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Numerical tool development of fluid-structure interactions for investigation of obstructive sleep apnea CHIEN-JUNG HUANG, University of California, SUSAN WHITE, UCLA School of Dentistry, SHAO-CHING HUANG, UCLA Institute for Digital Research and Education, SANJAY MALLYA, UCLA School of Dentistry, JEFF ELDREDGE, University of California — Obstructive sleep apnea (OSA) is a medical condition characterized by repetitive partial or complete occlusion of the airway during sleep. The soft tissues in the upper airway of OSA patients are prone to collapse under the low pressure loads incurred during breathing. The ultimate goal of this research is the development of a versatile numerical tool for simulation of air-tissue interactions in the patient specific upper airway geometry. This tool is expected to capture several phenomena, including flow-induced vibration (snoring) and large deformations during airway collapse of the complex airway geometry in respiratory flow conditions. Here, we present our ongoing progress toward this goal. To avoid mesh regeneration, for flow model, a sharp-interface embedded boundary method is used on Cartesian grids for resolving the fluid-structure interface, while for the structural model, a cut-cell finite element method is used. Also, to properly resolve large displacements, non-linear elasticity model is used. The fluid and structure solvers are connected with the strongly coupled iterative algorithm. The parallel computation is achieved with the numerical library PETSc. Some two- and three- dimensional preliminary results are shown to demonstrate the ability of this tool.

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