PHOTONICS RESEARCH LABS

HEAD OF THE GROUP RESEARCH REPORT

The Photonics Research Labs (PRL) brings together research lines or Labs focused on different technologies and fields of application within the area of photonics and optical communications. Currently formed by more than 40 researchers, PRL mission is to produce high-quality scientific knowledge in the field of optics, quantum optics and photonics, through research projects, R&D contracts and collaboration agreements with the private sector. Our research activity is focused on several applications of photonics, mainly on optical communications of analog and digital signals, radio-over-fiber systems, space-division multiplexing fibers, photonic integrated circuits, fiber optic sensing and industrial scenarios.

PRL is nowadays involved in different H2020 EU funded projects: "NEuromorphic Reconfigurable Integrated Photonic Circuits as artificial image processor" (NEoteRIC), "Building on the Use of Spatial Multiplexing 5G Networks Infrastructures and Showcasing Advanced technologies and Networking Capabilities" (BlueSpace), "European Network for High Performance Integrated Microwave Photonics" (EUIMWP), "Fibre Nervous Sensing Systems" (FINESSE), "European Network on Future Generation Optical Wireless Communication Technologies" (NEWFOCUS). Of particular interest regarding excellence are the three projects granted by the European Research Council (ERC): Consolidator Grant "Revolutionizing fibre-wireless communications through space-division multiplexed photonics" (InnoSpace), Advanced Grant "Universal microwave photonics programmable processor for seamlessly interfacing wireless and optical ICT systems" (UMWP-Chip), and Proof-of-Concept Grant "Field Programmable Photonic Arrays" (FPPAs).

A complete list of research activities can be found at http://www.iteam.upv.es/group/photonics research-labs-prl and http://www.prl.upv.es

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1.- PROJECT ACTIVITIES

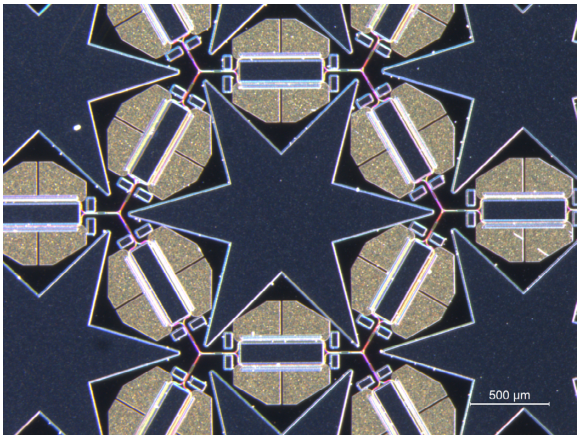
1.1.- ONGOING PROJECTS

Name of the project: *Universal microwave photonics programmable processor for seamlessly interfacing wireless and optical ICT systems (UMWP-Chip)*

Webpage of the project: *https://cordis.europa.eu/project/id/741415*

Funding entity and duration: *European Research Council (ERC), 60 months*

Summary of the project: *Information and communication technology (ICT) systems are expanding at an awesome pace in terms of capacity demand, number of connected end-users and required infrastructure. To cope with these rapidly increasing growth rates there is a need for a flexible, scalable and future-proof solution for seamlessly interfacing the wireless and photonic segments of communication networks. RF or Microwave photonics (MWP), is the best positioned technology to provide the required flexible, adaptive and future-proof physical layer with unrivalled characteristics. Its widespread use is however limited by the high-cost, non-compact and heavy nature of its systems. Integrated Microwave Photonics (IMWP) targets the incorporation of MWP functionalities in photonic chips to obtain cost-effective and reduced space, weight and power consumption systems. IMWP has demonstrated some functionalities through application specific photonic circuits (ASPICs), yielding almost as many technologies as applications and preventing cost-effective industrial manufacturing processes. A radically different approach is based on a universal or general-purpose programmable photonic integrated circuit (PIC) capable of performing with the*



Reconfigurable photonic integrated processor

same hardware architecture the main required functionalities. The aim of this project is the design, implementation and validation of such a processor based on the novel concept of photonic waveguide mesh optical core and its integration in a Silicon Photonics chip.

