# SEMM/PEER Seminar

Origami Engineering: Structures, Metamaterials, and Robots
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Monday, April 26, 12 – 1 pm via ZOOM*

Abstract: We study the geometric mechanics of origami assemblages and investigate how geometry affects behavior and properties. Understanding origami from a structural standpoint allows for conceptualizing and designing feasible applications across scales and disciplines of engineering. We review the basic mathematical rules of origami and use 3D-printed origami legos to illustrate those concepts. We then present a reduced-order-model (bar-and-hinge) to simulate nonlinear origami mechanics. We explore the stiffness of tubular structures based on the Miura-ori folding pattern. A unique orientation for zipper coupling of rigidly foldable origami tubes substantially increases stiffness in higher order modes and permits only one flexible motion through which the structure deploys. We couple compatible origami tubes into a variety of cellular assemblages leading to the design of structures and configurational metamaterials that can be deployed, stiffened, and tuned. We miniaturize the metamaterial by means of direct laser writing fabrication and in-situ testing (SEM) at the micron-scale. This results not only in the smallest scale origami assembly, but also in a metamaterial with intriguing mechanical properties, such as anisotropy, reversible auxeticity, and shape recoverability. The presentation concludes with a vision toward the field of origami engineering, including origami robots with distributed actuation, allowing for on-the-fly programmability, and other interdisciplinary applications.
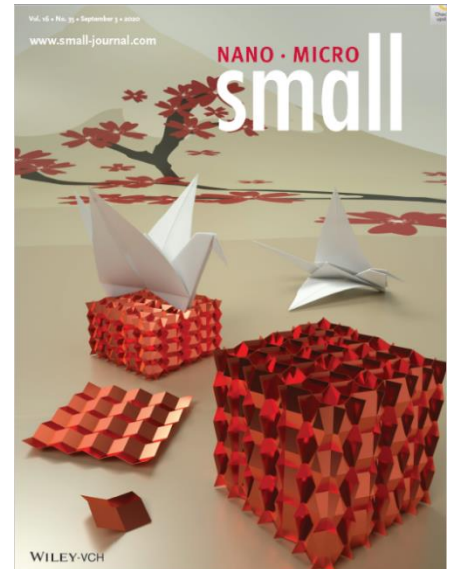
Bio: Professor Paulino is the Raymond Allen Jones Chair at the Georgia Institute of Technology. His seminal contributions in the area of computational mechanics include the development of methodologies to characterize the deformation and fracture behavior of existing and emerging materials and structural systems; topology optimization for large-scale multiscale/multiphysics problems; variational methods; deployable structures and origami engineering. Last year (2020), he received the Daniel C. Drucker Medal of ASME, the Raymond D. Mindlin Medal of ASCE, and the Reddy Medal from Mechanics of Advanced Materials and Structures (MAMS 2020). He also received the 2015 **Cozzarelli Prize** from the National Academy of Sciences, "which recognizes recently published PNAS papers of outstanding scientific excellence and originality." He is a former President of the Society of Eng. Science (SES). Recently, he was elected to the US National Academy of Engineering (NAE). More information about his research and professional activities can be found at the following url: *http://paulino.ce.gatech.edu*

*URL: https://berkeley.zoom.us/j/97852094677?pwd=LzVhU1NuWUJ6NFh1cDkzaEo4c1Jadz09