

Analysis of Mechanical Metamaterials – A Short Course

Overview

Mechanical metamaterials have surged to the forefront over the past five years against the backdrop of the unprecedented developments in optical, electromagnetic and acoustic metamaterials. Metamaterials are designer media with periodic units comprised of unique tailor-made geometry (see Fig. 1) and patterns that produce extraordinary and unusual bulk properties not seen in conventional materials. The effective properties of metamaterials originate from the geometry and structure, and not from the intrinsic property of the constitutive material. Intense research in recent years show truly exciting developments such as ultralight metamaterials approaching theoretical strength limit, pentamode materials, negative refraction elastic waves elastic cloaking and hyperbolic elastic metamaterials. This course will introduce essential techniques for the analysis of cellular mechanical metamaterials. This is a research-led teaching course and consequently the topics to be covered are in general not systematically available in any books but scattered in research papers including those authored by the lecturer. The lecture course will cover the following topics in depth:

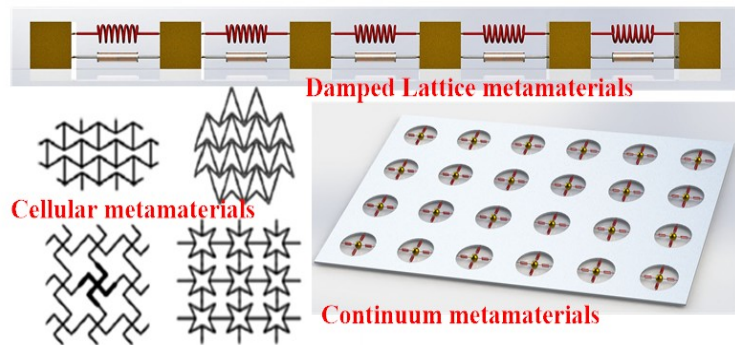


Fig 1: Illustrations of three types of mechanical metamaterials

1. Introduction to mechanical metamaterials

2. Static structural mechanics of cellular metamaterials – homogenised properties
3. Effective mechanical properties of disordered cellular metamaterials
4. Mechanics of viscoelastic cellular metamaterials,
5. Homogenised properties of general multiplanar and multiscale 2D metamaterials
6. Dynamic homogenisation of cellular metamaterials
7. Multiphysics wave characteristics of piezoelectric metamaterials
8. Wave propagation in disordered cellular metamaterials

Dates for the course	<u>13 June 2018 – 15 June 2018</u>
Host Institute	Politecnico di Torino, Italy

Handouts and detailed lecture slides will be given during the lecture. Additionally, there will be training sessions on developing Matlab codes for metamaterials.

The Teaching Faculty



Prof Adhikari (PhD, Cambridge) is the Chair Professor of Aerospace Engineering at the College of Engineering of Swansea University. He Received the Wolfson Research Merit Award from the Royal Society (UK academy of sciences). He was an Engineering and Physical Science Research Council (EPSRC) Advanced Research Fellow and winner of the Philip Leverhulme Prize in Engineering (given to an outstanding scholar under the age of 35). He obtained his Ph.D. in Engineering at the Trinity College of the University of Cambridge. He was a lecturer at the Bristol University and a Junior Research Fellow in Fitzwilliam College, Cambridge. From 2015 he has been a Distinguished Visiting Professor at the University of Johannesburg (South Africa). He was a visiting Professor at the University of Paris East (France), Carleton University (Canada) and a visiting scientist at the Los Alamos National Laboratory (USA).

Professor Adhikari's research stands on three fundamental footings - structural dynamics, probabilistic methods and computational mechanics. His research works use these basic principles to understand cutting edge multiscale and multidisciplinary problems in applied science and engineering. He has published 4 books, 270 peer-reviewed journal papers, and 175 conference papers. He is one of the most cited researchers in his field (over 6800 citations with h-index=45 in Scopus). Professor Adhikari is a Fellow of Royal Aeronautical Society (FRAeS) and the member of the AIAA Non-Deterministic Approaches Technical Committee (NDA-TC). He is a member of the editorial board of several journals such as: Computers and Structures, Probabilistic Engineering Mechanics, Advances in Aircraft and Spacecraft Science and Journal of Sound and Vibration.

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