Stuttgarter Physikalisches Kolloquium

Fachbereich Physik, Universität Stuttgart
Max-Planck-Institut für Festkörperforschung
Max-Planck-Institut für Intelligente Systeme

Ansprechpartner: Prof. Harald Giessen
E-Mail: giessen@physik.uni-stuttgart.de
Telefon: 0711 - 685-65111

Dienstag, 8. November 2022	16:15 Uhr	V57.01

Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart-Vaihingen

Gastgeber: Prof. Dr. Christian Holm, Universität Stuttgart, Telefon: 0711 - 685-63701#

Artificial muscles for the lifelike robots of the future

Christoph Keplinger
MPI Stuttgart

Abstract

Nature uses soft materials such as muscle and skin to build organisms that drastically outperform robots in terms of agility, dexterity, and adaptability. Biological muscle in particular is a masterpiece of evolution, as it powers the versatile arms of an octopus, is strong enough to move an elephant and fast enough for the wings of a hummingbird, self-heals after damage, and is seamlessly integrated with distributed sensing. These astonishing capabilities have inspired the creation of artificial muscles, a grand challenge of science and engineering that dates back all the way to the 17th century, when Robert Hooke first recorded the idea.

The Robotic Materials Department at the Max Planck Institute for Intelligent Systems currently aims to understand the fundamental principles and materials science, as well as to develop robotics applications of a new class of self-sensing, high-performance artificial muscles, termed hydraulically amplified self-healing electrostatic (HASEL) actuators, a platform technology pioneered by this research group. HASEL artificial muscles achieve high speed and efficiency by harnessing an electrohydraulic mechanism, where electrostatic Maxwell stress activates soft, hydraulic structures to achieve a wide variety of actuation modes. Experiments show that current HASELs match or exceed most performance metrics of biological muscle; modeling results reveal rich underlying materials science to be further explored, and they lay out a roadmap showing how to drastically improve performance of HASELs, far surpassing both biological muscle and traditional electromagnetic motors.