‘Nature Photonics’ publishes an article by UPV researchers on the latest landmark achievements in light slowing techniques applied to microwave photonics

• The application of light slowing techniques to microwave photonics opens the door to the integration of multiple functionalities into optical chips.

• The article summarizes the work done by researchers at the UPV and other research centres within the European project GOSPEL, which aims at “governing the speed of light”, using "innovative and pioneering" technologies.

• Professor José Capmany, the head of the UPV’s ITEAM, explains that controlling the speed of light would allow us, for example, to improve the processing of high resolution images for biomedical applications and the space sector.

In its latest issue, *Nature Photonics*, a journal published by the Nature group, includes an article by researchers from the Universitat Politècnica de València on the most significant advances worldwide in the field of light-slowing techniques applied to microwave photonics, which open the door to integrating multiple functionalities into optical chips in the short and medium term, and also to marketing these functionalities.

The article, written by José Capmany, Salvador Sales and Gasulla Ivana, from the optical and quantum communications group of the UPV’s ITEAM institute, is included in the section "Technology Focus". It summarizes the work done in recent years by researchers from the UPV and other research centres within the European project GOSPEL, which aims at “governing the speed of light”, using "innovative and pioneering" technologies.

Professor José Capmany, the head of the UPV’s ITEAM, explains that the possibilities that will arise in the telecommunications field if we can control the speed of light are really broad: "we will be able to make very versatile processors with a high bandwidth, to efficiently interconnect systems using optical fibres as a transmission medium, and, generally speaking, to improve performance in other fields of application, such as sensor development, the processing of high-resolution images for biomedical and space sector applications, and the manufacturing of high-precision parts."

Within the GOSPEL project, researchers from the UPV’s ITEAM are working towards an efficient phase shifter that can be transferred to the industry, based on light slowing in semiconductors and optical fibres. About a year and a half ago, Professor José Capmany’s team, in collaboration with the Technical University of Denmark, achieved a world record in the telecommunications field by developing the first complete phase shifter with record bandwidth (50 GHz). It was a pioneering device for slowing down the pace and speed of light, thus improving the information transmission flow, avoiding congestion and ensuring optimum performance of the

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entire communication system.

In August this year, UPV researchers presented the first broadband radio frequency (RF) photonic phase shifter which is tunable and based on a single semiconductor element. Its advantages are that producing it will be cheaper and that it will provide a saving in energy consumption of up to 80%.

Future applications: biomedical imaging and quantum communications

According to the ITEAM researchers, although initially the microwave photonics field focused on applications closely related to telecommunications for defence, in recent years it is becoming increasingly oriented towards the civilian sector. In particular, an area of activity which arouses much interest is that of high bandwidth (1-2 Gbit/s) wireless access networks, in which optical fibre is combined with pico- and femtocells providing coverage. "These cells use antennas with a very low power consumption, which favours the deployment of telecommunication networks that are *greener* than current macrocell-based networks. High-speed information transmission through pico- and femtocells requires using a millimetre frequency band (60-100 GHz). And it indispensably requires using optical fibres, as a transmission medium to the antenna with a very low loss", says José Capmany.

Among the emerging applications in which microwave photonics is to play an important role are biomedical imaging systems using optically generated waves in the terahertz band. "These waves can be used to examine samples and tissues without causing the damage that, for instance, X-rays cause; besides, they are able to find out more sophisticated information about processes involving molecules, radicals and ions", José Capmany points out.

Another field of application is the so-called "Internet of things", in which a global network connects physical objects with virtual objects through the combination of data capture techniques and communication networks. An instance of this may be radio frequency identification (RFID) sensor networks.

Looking farther into the future, Capmany highlights the applications of microwave photonics in communications and quantum logic, "a field in which very promising advances are being made."

Reference:

José Capmany, Salvador Sales and Gasulla Ivana, "Microwave Photonics: Harnessing Slow Light", *Nature Photonics*, 5, 731-733, (2011)

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