NextManufacturing
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Scott Hall 6142

SimuLearn: Fast and Accurate Simulation for the Iterative Design of Topological Morphing Structures

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Harnessing the active and transformative nature of materials, recent HCI advancements have created a library of shape-changing interfaces that afford new modalities of interaction and fabrication. 4D printing, in particular, empowers users to design and prototype more rapidly and economically. However, due to the lack of fast and accurate transformation predictions, currently available CAD tools cannot afford users to iterate designs that have complex topologies with high efficiency digitally. To address this issue, we take mesh-like structures as an example to introduce a novel SimuLearn system that combines finite element analysis (FEA) and graph convolutional networks (GCN) to truthfully (97% accuracy versus FEA) inform design decisions in real-time (0.6 seconds), and deploy our implementation in a computational design tool to unveil the enabled design space. Beyond 4D printing, SimuLearn also enriches the toolbox for shape-changing interfaces and paves the way for interactive CAD tools to unfold.

BIOGRAPHIES

Lining Yao is an Assistant Professor of Human-Computer Interaction Institute (HCII) at Carnegie Mellon University, School of Computer Science, with courtesy appointments in Mechanical Engineering and Materials Science and Engineering. She directs the Morphing Matter Lab which develops materials, tools, and applications of adaptive, dynamic and intelligent morphing matter from nano to macro scales. Her research often combines material science, computational fabrication and creative design practices.

Jessica Zhang is the George Tallman Ladd and Florence Barrett Ladd Professor of Mechanical Engineering at Carnegie Mellon University with a courtesy appointment in the Department of Biomedical Engineering. Her research interests include computational geometry, image processing, finite element method, isogeometric analysis, and their applications in computational biomedicine, materials science and engineering. Zhang's group develops novel numerical algorithms to address challenging problems in multiscale physics-based modeling and simulation, and explores applications in various fields.