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Patient-Specific Computational Modeling of Human Phonation[1]
QIAN XUE, XUDONG ZHENG, University of Maine, UNIVERSITY OF MAINE TEAM — Phonation is a common biological process resulted from the complex nonlinear coupling between glottal aerodynamics and vocal fold vibrations. In the past, the simplified symmetric straight geometric models were commonly employed for experimental and computational studies. The shape of larynx lumen and vocal folds are highly three-dimensional indeed and the complex realistic geometry produces profound impacts on both glottal flow and vocal fold vibrations. To elucidate the effect of geometric complexity on voice production and improve the fundamental understanding of human phonation, a full flow-structure interaction simulation is carried out on a patient-specific larynx model. To the best of our knowledge, this is the first patient-specific flow-structure interaction study of human phonation. The simulation results are well compared to the established human data. The effects of realistic geometry on glottal flow and vocal fold dynamics are investigated. It is found that both glottal flow and vocal fold dynamics present a high level of difference from the previous simplified model. This study also paved the important step toward the development of computer model for voice disease diagnosis and surgical planning.

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Qian Xue
University of Maine

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