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Simulation of Acoustic Pressure and Flow Velocity in Human Glottis

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The pressure and velocity fields in coronal plane along the vibrating vocal folds were studied using a finite element mathematical model. The shapes of the vocal folds were specified according to data measured on excised human larynges in phonation position. The mathematical model of the flow is based on 2D incompressible Navier-Stokes equations adapted to deal with the time-variable shape of the domain, caused by vocal fold vibration. The numerical simulations allow to observe closely various flow features related to phonation - flow separation in the glottis, Coanda effect or vortex shedding. The numerical results were verified experimentally by Particle Image velocimetry (PIV) on a physical vocal fold model. In addition to acoustic, subglottal pressure and impact intensity measurements, flow velocity fields were recorded in the domain immediately above glottis. Analysis of the PIV images gives good insight into the dynamics of the supraglottal flow. Among other applications, the results should be used in the future for singing voice simulations based on physical models.