

Fiber Optic Sensor Robotic Arm



Article Overview

Fiber optic sensors enable robotic arms to detect force, tactile feedback, and object interaction with high precision, enhancing dexterity and manipulation capabilities.

Overview of Fiber Optic Sensing in Robotics

Fiber optic sensors on robotic arms are designed to mimic human mechanoreception, allowing robots to sense force magnitude, direction, and contact location. These sensors are often embedded in modular robotic skin or at the robotic gripper tip, providing real-time tactile feedback for complex manipulation tasks. The sensors work by detecting strain or light power loss in optical fibers caused by external forces, which can then be converted into quantitative force measurements.

Types and Design Principles

- Modular Robotic Skin with Fiber Optic Strain Sensors
 - Uses a triangular beam structure beneath a flexible skin cover.
 - Force applied to the skin bends the beam, which is detected by fiber optic strain sensors.
 - Capable of measuring force magnitude and contact location in three degrees of freedom.
 - Achieves resolutions of 1.45 N for force and 1.85–1.91 mm for contact localization.
 - Can be integrated on commercial robotic arms for remote or autonomous control.
- Polymer-Based Soft Optical Fiber Tactile Sensors
 - Employs a two-layered weaved polymer optical fiber structure embedded in soft elastomer....

Article Content

Dec 25, 2025

Single-ended robotic arm pose sensor based on a multimode fiber

We propose and demonstrate a single-ended multimode fiber (MMF)-based shape sensor for robotic arm pose estimation. Swept

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A fiber positioner robotic arm with sensor based on 4mm motor

An optical fiber is hold with X-unit and introduced to spectroscope, thus the optical fiber can be moved anywhere

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Dynamic Rotational Sensor Using Polymer Optical Fiber

A complex signal processing technique is usually required to process the data in most

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A force applied to the skin cover causes the bending of the beam, which is detected by fiber optic strain sensors. The

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This loopback optical fibre system is inherently safe as no electrical current is required at the

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(PDF) Light Intensity Based Optical Force/Torque Sensor for Robotic ...

This paper presents a novel three-axis force sensor based on optical photo interrupters and integrated with the robot

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Soft and Highly-Integrated Optical Fiber Bending Sensors for Proprioception in Multi-Material 3D Printed Fingers Ellis Capp1*, Marco

Jun 06, 2026

Fiber-Optic Sensors of Angular Position for Robotics

The sensitive element of FOS-AP is a piece of optical fiber with a diameter of 0.25 mm. Keywords-anthropomorphic robot gripper;

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On the integration of FBG sensing technology into robotic grippers ...

This work proposes an optical fiber-based technology, namely fiber Bragg grating (FBG) optical fiber, as a tactile

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This study introduces an optical fiber-based continuum robot integrated imaging, high-precision motion, and

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Review Advancements in fiber optic tactile sensors: A comprehensive ...

The interrogators used for fiber-optic tactile sensors are often bulky, expensive, and unsuitable for robotic applications.

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Shape Detection and Reconstruction of Soft Robotic Arm Based on Fiber ...

The simultaneous measurement of curvature and temperature of fiber-optic sensors is an essential application in

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Kim et al. introduced a novel force and tactile sensing system for robotic end-effectors using fiber optic sensors in

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Low-Cost Angle Sensor for Robotics Applications Using Plastic Optical ...

Therefore, we have developed an angle sensor based on step-index profile plastic optical fiber (SI-POF), which is

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Fiber Optic Shape Sensing for Soft Robotics

Fiber optic shape sensor In this pilot study, we use a research grade FOSS from Luna Innovations, Inc. (Blacksburg,

Feb 19, 2026

Fiber optic sensor embedded in robotic systems for 3-D orientation ...

Overall, a three-dimensional rotational sensor based on polymer optical fiber is a useful tool for measuring the

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(PDF) Fiber Optic Shape Sensing for Soft Robotics

This work explores the potential of a nearly commercial fiber optic shape sensor (FOSS) and presents the first

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Color-Coded Fiber-Optic Tactile Sensor for an Elastomeric Robot Skin

Abstract—The sense of touch is essential for reliable mapping between the environment and a robot which interacts physically with

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Collision Localization for a Robotic Arm Based on Fiber-Optic Sensing ...

