Photonic sensors for safety, security and industrial applications

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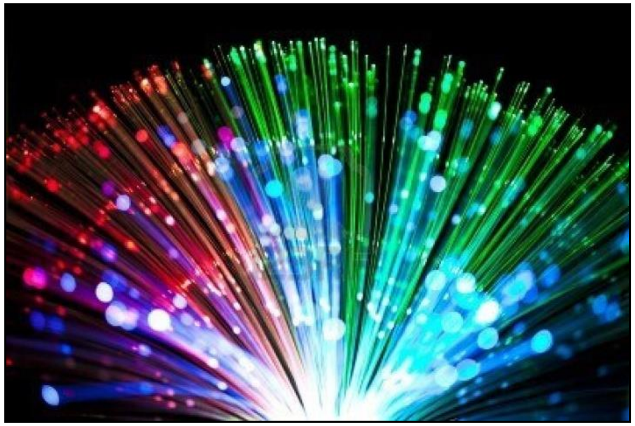
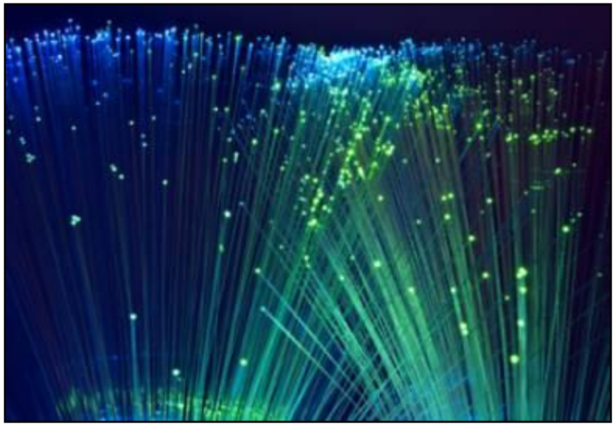
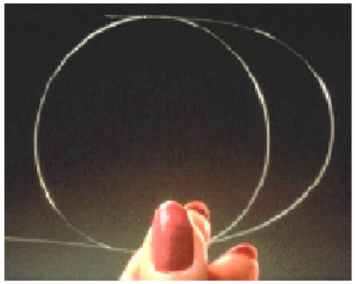




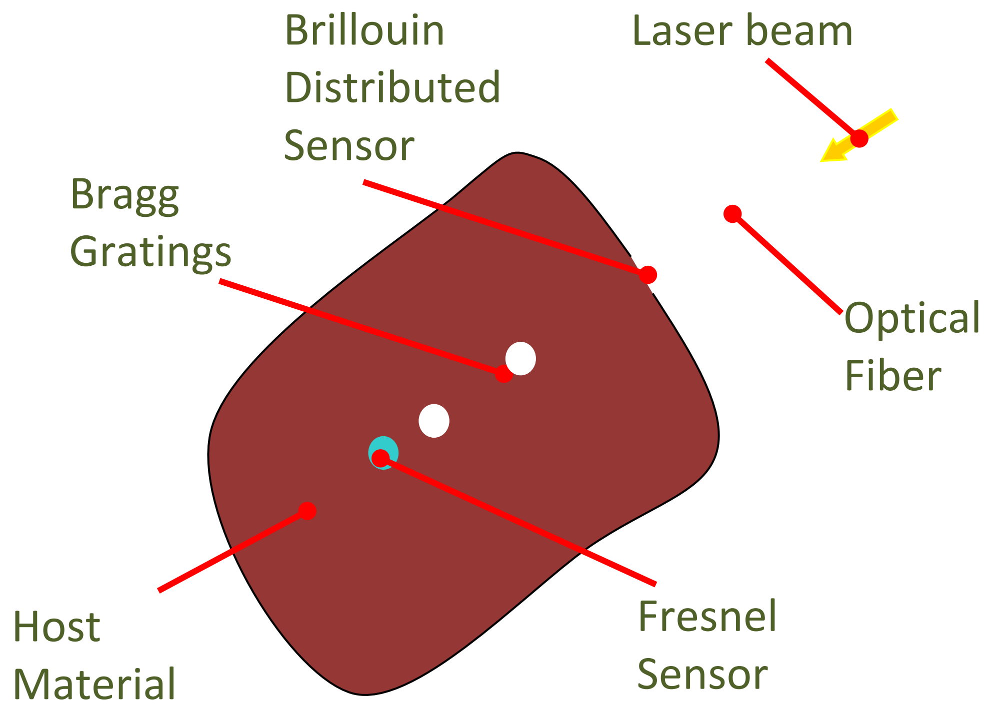
Advantages of Fiber Optic Sensors



- *Galvanic isolation*
- *EMI immunity*
- *Intrinsically safe*
- *Passive: no need for electrical power*
- *Possibility of remote, multiplexed operation*
- *Small size and lightweight*
- *Integrated telemetry: fiber itself is a data link*
- *Wide bandwidth*
- *High sensitivity*

THE BASIC "IDEA"

- Multifunctionality
- Localized and Distributed
- Integration

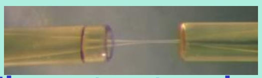


TOP-IN Tecnologie Optoelettroniche per l'Industria

An Integrated Multidisciplinary Approach for Advanced Multifunction Photonic Sensing Systems

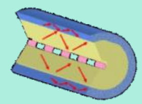
A.Cutolo, A. Cusano, M. Pisco, M. Consales, A. Iadicicco, P. Pilla, C. Ambrosino,
G. Breglio, D. Paladino, A. Crescitelli, A. Ricciardi, S.Campopiano, M. Giordano

Photonic devices

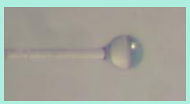


Micro-structured Fiber Gratings

Tapered Fiber



Long period Fiber Gratings



Micro resonators

Hollow core optical fiber

Integration with:

Metal oxide particle layers

Nanoporous Polymers

Carbon nanotubes

Bandgap engineering

Microstructuration

Tapering

Measured parameters:

Strain	1 με
Temperature	0.1 C°
Vibration	Up to 1 MHz
Refractive index	10^{-5}
Chemical detection	< 1 ppm
Humidity	< 1%
Electric and Magnetic field	

Application to:

