



# PROTEU

ADVANCED OPTICAL SENSOR  
FOR MONITORING ESTUARINE  
AND COASTAL ENVIRONMENTS



**INESC TEC**  
TECHNOLOGY & SCIENCE



# PROTEU

## ADVANCED OPTICAL SENSOR FOR MONITORING ESTUARINE AND COASTAL ENVIRONMENTS

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INESC Porto has developed technology to monitor temperature and salinity in coastal environments using an innovative fully integrated monitoring infrastructure based on optical fibre. As part of the research project PROTEU, an 11 km optical fibre cable, with Bragg sensors placed every 500 meters, was installed that runs from the mouth of the Ria de Aveiro and follows the Espinheiro channel bed to the Vouga river. This made it possible to measure the water temperature at each sensor location in real-time. The results of this project are currently being used in several studies concerning the Ria de Aveiro and the surrounding area and are crucial for continuous environmental assessment and management.

This technology is now being explored further and will be able to measure salinity and other chemical and biological parameters (dissolved CO<sub>2</sub>, cyanobacteria) making it an advanced analytical tool for the monitoring and study of marine conditions in estuarine environments.

Developed in 2004

### MAIN FEATURES

Electromagnetic immunity

Based on standard telecom optoelectronics

Multipoint detection

High sensitivity

Real-time remote operation

Quasi distributed sensing

Adaptable for the detection of other environmental parameters

### SPECIFICATIONS

11 km Optical fibre cable (TONGERE from CABELTE S.A.) with three SMF 28® optical fibres with 19 Fibre Bragg grating temperature sensors distributed every 500 m. Cable anchored to the river bed with concrete structures placed every 500 m in the vicinity of the sensors.



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# OPTOFLUIDIC DEVICES FOR MICROANALYSIS

HYBRID MICROFLUIDIC CHIP  
FOR SINGLE CELL DIAGNOSIS



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# OPTOFLUIDIC DEVICES FOR MICROANALYSIS

## HYBRID MICROFLUIDIC CHIP FOR SINGLE CELL DIAGNOSIS

Miniaturisation and portability, increased automation, minimum reagent consumption, high throughput and reduced manufacturing costs are some of the strong motivations to develop microfluidic sensing platforms.

In this project, partners with complementary expertise (INESCTEC – Optoelectronics, CENIMAT – Material Science, ITQB – Biomolecular diagnosis) joined to develop a new optofluidic chip capable of performing optical and electrical characterisation of biological fluids and single cells.

The technology currently being developed makes it possible to perform multiple simultaneous measurements with extremely reduced sample volumes. As a result, this project guarantees an improved analytical diagnostic tool. In this particular project, the goal is to analyse red blood cells (RBC) simultaneously using impedance spectroscopy and refractive index measurements. The aim is to provide a way to differentiate infected and healthy cells more accurately. Nevertheless, the technology is versatile and will allow a diversity of analytical applications.

### POTENTIAL APPLICATIONS

- **Security and defence:** high sensitivity detection of multiple chemical and biological threats using minimal sample amounts.
- **Biomolecular diagnosis:** single cell manipulation and diagnosis (infectious states, cancer).
- **Point of care analysis:** fast and sensitive multiparameter analysis of biological fluids (blood, urine).
- **Quality control:** spectroscopic and refractive index analysis of dye solutions and other fluids (chemical industry, food industry).

### PARTNERS

**ITQB-UNL/IBET** BIOMOLECULAR DIAGNOSTIC LABORATORY (PT)

**CENIMAT** DEPARTAMENTO DE CIÊNCIA DOS MATERIAIS (PT)

**INESC TEC** INESC TECHNOLOGY AND SCIENCE (PT)

Financed by National Funds through the FCT – Fundação para a Ciência e a Tecnologia (Portuguese Foundation for Science and Technology) as part of project «HYBRID - PTDC /SAU -BEB /102247/2008»



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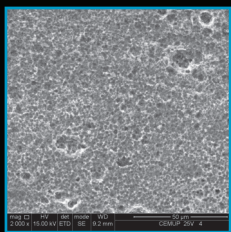
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Fundação para a Ciência e a Tecnologia  
membro da associação FCT/CTA

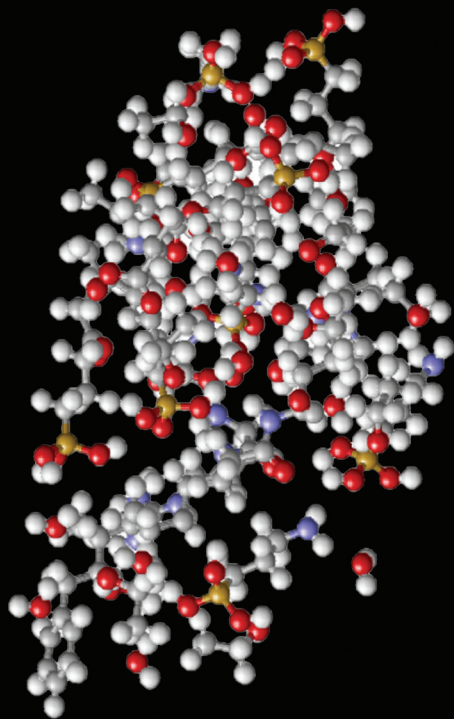


# SNIFFER

NETWORK OF CHEMICAL  
AND PHYSICAL SENSORS  
FOR FOOD SUPPLY  
CHAIN SECURITY



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# SNIFFER

## NETWORK OF CHEMICAL AND PHYSICAL SENSORS FOR FOOD SUPPLY CHAIN SECURITY

The aim with project SNIFFER is to design and develop a network of distributed devices capable of rapidly detecting on-site multiple kinds of agents and CBR agents which are highly sensitive and specific throughout the most vulnerable stages of the food supply chain (such as farms, large collection centres, wholesalers).

