# Robust microfluidic tactile sensor skin for robotic applications

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## Technology description

Prosthetics have been around for thousands of years as evidenced by carved wooden toes found on mummified remains of ancient Egyptians. Since that early age, enormous advances in technology have made extremely sophisticated prosthetics possible. Through advanced robotics, artificial limbs that can nearly perfectly mimic the mechanics of human limbs are available. However when it comes to sensing the environment, the human body reigns supreme. In the human hand alone there are 17,000 tactile sensors, with 2,000 concentrated in each fingertip. This high number of tactile sensors makes the fine motor skills that are natural to humans difficult to replicate in robotic equivalents. Many of the existing tactile sensors have focused on detection of normal forces alone, which are necessary, but not sufficient for reliable artificial grasp. Too often, users of prosthetics endure the frustration of crushing or dropping objects due to lack of sufficient tactile feedback. What is sorely needed is a multimodal tactile sensor that can detect additional important features of finger-object interactions such as shear force, vibration, and slip direction.

Researchers at Arizona State University have developed a technology that aims to reduce the cognitive burden on the prosthetic user by strengthening the ability of an artificial hand to perform automated behaviors reliably by detecting, processing, and utilizing rich, real-time information about finger-object interactions with an innovative multimodal tactile sensor skin. This is accomplished by the design of a new multi-modal tactile sensor. The tactile sensor developed is a flexible and stretchable sensor built on a polymeric organosilicon substrate called polydimethylsiloxane (PDMS). The PDMS provides a robust and durable substrate that is also flexible enough to conform to the curvature of finger tips. Instead of metal wires that are brittle and fatigue quickly, a metal conductive fluid called Galinstan is used. This conductive fluid allows the sensor to bend, twist, and stretch while maintaining connections and sensory properties. This invention will provide prosthetics and robotic application with the ability to sense more than just normal force, this sensor provides a multimodal solution to sense normal force, shear force, vibration, and slip detection.

## Application area

Prosthetics
Rehabilitation

Space and Other Hazardous Environments
Military
Medical
Human-Robotic Interactions

## Advantages

Robustness - durable construction
Flexibility - greater sensor flexibility, no wire connection involving epoxy, no need for complicated evaporation processes, and less prone to fatigue
Multimodal - allows measurement of shear and normal forces, as well as local vibration and skin stretch
Realism - a more realistic tactile sensor e.g. for prostheses, human-robot interactions

## Institution

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