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A comparison between Dirichlet and Neumann boundary conditions for 0D/3D coupling in cardiovascular simulations MAHDI ESMAILY MOGHADAM, MAE Dept., UC San Diego, TAIN-YEN HSIA, Great Ormond Street Hospital, UK, ALISON MARSDEN, MAE Dept., UC San Diego — Implementation of boundary conditions (BCs) in cardiovascular simulations poses numerical challenges due to the complex dynamic behavior of the circulatory system. A closed-loop lumped parameter network (LPN) coupled to a 3D domain is a powerful tool that can be used to model the global dynamics of the circulatory system and its response to local changes in surgery design. In this study, the essential formulations for coupling a 0D model using both Dirichlet and Neumann BCs to a discretized 3D finite element domain are discussed. Using a closed loop LPN with a heart model and pure Dirichlet or Neumann BCs, the limitations of these two approaches are studied and stability, accuracy, and computational cost are compared. Results show that the Dirichlet BC is more accurate for the tested mesh sizes with better stability characteristic at larger time step sizes, although this method requires additional velocity profile information. Application to patient specific models is also presented and discussed.

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