Structural health monitoring

Damage detection

Aeronautic monitoring

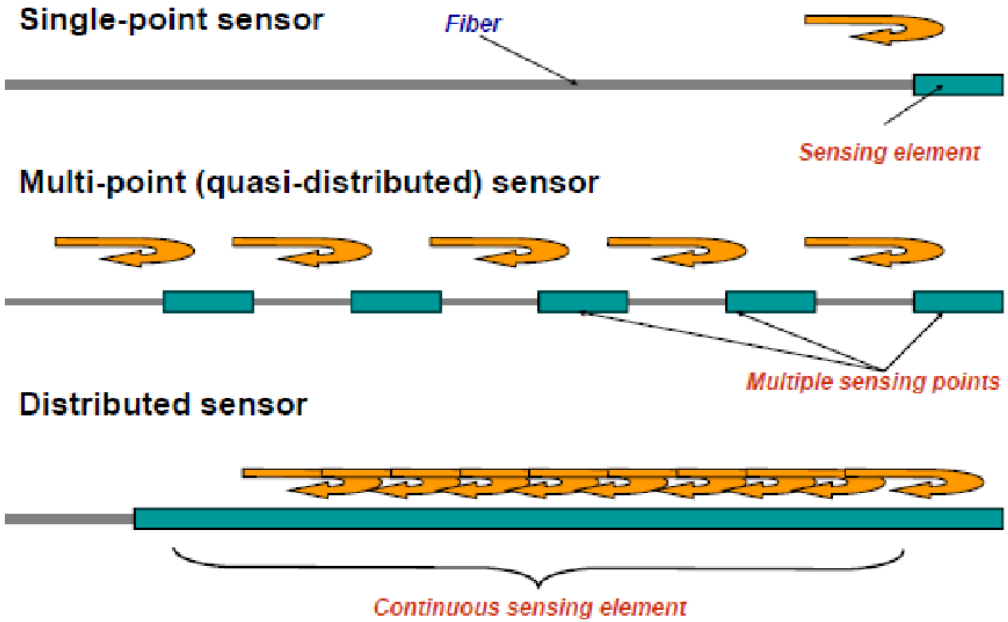
Geodetical monitoring

Enviromental monitoring

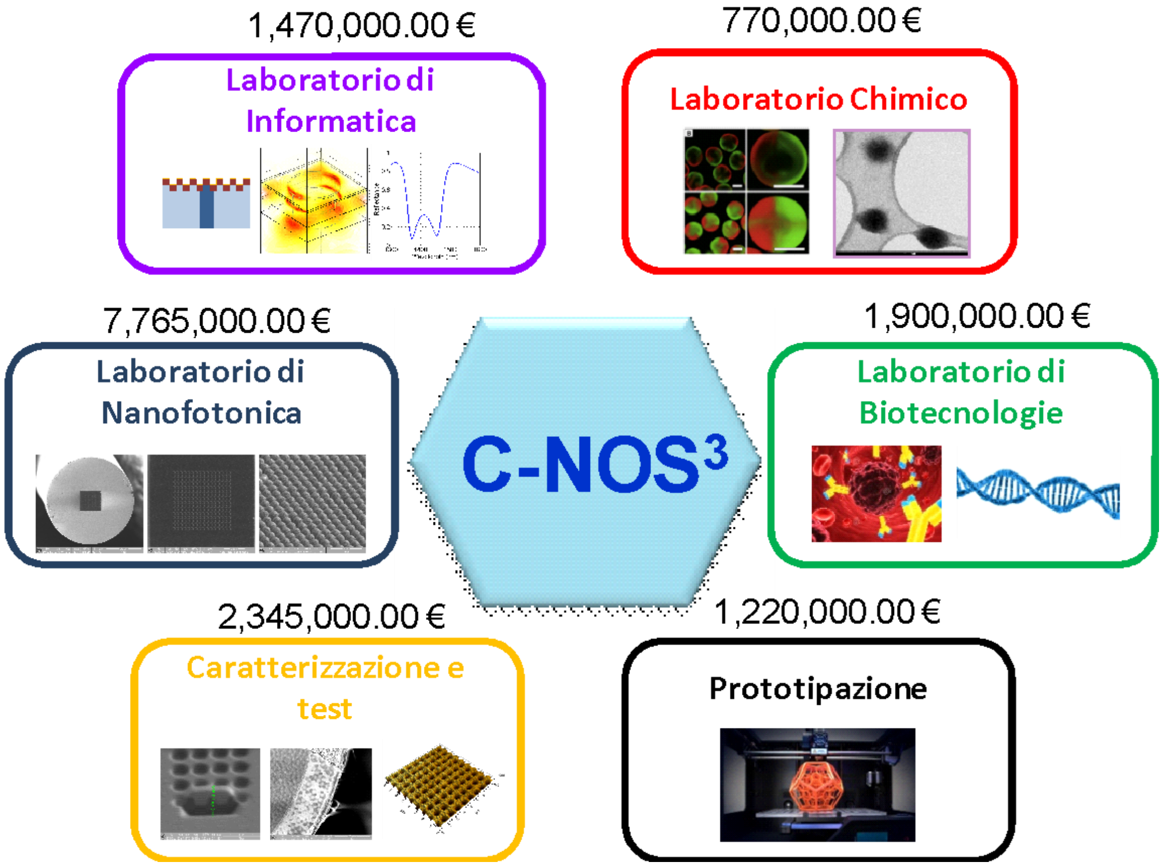
Acoustic monitoring

Railways monitoring

Fiber Sensors Configurations



NANOPHOTONIC CENTER FOR MEDICAL AND INDUSTRIAL APPLICATIONS «EMILIA»



Optoelectronics Group – Engineering Dept,
University of Sannio – Benevento (Italy)

Università degli Studi del Sannio

OPTOELECTRONICS group University of Sannio

INDUSTRIAL APPLICATIONS

Railway Monitoring

AnsaldoSTS

Underwater Monitoring

WASS A Finmeccanica Company

Aeronautical Monitoring

Avio propulsione aerospaziale

CIRA

MAGNAGHI AERONAUTICA SpA

Structural and Civil Monitoring

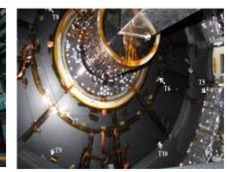
D'APPOLONIA

Musical Applications

Agricultural Monitoring

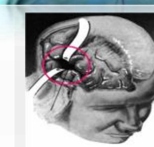
Process Monitoring

High-energy phisics



CERN

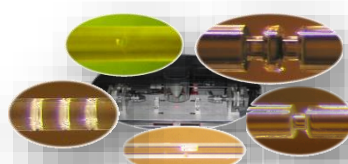
Biomedical Applications



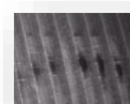
Environmental Monitoring

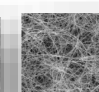
Lab on Fiber Technology

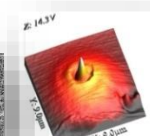
Local Optical fiber micro and nano structuring