Name of the project:
Field Programmable Photonic Arrays (FPPAs)

***Webpage of the project**:*
https://cordis.europa.eu/project/id/859927

Funding entity and duration:
European Research Council (ERC), 18 months

Summary of the project: *The main idea behind this ERC Proof of Concept project spins-off from the activity of the Advanced Grant ERC-ADG-2016-741415 UMWPCHIP. The aim of that project is to develop a generic universal signal processor for microwave photonics applications. The central part of such processor is a reconfigurable waveguide mesh circuit.*

The waveguide mesh circuit can enable a much more powerful concept with a considerable wider scope of applications. This new paradigm, which we call programmable photonics is radically different from the so-far dominant Application Specific Photonic Circuit paradigm. Furthermore, we expect that, as it happened in electronics, programmable circuits will play a key role in photonics.

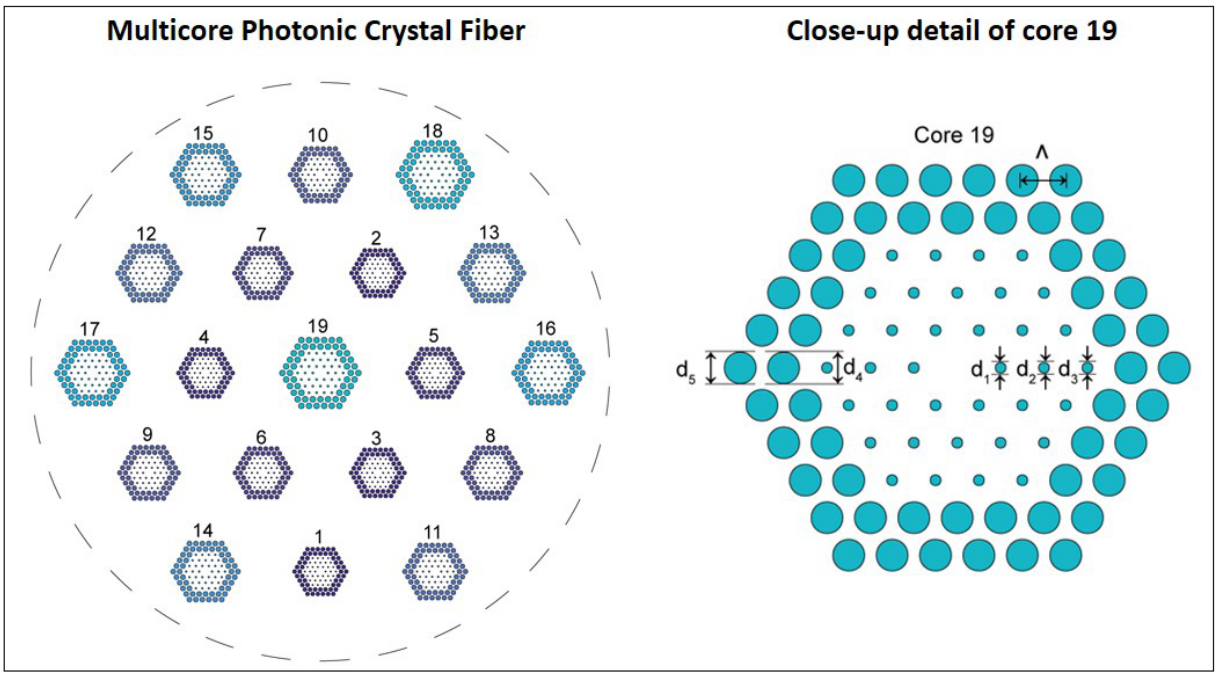
In programmable electronics, the key device is the field Programmable Gate Array (FPGA). For photonics we have proposed a novel device, the Field Programmable Photonic Array (FPPA). The FPPA has a similar rationale as the FPGA in electronics: A common hardware is designed to provide several resources that can be employed to implement different functionalities by means of programming. However, the FPPA is different from the FPGA in the sense that it does not carry digital logic operations but rather exploits optical interference to perform very high-speed analog operations acting over the phase and amplitudes of optical signals in a controlled environment provided by the chip's reduced footprint. Now that we have demonstrated the potential of developing FPPA, the challenge is to demonstrate its innovation potential, developing the first steps towards its technical and commercial viability and launching a spin-off company based on this concept.

