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Reduced-order glottal airflow model enhanced by machine learning ZHENG LI, YE CHEN, HAOXIANG LUO, Vanderbilt University — Complementary to expensive 3D flow simulations, reduced-order glottal airflow models are useful in the simulation of vocal fold vibration for various purposes such as tissue property identification and optimization of surgical implants. Existing reduced-order models are typically based on the Bernoulli principle and have limited accuracy. In recent works, we have developed a novel one-dimensional flow model including pressure loss along the glottis and also the entrance effect. The model has shown advantages over the Bernoulli based model. In this work, we introduce machine learning to enhance this one-dimensional flow model. In particular, we firstly perform 3D fluid-structure interaction (FSI) simulation for vocal fold vibrations with different vocal fold stiffnesses and medial thicknesses. Using the 3D data, sparse regression is performed to estimate the loss coefficient and entrance effect parameter for the reduced-order flow model. We then combine this enhanced reduced-order flow model with 3D FEM tissue model to simulate the vocal fold vibration. In comparison with full 3D FSI model, very good agreements are achieved in terms of vibration amplitude, frequency, as well as phase delay of the medial surface in all cases considered.

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