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INVERSE PROBLEM IN HIGH-SPEED RECORDINGS OF THE VOCAL FOLDS

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High-speed recordings of the vocal fold dynamics during phonation have been shown to be a powerful tool for clinical assessment of speech disorders. Although visual inspection may be sufficient for voice clinicians to diagnose certain pathologies, quantitative image analysis provides additional useful information, in particular for functional voice disorders. Image segmentation algorithms have been used for tracking quantitative features, such as the projected glottal area, amplitudes or phase ratios (e.g., see [1]). Given a biomechanical model of the vocal folds, it is possible to infer material parameters by inverse problem solution, when image features are taken as input data [2]. Previous studies have shown satisfactory results for lumped-element model of the vocal folds [2-3]. Even though lumped-element models may be convenient with regard to the computational cost, crucial vocal fold characteristics for medical research, such as geometry and layered structure of the tissue, are not described in detail.

The present work is a preliminary investigation on the inverse problem for parameter estimation of a three-dimensional continuum model of the vocal folds. The discussion mainly focusses on inversion methods and image processing procedures. The initial vocal fold model to be used in the inversion procedure involves flow-solid coupling and additional position-based constraints at collision [4]. Due to the complexity of the equilibrium equations, special attention must be paid to the choice of the inverse formulation, as deterministic inverse schemes may show limitations regarding the convexity of the objective function and statistical inverse schemes may require averaging process.. Furthermore, the suitability of different image segmentation techniques for input data extraction from high-speed recordings is analyzed.

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