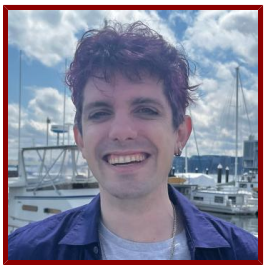
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Bio

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My research includes developing custom mathematical models and algorithms to comprehensively simulate the biophysics underlying brain dynamics. These models are then used to simulate the detailed blood flow, volume, and oxygenation changes that accompany neural activity with a focus on detailed, realistic microvascular geometry to predict the impact of hemodynamic states and vascular structure on fMRI signals (for BOLD and non-BOLD sequences). This interdisciplinary work includes advances in mathematics, biophysics, neuroscience, and computer science to enable simulations of vascular structures orders of magnitude larger than previously possible in only a few hours.

These advancements have led to the quantification of many fMRI biases previously overlooked or undervalued. This includes the geometric blurring by the capillary bed between the site of neurovascular coupling and the venous response, ultimately measured by BOLD. Moreover, the microvascular blood volume at resting-state gave a non-neuronal explanation for the mid-cortex “bump” observed in layer-fMRI BOLD signals. This tool also proposed mechanistic explanations underlying the BOLD frequency nonlinearity observed during oscillatory stimulus. In non-BOLD acquisitions, these tools discovered artifacts in IntraVoxel Incoherent Motion (IVIM) and VAscular Space Occupancy (VASO) signals caused by vascular structural and flow asymmetries and velocity heterogeneity which help explain discrepancies in experimental findings with these methods.

Google Scholar: https://scholar.google.com/citations?user=ihwU5t8AAAAJ&hl=en

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