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The Department of Mechanical Engineering Presents

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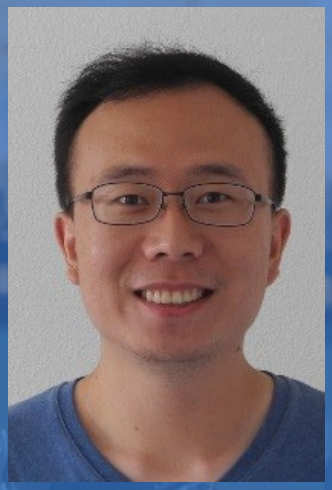

Title: Nanomagnetic Encoding of Shape-morphing Micromachines

Abstract: Shape-morphing systems, which can perform complex tasks through morphological transformations, are of high interest for future applications in minimally invasive medicine, soft robotics, active metamaterials, and smart surfaces. With current fabrication techniques, shape-morphing configurations have been embedded into structural design, for example by spatially distributing heterogeneous materials, which cannot be altered once fabricated. The systems are therefore restricted to a single type of transformation that is predetermined by their geometry. In this work, we have developed a strategy to encode multiple shape-morphing information into a micromachine, by programming the magnetic configurations of arrays of single-domain nanomagnets.[1] Inspired by origami, our micromachines consist of rigid panels carrying these nanomagnets separated by structured soft creases. By tailoring the switching fields of the nanomagnets, the magnetic configurations can be programmed using a specific sequence of magnetizing fields and, with customized micromachine designs, these magnetic configurations result in specific shape transformations in an applied magnetic field. Using this concept, we have built an assembly of modular units that can be programmed to morph into alphabetic letters, and we have constructed a microscale 'bird' capable of complex behaviors, including 'flapping 'hovering', 'turning' and 'side-slipping'. This establishes a route for the creation of future intelligent microsystems that are reconfigurable and reprogrammable in situ, and can therefore adapt to complex situations.

About the Speaker: Dr. Jizhai Cui is a postdoctoral fellow in the Department of Materials at ETH Zurich, and Paul Scherrer Institute, in Switzerland, where he holds the Marie Curie Co-fund Fellowship "PSI-Fellow" (2017-2019). He received his B.S. in Mechanical Engineering from University of Science and Technology Beijing in 2011 and his Ph.D. from University of California, Los Angeles in 2016. His research interests include nanomagnetism and its device applications, piezoelectric materials and multiferroics.

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