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COMPUTATIONAL FRAMEWORK FOR MODELING AND IDENTIFYING ANGIOGRAPHIC SIGNATURES OF BRAIN COLLATERAL CIRCULATION

Fernando Mut[a], Juan R. Cebral[a] and Rainald Löhner[b]

[a]*Bioengineering Department, George Mason University. Fairfax, VA 22030 USA,*
https://bioengineering.gmu.edu/

[b]*Center for Computational Fluid Dynamics, George Mason University. Fairfax, VA 22030 USA,*
https://cfd.science.gmu.edu/

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Abstract. The outcome of ischemic stroke interventions, particularly thrombectomy, is heavily influenced by the degree of collateral circulation in the brain. However, assessing collateralization remains a major clinical challenge due to the complexity and variability of the cerebral vasculature. In this talk, I will present a computational framework for modeling anatomically realistic brain vascular networks, incorporating variability in both the circle of Willis and the pial collateral system. Using virtual patient populations, we perform blood flow and transport simulations to study how structural differences affect collateral flow during large vessel occlusion. We further introduce a method to extract quantitative angiographic signatures from simulated and clinical image sequences, enabling objective assessment of collateralization. This approach bridges anatomy, hemodynamics, and imaging, offering a pathway toward more personalized stroke diagnosis and treatment planning.

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