National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Sensors

Sensing Magnetic Fields

Using an Innovative Optical Waveguide Fiber Bragg Grating

Innovators at NASA's Armstrong Flight Research Center have developed an optical waveguide fiber Bragg grating (FBG) that is sensitive to an external magnetic field. The technology allows direct coupling of the external field to the electromagnetic (EM) wave propagating in the fiber, bypassing the need to first measure strain. The properties of the waveguide material are directly and incontrovertibly influenced when exposed to an external field. In contrast to other FBG-based methods that detect external fields via a mechanical change (e.g., magnetostriction-induced strain), this innovation uses ferromagnetic nanoparticles to achieve a direct coupling of the external field to the optical behavior of the fiber. Thus, the technology can be used as a sensor to detect and map magnetic fields. Alternately, a known magnetic field can be applied to create a particular optical transmission behavior in the waveguide, thus creating an optical switch or selective filter.

BENEFITS

- Sensitive: Reduces the effects of extraneous thermal and mechanical influences
- Lightweight and compact: Lighter than many conventional electronic magnetic field devices
- High resolution: Allows high spatial resolution maps of magnetic fields

THE TECHNOLOGY

This technology is part of Armstrong's portfolio of fiber optic sensing technologies known as FOSS. The innovation leverages Armstrong's cutting edge work in this area, including its patented FBG interrogation system, which allows for a diverse set of engineering measurements in a single compact system. In addition to magnetic field, other measurements include structural shape and buckling modes, external loads, and cryogenic liquid level. The system and measurement technology is commercially available for research applications. In addition to capitalizing on the significant advancements in fiber optic and laser technologies that have been made to support the telecommunications industry, Armstrong has also partnered with UCLA's Active Materials Lab (AML) to tap their expertise in the field of magnetics.

For more information about the full portfolio of FOSS technologies, see DRC-TOPS-37 or visit https://technology-afrc.ndc.nasa.gov/featurestory/fiber-optic-sensing

APPLICATIONS

The technology has several potential applications:

- Military and homeland security: Detection of explosive devices
- Aerospace: Navigation, observations, altitude sensing
- Navigation: Ground transportation, backup for satellite GPS system
- Electromagnetic receptors/antennas
- Mineral exploration
- Oil and gas drilling
- Geophysical surveys
- Archaeology
- Earth tectonics

PUBLICATIONS

Patent No: 9,274,181

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

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Agency Licensing Concierge

Armstrong Flight Research Center

PO Box 273, M/S 1100
Edwards, CA 93523-0273
202-358-7432
Agency-Patent-Licensing@mail.nasa.gov

www.nasa.gov

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