A novel method has been developed to massively multiplex FBG sensors, supported by a parallel processing interrogator, which enables high sampling rates combined with highly distributed sensing (up to 96 sensors per system). The interrogation system comprises several subsystems. A broadband optical source subsystem (BOSS) and routing and interface module (RIM) send light from the interrogation system to a composite embedded FBG sensor matrix, which returns measurement-dependent wavelengths back to the interrogation system for measurement with subpicometer resolution. In particular, the returned wavelengths are channeled by the RIM to a photonic signal processing subsystem based on powerful optical chips, then passed through an optoelectronic interface to an analog post-detection electronics subsystem, digital post-detection electronics subsystem, and finally via a data interface to a computer.

A range of composite structures has been fabricated with FBGs embedded. Stress tensile, bending, and dynamic strain tests were performed. The experimental work proved that the FBG sensors have a good level of accuracy in measuring the static response of the tested composite coupons (down to submicrostrain levels), the capability to detect and monitor dynamic loads, and the ability to detect defects in composites by a variety of methods including monitoring the decay time under different dynamic loading conditions.

In addition to quasi-static and dynamic load monitoring, the system can capture acoustic emission events that can be a prelude to structural failure, as well as piezoelectric-induced ultrasonic Lamb-waves-based techniques as a basis for damage detection.

This work was done by Behzad Moslehi and Richard J. Black of Intelligent Fiber Optic Systems Corp. and Yasser Gowayed of Auburn University for Dryden Flight Research Center. Further information is contained in a TSP (see page 1). DRC-011-004

In preliminary tests of the electrical characteristics of these devices, forward and reverse current-voltage characteristics were measured in a dark enclosure. The measurements confirmed that as desired, these devices are characterized by low levels of dark current at low reverse bias voltage: For example, one device having an active area of 0.25 cm² exhibited a leakage current density of only 14 pA/cm² at a reverse bias of 0.5 V (see figure).

This work was done by Shahid Aslam and David Franz of Raytheon Co. for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-14777-1