Materials Integration

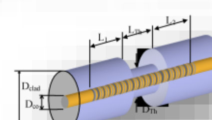




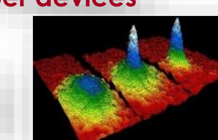


Integrated and Multifuctional all-fiber devices

Multifunctional sensors

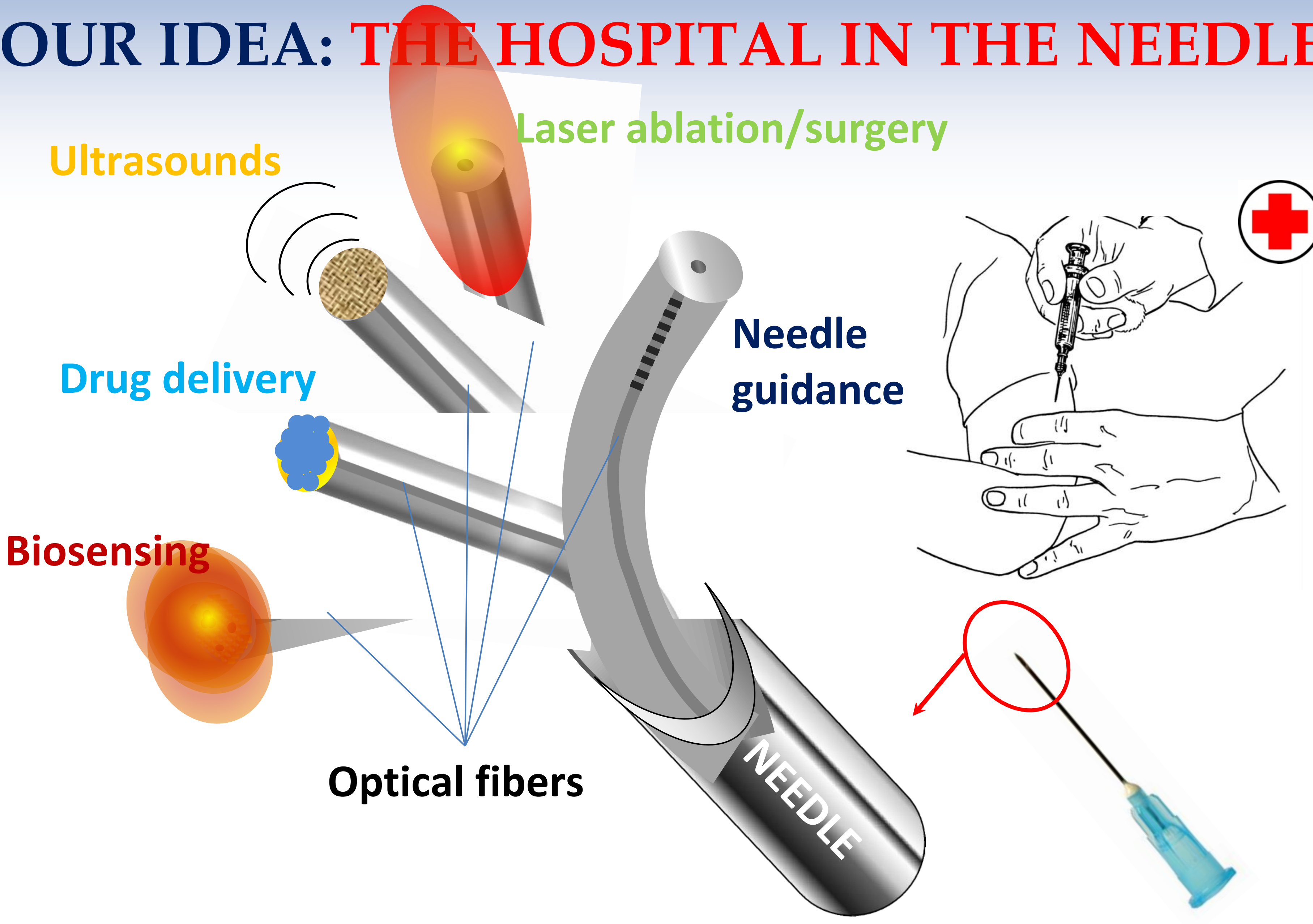


Optical Modulators



Optical True Time Delay

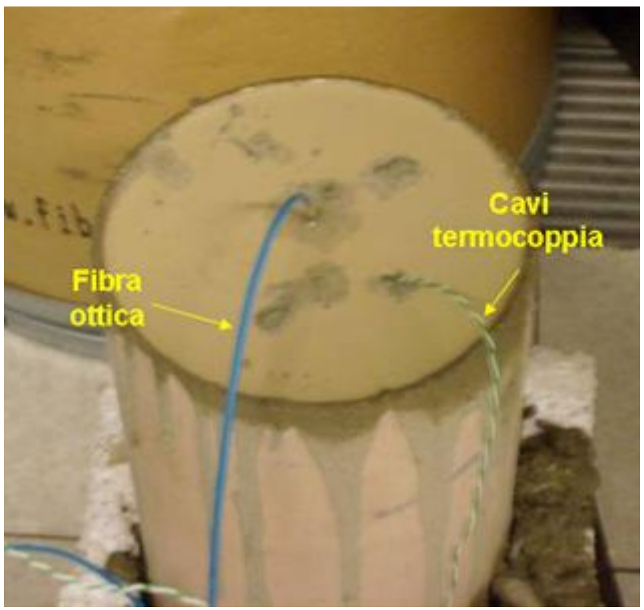
OUR IDEA: THE HOSPITAL IN THE NEEDLE

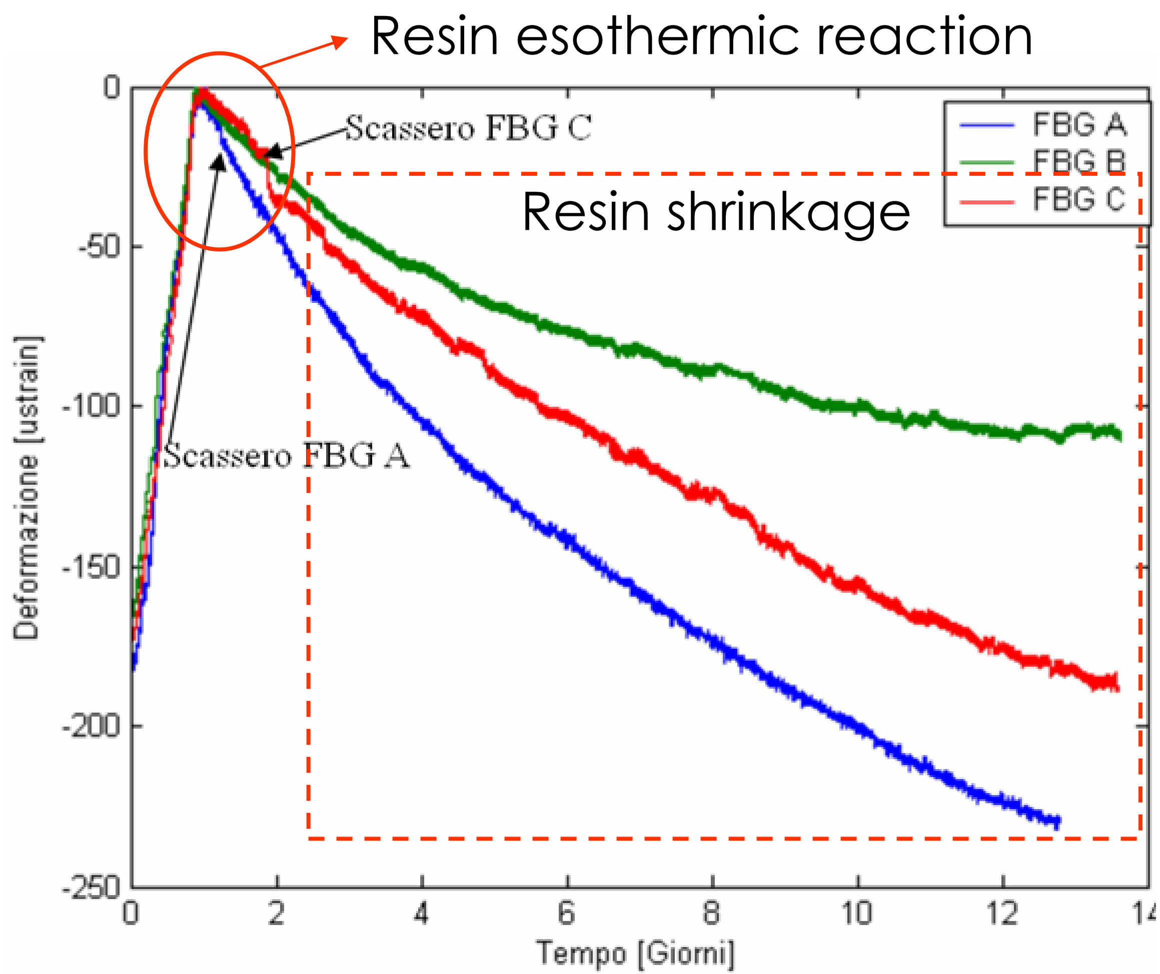


Resin & Mortar Process Cure Monitoring

Mortar Cure Monitoring

Italcementi
Italcementi Group

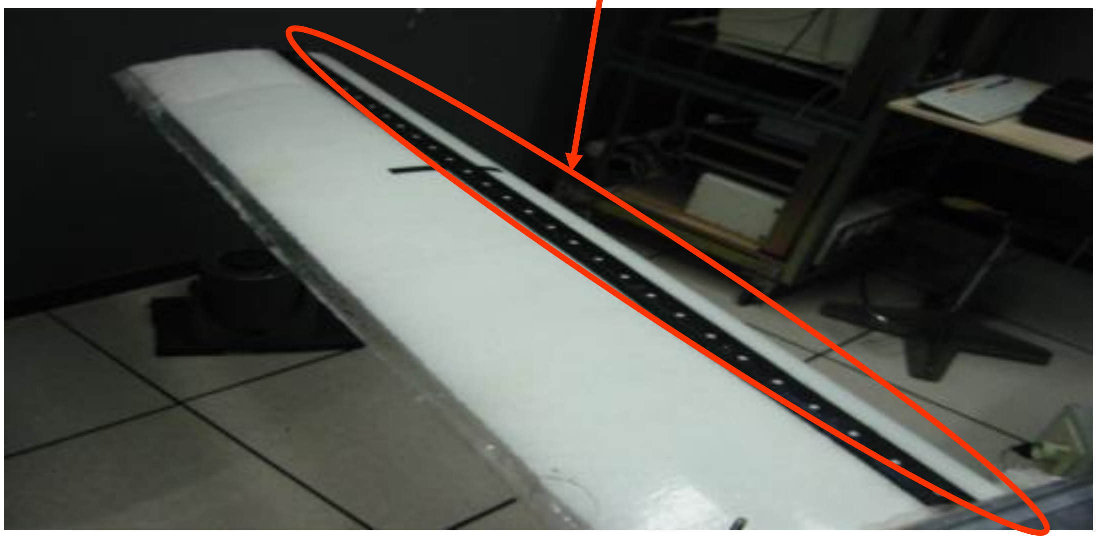




Aircraft Wing

