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Uncovering the mechanics of architected materials in dynamic conditions

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ABSTRACT:

Architected materials across length scales—from nanometers to centimeters—have demonstrated unique mechanical properties enabled by a variety of 3D material morphologies. Significant advances in our understanding of these materials have pointed to structure-property relations that lead to unique macroscopic mechanical properties. Despite this progress, our knowledge of these materials is primarily limited to quasi-static deformation, while their dynamic properties remain to be fully understood. In this talk, we present explorations on the dynamic response of nano- and micro-architected materials under extreme dynamic conditions, presenting novel non-contact and impact characterization techniques to determine acoustic and energy dissipation properties. Specifically, we will discuss high-throughput dynamic elastic-property characterization and supersonic microparticle impact testing on periodic architected materials at the nano- and microscale, along with explorations on the design and implementation of microscale acoustic metamaterials.

BIOGRAPHY:

Carlos Portela is the d'Arbeloff Career Development Professor in Mechanical Engineering at MIT. Dr. Portela received his Ph.D. and M.S. in mechanical engineering from the California Institute of Technology, where he was given the Centennial Award for the best thesis in Mechanical and Civil Engineering. His current research lies at the intersection of materials science, mechanics, and nano-to-macro fabrication with the objective of designing and testing novel materials—with features spanning from nanometers to centimeters—that yield unprecedented mechanical and acoustic properties. Dr. Portela's recent accomplishments have provided routes for fabrication of these so-called 'nano-architected materials' in scalable processes as well as testing nanomaterials in real-world conditions such as supersonic impact. Dr. Portela received the 2023 Spira Award for Excellence in Teaching at MIT, was recognized as an MIT TR Innovator Under 35 in 2022, and was a recipient of the 2022 NSF CAREER Award and the 2019 Gold Paper Award from the Society of Engineering Science (SES).