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Flow-structure interaction simulation of voice production in a canine larynx. WEILI JIANG, XUDONG ZHENG, QIAN XUE, University of Maine, LIRAN OREN, SID KHOSLA, University of Cincinnati — Experimental measurements conducted on a hemi-larynx canine vocal fold showed that negative pressures formed in the glottis near the superior surface of the vocal fold in the closing phase even without a supra-glottal vocal tract. It was hypothesized that such negative pressures were due to intraglottal vortices caused by flow separation in a divergent vocal tract during vocal fold closing phase. This work aims to test this hypothesis from the numerical aspect. Flow-structure interaction simulations are performed in realistic canine laryngeal shapes. In the simulations, a sharp interface immersed boundary method based incompressible flow solver is utilized to model the air flow; a finite element based solid mechanics solver is utilized to model the vocal fold vibration. The geometric structure of the vocal fold and vocal tract are based on MRI scans of a mongrel canine. The vocal fold tissue is modeled as transversely isotropic nonlinear materials with a vertical stiffness gradient. Numerical indentation is first performed and compared with the experiment data to obtain the material properties. Simulation setup about the inlet and outlet pressure follows the setup in the experiment. Simulation results including the fundamental frequency, air flow rate, the divergent angle will be compared with the experimental data, providing the validation of the simulation approach. The relationship between flow separation, intra-glottal vortices, divergent angle and flow rate will be comprehensively analyzed.

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