simVoice

efficient acoustic propagation model of the human voice source using finite element method

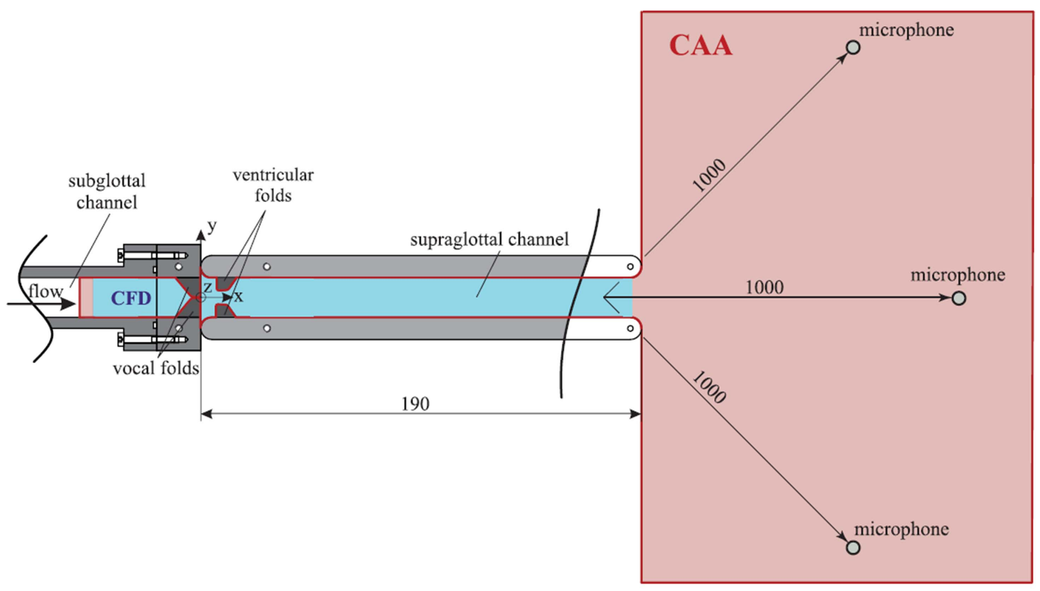
S. Schoder[1], A. Hauser[1], P. Maurerlehner[1], S. Falk[2], S. Kniesburges[2], M. Döllinger[2], M.Kaltenbacher[1]
[1]IGTE, TU Graz, Austria
[2]University Hospital Erlangen, Germany
stefan.schoder@tugraz.at

Abstract

The main objective of *simVoice* is the development of a 3D CAA model for a prospective application in a clinical environment. The model consists of a CFD model with externally driven vocal folds motion, based on the FV method, and a CA model, based on the 3D FEM using the PCWE. This contribution assesses the performance increase of a reference simulation model when changing discretization parameters while maintaining accuracy of the sound spectra in the acoustic far-field.

Objectives

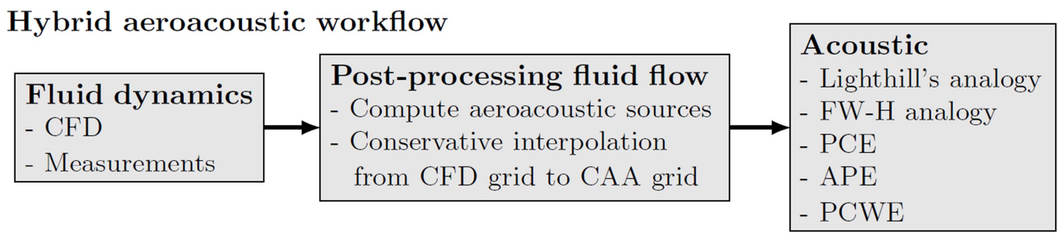
- Validation of the sound propagation simulation



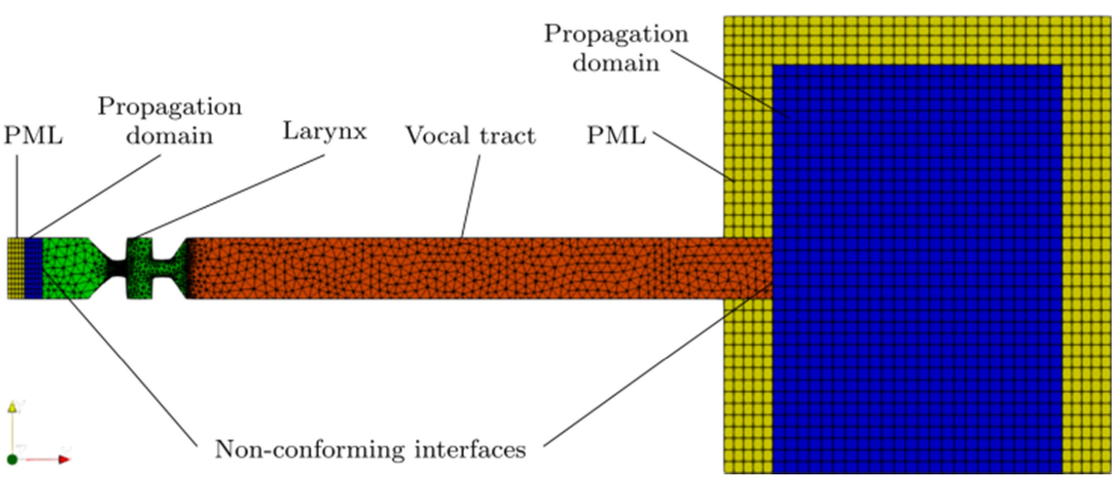
- Reduce the computational complexity of the acoustic simulation
- Without reducing the accuracy of the propagated sound signal

