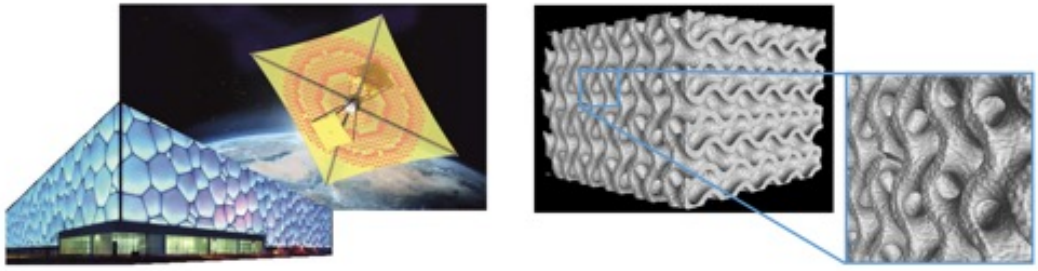
Università degli Studi di Pavia
Computational Mechanics & Advanced Materials Group - DICAr

SEMINAR

The strength of ultralightweight membranes and additively manufactured metamaterials

From nature to structural applications, the quest for ultralightweight and strong materials drives the progress toward highly efficient systems. In this framework, membranes and cellular solids represent two classes of materials that offer unmatched strength-to-weight ratios. The talk discusses advances in the modelling, design and characterisation of ultralightweight solids to enhance their mechanical properties and promote their use in several engineering applications, from sustainable buildings to additive manufactured robotic components. In the first part, we present a new imaging technique to precisely characterise the yield strength of membrane materials, thus overcoming the limitations of the available experimental methods. In the second part, we demonstrate how the mechanical properties of lightweight metamaterials can be enhanced by altering their architecture through the redistribution of solid material along the cell walls. Analytical calculations, finite element simulations coupled with Bayesian machine learning and experiments are performed to maximise stiffness, yield and buckling strength of additively manufactured architected materials.



Left: applications of structural membranes in building façades and space engineering. Right: computed tomography images of an additively manufactured carbon microlattice with cell wall size <100 µm.

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