Easy Integration in Composites

FBG embedded in composite material to detect, identify, and localize damage generation

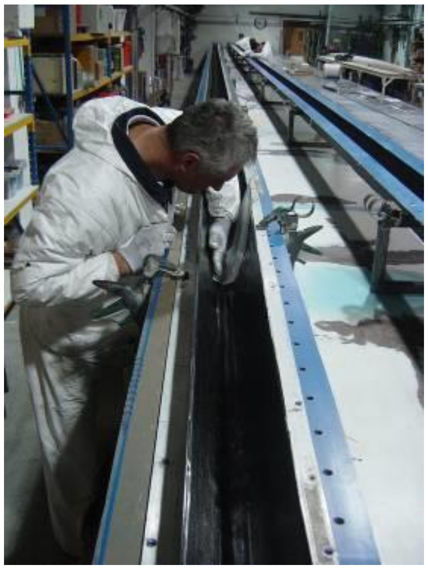


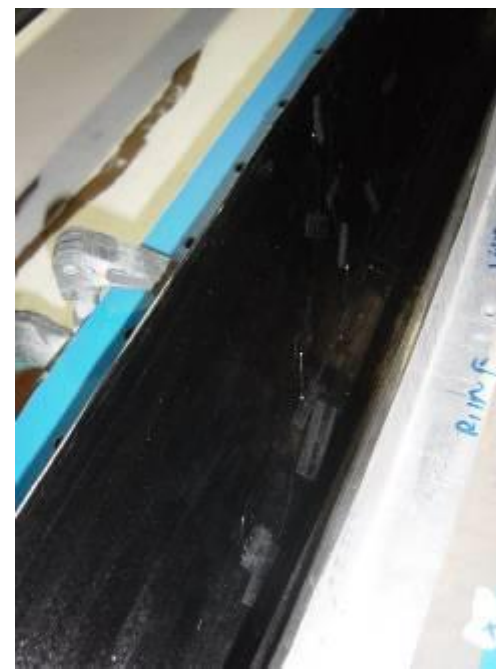
I Bending Mode-Resonant Frequency [Hz]		
Simulation	Displacement (Accelerometer)	Strain (FBG)
10.27	9.58	9.48

II Bending Mode-Resonant Frequency [Hz]		
Simulation	Displacement (Accelerometer)	Strain (FBG)
72.72	63.58	62.43

To evaluate the resonance frequencies (forced evolution) and the modal deformation with their frequencies (free evolution)

