RESEARCH SEMINAR

Geometric mechanics of periodically corrugated shells

MONDAY MARCH 25TH 9:00AM-10:15AM
FRNY G124 OR WEBEX

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Faculty Candidate - AAE Open Search

ABSTRACT

Compliant shell mechanisms are thin-walled structures ornate with folds and corrugations that can change shape in order to move, to deploy, or to adapt to a changing environment. As such, they have found use cases in the context of recent space programs as well as in other domains ranging from biomedical technology to architectural geometry. Not unlike slender beams, thin shells prefer bending over stretching. But in contrast to curve geometry, surface geometry rarely allows shells to deform by pure bending: a little stretching is often needed. Thus, to perform modeling and design tasks, it is in principle necessary to employ a full theory of shells with competing membrane and flexure strain energies. Here, we theorize for a simpler purely geometric alternative rooted in a formalized notion of "asymptotically inextensional" deformations. The theory is micromechanical in nature and is valid for compliant shells with periodic corrugations be them smooth or with straight and/or curved creases (namely, for closed periodic piecewise smooth surfaces). The theory succeeds in predicting salient features of the behavior of compliant shells. In particular, it demonstrates that the effective Poisson's coefficient of any periodic shell is equal to the ratio of effective curvatures of the shell's midsurface. Numerical models as well as folded and 3D printed samples are presented to substantiate the claims.

BIOGRAPHY

Hussein Nassar is an Assistant Professor of Mechanical and Aerospace Engineering at the University of Missouri – Columbia (MU). He holds a double degree in Mathematics and Engineering from Sorbonne Université and École des Mines – PSL as well as a PhD in Mechanics from Université Gustave Eiffel. He joined the faculty at MU in 2018. His research investigates theoretical models of continuum mechanics applicable to architected solids and shells with emphasis on interactions between geometry and elasticity, both in static and dynamic regimes. His research has been supported by the NSF and the Army Research Office; he is a recipient of the NSF CAREER Award.

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