

Functional Acoustic Boundary using MEMS technology

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We have studied on a functional acoustic boundary (FAB) based on the following concept: Micro mechanism can bring out a drastic effect on a macro domain. The sound reflection, absorption, and transmission occur when incident sound comes into an acoustic boundary. Functional acoustic boundary can adjust its acoustic characteristics to desired one so as to control a sound environment at the acoustic boundary.

As the first step of this research, the adaptive passive noise control system was developed with focusing on a sound absorption. The simple open loop control algorithm was employed as a control strategy in order to reduce extra hardware and realize the compact system. The developed adaptive passive acoustic system employed high aspect ratio holes fabricated by X-ray lithography in the absorber and adapted for a lower frequency range without increasing the cavity gap. In the experiment, the compact system could absorb less than 1000 Hz frequency noise with a thin cavity gap, 23mm.

As the second step, the sound insulation characteristic of the tunable acoustic resonator has been investigated. We focused on the following two common features between the tunable acoustic resonator and acoustic double wall which is a standard acoustic insulator. (1) Both consist of double wall. (2) Both have resonance phenomena effecting on their acoustic characteristics. The experimental results told us that it was possible to tune the sound insulation characteristics of the acoustic resonator like the double wall structure.

As the third step, a structural control of acoustic impedance has been studied. We proposed to apply micro actuators for an impedance control of the acoustic resonator. The fabricated pneumatic balloon actuators at acoustic holes could tune the acoustic resistance and the inertance. In the experimental results, a slight deformation of actuators could provide a large change of the acoustic impedance.