THE UNIVERSITY OF HONG KONG

Institute of Mathematical Research
Department of Mathematics

COLLOQUIUM

Dynamic Elastic Metamaterials

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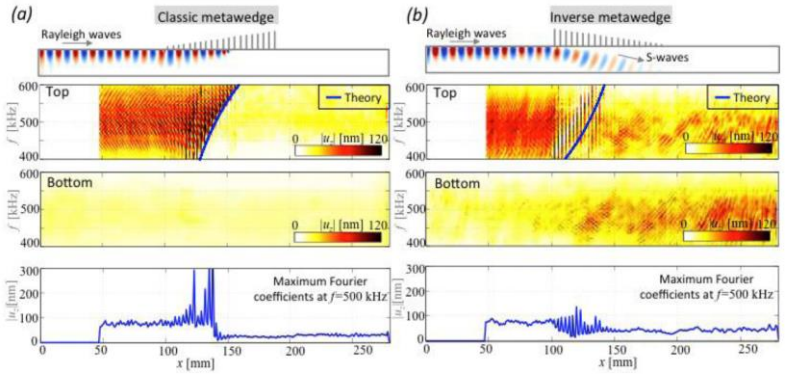
Abstract

An exciting area of physics, metamaterials that began in optics and electromagnetism is now finding application in other wave systems. Notably mechanical and acoustic metamaterial devices are beginning to impact upon soundproofing and vibration control and management; one such area is that of modifying and mitigating ground vibration and and other elastic wave systems. This talk will cover three proof-of-concept studies both from the point of view of experiments and theory and give an overview of current work in this area. The ultimate aim is to be able to control, redirect or prevent low frequency waves, with long wavelength, by devices that are themselves sub-wavelength. The first approach is that of using graded resonator arrays to design for broadband wave control [1,5] as illustrated in the Figure below showing the graded array and the vertical displacements on the top, and bottom, of an elastic slab.



The ideas themselves are independent of lengthscale and we discuss fieldwork involving forests of trees, and the associated modelling, to investigate whether metamaterials have any relevance on large-scale geophysical vibration management. On another scale we look at ultrasonic measurements and modelling to generate elastic wave "rainbow" trapping, surface wave mode conversion and consider how these ideas can be used in devices. We then consider gradient-index lenses for surface waves, [2] in other words can we modify the elastic properties to create a lens that will focus, or redirect, Rayleigh waves? Finally we turn to more traditional phononic crystals [3] but now design them to have a zero-frequency stopband and hence, in theory, a device that is capable of stopping all waves below a certain frequency. Although often couched in the language of largescale elastic wave systems the ideas translate readily to small-scale elastic plate systems in the laboratory [4] and these experiments and associated modelling will also be described.

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References:

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Date:	March 10, 2021 (Wednesday)
Time:	4:00 – 5:00pm (Hong Kong Time)
Venue:	ZOOM: https://hku.zoom.us/j/ Meeting ID: 940 0886 9846 Password: 613034

All are welcome