香港浸會大學
HONG KONG BAPTIST UNIVERSITY
FACULTY OF SCIENCE

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JOINT COLLOQUIUM

Novel Ways of Sound Field Control with Acoustic Metamaterials

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Abstract

Metamaterials are man-made media with properties emerging as the collective response of the subwavelength building blocks. The research of acoustic metamaterials has matured into a robust and active field driven by scientific discoveries and application potentials [1]. In this talk, I will discuss our recent progress in sound field control with membrane-type acoustic metamaterials. In the first part, I will show the way to reshape reverberating sound field in a room by building a "spatial sound modulator" which is based on a metasurface that is an array of actively controllable metamaterials. We show the functionality of the on-demand creation of quiet zones and acoustic hotspots at audio frequencies anywhere in a reverberating room. This is the first realization of the adaptive wavefield shaping for acoustic waves [2]. If time permits, I will also show that by building a subwavelength absorber for spherical waves, the focal spot formed by an isotropic converging wave in 3D can become smaller than the diffraction limit. The idea is based on the observation that diffraction limit is the consequence of the interference between incoming and outgoing waves, therefore by removing a majority of the outgoing energy with a subwavelength absorber, the total field profile is drastically modified, leading to sub-diffraction focusing. This result can also be interpreted as the realization of a stand-alone anti-causal Green's function up to the surface of the absorber. The absorber also plays an important role of an acoustic sink, which is the time-reversal counterpart of a source [3].

References

1. G. Ma and P. Sheng, *Acoustic metamaterials: From local resonances to broad horizons.* Science Advances **2,** e1501595 (2016).
2. G. Ma, X. Fan, P. Sheng, and M. Fink, *Shaping reverberating sound fields with an actively tunable metasurface*. PNAS **115**, 6638 (2018).
3. G. Ma, X. Fan, F. Ma, J. de Rosny, P. Sheng, and M. Fink, *Towards anti-causal Green's function for three-dimensional sub-diffraction focusing.* Nature Physics **14**, 608 (2018).

All Interested Are Welcome!