SAIL BOAT MAST MONITORING





FBG Health Monitoring Feasibility for Solid Rocket Motor Composite Case

optosmart
OPTOELECTRONIC AND SMART SYSTEMS

Avio
propulsione aerospaziale

Vibrational Spectroscopy on Naval Engines

OPTOELECTRONIC AND SMART SYSTEMS

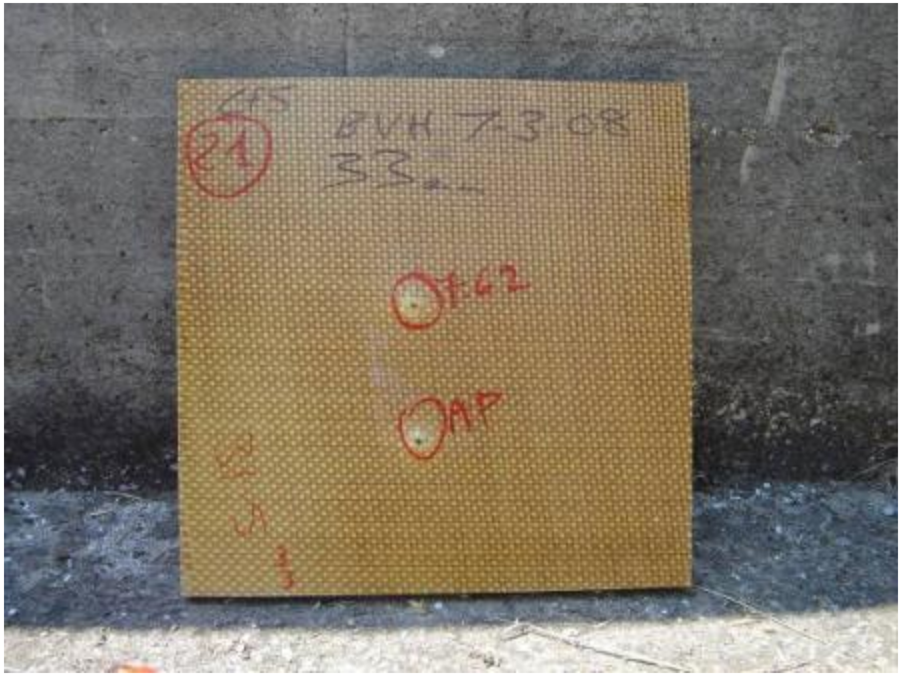
Tests conducted on MTU Engines used by Grimaldi Ferries

Use of FBGs sensors for vibration monitoring in marine engines for early fault detection

Ballistic Tests on Naval Panels

Aim: Use of FBGs sensors for monitoring of ballistic impacts on composite panels for Fincantieri

Ballistic Equipment



Composite Panel after shooting

UNDER WATER APPLICATIONS

Under water acoustic detection

Harbor security

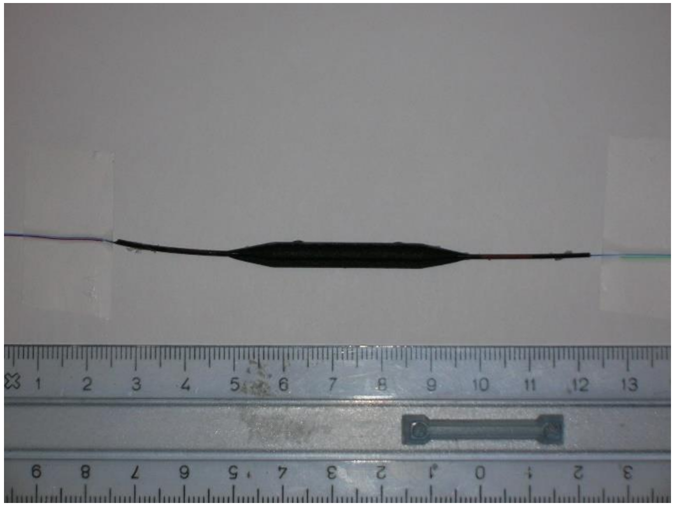
Fiber Bragg Gratings Sensors: Manufacturing

