Different Inlet Boundary Conditions for Fluid-Structure Interaction Problem Approximated by FEM

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The contribution deals with the numerical simulation of fluid-structure interaction problem, here represented by the human vocal folds vibration excited by the fluid flow. The main attention is paid to the inlet boundary conditions. The classical Dirichlet boundary condition in the form of prescribed velocity has the drawback of unphysical pressure increase during channel closing phase at each vocal folds vibration cycle. The another often used possibility is to prescribe pressure drop between inlet and outlet by the the do-nothing type of boundary condition. It usually leads to quite high oscillation of inlet velocity. In order to overcome these disadvantages, the penalization approach is investigated, where beside the given pressure drop the inlet velocity is weakly enforced with the aid of the penalization term. This is quite original approach within scope of finite element method, although usual approach within discontinuous Galerkin methods.

The vocal folds are modelled as an elastic isotropic body with assumption of small displacements. Due to the small velocities compared to the speed of sound the fluid flow can be described by the incompressible Navier-Stokes equations. For the purpose of numerical simulation of the time varying computational domain the arbitrary Lagrangian-Euler method is applied. The whole problem is solved by the finite element method based solver.

Numerical results will be presented and analyzed.

References:

[1] *https://doi.org/10.1016/j.amc.2017.02.026*

[2] *https://doi.org/10.1007/s10494-018-9900-z*

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