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Numerical approximations of flow induced vibrations of vocal folds

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ABSTRACT

The paper is interested in mathematical and numerical modelling of incompressible channel flow interacting with elastic part of its walls simulating the oscillations of vocal folds. The flow in moving domain is described with the aid of the Arbitrary Lagrangian-Eulerian (ALE) method, see e.g. [2], and governed by the incompressible Navier-Stokes equations. The geometry of the channel and of the vibrating glottal region is chosen according [3]. The flow model is coupled with the structural motion modelled by the two-mass model, cf. [1].

The described fluid-structure interaction problem is discretized in time by backward finite difference higher order scheme and in space by a stabilized finite element method, cf. [2]. Furthermore, the space-time discretized system is solved by Oseen linearizations. The strong coupling algorithm is applied for solution of the coupled fluid-structure problem.

The numerical results of a channel flow modelling the glottis region of the human vocal tract including the vibrating vocal folds will be shown. The vibrations of the channel walls will be either prescribed (1st case) or induced by the aerodynamical forces (2nd case). In order to obtain physically relevant results the pressure drop boundary conditions will be employed.

References

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