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A Multiscale Model for the Brain Vascular Network LEOPOLD GRINBERG, GEORGE KARNIADAKIS, Brown University — Simulations of blood flow in arterial networks requires physiologicaly correct boundary condition at inlets and outlets. Outflow boundary conditions for the Macrovascular Network (MaN) can be imposed by solving a closure problem based on modeling the rest of the flow in ten millions arterioles (Mesovascular Network, MeN) and one billion capillaries (Microvascular Network, MiN). Numerical solution of the three-level MaN-MeN-MiN integration can be performed on the future generation of petaflop supercomputers. An alternative approach for the MaN simulation is to impose the clinically measured flow rates at outlets. We have developed a new method to incorporate such measurements at multiple outlets, it is based on imposing Neumann boundary condition for the velocity and time-dependent resistance boundary conditions for the pressure. The convergence of numerical solution for the outlet flow-rates is achieved immediately. The computational complexity of the method is comparable to the widely used constant pressure boundary condition. Our approach is verified on a model of Brain Vascular Network with tens of arterial segments and outlets.

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