Case Study: Marine

Fiber Optic Damage Assessment System

Mobile Bay, AL

January, 2008

Fiber Optic Damage Assessment System (FODAS)

Aim	The implementation of an automated network of ship condition sensors will have a number of direct benefits that will increase ship and crew survivability during a ship damage event.
Location	System Trial on ex-USS Shadwell, Mobile Bay, AL
System Integrator	Aither Engineering, Inc.
Customer	U.S. Navy
Date	January 2008
Instrumentation	• Micron Optics si425, Optical Sensing Interrogator • Micron Optics sm041, Channel Multiplexer
Sensors	• Aither Flooding Sensors, Door Closure Sensors, and Fire/Temperature Sensors were tested • Other Sensors available for the system: Aither FBG Accelerometers • Micron Optics, os3100 Optical Strain Gage Sensors
Software	Custom Aither Software
FBG Technology Benefit	Multiplexing FBG sensors monitoring different parameters.

Fiber Optic Damage Assessment System (FODAS)

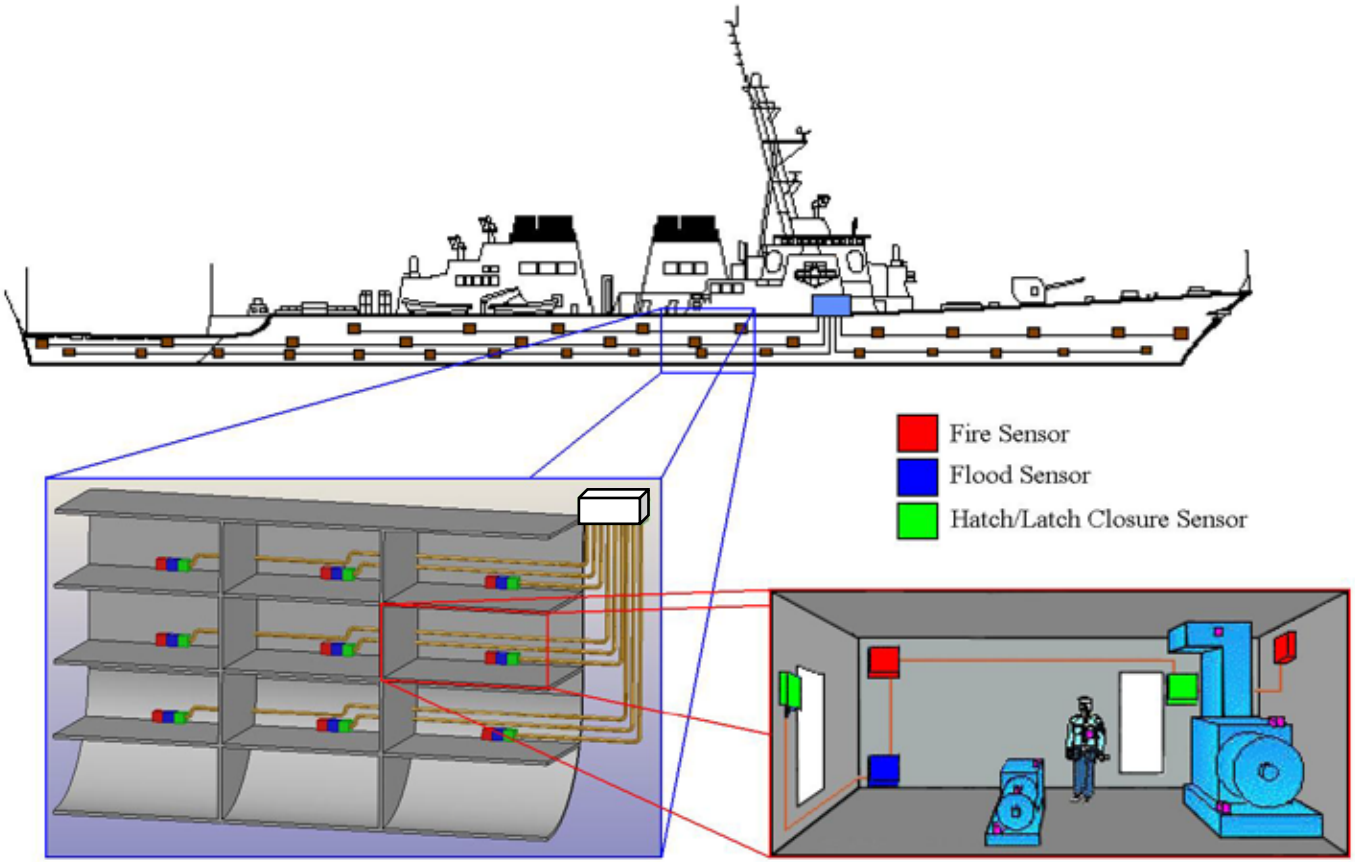
- Problem Statement
  - No automated monitoring system exists on Navy vessels to provide real time assessment of damage.
  - Uncertainty in damage assessment can result in a ship lost during a crisis situation.

