Photonics21 Press Release

New EU Project to Develop Advanced Navigation for Space Satellites, boosting Industries and EU Sovereignty

- **European scientists developing ways to make space missions more efficient and cost-effective.**
- **Two new sensors will help satellites fly more precisely and for longer, seeing through areas with zero visibility.**
- **The project aims to make Europe a self-sufficient ecosystem for Photonic Integrated Circuits (PICs).**

A consortium funded by Horizon Europe is developing laser sensors that help satellites navigate with ultra precision and enable drones to fly further for longer – unlocking new possibilities in space navigation, autonomous systems, and earth monitoring while boosting Europe's technological sovereignty.

An ambitious new project, launched by the European Commission under the Photonics Partnership and supported by Photonics21, is poised to transform space exploration and autonomous systems with new sensors that use tiny pulses of laser light to improve satellite navigation and earth observation.

The sensors we use in space navigation and autonomous systems today can struggle with precision in harsh environments with low visibility, like fog or dust. The smallest measurement error can lead to major problems in trajectory and positioning over long distances in space, costing millions of Euros in mistakes over time.

At the same time, existing sensors can consume large amounts of power, which is extremely limited in space and autonomous systems. High power consumption can quickly drain batteries and limit the operational time of space satellites and drones.

But, the 'INPHOMIR' project aims to change this with the development of two new ultra-low-power compact sensing devices – an optical gyroscope and a mid-infrared FMCW lidar – that will aim to make space missions more efficient and cost-effective.

Daniele Palaferri, senior scientist at GEM Elettronica and project coordinator of INPHOMIR, said: "As we aim to explore space much deeper while conducting more complex missions, the need for precise, reliable, and efficient sensors is now more critical than ever. The advanced sensing technologies we are developing will hopefully enhance the accuracy of satellite positioning, improve navigation for interplanetary missions, and ensure the success of space exploration."

Laser Navigation

The team is developing an advanced optical gyroscope – a super-smart balancing tool for machines and vehicles like satellites and drones that helps them navigate with ultra precision and stay on course.

Instead of mechanical parts, it uses laser light to measure how fast and in which direction something is spinning.

Inside the gyroscope, beams of light are sent spinning around in circles. When the device moves or turns, the path of this spinning light changes slightly. Sensors then detect these changes and calculate the exact movement and direction.

The team is also developing a brand new mid-infrared FMCW lidar – a technology similar to radar, only with laser light instead of sound to create detailed 3D maps of the environment.

"Think of a bat's echolocation system, but for machines like drones and self-driving cars. Our frequency-modulated continuous wave (FMCW) is a fancy way of saying that the lidar sends out a continuous laser beam that changes its frequency over time. By doing this, it can measure distances very accurately, even if objects are moving."

The team is developing its sensors with mid-infrared light because it can see through things that usually block normal light, such as dust, fog, and other obstacles.

"For drones and self-driving cars, this lidar helps them "see" their surroundings in incredible detail, even in bad weather or at night, allowing safer and more reliable operation. In space missions, this technology can help satellites and rovers navigate and map out unknown terrains with precision", Palaferri said.

How INPHOMIR is different – PICs, AI, Data Fusion

The INPHOMIR project is building its sensors onto Indium Phosphide (InP), a special material that allows scientists to squeeze large computing power into something the size of a thumbnail – creating super-efficient, tiny sensors. The team uses InP to make advanced photonic integrated circuits or 'PICs' that surpass current technologies.

PICs are similar to microchips in a phone or computer, but instead of using electricity to move information around, PICs use light. In a regular chip, electric signals travel through wires to process information. In a PIC, however, light beams travel through tiny channels, doing the same job but often much faster and using much less energy.

"Unlike existing optical gyroscopes and mid-IR lidar systems, INPHOMIR integrates all photonic components onto a single chip, reducing size, weight, and power consumption. This means all parts of a sensor can be combined on a single chip, and the overall device can be much smaller. By addressing big-data challenges through the development of data-fusion and AI algorithms, we aim to create solutions capable of handling massive flows of data", said Palaferri.

AI-Driven Drones

The INPHOMIR sensing technologies are also being developed to improve upon existing drones – including the Horus, Helyx-Zero, and Helyx-One varieties – helping them navigate on their own. Horus can carry heavy equipment and is perfect for creating detailed 3D maps and doing tricky jobs all by itself. Helyx-Zero is small and lightweight, which is ideal for farming and examining areas like fields.

These drones will make tasks like surveying land, inspecting buildings, and farming much easier and more accurate. Using the advanced AI technology being developed by the INPHOMIR team, these drones will work on their own, saving time and reducing human effort.

Boosting European Industries

Developing PICs is complicated and expensive, requiring billions of euros, advanced technology, and a highly skilled workforce. At present, most PICs are made in parts of Asia, where considerable investment has been made to develop this industry over decades.

However, by providing miniaturised and advanced photonic technologies, the INPHOMIR project is set to boost European industries and help create an EU PIC ecosystem.

"Our pioneering advancements in PIC-based hardware technology promise to revolutionise the supply chain management (SCM) processes of EU companies. With our own supply of PICs, Europe can innovate faster and create new technologies, keeping us at the forefront of technological advancements. We are helping to enhance the EU's sovereignty by developing a self-sufficient ecosystem for photonic technologies. The project's success will mark a significant milestone in photonic sensing technology, offering a competitive edge to European industries, reinforcing the EU's commitment to technological excellence", said Palaferri.

The INPHOMIR project is a collaborative endeavour funded under the HORIZON-RIA (HORIZON Research and Innovation Actions) and supported by the Horizon Europe program, the EU's key funding program for research and innovation. The project brings together a consortium of academic institutions and industrial partners. The multidisciplinary project is coordinated in Italy by GEM ELETTRONICA SRL and will conclude in 2027. It includes eight other partners: Politecnico Di Bari, Sigma Ingegneria Srl, Warrant Hub Spa (Italy), Technische Universiteit Eindhoven (Netherlands), Technische Universitaet Muenchen(Germany), University College Cork - National University Of Ireland, Cork (Ireland), Endurosat Ad (Bulgaria), and Bewarrant (Belgium).