Overview of Fiber Optic Sensing Solutions and Technologies

January 18, 2020

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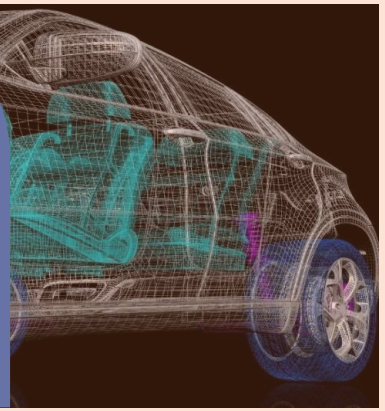
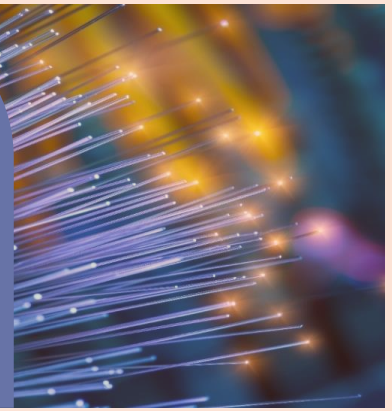
Director of Marketing
Luna Innovations

LUNA

FO Sensing and Non-Destructive Test



Communications Test and Photonic Controls



History
Incorporated 1990
IPO 2006

Reporting Segments
Lightwave
Luna Labs

- Specializing in advanced fiber optics measurement and sensing solutions
- 12 locations around the world
- 400+ Employees

Mission: Enhance the safety, security and connectivity of people…

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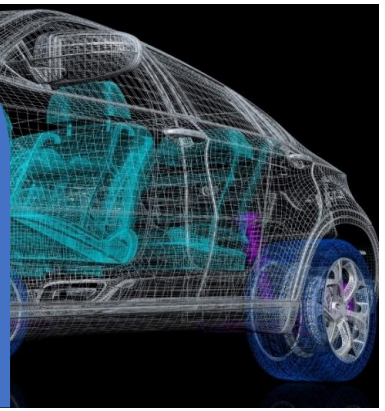

Aerospace, Automotive, Infrastructure Safety & Security, Process Control

- Enabling next generation designs in aerospace and automotive through through better measurement
- Protecting infrastructure and perimeters through smarter sensors and systems
- Enhancing process control & non-destructive testing (NDT) with Terahertz technology

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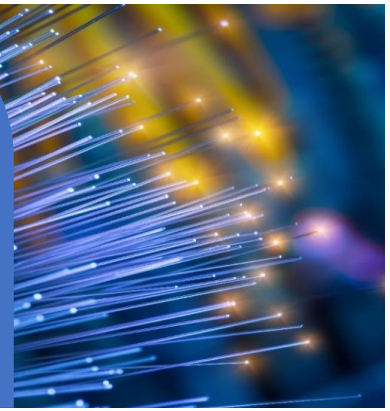

Communications and Defense

- Enabling next generation high speed optical networking through faster, better measurements
- Enhancing optical systems and instruments through high quality, precise control of light

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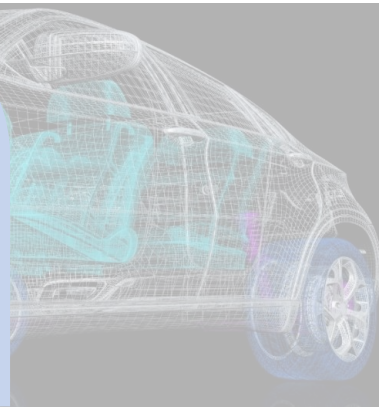

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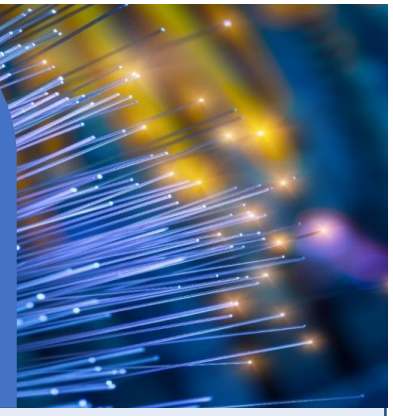

Characterize Fiber and Optical Components

- Component Analyzers
- High-Res Backscatter Reflectometers
- Polarization Analyzers and Controllers

