Development of a Wideband Steerable Acoustic Metasurface with COMSOL

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Abstract

The recent introduction of acoustic metamaterials and metasurfaces in the literature has triggered an tremendous interest in the scientific community, with their capability to achieve extraordinary acoustic properties for various acoustic and noise control applications, although limited frequency-wise. Coupled with active acoustic control concept, a step towards broadband extraordinary properties has been unveiled.
We present the design of an active acoustic metasurface concept allowing steering reflected wavefronts toward a prescribed direction over a wide frequency bandwidth, thanks to active unit-cells. The metasurface is composed of an array of small (with respect to the wavelength) loudspeakers, the acoustic impedance of which can be programmed through active impedance control in order to adjust the reflection phase at each position over the metasurface. The control strategy inspires from the Active Electroacoustic Resonator concept, using a microphone feedback and a current-driven control, allowing achieving a wide range of acoustic impedances on the loudspeaker diaphragm. Numerical simulation with COMSOL Multiphysics® Acoustic Module allows assessing the global performance of the concept, and open the discussion on possible practical applications.