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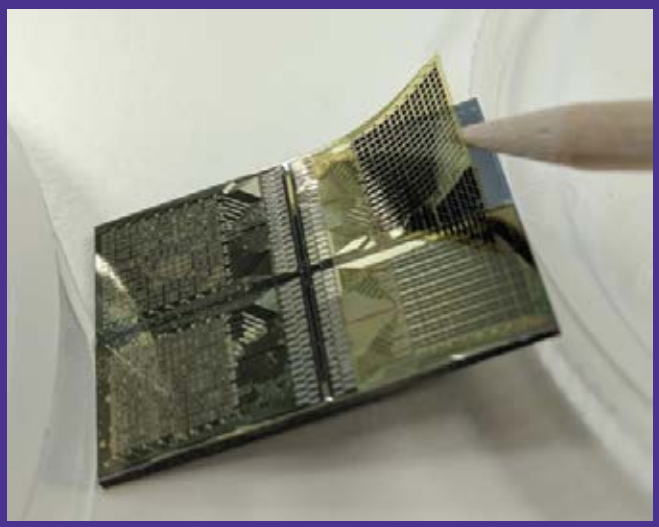


FLEXIBLE TACTILE SENSORS

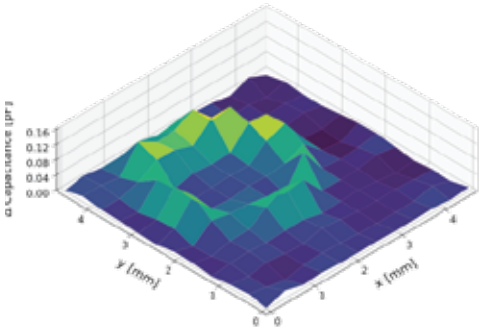
FEATURES

- Sub-mm surface morphology and tactile sensor
- Better than human fingertip resolution
- 16x16 array of 340x340 µm² capacitive sensing units
- 2D normal and shear force measurements at 1.5 fps

SUGGESTED APPLICATIONS

- Artificial multimodal fingers
- Flexible electronics
- Robotic grip sensors
- Texture detection

Morphology of an M2 nut measured using the flexible tactile sensor developed at INL:



Tactile perception, or touch perception, is the brain's ability to perceive information coming from the skin. Humans can recognise a surface by touching it, to feel the static pressure distribution created by the surface profile, or by sliding on it, to feel the vibration generated by dynamic contact with the fine texture.

It is essential that tactile sensors that mimic the human ability to perceive surfaces are able to detect force distribution with high spatial and temporal resolution. The flexible tactile sensor developed at INL uses polyimide-based microfabrication technology, and provides sub-millimetre spatial resolution, reproducing a morphology detection similar to the sensitivity of human fingertips.

The tactile sensor comprises an array of capacitive sensing units, and each unit is composed of parallel square electrode pairs separated by a compressible 1 µm air cavity. Each sensing unit is protected from external electromagnetic interference through active shielding embedded directly into the device, enabling its use in noisy environments such as factories and near robotic servo motors. A thin compressible PDMS layer is used to tune the normal pressure sensitivity and dynamic range, depending on the application. Shear force sensitivity is provided by the deformation of small dome-shaped bumps over the tactile array.

The flexibility of the tactile sensor enables the conformal integration of the device onto complex geometries, while maintaining normal morphology sensitivity. In addition, this flexible device can be connected to an electronic readout using a standard flat connector, measuring the whole sensor matrix at 1.5 frames per second.

The flexible tactile sensor technology has been used to extract real surface texture parameters for virtual reality environments. Furthermore, the sensor has the potential to be used in artificial multimodal fingers, robotics and robot grippers, and in the feedback loop of control systems where 2D surface morphology with sub-millimetre spatial resolution is critical.

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www.inl.int
Av. Mestre José Veiga,
Braga 4715-330, Portugal