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Finite element modeling of mass transport in high-Péclet cardiovascular flows[1] KIRK HANSEN, AMIRHOSSEIN ARZANI, SHAWN SHADDEN, Univ of California - Berkeley — Mass transport plays an important role in many important cardiovascular processes, including thrombus formation and atherosclerosis. These mass transport problems are characterized by Péclet numbers of up to 10^8, leading to several numerical difficulties. The presence of thin near-wall concentration boundary layers requires very fine mesh resolution in these regions, while large concentration gradients within the flow cause numerical stabilization issues. In this work, we will discuss some guidelines for solving mass transport problems in cardiovascular flows using a stabilized Galerkin finite element method. First, we perform mesh convergence studies in a series of idealized and patient-specific geometries to determine the required near-wall mesh resolution for these types of problems, using both first- and second-order tetrahedral finite elements. Second, we investigate the use of several boundary condition types at outflow boundaries where backflow during some parts of the cardiac cycle can lead to convergence issues. Finally, we evaluate the effect of reducing Péclet number by increasing mass diffusivity as has been proposed by some researchers.

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