Numerical modeling of electrical-mechanical-acoustical behavior of a lumped acoustic source driven by a piezoelectric stack actuator

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Introduction

The present work describes the electrical, mechanical and acoustical behavior of a thin honey-comb structure as an acoustic source (Fig. 1). The acoustic source has to operate in the low frequency, quasi-static regime and is driven by a piezoelectric stack actuator.
In addition, a two-way energy flow between the actuator and a connected amplifier is investigated. In particular, the effectiveness of energy recovery from the reactive components of the acoustic source is evaluated to improve the overall radiation efficiency.

Methodology

A lumped model is used to represent the acoustic source that is excited by a stacked piezoelectric element. The required power supply and resulting radiation efficiency are evaluated when a conventional analogue amplifier is used. The result is compared to the case in which some parts of the stored power are recovered and sent back to the connected switching amplifier. The study reveals 20% increase in the radiation efficiency and more than 80% decrease in the amount of required input power through recovering the reactive power in the system.

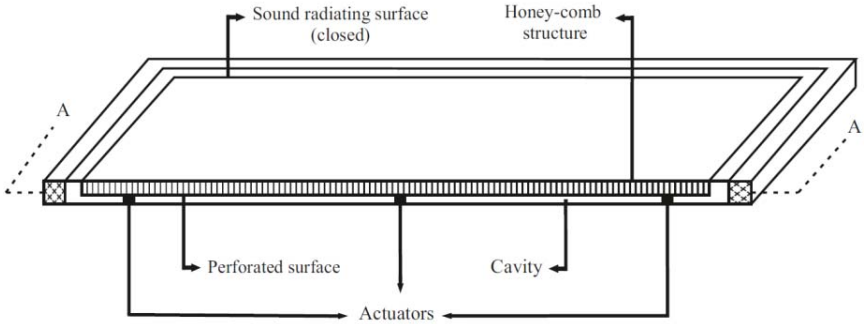

Figure 1: Acoustic source

Reference

[1] American National Standards Institute and IEEE Ultrasonics, IEEE Standard on Piezoelectricity, 1987.
[2] H. Janocha, Ch. Stiebel, Th.Wurtz, Power amplifiers for piezoelectric actuators, 2002.