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Efficient Unstructured Cartesian/Immersed-Boundary Method with Local Mesh Refinement to Simulate Flows in Complex 3D Geometries DIANE DE ZELICOURT, Georgia Tech, LIANG GE, University of California SF, FOTIS SOTIROPOULOS, University of Minnesota, AJIT YOGANATHAN, Georgia Tech — Image-guided computational fluid dynamics has recently gained attention as a tool for predicting the outcome of different surgical scenarios. Cartesian Immersed-Boundary methods constitute an attractive option to tackle the complexity of real-life anatomies. However, when such methods are applied to the branching, multi-vessel configurations typically encountered in cardiovascular anatomies the majority of the grid nodes of the background Cartesian mesh end up lying outside the computational domain, increasing the memory and computational overhead without enhancing the numerical resolution in the region of interest. To remedy this situation, the method presented here superimposes local mesh refinement onto an unstructured Cartesian grid formulation. A baseline unstructured Cartesian mesh is generated by eliminating all nodes that reside in the exterior of the flow domain from the grid structure, and is locally refined in the vicinity of the immersed-boundary. The potential of the method is demonstrated by carrying out systematic mesh refinement studies for internal flow problems ranging in complexity from a 90 deg pipe bend to an actual, patient-specific anatomy reconstructed from magnetic resonance.

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