Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Control volume analyses of glottal flow using a fully-coupled numerical fluid-structure interaction model JUBIAO YANG, Rensselaer Polytechnic Institute, MICHAEL KRANE, Pennsylvania State University, LUCY ZHANG, Rensselaer Polytechnic Institute — Vocal fold vibrations and the glottal jet are successfully simulated using the modified Immersed Finite Element method (mIFEM), a fully coupled dynamics approach to model fluid-structure interactions. A self-sustained and steady vocal fold vibration is captured given a constant pressure input at the glottal entrance. The flow rates at different axial locations in the glottis are calculated, showing small variations among them due to the vocal fold motion and deformation. To further facilitate the understanding of the phonation process, two control volume analyses, specifically with Bernoulli's equation and Newton's 2nd law, are carried out for the glottal flow based on the simulation results. A generalized Bernoulli's equation is derived to interpret the correlations between the velocity and pressure temporally and spatially along the center line which is a streamline using a half-space model with symmetry boundary condition. A specialized Newton's 2nd law equation is developed and divided into terms to help understand the driving mechanism of the glottal flow.

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Date submitted: 01 Aug 2013 Electronic form version 1.4