Modeling a hearing aid loudspeaker

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Introduction
A hearing aid loudspeaker is a very small acoustic actuator; it transforms an electric signal to an acoustic signal. Hearing aid loudspeakers are so small, that viscothermal effects are not negligible. The aim of my research is to develop tools to optimize these loudspeakers for, for instance, efficiency, frequency range and pressure output.

Multi-physics
A 'balanced armature motor' is often used in current hearing aid loudspeakers; see Figure 1. In these motors an alternating electric current generates a magnetic field. This magnetic field is used to drive a membrane which is used to compresses the air inside the ear canal. This is perceived as sound. Given these four different physical domains (electric, magnetic, mechanical and acoustic), the optimization of hearing aid loudspeakers requires a multi-physical analysis.

Presentation
In my presentation I will introduce the working principle of the balanced armature motor, its four physical domains and how they are coupled. The coupling of the viscous air and vibrating membrane is discussed in more detail; results from a semi-analytical model of a membrane coupled to a viscous air layer will be presented. Finally, the ideas for future research and the latest progress will be presented.

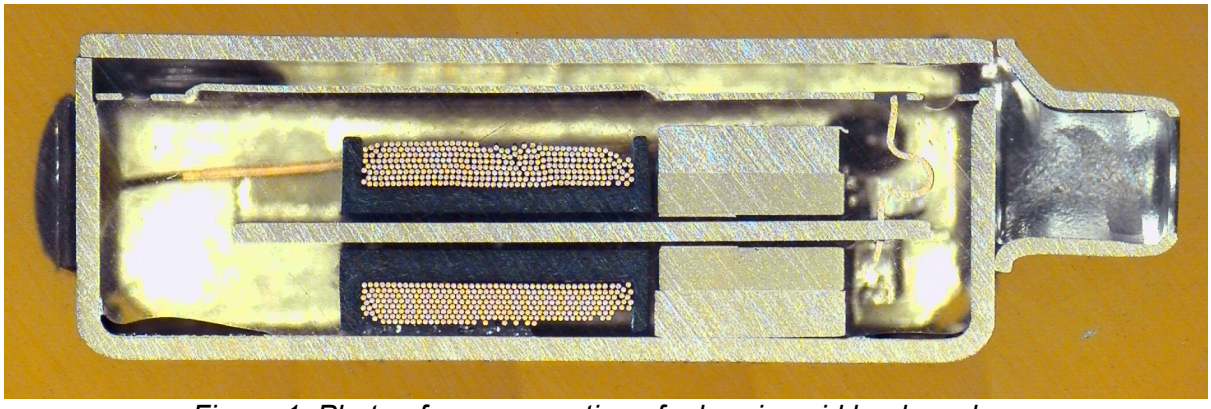

Figure 1: Photo of a cross section of a hearing aid loudspeaker