



Vision Paper Photonic Sensors: key components for safety, security, computer vision and embedded systems

Photonics sensors are key elements in a wide range of applications: Multimedia, healthcare, defence, security, safety, scientific instruments, space and many others. They are now everywhere in our current life, professional life, infrastructures and often enable industrial independence as well as sovereignty (defence, security, space) in addition to competitiveness.

Our vision considers the evolution of photonic sensors in seven major application areas:

- Imaging
- Structural health monitoring
- Oil and gas exploration
- Defense and security
- Sensors for manufacturing control
- Sensors for transportation
- Pollution detection

Our vision: Photonic sensors will evolve from stand-alone components to integrated, intelligent systems that are embedded in the machinery or the process that they monitor and control.

Image sensors with single-photon sensitivity can be developed from Si and also from association of Si with several materials such as HgCdTe, InGaAs, or Ge, enabling this ultimate performance over the entire spectral range from UV to mid-IR.

Intensity imaging will evolve to hyperspectral imaging enabling chemical and molecular identification of pollutants, explosives, diseased tissues, as well as for control of product formulation in manufacturing, quality control of pharmaceuticals.

Sensors+ICT+Lasers will enable Photonics-Powered-Production, a key manufacturing tool for factories of the future.

Remote sensing that combines sensing components, intelligence and communications will implement home health care diagnosis and treatment, improving quality of life, health care delivery and reduced health-care costs.

Coordination between civilian and military R+D+I of photonic sensors will lead to optimised industrial growth for consumer applications, optimum security for European citizens and European sovereign control of and access to state of the art technologies.

Photonic Sensors: a ubiquitous technology

According to the Photonics-21 Strategic Research Agenda, the civilian market for photonic sensors was 22 billion euros in 2008. The defence market is similar in size. European production volume for photonic sensors is about 25 billion euros annually.

In the past photonic sensors were developed primarily for high performance applications tailored to specific market niches, such as night-vision. Today, photonic sensors are ubiquitous: From patient blood-oxygen monitors to flushing toilets, motion detectors and cameras in every mobile telephone.

It is clear that photonic sensors will be integrated in nearly every kind of apparatus, implementing remote sensing and control, safety, and security.

Dual-Use means Dual Coordination

The defence and civilian security markets are similar in size and account together for the major part of the photonics sensor applications market. The defence sector is the leader in development of high-performance sensors and systems. Military innovations are increasingly being industrialised for the consumer applications. CBRNE (Chemical, Biological, Radiological, Nuclear, Explosive) sensor development is transferring military technology to civilian security applications. In return, defence benefits from the technology progress in silicon-based components supported by the consumer market. This virtuous circle is a key element in the sustained growth of photonic sensors.

At present, European Commission support for R&D is limited to unclassified, civilian applications. As such, EC R&D programmes are restricted to only one-half the market, and focus on developments with lower levels of innovation. EPIC advocates a much greater coordination between the Commission and agencies throughout Europe that develop technologies for military applications in order to establish R&D priorities that favour a well thought-out flow of technology and capabilities from military to civilian applications.

Technology Sovereignty

We live and work in a global market. Commercial technologies cross national borders on a click of the mouse. Sensor technologies for defence and security should be considered in a different light. Europe must maintain leadership in the development and manufacture of critical components for defense and security. The alternative is dependence on a foreign state for access to such components, which could result in unacceptable loss of sovereignty. For example, the United States, although a long-standing ally of the EU, imposes unilateral restrictions, such as technology export licenses on critical defence and security components. Photonic sensors are often on the list. We should not harbour illusions about the openness of less friendly states to share their critical technologies with EU companies for defence and security systems.

The EU R&D Context

We recommend the formation of a committee to develop relevant R&D programmes, with input from both civilian and defense industries and agencies concerned with sensor development across the EU. This would include the ESA, European Defence Agency as well as member state agencies.

While the Commission may choose to continue funding developments for civilian applications, it should build its programmes in the context of the entire field of sensor innovation and deployment.

Large-Scale Action for Security Surveillance

This large-scale action can drive sensor development in the direction of our vision. We support the specific proposal in the Photonics-21 SRA for a wireless security surveillance network, which will result in a dramatic improvement in the competitiveness and deployment capability resulting in a stronger Europe, regarding both economy and security. The main challenge in building an integrated, wireless sensor network lies in the energy management at each node. Energy consumption at the sensor node comes from three sources:

- The sensors themselves
- Communication between nodes
- Computing that converts raw data into useful information

all of which are areas for R+D+I in the Cooperative Framework programme under development.

Partnership and instruments:

Although it is important to maintain instruments that have proven their merit, the challenge facing sensor innovation and exploitation in Europe requires new funding instruments to coordinate science and technology developments in both the civilian and military sectors.

These instruments should:

- Support photonic sensor development in the context of the industry value chain with emphasis on the key elements of this vision: integration in systems, remote sensing, single photon sensitivity
- Enhance sovereign European capability in sensor technologies

These instruments should seek transformational results. This is more than disruptive R&D.

As always, you are invited to exchange ideas with EPIC and to use this communication to leverage your programmes and initiatives.

About this Vision Paper:

This document has been prepared by EPIC and has been approved by its Governing Board.

About EPIC:

EPIC, with 80 corporate members, is Europe's leading photonics industry association. EPIC participates in photonics initiatives on an international level, seeking to improve business and revenues for its member companies and their employees.