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Modeling and Simulation of Cardiogenic Embolic Particle Transport to the Brain[1] DEBANJAN MUKHERJEE, NEEL JANI, SHAWN C. SHADDEN, University of California, Berkeley — Emboli are aggregates of cells, proteins, or fatty material, which travel along arteries distal to the point of their origin, and can potentially block blood flow to the brain, causing stroke. This is a prominent mechanism of stroke, accounting for about a third of all cases, with the heart being a prominent source of these emboli. This work presents our investigations towards developing numerical simulation frameworks for modeling the transport of embolic particles originating from the heart along the major arteries supplying the brain. The simulations are based on combining discrete particle method with image based computational fluid dynamics. Simulations of unsteady, pulsatile hemodynamics, and embolic particle transport within patient-specific geometries, with physiological boundary conditions, are presented. The analysis is focused on elucidating the distribution of particles, transport of particles in the head across the major cerebral arteries connected at the Circle of Willis, the role of hemodynamic variables on the particle trajectories, and the effect of considering one-way vs. two-way coupling methods for the particle-fluid momentum exchange. These investigations are aimed at advancing our understanding of embolic stroke using computational fluid dynamics techniques.

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