institute of Fluid Dynamics, ETH Zurich, FRANCA SCHMID, BRUNO WEBER, Institute of Pharmacology and Toxicology, University of Zurich, PATRICK JENNY, Institute of Fluid Dynamics, ETH Zurich — The brain is capable of regulating cerebral blood flow in response to local changes in neural activity. However, the precise mechanisms of the underlying vasodynamics are still poorly understood. The goal of our work is to use an inverse model to calculate diameter changes that are required to achieve pre-defined flow distributions in microvascular networks. We solve the inverse problem by minimizing a cost function J, where the sensitivity of J with regard to the diameters is calculated with the adjoint method. The vasculature is represented by a flow network and the impact of red blood cells (RBCs) on flow resistance is considered by tracking the motion of RBCs through the network. Due to the stochastic behaviour of RBCs at bifurcations, the instantaneous flow characteristics are highly unsteady. Therefore, our inverse problem is solved iteratively and the adjoint equation is solved based on time averaged flow rates and pressures. We performed simulations in realistic microvascular networks and computed the diameter changes necessary to increase blood flow in specific regions of the mouse cerebral cortex. Our study revealed that fine scale regulation at the level of capillaries is necessary to achieve very localized changes in flow distributions during functional activation.

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