Name of the project: *Revolutionizing fibre-wireless communications through space-division multiplexed photonics (InnoSpace)*

Webpage of the project:
https://cordis.europa.eu/project/id/724663

Funding entity and duration:
European Research Council (ERC), 66 months

Summary of the project: *InnoSpace aims to revolutionize next generation fiber-wireless communication paradigms, such as 5G systems and Internet of Things, by pioneering the use of the photonic Space dimension. The present fiber-wireless landscape is characterized by radio-over-fiber distribution architectures that are static and inefficient, (with a replication of*



Schematic cross-section view of the 19-core multicore photonic crystal fiber developed in the European project InnoSpace.

bundles of optical fibers) as well as by radiofrequency signal processing systems, such as antenna beam-steering or signal generation, which are nowadays bulky, heavy and power consuming. To overcome these limitations, we propose the application of Space-Division multiplexing to fiber-wireless scenarios where we provide "simultaneously" in a single optical fiber, a compact approach for both distribution and processing functionalities. This leads to the novel concept of "fiber distributed signal processing".

Name of the project: *NEuromorphic Reconfigurable Integrated Photonic Circuits as artificial image processor (NEoteRIC)*

Webpage of the project: *https://neoterich2020.eu/*

Funding entity and duration: *European Union's Horizon 2020, 36 months*

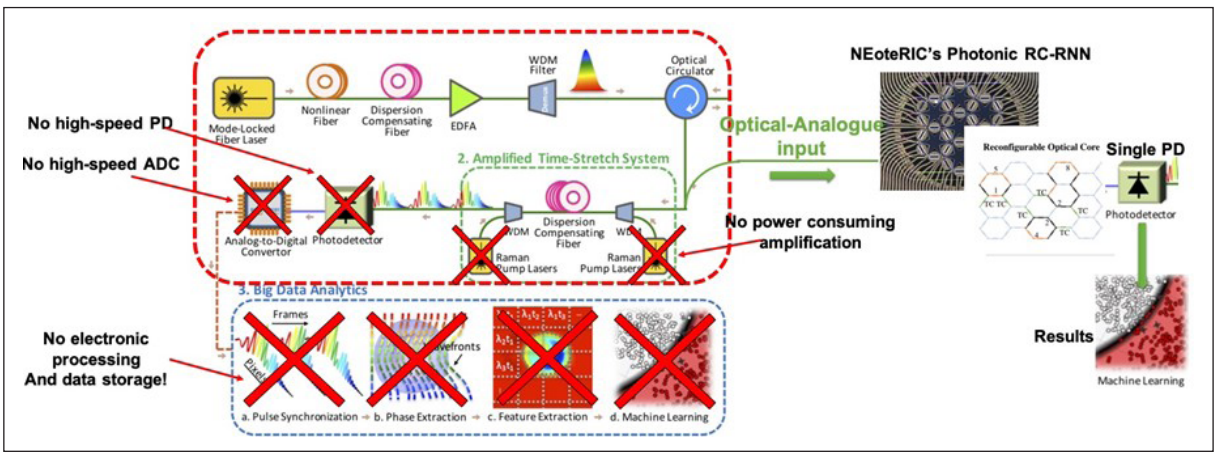
Summary of the project: *NEoteRIC's primary objective is the generation of holistic photonic machine learning paradigms that will address demanding imaging applications in an unconventional approach providing paramount frame rate increase, classification performance enhancement and orders of magnitude lower power consumption compared to the state-of-the-art machine learning approaches. NEoteRIC's implementation stratagem incorporates multiple innovations spanning from the photonic "transistor" level and extending up to the system architectural level, thus paving new, unconventional routes to neuromorphic performance enhancement. The technological cornerstone of NEoteRIC relies on the development and upscaling of a highspeed reconfigurable photonic FPGA-like circuit that will incorporate highly dense and fully reconfigurable key silicon photonic components (ring resonators, MZIs, etc.). High-speed reconfigurability will unlock the ability to restructure the photonic components and rewire inter-component connections. Through NEoteRIC the integrated photonic FPGAs will be strengthened by the incorporation of novel marginal-power consuming non-volatile high-speed phase shifters that will push the boundaries of energy consumption. NEoteRIC's "unconventional" chips will be utilized as a proliferating neuromorphic computational platform that will merge the merits of photonic and electronic technology and will allow the all-optical implementation of powerful non-von Neumann architectures such as Reservoir Computing, Recurrent Neural Networks, Deep Neural Networks and Convolutional Neural Networks simultaneously by the same photonic chip. The in-project excellence will be tested through demanding high impact application such as high frame-rate image analysis and in particular single-pixel time-stretch modalities thus pushing the boundaries of state-of-the-art; exhibiting simultaneous high spatial resolution and Gframe/sec processing rate.*

Name of the project: *Building on the Use of Spatial Multiplexing 5G Networks Infrastructures and Showcasing Advanced technologies and Networking Capabilities (BlueSpace)*

