

This work gives an introduction to the numerical modeling of locally reacting acoustic treatments. A time-domain impedance model and its implementation with a numerical method for Computational Aeroacoustics are presented. A special emphasis is put on the modeling of the flow effect on the impedance and the treatment of the related flow instability. First, the numerical method is described in detail including a variety of mathematical model equations, which are used in the present work. Boundary conditions and numerical approaches for the handling of arbitrary base flow fields and curvilinear meshes are presented as well. A method for the direct validation of a numerical solution by using the acoustic intensity is developed. It does not require an analytical solution. In a first validation, several benchmark problems from the literature, concerning the sound propagation in lined flow ducts and the radiation from such ducts, are considered. The almost perfect agreement of the current method for a large number of different problems verifies the correct implementation of the impedance model and the numerical method. Modal-axisymmetric, two- and three-dimensional examples are covered. The effect of removing the flow instability is studied with these examples. An impedance eduction method is applied, using an optimization to obtain the model parameters of the extended Helmholtz resonator model from *in-situ* measurements with four different liner samples. All are found to be well described by the extended Helmholtz resonator model. The time-domain impedance eduction provides the whole frequency response of the impedance by one optimization. The impact of the numerical modeling on the resulting impedance is also studied. The results indicate a significant influence of reflections in the experiment on the resulting impedance, when using pressure amplitude data as input for the impedance eduction. Thereafter, reflection independent energy transmission and reflection coefficients are used as input for the impedance eduction. The link between the educed model parameters and the geometry of the liner is pointed out. The connection is used to calculate measurable parameters of the liner from known geometry parameters and the eduction result. The educed geometry is found to be in a reasonable range for most of the examples. An exception is found with few cases, where the resonant frequency of the liner is not covered by the range of frequencies that is considered in the experiment. Finally, the link between geometry and impedance model is used in three different applications. The application of a time-domain impedance model significantly reduces the problem size in these cases.

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Richter



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Christoph
Richter

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