Building Blocks for Photonic Systems

- Polarization Controllers/Mon.
- Delay Line Controllers
- Detectors
- Tunable Filters
- Lasers

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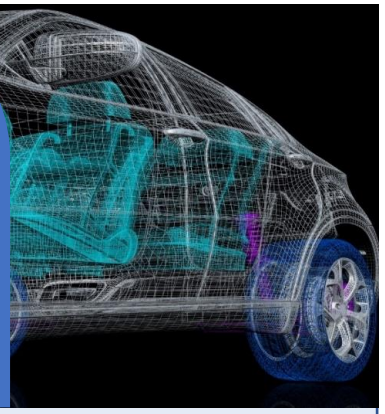


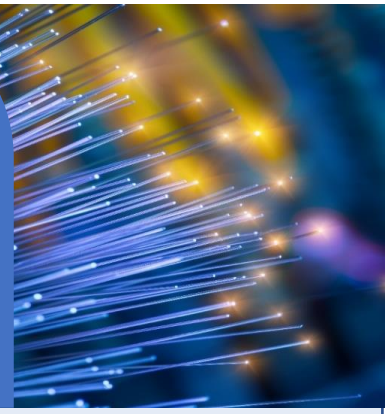
Fiber Optic Sensing

- FBG Interrogators and Sensors
- High-Def Distributed Interrogators and Sensors
- **New! OptaSense** Distributed Acoustic Sensing

Terahertz Gauging and Imaging

- T-Ray Control Units
- Sensors and Gauges

Communications Test and Photonic Controls



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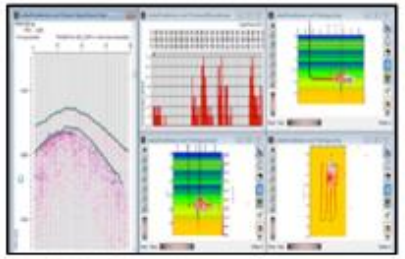
OptaSense®

A LUNA company

DFOS processing, analysis and interpretation		OptaSense, have developed the software tools and techniques to provide industry leading processing, analysis and interpretation of DFOS data
Distributed Fibre-Optic Sensing (DFOS) acquisition		Our experienced field crews, provide high quality acquisition of DFOS data on land and offshore
Distributed Acoustic Sensing (DAS) system development and design		Development and design of the industry leading product range of DAS Interrogator Units and ancillary equipment, including hardware, signal processing and software
Development, design and manufacturer of high performance lasers		RIO is an OptaSense company which develops, designs and manufactures highly coherent semi-conductor lasers used in sensing applications including DAS Interrogator Units

Fiber Optic Sensing: 3 Platforms, 3 Technologies

	High-Speed Multipoint	High-Definition Distributed	Distributed Acoustic Sensing
		 ODiSI	 ODH/QuantX
FOS Technology:	**Fiber Bragg gratings (FBGs) and Fabry-Perot sensors**	**Rayleigh backscatter**	**Rayleigh backscatter**
Point/Distributed:	**Multipoint sensing**	**Distributed**	**Distributed**
Sensor/gage spacing:	**FBG placement**	**Down to <1 mm**	**~10 m typical**
Sensor fiber length:	**Up to 10's of km's**	**50 m**	**Up to 10's of km's**
Measurements:	**Strain, temperature, acceleration, displacement and pressure**	**Strain and temperature**	**Acoustics Strain, temperature**
Example applications:	Civil infrastructure monitoring Aerospace condition monitoring Wind turbine monitoring	Battery thermal analysis Structural and material test Precision process monitoring	Pipelines Transportation/rail Perimeter security Oil and gas

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Summary

lunainc.com

optasense.com

- **What Luna can offer to EPIC members?**
  - Fiber optic sensing systems
  - Photonic modules
    - Polarization management
    - Polarization monitoring
    - Variable delay control
    - Detectors
    - Tunable filters
  - Laser sources
  - Fiber coils
  - Measurement and analyzer tools
    - Distributed loss analyzer (reflectometers)
    - Precision path length measurement
    - Optical component analyzers
    - Polarization emulation and analysis
- **What can EPIC do for Luna?**
  - Application partners for fiber optic sensing
  - Technology partners for fiber optic sensing
  - Sensing fiber options for harsh environments
    - High temperature

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