Demo Model-Manufacturing tools

Optoacoustic Sensor Mould

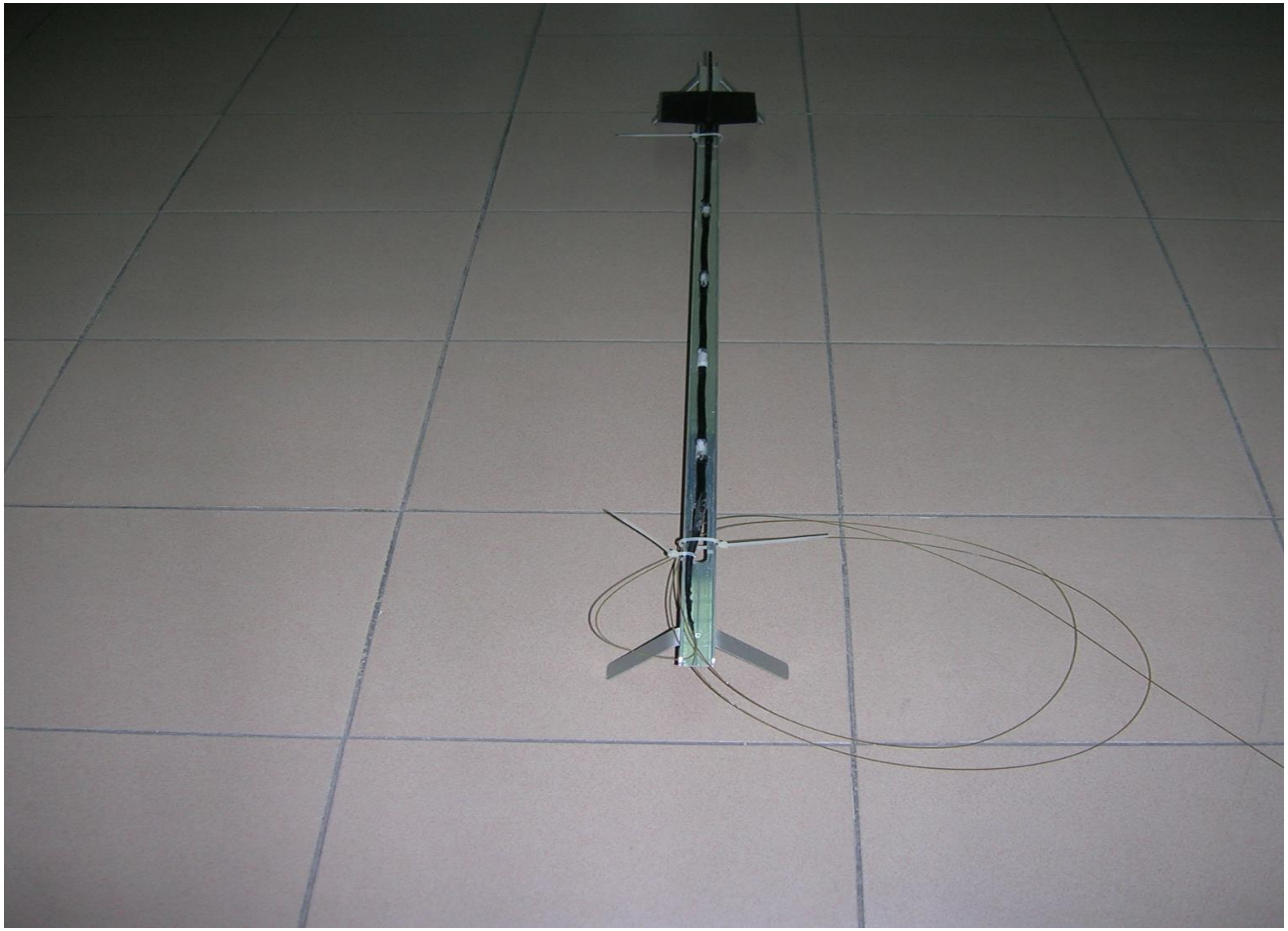
Optoacoustic Sensor Array

Optoacoustic Sensor



Optoacoustic Spending Antenna

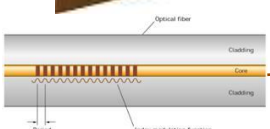
Four Element Spending Antenna

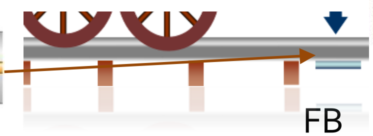


RAYLWAY APPLICATIONS

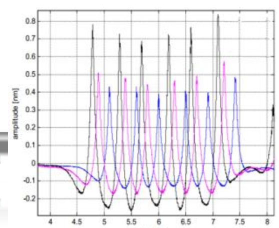
STRUCTURAL APPLICATIONS: RAYLWAYS

Obiettivo: migliorare la sicurezza, affidabilità ed efficienza nell’ambito dell’industria ferroviaria



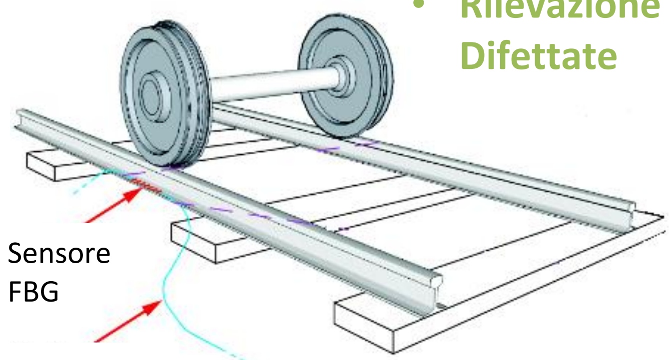


FB
G



AnsaldoSTS
A Finmeccanica Company

- Conta Assi
- Pesa Dinamica
- Rilevazione Ruote Difettate



Sensore FBG

Fibra Ottica

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Tecnologie Optoelettroniche per l’Industria

LARGE AREA PROTECTION

Anti intrusion systems

Architecture

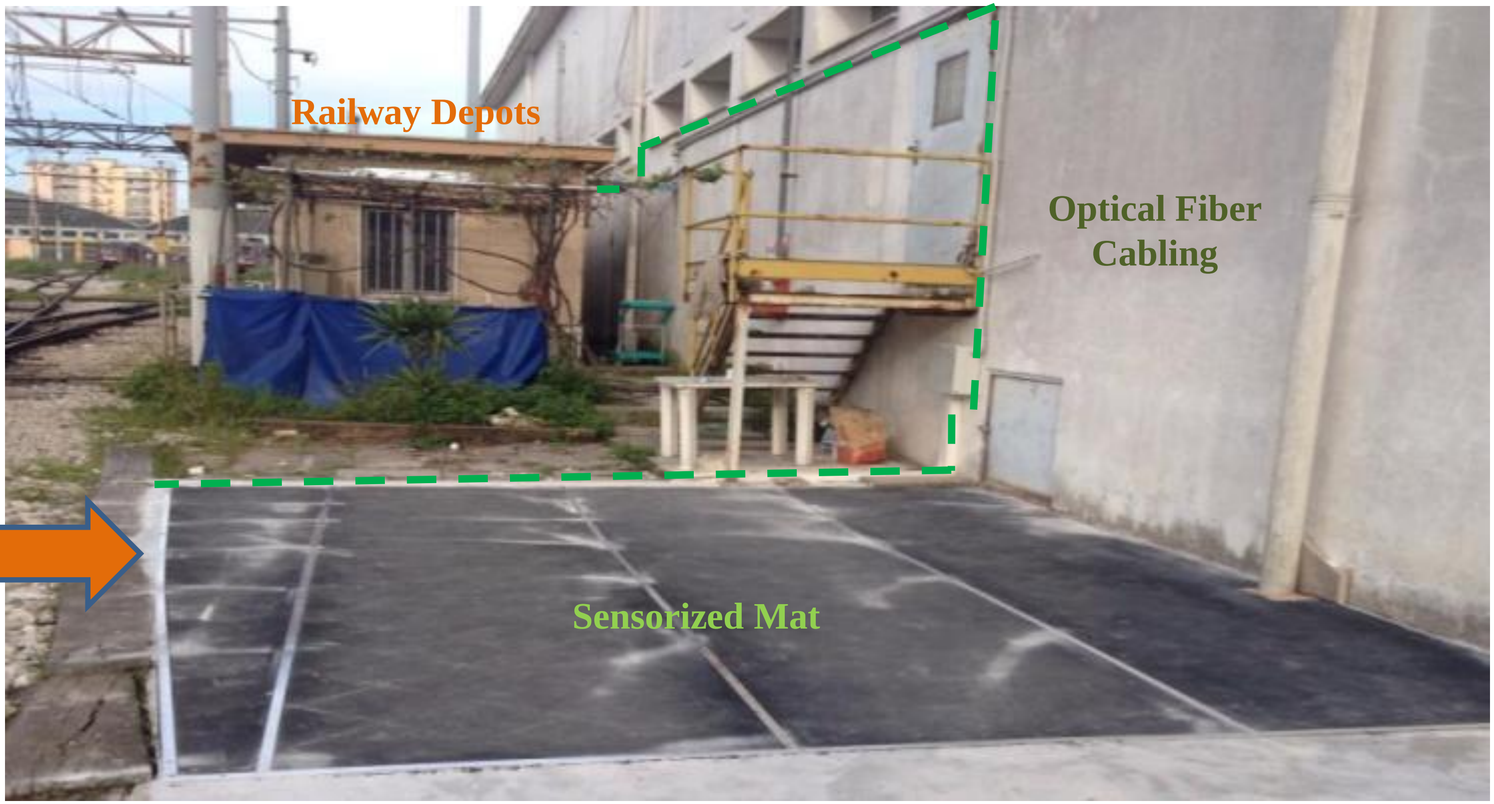
Sensorized Mat	Optical Fiber Bundle	Optical Fiber Couple Box	Interrogation Unit	Server - PC





EAV Ponticelli Depot Naples (Italy)

75 FBG to sensorize a rubber mat of about 18 m².



HOSTILE ENVIROMENT APPLICATIONS

High energy physics accelerators
High level power plants
Low temperature and high frequency radiation enviroments

