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Self-Sensing Electrostatic Actuators for Measuring the Mechanics of Soft Materials

Dual-function actuator/sensor measures soft tissue stiffness via capacitance shifts.

Purdue researchers have developed a self-sensing electrostatic actuator that estimates tissue stiffness. In this device, the dielectric elastomer actuator (DEA) assumes both actuator and sensor functions to assess mechanical properties of tissues through changes in capacitance. Current methods, like atomic force microscopy (AFM) and elastography, require large, dedicated equipment and involve complex data processing. Applications ranging from tissue engineering to drug testing and robotic surgery can all benefit from advantages provided by this technology in cost, miniaturization potential, and adaptability for in-situ and wearable systems.

Technology Validation:

The DEA was tested under free displacement, completely blocked, and in-contact with soft and rigid elastomers. As expected, the capacitance changes depended on the material stiffness. Stiffer materials restricted the deformation more than the soft one, thus confirming that the actuator can measure tissue stiffness using capacitance responses.

Advantages:

-Compact

-Cost effective

-Simple system design

-Self-sensing

Applications:

-Tissue engineering

-Biomedical research

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Category

Digital Health & Medtech/Wearable Health Tech & Biosensors

Digital Health & Medtech/Medical Image Processing

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View online

-Robotic surgery

-Wearables

Related Publication:

Chortos et al, 3D printing of interdigitated dielectric elastomer actuators, Advanced Functional Materials, 30:1907375, 2020.

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Intellectual Property:

Provisional-Patent, 2024-09-30, United States

Utility Patent, 2025-09-30, United States

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