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Deep Learning assisted Textile Sensor Matrix for co-adaptive human-robot collaboration

Comfortable deep-learning e-textile matrix provides high-resolution, energy-harvesting touch/gesture sensing for co-adaptive robots.

Researchers at Purdue University have developed an innovative deep learning-assisted sensor matrix that can be embedded in textiles for applications in human-robot collaboration. Textiles with embedded sensing capabilities, known as e-textiles, are a promising approach in human-robot collaboration for their flexibility, conformability, and comfort. However, balancing wearer comfort with sensing accuracy has remained an ongoing challenge. To overcome this limitation, these researchers have developed a solution that can transform textiles into intelligent sensory platforms that offer high-density, high-resolution, and power-efficient sensing while maintaining comfort, flexibility, and industrial scalability. To do this, they have designed a novel sensor matrix assisted by deep learning. Deep learning enhances signal accuracy and stability, allowing the e-textile to be worn more loosely, increasing wearer comfort. This advancement opens new possibilities for real-world applications in robotics, human-computer interaction, and next-generation smart wearables, paving the way for intuitive and adaptive human-machine collaboration.

Technology Validation:

Researchers created a series of prototypes based on a carefully designed matrix, which simultaneously senses and harvest energy to maintain maximal energy efficiency. In testing, this system achieved 96.2% accuracy in classifying distinct hand gestures, as well as 92.5% accuracy in replicating object manipulation with a robotic hand.

Advantages:

-Flexible and conformable

-Ensures wearer comfort

Technology ID

2025-LI-71092

Category

Artificial Intelligence & Machine Learning/AI Model Optimization & Acceleration Tools

Digital Health & Medtech/Wearable Health Tech & Biosensors

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-More durable than alternative materials, such as hydrogels or ultrathin metals

-High-density, high-resolution sensing

-Energy-efficient

-Scalable

Applications:

Human-robot collaboration, with applications in:

-Display technologies

-Medical devices, such as adaptive prosthetics

-Assistive robotics, and more

Publications:

A manuscript is under review for this work.

TRL: 3

Intellectual Property:

Provisional-Patent, 2025-04-04, United States

Keywords: deep learning, e-textiles, Electrical Engineering, human-robot collaboration, Mechanical Engineering, Wearable Technology