

# ELSEVIER DISTINGUISHED LECTURE

## “Morphing materials in freeform objects, at the micro- and macro-scales”



**Chiara Daraio**  
*Caltech*

**Abstract:**

Morphing two-dimensional sheets into three-dimensional objects is a classical problem in mechanics, mathematics and art, pursued over centuries of human history. Today, the ability to manufacture materials with an almost arbitrary microstructure, architecture and pre-stress distribution opens the door to new approaches for bending sheets into complex forms or actuating complex three-dimensional structures. In this talk, I will discuss recent progress in the design of micro- and macro-scale, nonuniform materials that can bend into freeform objects, in response to environmental stimuli or with simple application of point loads. Engineering the distribution of residual stresses, stiffness gradients and/or cut patterns, we control the sheets' buckling at both local and global scales. The designed distribution of responsive materials in the sheets provides a time dependent control of the developing shapes. Programming 2D sheets into rigid, 3D geometries expands the potential of existing manufacturing tools for efficient and versatile production of 3D objects and may allow the creation of autonomous soft robots.

**BIO:**

Professor Daraio received her undergraduate degree in Mechanical Engineering from the Universita' Politecnica delle Marche, Italy (2001). She received her M.S. (2003) and Ph.D. degrees (2006) in Materials Science and Engineering from the University of California, San Diego. She joined the Aeronautics and Applied Physics departments of the California Institute of Technology (Caltech) in fall of 2006 and was promoted to full professor in 2010. From January 2013 to August 2016, she joined the department of Mechanical and Process Engineering at ETH Zürich, with a chair in Mechanics and Materials. She returned to Caltech in August 2016, as a Professor of Mechanical Engineering and Applied Physics. She received a Presidential Early Career Award from President Obama (PECASE) in 2012, was elected as a Sloan Research Fellow in 2011 and received an ONR Young Investigator Award in 2010. She is also a winner of the NSF CAREER award (2009), of the Richard Von Mises Prize (2008) and received the Hetenyi Award from the Society for Experimental Mechanics (2015). She was selected by Popular Science magazine among the "Brilliant 10" (2010). She serves as a Board Editor for Science (AAAS) and as an Associate Editor for the journals "Extreme Mechanics Letters" and "Multifunctional Materials".