HOSTILE ENVIROMENTS

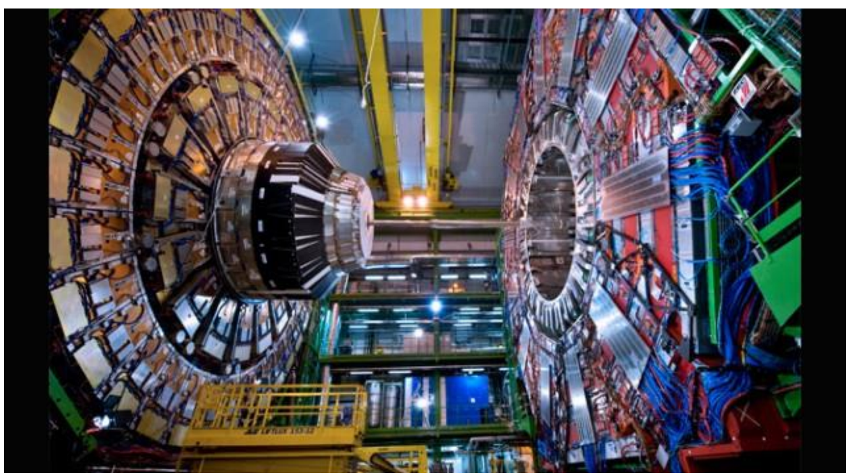
In collaborazione con il CERN di ginevra

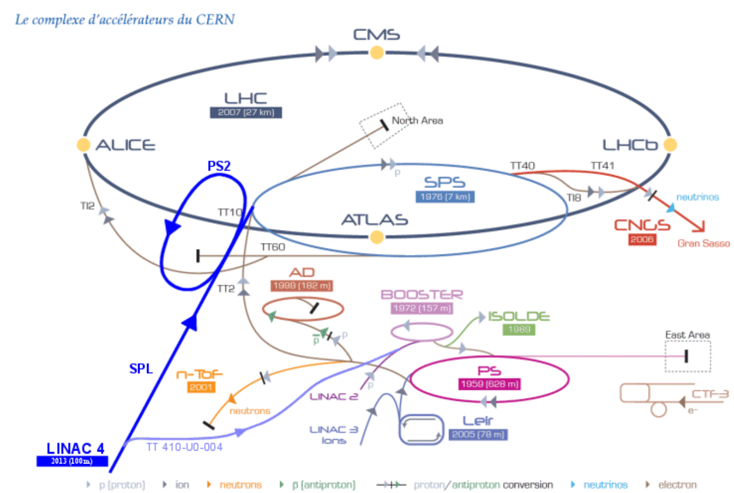
Università degli Studi del Sannio

optosmart

CERN

Obiettivo: Sviluppo di sensoristica avanzata in fibra ottica per il monitoraggio di Temperatura, Deformazione, Umidità all'interno dell'acceleratore di particelle





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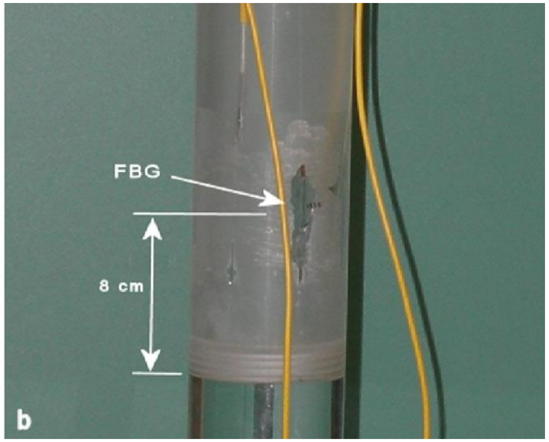
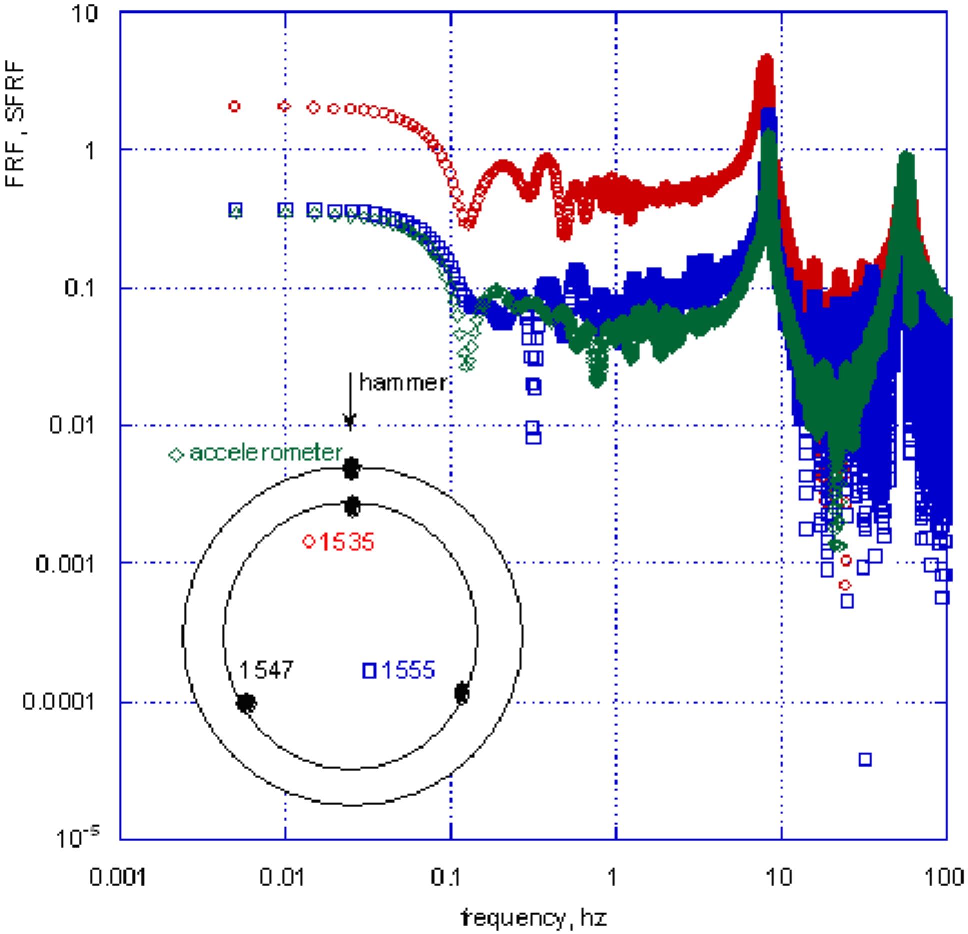
Tecnologie Optoelettroniche per l'Industria

