

Scientific Lecture

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Department of Aerospace Engineering

سخنرانی علمی

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دانشکده مهندسی هوافضا

K. N. Toosi University of Technology

Politecnico di Milano

آزمایشگاه تحقیقاتی سازه‌های پیشرفته، با حمایت معاونت بین‌الملل دانشگاه و دانشکده مهندسی هوافضا، سخنرانی‌های علمی با حضور اساتیدی از دانشگاه پلی‌تکنیک میلان (ایتالیا) برگزار می‌کند. از عموم علاقه‌مندان برای شرکت در این جلسات دعوت به عمل می‌آید.

3D Printed Bone Inspired Materials: A Computational Model to Predict Their Failure and Performance.

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Full Professor



Abstract:

Bone and its substructures have recently been a source of inspiration for the design of novel composites, offering optimal strength-toughness and stiffness-density combinations, traits endowed by the abundance of complex biointerfaces. Bone-inspired design combined with engineering principles may offer a path toward reaching an optimal strength-toughness balance in new materials. On the one hand, with the advent of micro- and nanoreinforcements and novel manufacturing techniques, new possibilities for advanced materials have opened. On the other hand, the endeavor for novel materials with radically improved properties is spurring the research toward accurate and versatile numerical models to be used in the design phase. In this work, we present a 2D lattice-spring model to predict the performance of previously tested 3D-printed bone-inspired composites, and their failure modes. The model has the capacity to correctly estimate the material performance and to reproduce the bonelike toughening mechanisms, occurring at different length scales in our composites. The numerical results show how the material properties, the interfaces and reinforcement geometry, and the topological pattern affect the stress distribution and the propagation of defects, significantly decreasing the flaw sensitivity of the material. Our framework could be used for the design of new materials with improved fracture resistance and balance with stiffness and strength.