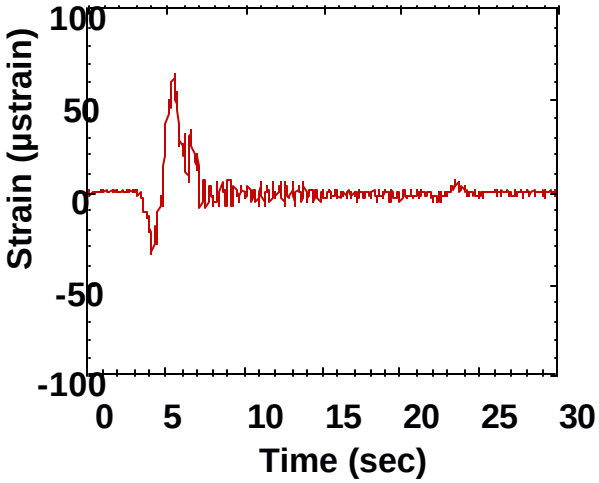
DISTRIBUTED FIBER OPTIC POINT STRAIN SENSORS



The Naval Research Laboratory has developed and demonstrated fiber optic methods for simultaneous point measurements of strain at a large number of locations on various structures, including bridges, dams, ship hulls and decks, spacecraft, and aircraft. This technology is based on the fiber Bragg grating (FBG) strain sensor, whose optical wavelength shift is linearly proportional to strain from parts-per-billion to percent. Since FBGs can be written with different initial Bragg wavelengths at arbitrary locations along a single fiber, the strain sensors can be multiplexed and interrogated from a single fiber lead. Simultaneous interrogation of 24 multiplexed sensors has been demonstrated by NRL. Such multiplexing enables a structure to be instrumented with a large number of sensors with little additional complexity or cost. Because the strain is encoded as a wavelength shift in the FBG sensor arrays, there is no baseline offset, and absolute strain measurements are possible without constant monitoring. Fiber Bragg grating strain sensors can be used in any application where conventional strain sensors are used.

Advantages and features include:

- Strain sensitivity from 10^{-9} to 10^{-2} $\Delta L/L$
- Frequency bandwidth from static strain to 1 MHz
- Simultaneous interrogation of 20-30 sensors multiplexed on a single optical fiber
- Sensor location on structure and inter-sensor spacing can be arbitrarily selected; array lengths of >1 km possible; instrumentation can be several km from sensor array
- No electromagnetic interference or pickup
- Sensors can be surface mounted using conventional strain gage application techniques or embedded in composite structures during manufacture; small size, light weight
- Thermally stable to 300 °C; mechanically robust (no fatigue, hysteresis, or baseline shift)
- Absolute strain sensing without constant monitoring

Applications include:

- *Transportation:* Bridges, highways, railroads, weigh-in-motion
- *Civil structures:* Dams, tunnels, mines, buildings, stadiums, pipelines, storage tanks
- *Shipboard:* Hull and deck monitoring, propulsion systems, submersibles, machinery
- *Aerospace:* Aircraft, spacecraft, cryogenic tanks, wind tunnel testing, space qualification
- *Alarm/Intrusion:* Perimeter sensing, intrusion detection

Licenses are available to companies interested in commercialization.

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