Approach

- Validated Hybrid Aeroacoustic Workflow

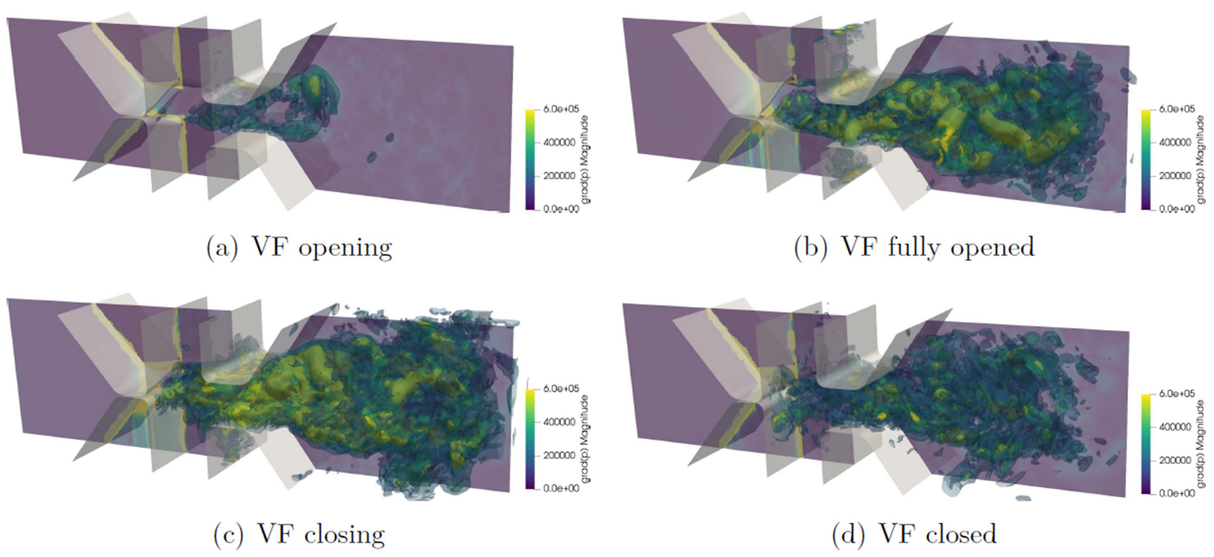


- **First CFD**: externally driven VFs, inkompressible, LES, WALE subgrid-scale
- **Second CAA sources**: PCWE source, conservatively integrated
- **Third acoustic simulation**: PCWE using FEM, grid study, validated



Results

- Visualization of the aeroacoustic sources

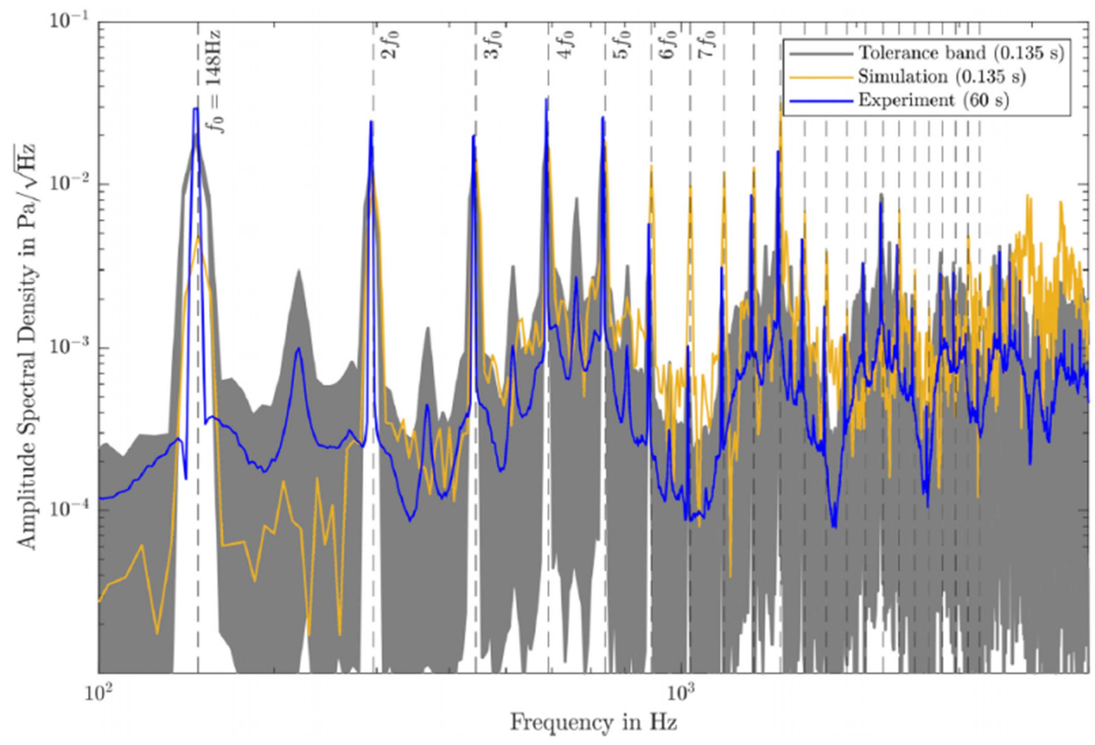


(a) VF opening (b) VF fully opened

(c) VF closing (d) VF closed

- Results published in S. Schoder, et. al, "**Hybrid aeroacoustic approach for the efficient numerical simulation of human phonation**" JASA 147, 1179 (2020); https://doi.org/10.1121/10.0000785

- **Validated CAA workflow**



Conclusion

- **Reduce the simulation time by 95%**
- **The accuracy was reduced by 7%**