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## **Multipoint Dynamically Reconfigure Adaptive Distributed Fiber Optic Acoustic Emission Sensor (FAESense™) System for Condition Based Maintenance**

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This paper describes preliminary results obtained under a Navy SBIR contract by Redondo Optics Inc. (ROI), in collaboration with Northwestern University towards the development and demonstration of a next generation, stand-alone and fully integrated, dynamically reconfigurable, adaptive fiber optic acoustic emission sensor (FAESense™) system for the in-situ unattended detection and localization of shock events, impact damage, cracks, voids, and delaminations in new and aging critical infrastructures found in ships, submarines, aircraft, and in next generation weapon systems. ROI's FAESense™ system is based on the integration of proven state-of-the-art technologies: 1) distributed array of in-line fiber Bragg gratings (FBGs) sensors sensitive to strain, vibration, and acoustic emissions, 2) adaptive spectral demodulation of FBG sensor dynamic signals using two-wave mixing interferometry on photorefractive semiconductors, and 3) integration of all the sensor system passive and active opto-electronic components within a 0.5-cm x 1-cm photonic integrated circuit microchip. The adaptive TWM demodulation methodology allows the measurement of dynamic high frequency acoustic emission events, while compensating for passive quasi-static strain and temperature drifts. It features a compact, low power, environmentally robust 1-inch x 1-inch x 4-inch small form factor (SFF) package with no moving parts. The FAESense™ interrogation system is microprocessor-controlled using high data rate signal processing electronics for the FBG sensors calibration, temperature compensation and the detection and analysis of acoustic emission signals. Its miniaturized package, low power operation, state-of-the-art data communications, and low cost makes it a very attractive solution for a large number of applications in naval and maritime industries, aerospace, civil structures, the oil and chemical industry, and for homeland security applications.

**Ключевые слова:**

### **Содержание.**

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