MEMS Origami for Energy Harvesting at Soft Surfaces

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Abstract

Microelectromechanical systems (MEMS) are miniature devices built using microfabrication technology. The silicon substrate of most MEMS devices is a non-flexible material which cannot bend to conform to the human body. If MEMS sensors were engineered to move with the body, wearable technology could track human movement better. The ability to place sensors on moving surfaces would increase spatial density and sensitivity to local forces for higher resolution data collection. While some MEMS packages are small enough to be easily placed on the skin, the gathered data is limited by the non-conforming shape of the devices. Stretchable semiconductor circuits have recently been developed, but they are distorted when stretched, so there is also an emerging need for connectors that tolerate extreme deformation. Our approach to such a system involves transferring thin MEMS devices from silicon wafers to soft, breathable fabrics using a "pop-up" process based on strain engineering. Because fabric-based construction is done by cutting and patching deformable materials, our target circuit is a diode array that can extract power from random placement on a contact grid. Toward this goal, we demonstrate that porous fabrics are compatible with pop-up MEMS processing, leading to devices that successfully release underneath the fabric and interact with it mechanically. We investigate the relationship between the devices' radius of curvature, layout, fiber diameter and fiber pitch, and the quality of the resulting connections. Results show that it is indeed possible to integrate fabrics into MEMS packaging, rendering comfortable, porous MEMS and microelectronic devices a possibility.

Biography of Presenter Canisha Ternival

Canisha Ternival is currently pursuing a Bachelor of Science in Electrical Engineering at the University of Florida. A strong penchant for learning helped her see that undergraduate school alone would not satiate her desire to grow intellectually and contribute to new information. This realization, combined with exciting past and current research experience, has inspired her to work towards attending graduate school immediately following graduation.