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A Study of Aero Acoustics in Constricted Pipes at Low Mach Numbers

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Abstract

Computational Aero-acoustics (CAA) modeling of flow-generated sound in low Mach number internal flow might help researchers better understand physiological phenomena including artery murmurs, phonation, and partial airway obstructions like stridor. In these applications, accurate acoustic field modeling will aid in the understanding of sound generating systems, which will aid in the diagnosis of medical disorders. However, due to their limited shape (internal flow), which causes acoustic reflections and near-field acoustic modeling, modeling the acoustics field in such applications might be difficult (i.e., when computational domain is smaller than acoustic wave lengths). The use of widely used CAA methods such as FW-H and Light hill's analogies, which are better suited to modeling the acoustic field in far-field and free space, is prohibited due to these challenges (with no reflections). Direct approaches for modeling the acoustic field by solving compressible Navier-Stokes equations are computationally expensive due to the length scale discrepancies between the acoustic and flow domains, which necessitate a very small time step. Furthermore, additional processing work is required to keep the numerical errors in direct simulations substantially smaller than the acoustic variables, which are modest for low Mach numbers (M). These variables are thought to be in the range.

Computational Modeling

The acoustic field is treated in tandem with an incompressible flow simulation in this study, which uses a hybrid CAA technique. R. Ewert and W. Schroder created a system of Acoustic Perturbation Equations (APEs) to simulate the acoustic field using the results of Computational Fluid Dynamics (CFD) simulations, and this method was first used by them. To accurately represent the flow instabilities generated by the constriction, the flow field is simulated using a Large Eddy Simulation (LES) model in the current work. The velocity measurements utilizing laser doppler anemometry were used to validate the CFD simulation findings (LDA). Previous research provides a full explanation of the CFD simulation and experimental measurements. The simulated sound pressure spectra were compared to observed sound pressure spectra at various places on the pipe wall to validate the CAA simulation results. The results of the CAA simulation were also used to investigate the acoustic sources and propagation in the pipe.

The field of psychology and neuroscience has been transformed by computational modeling of behavior. We can examine the algorithms underpinning behavior, identify neural correlates of computational variables, and better understand the impacts of medications, sickness, and therapies by fitting models to experimental data. Enormous power, however, comes with great responsibility. We've put up a list of ten easy criteria to ensure that computational modeling is done correctly and delivers useful results. We provide a beginner-friendly, pragmatic, and detail-oriented introduction to how to tie models to data in particular. What can a model tell us about the mind, exactly? To answer this, we apply our guidelines to the most basic modeling techniques most accessible to novice modelers, and we demonstrate them with examples and code that can be found online.

Conclusion

A hybrid Computational Aero-Acoustics (CAA) technique based on acoustic perturbation equations was used to simulate the flow-generated sound field in a constricted conduit at low Mach numbers (APEs). The results of the CAA were confirmed by comparing simulated and measured sound pressure spectra. The flow dynamics found in different sections of the flow domain were studied in relation to acoustic sources and sound propagation. Proper Orthogonal Decomposition (POD) of sound pressure revealed information about acoustic sources that corresponded to frequency peaks in the recorded sound pressure spectra. The CAA approach and analysis techniques used in this study can be applied to biomedical applications such as phonation and airway blockages to examine sound generating mechanisms.

References

1. Ahmed SA, Giddens DP (1983) Flow disturbance measurements through a constricted tube at moderate Reynolds numbers. J biomech.16: 955-963.
2. Borisyuk AV (2010) Experimental study of wall pressure fluctuations in rigid and elastic pipes behind an axisymmetric narrowing. Journal of Fluids and Structures. 26: 658-674.
3. Zhao W, Frankel S, Mongeau L (2001) Numerical simulations of sound from confined pulsating axis symmetric jets. AIAA journl. 39: 1868-1874.
4. Ewert R, Schröder W (2003) Acoustic perturbation equations based on flow decomposition via source filtering. Journal of Computational Physics. 188: 365-398.
5. Abdallah SA, Hwang NH (1998) Arterial stenosis murmurs: an analysis of flow and pressure fields. J. Acoust. Soc. 83: 318-334.

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