



Fiber-Based Pneumatic Gripper with Integrated Tactile Sensing

A soft, versatile pneumatic gripper with integrated fiber sensing that identifies and handles diverse objects in both air and underwater environments.

Robotic handling systems often struggle to grasp and assess objects in unstructured or variable environments, limiting their usefulness in manufacturing, inspection, and field applications. This innovation introduces a new class of soft pneumatic gripper that conceptually integrates tactile perception and object manipulation without relying on rigid sensors or fixed contact pads. Unlike traditional planar tactile sensors, the approach uses flexible fiber elements embedded within a soft structure to provide responsive, geometry-aware feedback during gripping. Initial laboratory prototype testing has shown that the system can recognize diverse object types and operate across air and water settings. This capability positions the technology as a pathway for more adaptive, versatile robotic end-effectors.

Technology Validation

Prototype evaluations in controlled environments demonstrated that the gripper can classify and distinguish among multiple object categories through its integrated sensing approach. These tests showed reliable operation in both terrestrial and aquatic conditions using non-enabling assessment methods.

Advantages

- Integrated grasping and tactile perception in a soft, compliant system
- Functional performance across air and underwater environments
- Distributed sensing without rigid external instrumentation
- Potential for low-cost scaling due to simple material system

Applications

- Robotic manipulation in manufacturing and inspection settings

Technology ID
2026-SHE-71456

Category

Robotics &
Automation/Perception &
Sensing
Robotics &
Automation/Automation &
Control
Materials Science &
Nanotechnology/Advanced
Functional Materials

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- Underwater robotic exploration and environmental monitoring
- Adaptive grippers for handling delicate or irregular items
- Research platforms for soft robotics and tactile sensing studies

TRL: 3

Intellectual Property:

Provisional-Gov. Funding, 2026-01-16, United States



Adaptive Tactile-Responsive Robotic Gripper with Integrated Sensing

A robotic gripper with tactile-responsive palm and compliant sensor-enabled fingers that improves dexterity and handling reliability for industrial automation and service robotics.

Industrial automation and service robotics often struggle to manipulate varied and delicate objects due to limited tactile awareness in low-degree-of-freedom grippers. This technology introduces a conceptual architecture for a robotic gripper featuring a tactile-responsive palm paired with compliant, sensor-enabled fingers. Unlike conventional fingertip-only sensing solutions, this approach distributes perception and actuation across the palm-finger system to improve adaptability and contact-rich manipulation.

Demonstrated through prototype-level evaluations, the system shows enhanced dexterity and stability across diverse tasks. The concept offers advantages for environments requiring reliable, informed grasping without increasing mechanical complexity. Manufacturers and robotics integrators can benefit from improved handling consistency and reduced need for highly specialized grippers.

Technology Validation

Validation was performed using a prototype gripper evaluated across standardized benchmarks and varied manipulation scenarios. Results demonstrated improved responsiveness and dexterity compared to typical low-DOF grippers, confirming the value of distributed tactile sensing.

Advantages

- Enhanced dexterity without increasing mechanical complexity
- Improved object handling reliability through multi-sensing fusion
- Supports adaptive, contact-rich manipulation
- Compatible with diverse robotic platforms
- Reduced need for highly customized end-effectors

Technology ID
2026-SHE-71472

Category

Robotics &
Automation/Perception &
Sensing
Robotics &
Automation/Automation &
Control
Artificial Intelligence & Machine
Learning/AI-Integrated Imaging
Systems & Industrial Vision and
Inspection

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Applications

- Industrial automation grippers requiring flexible object handling
- Agricultural and food-handling robotics
- Service robots interacting with varied objects
- Warehousing and logistics manipulators

TRL: 4

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