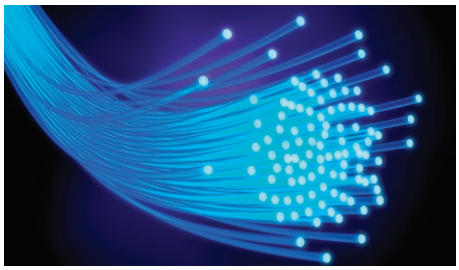
National Aeronautics and Space Administration

technology opportunity

Real-Time 3D Shape Rendering

Ultra-fast algorithms enable smart structures with unparalleled self-monitoring capabilities



Researchers at NASA's Armstrong Flight Research Center have developed an innovative method for rendering the bending shape of an optical fiber cable in real time. Unlike current methods used to calculate shape rendering, which are complex and time-intensive and which may have lag time, this technology's streamlined algorithms require no post-processing. Armstrong's system scans at a rate of 100 times per second, providing instantaneous three-dimensional (3D) shape rendering. The sensors, along with NASA's sophisticated algorithms, can be used to calculate a variety of critical parameters including shape, stress, temperature, pressure, strength, and operational load. The sensing system can be used for aerospace, civil structures, oil and gas drilling, renewable energy, and much more.

Benefits

- **Real-time shape rendering:** Armstrong's method of processing data from fiber optic sensors is much faster than other methods, allowing real-time visualization of 3D shape.
- **No lag time:** Unlike existing shape rendering methods, no post-processing is required.
- **Lightweight:** This technology can be used without adding significant weight or size to a structure, which is particularly important.

Applications

- **Medical:** Procedures involving endoscopes, catheters, or robotic surgery
- **Oil and gas:** Sophisticated industrial borescope usage in drilling and exploration
- **Aeronautics:** Structural monitoring for complex bending modes of in-flight aircraft
- **Renewable energy:** Structural monitoring for wind energy turbines
- **Robotics:** Precise position monitoring and control of robotic arms and tools
- **Automotive:** Structural monitoring
- **Nautical:** Pinpoint location of buoys or instrument packages

Patents

NASA has a patent pending for this technology.

Licensing and Partnering Opportunities

This technology is part of NASA's Technology Transfer Office, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing the In-Situ Three-Dimensional Shape Rendering from Strain Values Obtained through Optical Fiber Sensors (DRC-011-015) as well as other elements of the fiber optic sensing portfolio.

Technology Details

This technology measures differential strain through a unique computational method, offering real-time 3D shape rendering. Embedding sensors into the optical fiber and then attaching the fiber to a structure allows strain information to be collected and shape deformation determined. Once the strain data is correlated into displacement data, the shape and movement of the optical fiber, and therefore the attached structure, can be displayed in real time.

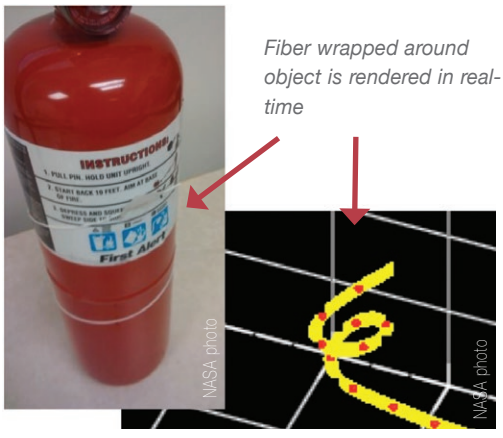
How It Works

To obtain the curvature and torsion, innovators embedded three optical fibers with sensors either with fiber Bragg gratings (FBGs) or other methods of obtaining strain through optical fiber. The strain of each fiber is measured through Armstrong's patent-pending strain algorithm and fiber optic strain sensor (FOSS) hardware, which interrogates the fiber at a rate of 100 samples per second. Armstrong innovators have also patented a method to mitigate signal loss due to polarization-induced fading (PIF), a common problem seen in multi-sensor fiber optic sensing systems. This ensures that signals from all sensors can be optimally retrieved, increasing the system's accuracy and reliability.

Why It Is Better

The most significant benefit of Armstrong's 3D shape rendering technology is its unparalleled speed. Its sophisticated algorithms enable real-time shape rendering without any lag time whatsoever. This capability is especially valuable for applications where a direct line of sight is impossible or impractical (as in an aircraft wing or underground pipelines) and where real-time structural health monitoring is critical. The small and lightweight system uses virtually weightless fiber optics and minimal hardware. Furthermore, the sensors can be placed at 1/4-inch intervals, enabling much more precise, high-resolution measurements than ever before.

For the first time ever, real-time strain measurements can be used to determine the shape of an aircraft's wing, monitor the structural integrity of buildings and pipelines, or ensure precise placement of the tiniest catheters, to name just a few potential applications.



Fiber wrapped around object is rendered in real-time

For more information about this technology, please contact:

Technology Transfer Office
NASA's Armstrong Flight Research Center
Phone: (661) 276-5743
E-mail: DFRC-TTO@mail.nasa.gov
Web: www.nasa.gov/offices/ipp/centers/dfrc/

NP-2012-11-12-DFRC
DRC-011-015
18.03.14