From Snapping to Buckling: a Path for New Multifunctional Materials

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MAE Seminar Series

Mechanical instabilities, like buckling and snap-through instabilities, have been traditionally considered a sign of onset of mechanical failure. While they have been mostly avoided in man-made systems, nature often exploits them to generate fast actuation and high-speed motion in the plant and animal kingdoms. Examples span from micron-sized bacteria able to perform fast turns by buckling instability in the flagellar hook to Venus flytraps able to catch their prey with a snap-through trapping motion. Mechanical instabilities allow to store and rapidly release energy and to achieve high output power amplification. These properties are appealing to the design of multifunctional devices where structural phase transitions can be sustained. In this talk, I will discuss two novel metamaterials exploiting mechanical instabilities to (i) control nonlinear transition wavefronts and to (ii) preprogram reversible sudden reconfigurations with a single pressure input, respectively. Finally, new functionalities for free thin-shell domes undergoing buckling instability will be presented. Both numerical and experimental approaches will be discussed and compared. Interesting applications such as fast sequential actuation, wave manipulation, and soft robotic distributed gripping strategies will be highlighted.

Dr. Eleonora Tubaldi is an Assistant Professor in the Department of Mechanical Engineering at the University of Maryland, College Park. She received her Ph.D. degree at McGill University in 2017 in Mechanical Engineering. Her research interests sit at the interface of nonlinear dynamics, fluid-structure interaction, and soft materials for applications in mechanical metamaterials, soft robotics, and biomechanics. Recently, she has been awarded the 2021 NSF and USNC/TAM Early Career presenter Fellowship to ICTAM 2020+1 and the 2020 Haythornthwaite Young Investigator Award from Robert M. and Mary Haythornthwaite Foundation and ASME Applied Mechanics Division.

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