INESC Porto will be responsible for developing sensors based on chemical or physical interactions. These sensors can be used to develop Molecular Imprinted Polymers (MIPs), which are highly selective materials, as well as on Resistive Pulse Experiments using functionalised and non-functionalised nanostructures. Electrical and optical sensors will be developed, extending the applicability of the sensors from single point low-cost sensors to wide area sensor networks.

SNIFFER IS AN FP7 APPROVED PROJECT  
IN WHICH THE FOLLOWING INSTITUTIONS PARTICIPATE

**TEKEVER ASDS** PT

**Centro de Investigação da Academia Militar**

/ **Laboratório de Bromatologia e de Defesa Biológica** PT

**Umeå Universitet** SE

**Instituto de Engenharia de Sistemas e Computadores do Porto** PT

**Universidad de Burgos** ES

**Österreichischen Agentur für Gesundheit und Ernährungssicherheit GmbH** AT

**Centre Suisse d'Electronique et de Microtechnique** CH

**Forsvarets forskningsinstitutt** NO

FP7-SE C-2012-1: Grant agreement 312411

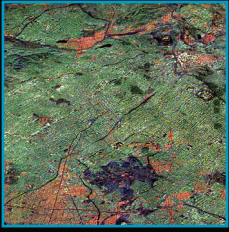


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# SEE THE UNSEEN

## COMPRESSIVE SENSING BASED CAMERAS



# SEE THE UNSEEN

## COMPRESSIVE SENSING BASED CAMERAS

Compressive sensing is an exciting and novel area of research and development that combines concepts from diverse fields, such as mathematics, signal processing, electronics, or optimization.

A camera with a single pixel is perhaps the most representative example of the breakthroughs provided by such technology. For certain scenarios, these cameras may constitute the most attractive solution or even the only available solution.

INESC TEC has recently developed a prototype of a hyperspectral single-pixel camera with a 10 pm spectral resolution, which represents an improvement of two orders of magnitude relatively to the best systems available on the market.

### APPLICATIONS

- **Security and defence:** detection of chemical species related with chemical and biological attacks, ability to see through foliage, night vision (InfraRed), Ultra-Violet imaging, Millimeter-Wave imaging, TeraHertz imaging.
- **Quality control:** spectroscopic imaging (detecting contaminations, lesions, defects in agro-food industries), determining the ripeness state and quality of fruits and vegetables.
- **LIDAR imaging:** aerial 3D imaging, unmanned navigation of vehicles.
- **Data encryption/security:** as the measurements depend on a random process, data will resemble noise for a receiver that does not know the originating seed.
- **Pharmaceutics:** detecting and quantifying compounds to uncover counterfeit medication, for example.
- **Remote sensing**
  - **Macro level:** classification of territorial areas (e.g. water, forest, sand);
  - **Local level:** mineralogical classification of the terrain (quarry, mining and oil industries).

### PARTNERS

**ESA** EUROPEAN SPACE AGENCY

**UM** UNIVERSITY OF MINHO (PT)

**UNCC** UNIVERSITY OF NORTH CAROLINA AT CHARLOTTE (USA)

By now, we believe you are comfortable to say that INESC TEC can be your perfect partner when it comes to developing high-tech imaging systems.



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# AQUAMONITOR

SENSORS FOR WATER QUALITY  
MONITORING IN INTENSIVE  
AQUACULTURE



**INESCTEC**  
TECHNOLOGY & SCIENCE

CO<sub>2</sub>  
O<sub>2</sub>  
pH

# AQUAMONITOR

## SENSORS FOR WATER QUALITY MONITORING IN INTENSIVE AQUACULTURE

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INESC TEC is leading a consortium – which includes CIMAR – Centro Interdisciplinar de Investigação Marinha e Ambiental –, the CIQ FCUP – Centro de Investigação em Química at the University of Porto, and the University of Pécs in Hungary – created to develop new sensors for real time water quality monitoring in hyper intensive aquaculture systems. In systems of stackable shallow raceway tanks with water recirculation there are more fish present in less water. Therefore, it is necessary to accurately and constantly monitor parameters, including dissolved CO<sub>2</sub> and O<sub>2</sub>, pH, nitrates and phosphates.

Currently used tools do not respond to the industry's needs. However, these types of tools are critical to reducing the investment risk and to increasing fish production and welfare. In order to make these tools capable of responding to these needs, they should be equipped with more effective optical sensors. New optical sensors are being developed by the consortium for this purpose.

In this project, optical fibre interferometric platforms are being combined with sensitive polymeric membranes to enable the detection of different analyte concentrations with the same instruments. The target analyte in the project is dissolved CO<sub>2</sub> but the technology will evolve towards the detection of multiple parameters to determine water quality.

Developed in 2 years (2011-2012)

### MAIN FEATURES

- Electromagnetic immunity
- Based on standard telecom optoelectronics
- Miniaturisation and versatility
- Multipoint multiparameter detection
- High sensitivity
- Real time remote operation
- Adaptable for different applications

FCT-PTDC/AAC-AMB/112424/2009; FCOMP-01-0124-FEDER-013911

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