On numerical simulation of FSI and FSAI models of human phonation by FEM

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Recently, the numerical solution of FSI problems becomesboth components of important also in biomechanics, among others in speech modeling. The numerical analysis of this case is very complicated: Human voice is created by passage of air flow between vocal folds, where the constriction formed by the vocal folds induces acceleration of the flow and vocal fold oscillations, which generates the sound. The modelling of such a complex phenomenon encounters many difficulties as it is a result of coupling complex fluid dynamics and structural behavior. In particular ine needs to address the nonlinear coupled problems of fluid-structure(FSI) interactions. This is realized by using the mathematical description of a relevant problem and its numerical approximation by the (stabilized) finite element method. This includes the discretization of the elasticity equations describing the motion of an elastic structure and the air flow modelled by the Navier-Stokes equations. Both models are coupled via interface conditions. The approximation of flow in moving domains is treated with the aid of the Arbitrary Lagrangian-Eulerian method. The incompressible Navier-Stokes equations are approximated by the stabilized finite element method. The time discretization based on a semi-implicit linearized scheme is described and the solution of the coupled problem of fluid-structure interaction is realized by a coupling algorithm. The aeroacoustics is treated using the so called hybrid approach, where either the Lighthill's approach is used to address the acoustic problem. The numerical results are shown.

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