



## Mechanical Engineering Seminar Series

### Inertial Amplification in Periodic Structures and Elastic Metamaterials

**Cetin Yilmaz**

Professor

Department of Mechanical Engineering  
Bogazici University

**Virtual Only**

Tuesday, September 27, 2022

**3:00 p.m.**

ME Seminar Zoom link (QR Code below)

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#### Abstract

Bragg scattering and local resonances are the two commonly used methods to generate phononic band gaps in periodic media. However, both methods face practical challenges when the aim is to design elastic structures that possess wide band gaps at low frequencies. The lowest frequency band gap due to Bragg scattering is of the order of the wave speed of the medium divided by the lattice constant. Hence, low wave speeds or large lattice constants are required to obtain a low-frequency Bragg gap, which necessitates the use of high-density/low-modulus materials or large-sized structures. With the use of local resonators, gaps can be obtained at much lower frequencies than can be obtained by Bragg scattering. Yet, to obtain wide gaps at low frequencies with the local resonance method, heavy resonators are needed. In 2007, we introduced an alternative band gap generation method based on inertial amplification. In this method, the effective inertia of a lattice can be increased with embedded amplification mechanisms. As a result, wide low-frequency band gaps can be obtained without using large masses. Since its inception, this method has been applied to 1D, 2D, and 3D periodic structures and elastic metamaterials. Moreover, it has been used on host structures to enhance their low-frequency responses. In this presentation, the development of the inertial amplification method will be explained. Recent progress and application areas will be highlighted. Finally, opportunities for future work will be discussed.

#### Bio

Cetin Yilmaz is a Professor and the Vice-Chairman in the Department of Mechanical Engineering at Bogazici University, Turkey. He is the director of the Vibrations Laboratory. Prior to Bogazici University, he was a Postdoctoral Researcher (2005-2007) in the Department of Mechanical Engineering at the University of Michigan, Ann Arbor. He holds a B.S. degree in Mechanical Engineering (2000) from Bogazici University, as well as M.S. degrees in Mechanical Engineering (2001) and Mathematics (2002), and a Ph.D. degree in Mechanical Engineering (2005) from the University of Michigan, Ann Arbor. Professor Yilmaz received Turkish National Science Foundation Career Award in 2011, Outstanding Young Scientist Award from the Turkish Academy of Sciences in 2017, and Excellence in Research Award from Bogazici University Foundation in 2019. His research focuses on vibrations and acoustics, mechanical design, phononic band gap structures and elastic metamaterials.

**Karen Brown [karenar@umich.edu](mailto:karenar@umich.edu)**

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University of Michigan Mechanical Engineering | 2336 G.G. Brown Building, 2350 Hayward Street, Ann Arbor, MI 48109-2125

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