

Study of an Electroacoustic Absorber

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Introduction

In this paper, the underlying concept of electroacoustic absorbers is studied with the help of Comsol Multiphysics® Acoustics Module. An electroacoustic absorber is a loudspeaker which acoustic impedance can be varied by electrical means, be it passive or active. Among the different ways to obtain variable acoustic properties on an electroacoustic transducer's voicing face is the shunting of the transducer's electrical input. With such shunt devices, the acoustic impedance that the transducer's membrane presents to the acoustic field takes account of an acoustic equivalent of the electrical load that can take many values within a specified range. Shunt strategies can either be passive, with a resistor, or active, with a negative resistance circuit including at least one operational amplifier. These active strategies allow variable acoustic impedances at the transducer's voicing face, assuming the systems remain linear. In order to quantify the sensitivity of such concepts to different physical constraints (static pressure, air flow, temperature, etc.), it has been chosen to develop a multiphysics model of the shunt loudspeaker. This presentation aims at providing the description of a finite-element model of the electroacoustic absorber, and assessing the performances of this concept as an acoustic damper of the modal behavior in an acoustic waveguide.

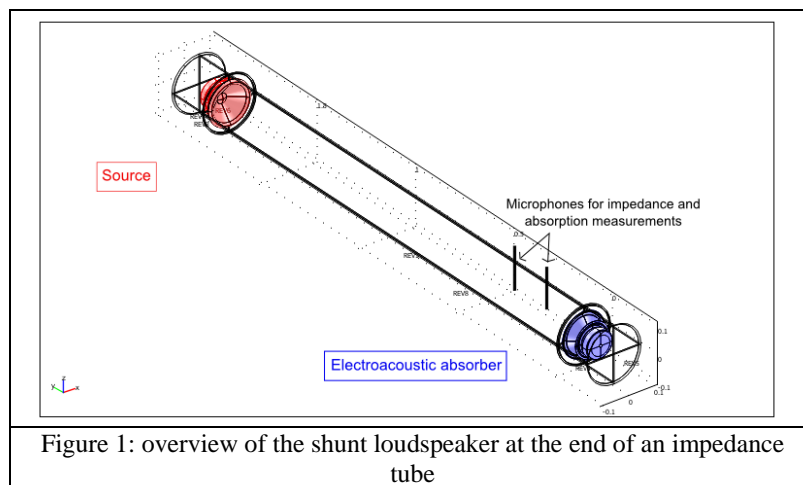


Figure 1: overview of the shunt loudspeaker at the end of an impedance tube

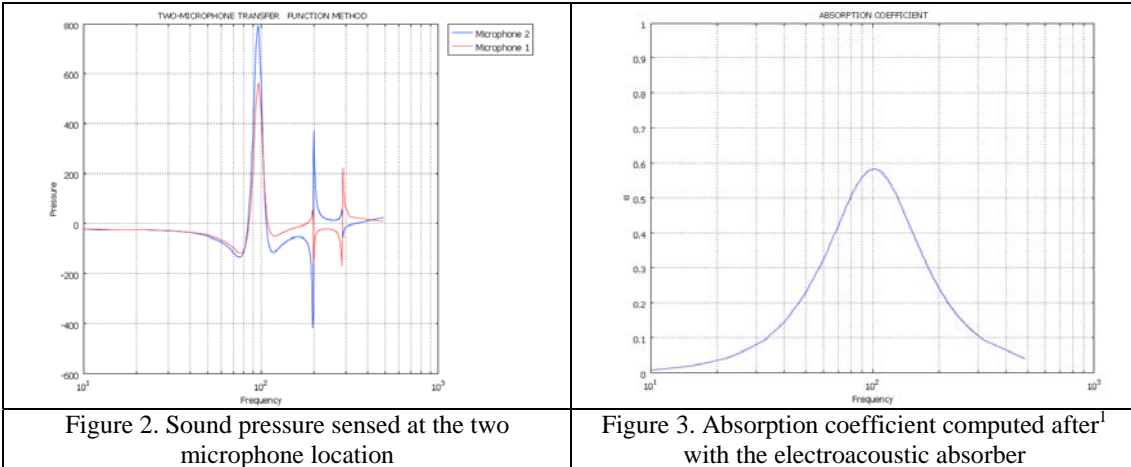
Use of COMSOL Multiphysics

The AC/DC and Acoustics Modules are used to model, on one hand, the loudspeaker source which is a source of pressure, and on the other hand, the electroacoustic absorber. The absorption coefficient is then computed after ISO 10534-2, using the two-microphone transfer function method¹.

Expected Results

The influence of the shunt circuit on the absorption coefficient, computed after pressure sensing at two locations inside the tube, can thus be studied. Figures 2 and 3 show first results obtained with an open-circuited loudspeaker.

The establishment of a model using conventional loudspeakers will aim at comparing the results of simulations with the experiments.



Reference

¹Chu, W.T., *Transfer function technique for impedance and absorption measurements in an impedance tube using a single microphone*. Journal of the Acoustical Society of America, 1986. **80**(2): p. 555-60.