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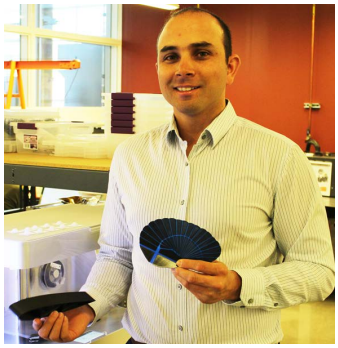

DIPARTIMENTO DI MECCANICA

LECTURES

Prof. Andres F. Arrieta
Purdue University

Property-Form-Function: a Route to Multifunctionality

May 25th, 2018 2:00 pm

Sala Consiglio
Dipartimento di Meccanica
Via La Masa 1, Milano

Abstract

Materials, structures and systems that are capable of shape adaptation exhibit multifunctionality capitalizing on their ability to adopt different geometrical configurations. Biological system are masters in exploiting adaptation to operate in unstructured environment fulfilling dissimilar functions. Recently, the idea of rendering engineering systems adaptable and multifunctional has resulted in a diversity of research fields, such as soft robotics, adaptive structures and programmable matter.

The multifunctionality and adaptability stems from the intimate relationship between property, form and function in which any variation in one results in changes in the other. An interesting avenue for exploiting this relationship utilizes large deflections arising from elastic instabilities, in which the careful design of such nonlinear systems enables the possibility for programming functionality into systems. Indeed, systems exhibiting geometrical multi-stability, the switching between the available stable configurations from compliance, naturally show fast adaptability of shape and stiffness which may be triggered by active control or passive response to environmental changes.

This seminar will present examples in which compliance and elastic instabilities are designed to enhance and create novel behaviour and augmented functionalities, resulting in programmable structures. The presented concepts will be illustrated through applications including strongly nonlinear wave guiding, energy harvesting, bioinspired self-shaping composites and aeroelastically driven morphing.

Speaker short CV

Dr. Andres F. Arrieta leads the Programmable Structures Laboratory at Purdue University. He joined the Insituttion in August 2015 as an Assistant Professor of the Mechanical Engineering School and in May 2017 as an Assistant Professor (by courtesy) in the Aeronautics and Astronautics School. Prior to joining Purdue, he held the Compliant Systems Group Team Leader position of the Composite Materials and Adaptive Structures Laboratory (CMAS) at ETH Zurich, Switzerland for 3 years.

While in Zurich, received the prestigious ETH Postdoctoral Fellowship from ETH Zurich in 2012, enabling him to conduct his research independently. Before this, he was a Marie Curie Early Training Fellow and Research Associate at the Dynamics and Oscillations Group of the Technical University Darmstadt in Germany between 2010 and 2012. He received his Mechanical Engineering degree in 2006 from Universidad de los Andes, Bogota, Colombia; Ph.D. in 2010 from the Mechanical Engineering Department of the University of Bristol, United Kingdom. Prof. Arrieta's research focuses on investigating the interrelation between shape-property-function of material systems and structures with a focus on exploiting nonlinearity to generating multifunctional systems. His work lies at the interface between structures and vibrations exploring nonlinear phenomena, such as buckling and multi-stability. These ideas are applied to light-weight morphing wing structures, energy harvesting systems, time-varying metamaterials and programmable structures.

Contact and registration:
phd-dmec@polimi.it