Collision Localization for a Robotic Arm Based on Fiber-Optic Sensing and Machine Learning

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Stress Monitoring and Adaptive Grasping for Robotic Grippers Using ...

Reliable and adaptive grasping in robotic systems remains challenging due to the lack of real-time structural feedback

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Force sensing in the proposed skin is enabled by a custom-designed triangular beam structure underneath the skin cover. A force

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On the integration of FBG sensing technology into robotic grippers ...

FBG optical fiber can also be potentially small in size, easy to fabricate, and demonstrate longer lifetimes. Finally,

Oct 06, 2025

Fiber-optic-based force and shape sensing in surgical robots: a review ...

With the increasing development of the surgical robots, the opto-mechatronic technologies are more potential in the

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A fiber positioner robotic arm with sensor based on 4mm motor

The fiber positioner robot is the most crucial actuator in the focal positioning system of a Multi-Object Spectrographs. The double

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Research on Characteristics of Fiber Optic Sensors for

Abstract Structure, operating principle, theoretical provisions, experimental characteristics of fiber optic sensors for

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(PDF) A Bioinspired Robotic Finger for Multimodal Tactile Sensing ...

Inspired by various organisms, a novel multimodal tactile-sensing soft robotic finger is proposed. This finger, based on

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Fiber Optic Shape Sensing for Soft Robotics

Although the experimental data presented in this study focus primarily on planar, open loop shape sensing of a fiber

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The Future of Optical Sensors in Robotic Hands

This article discusses the future of optical sensors in robotic hands and the need for the

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Collision Localization for a Robotic Arm Based on Fiber-Optic Sensing ...

To ensure regular operation and prevent severe damage, a reliable collision detection system is an indispensable

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zhen-cuhk/Optical-Shape-Sensor-for-Soft-Robotics

This repository presents a fiber optic sensor-based approach for monitoring deformations in flexible structures, with a focus on soft

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This article introduces a collision monitoring system for a robotic arm based on fiber-optic sensing. The system

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Fibertouch: A novel fiber-optic tactile sensor with deep learning ...

This article presents a novel soft tactile force sensor based on seven FBGs, introducing an innovative force sensing

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Fiber-Optic Force Sensing of Modular Robotic Skin for Remote and ...

Robots have taken the place of human operators in hazardous and challenging jobs requiring high dexterity in manipulation, and

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Optical Fibre Based Angle Measurement for Robotic Joints

Abstract: A multiplexed array of optical fibre based angle sensors for deployment on multiple joints of a robotic arm is demonstrated.

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Collision Localization for a Robotic Arm Based on Fiber-Optic Sensing ...

A collision monitoring system for a robotic arm based on fiber-optic sensing that employs distributed fiber Bragg grating

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Illuminating Robotics and the Role of Optical Sensors in Continuum Robots

A recent review published in Sensors explores the dynamic field of continuum robotics, with a particular focus on the

Mar 12, 2026

[2407.16085] Miniature Fibre-Optic based Shape Sensing for Robotic ...

continuum-robots, prosthetic devices and wearable body-shape sensors. A miniaturised one-degree-of-freedom joint

Feb 17, 2026

Force Sensitive Robotic End-Effector Using Embedded Fiber Optics

This letter proposes the design of a new force and tactile sensing mechanism for a robotic end-effector suitable for deployment in

Mar 22, 2026

(PDF) Integration of Fiber-Optic Sensor Arrays into a Multi-Modal ...

This publication is focused on the development of a compact sensor interface for a fiber-optic sensor array, as optic

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Collision Localization for a Robotic Arm Based on Fiber-Optic Sensing ...

In recent years, robotic arms have become universal tools across various industries. To ensure regular operation and prevent severe

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Flexible Optical Fiber Sensing: Materials,

Flexible optical fiber sensors benefit from both technology-merits of optical fiber sensing and flexible

Oct 04, 2025

Optical Force and Torque Sensor for Flexible Robotic Manipulators

This fibre-optic arrangement is 7.5 mm in diameter and is comprised of a two-segment flexible and stretchable Steiner

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