Short Bio: Mahmoud I. Hussein is an Associate Professor and an H. Joseph Smead Faculty Fellow in the Department of Aerospace Engineering Sciences at the University of Colorado Boulder. His research focuses on the dynamics of materials and structures, especially phononic crystals and locally resonant phononic metamaterials, at both the continuum and atomistic scales. His approach to phononics is rather broad ranging from vibrations of aerospace structures to lattice dynamics and thermal transport in silicon-based nanostructured materials. His studies are concerned with physical phenomena governing these systems, relevant theoretical and computational treatments, and analysis of the effects of dispersion, resonance, dissipation and nonlinearity. Recently he has also been conducting experiments to support the theoretical work. Among his honors is the 1st Prize Award at the Student Paper Competition at the annual meeting of the Society of Engineering Science in 2003, and the Robert J. Melosh Medal for Best Student Paper on Finite Element Analysis in 2005. In 2011, he was awarded a DARPA Young Faculty Award which aims "to identify and engage rising research stars in junior faculty positions at U.S. academic institutions". In 2013, he was awarded an NSF CAREER award from the Mechanics of Materials program at the foundation. This year he received the Outstanding Young Faculty Award from the Department of Aerospace Engineering Sciences at CU-Boulder. Dr. Hussein has served as guest editor for three special journal issues on phononic materials and structures. He has authored or co-authored 3 book chapters and over 70 papers in archival journals and peer-reviewed conference proceedings, and since 2006 has co-chaired over 15 symposia on "phononic crystals and acoustic metamaterials" at ASME and/or USNCM conferences. He co-chaired *Phononics 2011* (Santa Fe, New Mexico, May 29-June 2, 2011; www.phononics2011.org) and *Phononics 2013* (Sharm El-Sheikh, Egypt, June 2-7, 2013; www.phononics2013.org). The *Phononics 20xx* conference series is the world's premier event in the emerging field of phononics.

Education

THE AMERICAN UNIVERSITY IN CAIRO, EGYPT

BS	Mechanical Engineering	1994

IMPERIAL COLLEGE, UNIVERSITY OF LONDON, UK

MSc	Mechanical Engineering	1995

UNIVERSITY OF MICHIGAN-ANN ARBOR, USA

MSE	Applied Mechanics	1999
MS	Mathematics	2002
PhD	Mechanical Engineering	2004

Training and Employment

UNIVERSITY OF MICHIGAN-ANN ARBOR, USA — Jan. 2004–July 2005

Post-Doctoral Researcher
Department of Mechanical Engineering

UNIVERSITY OF CAMBRIDGE, UK — Aug. 2005–July 2007

Post-Doctoral Research Associate
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UNIVERSITY OF COLORADO BOULDER, USA — Aug. 2007–July 2014

Assistant Professor
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Phononic Metamaterials:
The Big, the Small and the Nonlinear

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Phonons may be understood as elastic waves, or transmitted vibrations, that take root at the material level. Although the study of phonons is a core discipline in conventional condensed matter physics, their analysis and manipulation over multiple scales–an area that has recently been termed *phononics*–is opening up a new technological frontier with a potential impact that could match that of electronics almost half a century ago. Broadly speaking, most phononic materials exhibit some form of crystal-like periodicity–which can be in the constituent material phases, the internal geometry, or even the boundary conditions. In addition to this engineered symmetry, it is also possible to introduce local resonators within, or attached to, the body of the material to further affect intrinsic properties. Recent research has shown that local resonances are capable of giving rise to a remarkable assortment of physical phenomena and overall properties that are not possible, or even conceivable, using conventional materials. These favorable qualities include low frequency stop bands where attenuation of long waves takes place, negative effective properties, group velocity reduction, among others.

In this seminar, I will present an overview of our research in the area of phononic metamaterials. The first part of the talk will consider locally resonant elastic metamaterials at the macroscale (*the Big*) with emphasis on design and the effects of finite deformation (*the Nonlinear*) on the band structure. In the second part, I will present the concept of a nanophononic metamaterial *(the Small)* in which a novel mechanism in phonon transport is revealed that allows the thermal conductivity to be reduced without impacting the electrical conductivity–a scenario that is highly advantageous for thermoelectric energy conversion.