USS Cole (DDG67)

  - On Oct. 12th, 2000, at 11:18 a.m. Bahrain time (3:18 a.m. EDT), when the small boat was situated on the port side of the destroyer an explosion occurred causing a 40-foot by 40-foot gash in the port side of the USS COLE. Damage control efforts to manage flooding in the ship's engineering spaces were reported successful that evening.

Fiber Optic Damage Assessment System (FODAS)

- A suite of networked fiber optic sensors to enable real time access to superior damage assessment data.



Distributed Network of FBG Sensors

Baseline Damage Assessment Technology

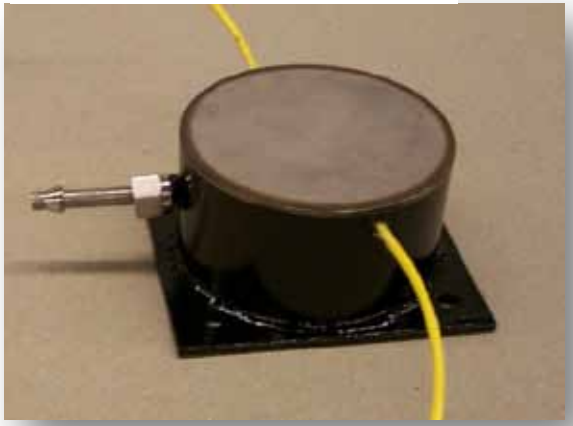
- Limited fire detection systems
- Visual inspections by damage control teams
- Limitations
  - § Exposes personnel to hazardous conditions
  - § Long delay time for situational awareness
  - § Requires significant human involvement

Performance benefits

Features	Benefits
All fiber optic sensors	No electrical power to sensor required, Immune to RF interference
Ship wide distributed sensing (multiplexed sensors)	Fast replacement, retrofit
Multiple sensor types on a single lead cable	Reduced cabling and installation time
Central processing system	Real-time data collection and analysis
Temperature sensor	Fast response rate
Flooding sensor	Perform ship listing measurements

Fiber Optic Sensors – FBG-based

Flooding Sensor



os3100 Strain Sensor

Fire/Temperature Sensor

Door Closure Sensor

Accelerometer

Fiber Optic Instruments – FBG Monitoring Technology

si425-500

sm041-416

Results and Acknowledgements

- Results
  - By eliminating in-person investigation of alarm events, the ship's damage assessment personnel will quickly have a complete picture of the ship's condition, thus increasing the likelihood of surviving and recovering from the attack in less time and with less overall damage.
  - The automated assessment of the ship's condition will also improve the operational readiness of U.S. Navy forces.
  - The realization of reduced manning in U.S. Navy ships will reduce the overall operations and support (O&S) costs for the fleet.

- Acknowledgements
  - U.S. Navy
  - Aither Engineering, Inc.

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