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Flow-Structure-Acoustic Interaction Computational Modeling of Voice Production inside an Entire Airway WEILI JIANG, XUDONG ZHENG, QIAN XUE, University of Maine — Human voice quality is directly determined by the interplay of dynamic behavior of glottal flow, vibratory characteristics of VFs and acoustic characteristics of upper airway. These multiphysics constituents are tightly coupled together and precisely coordinate to produce understandable sound. Despite many years' research effort, the direct relationships among the detailed flow features, VF vibration and aeroacoustics still remains elusive. This study utilizes a first-principle based, flow-structure-acoustics interaction computational modeling approach to study the process of voice production inside an entire human airway. In the current approach, a sharp interface immersed boundary method based incompressible flow solver is utilized to model the glottal flow; A finite element based solid mechanics solver is utilized to model the vocal vibration; A high-order immersed boundary method based acoustics solver is utilized to directly compute sound. These three solvers are fully coupled to mimic the complex flow-structure-acoustic interaction during voice production. The geometry of airway is reconstructed based on the in-vivo MRI measurement reported by Story et al.(1995) and a three-layer continuum based vocal fold model is taken from Titze and Talkin(1979). Results from these simulations will be presented and further analyzed to get new insight into the complex flow-structure-acoustic interaction during voice production. This study is expected to improve the understanding of fundamental physical mechanism of voice production and to help to build direct cause-effect relationship between biomechanics and voice sound.

Xudong Zheng
University of Maine

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