MECHANICAL ENGINEERING **SEMINAR**

Soft Machines: From Artificial Muscles and Renewable Energy to Stretchable Ionics and Bionic Skin

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The biological world and the engineered world differ in terms of mechanics: man-made machines are built from hard materials, while nature predominantly uses soft materials. The elegance of nature's design inspires scientists to create soft machines.

This talk starts with an elementary component: artificial muscles, materials that deform in response to external stimuli. Two approaches are presented to achieve giant voltage-induced deformation of an elastomer: electrode-free actuators, and actuators that harness snap-through instabilities. Subsequently, soft generators are identified as unique tools for electricity generation. Based on principles used in classical thermodynamics, experimental and theoretical methods are introduced to assess the maximum electrical energy that can be generated. Natural rubber is found to be a prime material for sustainable, high-power energy generation from ocean waves.

Soft machines require electrical conductors with special properties, such as stretchability, biocompatibility and transparency. This talk introduces stretchable ionics – a new class of devices enabled by ionic conductors that are highly stretchable, fully transparent, biocompatible and capable of operation at frequencies beyond 10 kilohertz and voltages above 10 kilovolts. The electromechanical transduction is achieved without electrochemical reaction.

Dr. Christoph Keplinger is a Postdoctoral Research Fellow at Harvard University, where he worked with Zhigang Suo (Mechanics of Materials and Structures) and currently works with George Whitesides (Department of Chemistry and Chemical Biology). Supervised by Siegfried Bauer (Department of Soft Matter Physics), he earned his PhD in physics from the Johannes Kepler University of Linz, Austria. His awards include the Award of Excellence (2011) and the Award for Outstanding Young Scientists (2011) (both from the Austrian government), the Loschmidt Award (2012) and the EAPromising European Researcher Award (2013) (awarded for evidence of a promising career in the field of electroactive polymers).

Dr. Keplinger enjoys collaborative, interdisciplinary research, with a current, primary focus on (i) bioinspired, soft actuators/sensors and robots/machines, (ii) sustainable energy generation and energy harvesting for biomedical applications

Wednesday: February 25th, 2015

10:30-11:30am
Room 227 Mudd