Wearable electronics

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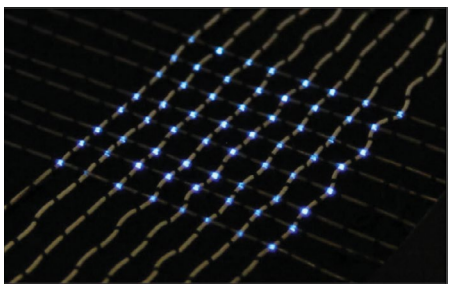
An embroidered sensor for prosthetic monitoring



Prosthetic limbs provide benefits to millions of people, but the interface between them and the residual limb typically experiences a complex combination of normal and shear forces that, if excessive, can create secondary problems such as ulceration. Monitoring these forces in real time can help to detect problems in the early stages and allow the prosthetic socket to be optimized.

However, existing approaches require complex signal processing to separate normal and shear forces or require modification of the socket for sensor mounting. Chi Hwan Lee, Edgar Bolívar-Nieto and colleagues at Purdue University and the University of Notre Dame now report an embroidered, multiaxial capacitive sensing system that is incorporated into a wearable textile and can detect both normal and shear forces at the limb–socket interface.

The sensor consists of a capacitor with a single, shared top contact and a quadrant of four bottom contacts; in addition to detecting normal forces, the difference in capacitance at the different corners can be used to find the magnitude and direction of shear. The system also has a Bluetooth-enabled data acquisition module, and an embroidered electroluminescent display for visual feedback. The sensor was tested by an individual who has a transtibial amputation and it was shown that the sensor could repeatedly measure gait-synchronized normal and shear signals during daily tasks.

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