GEOPHYSICS APPLICATIONS

Fiber Optic Seismic Sensor

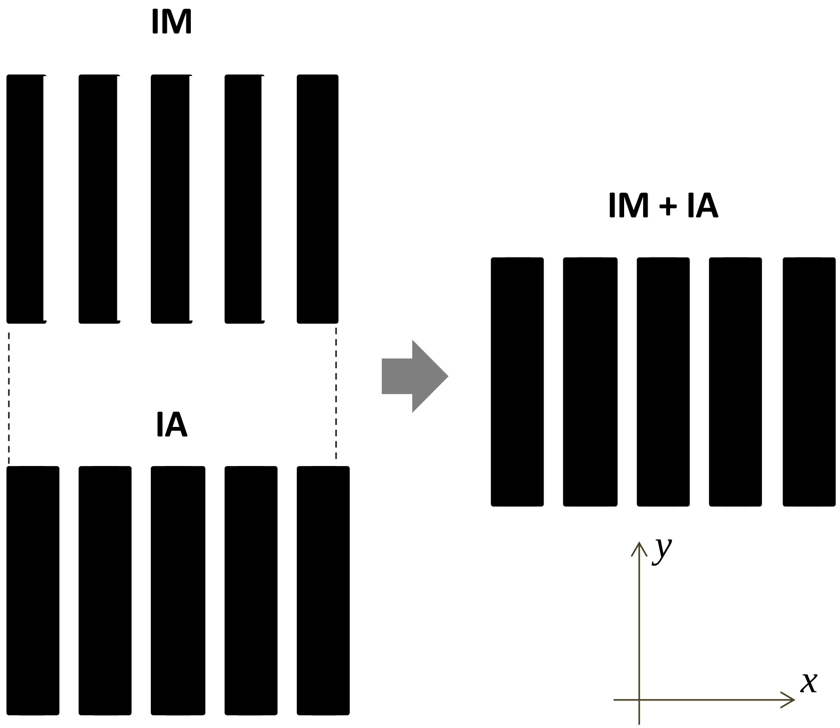




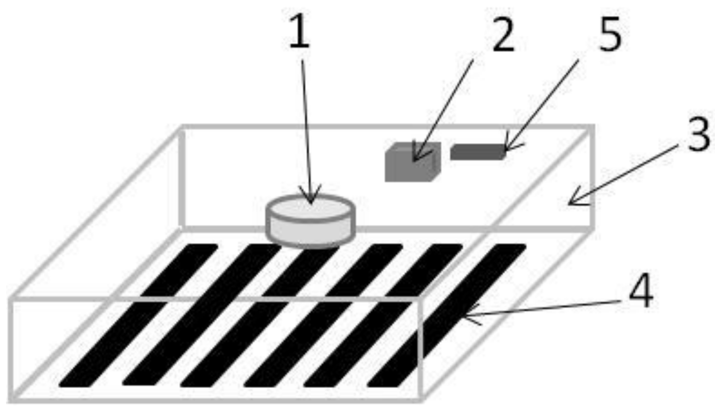
Integration of three FBGs strain sensors in a mechanical structure to measure the axial deformations due to bending stress of an oscillator subjected to a dynamic acceleration at the clamped basis.

The Bragg sensors and accelerometer have showed similar responses.

BAR and QR CODES as cheap structural sensors



TWO BASIC CONFIGURATIONS



POSSIBLE APPLICATIONS

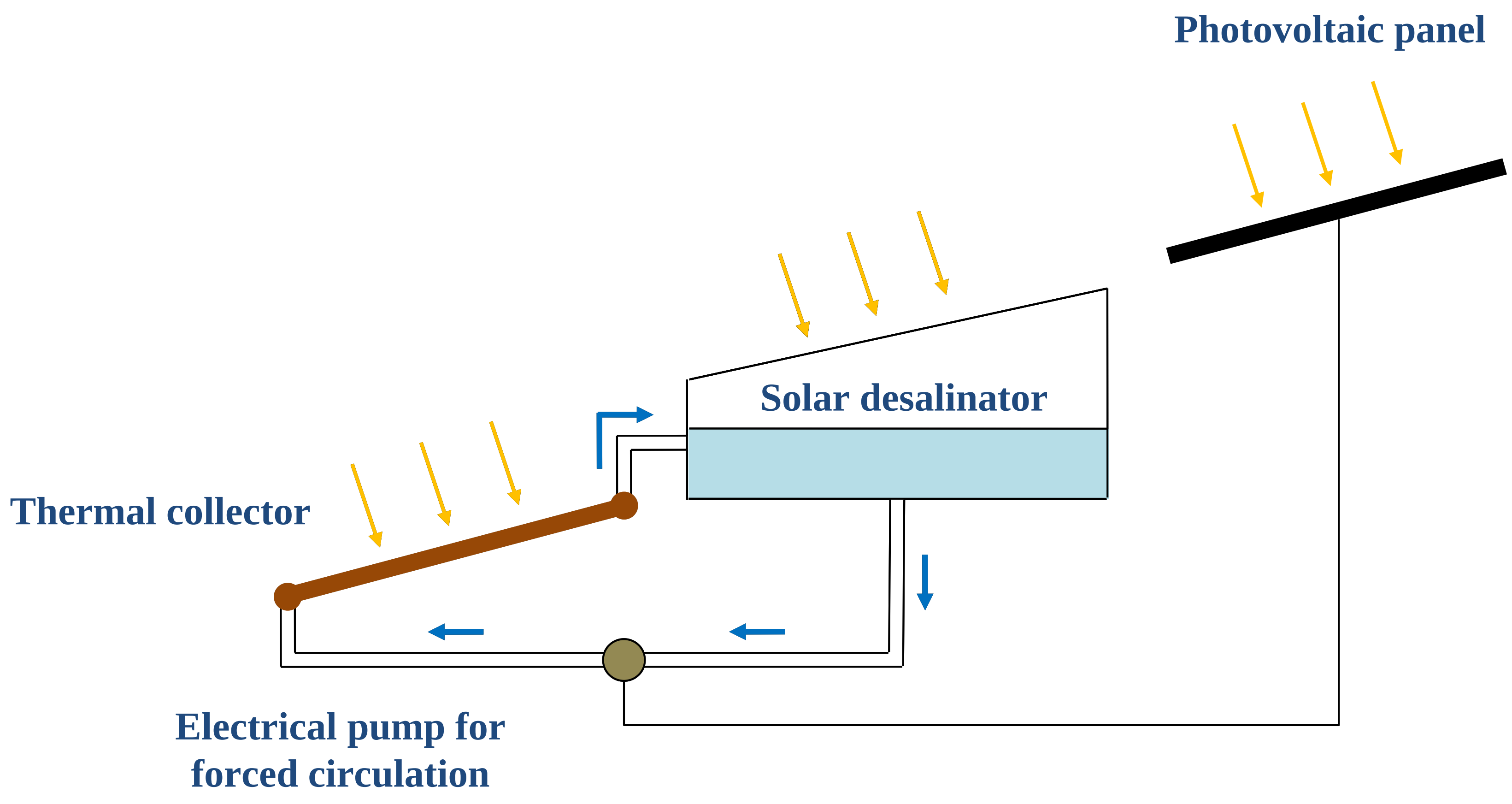
Cheap and easy handling structural health monitornig of

Buindingd, bridges etc.

Mecchanical pieces by simply mechanical working a small bar code on a surface in view of the piece

ENERGY APPLICATIONS

ACTIVE SOLAR DESALINATION



THANK YOU
FOR YOU PATIENCE

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