Webpage of the project: *https://5g-ppp.eu/bluespace/*

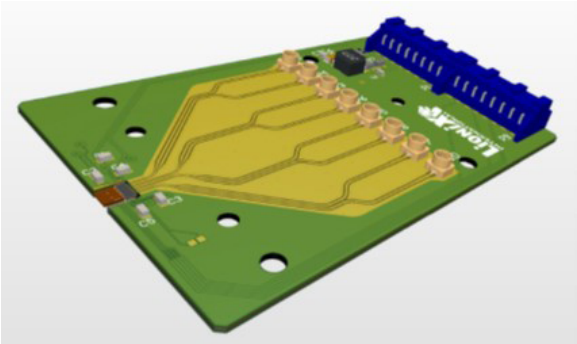
Funding entity and duration: *European Union's Horizon 2020, 42 months*

Summary of the project: *The core concept of BlueSpace is to exploit the added value of Spatial Division Multiplexing (SDM) in the Radio Access Network (RAN) with efficient optical beamforming interface for the pragmatic Ka band wireless transmission band. Both being seamlessly integrable in next generation optical access networks infrastructures with massive beam steering capabilities and with flexible network management control. The main objectives targeted by the BlueSpace project are: to develop a truly viable and efficient path for 5G wireless communications with a 1000-fold*



Conceptual depiction of STEM cytometry alongside NEoteRIC induced changes

increase in capacity, connectivity for over 1 billion users, strict latency control, and network software programming. BlueSpace targets a disruptive yet pragmatic approach for the deployment of scalable, reconfigurable and future-proof fronthaul solutions for 5G communications, offering unrivalled characteristics that include: a) increased bandwidth provision by naturally enabling and supporting massive multiple Input Multiple Output (MIMO) transmission starting/ending in the fiber medium by enabling space diversity in the RF domain by supporting RF beam steering in the photonic domain, b) compact infrastructure that is reconfigurable by means of Software Defined (SDN) and Network Function Virtualization (NFV) paradigms and c) the possibility of providing full integration with other existing approaches for the implementation of access networks, such as Passive Optical Networks (PONs). This approach relies on the core concept of this project, which is the introduction of Spatial Division Multiplexing (SDM) in the fronthaul of the mobile access network.



Optical beamformer developed by BlueSpace H2020 project

Name of the project: *European Network for High Performance Integrated Microwave Photonics (EUIMWP)*

Webpage of the project: *https://euimwp.eu/*

Funding entity and duration: *European Union's Horizon 2020, 41 months*

Summary of the project: *This Action aims to shape and bring the relevant integrated Microwave Photonics community, supporting coordination and networking actions to consolidate this new ecosystem. EUIMWP is providing exchange of knowledge, ideas and, equally important, delivering a portfolio of technological benchmarkings to establish performance indicators and define future technological requirements in high-performance scenarios, mainly radar, 5G, Internet of Things, automotive and aerospace technologies. Over 40 partners from academia, industry and public organizations are founding members of the Action.*

Name of the project: *European Network on Future Generation Optical Wireless Communication Technologies (NEWFOCUS)*

Webpage of the project:

https://www.cost.eu/actions/CA19111

Funding entity and duration: *European Union's Horizon 2020, 41 months*

Summary of the project: *The design of future wireless communication networks that cope with the ever-growing mobile data traffic as well as support varied and sophisticated services and applications in vertical sectors with a low environmental impact is recognized as a major technical challenge that European engineers face today. The COST Action NEWFOCUS will propose truly radical solutions with the potential to impact the design of future wireless networks. Particularly, NEWFOCUS aims to establish optical wireless communications (OWC) as an efficient technology that can satisfy the demanding requirements of backhaul and access network levels in beyond 5G networks. This also includes the use of hybrid links that associate OWC with radiofrequency or wired/fiber-based technologies.*

Towards this vision, NEWFOCUS will carry out a comprehensive research programme under two major pillars. The first pillar is on the development of OWC-based solutions capable of delivering ubiquitous, ultra-high-speed, low-power consumption, highly secure, and low-cost wireless access in diverse application scenarios. The developed solutions will in particular support Internet-of-Things (IoT) for smart environments with applications in vertical sectors. The second pillar concerns the development of flexible and efficient backhaul/fronthaul OWC links with low latency and compatible with access traffic growth.

In addition to scientific and technological advances, NEWFOCUS will serve as a global networking platform through capacity building of all relevant stakeholders including universities, research institutions, major industry players, small medium enterprises, governmental bodies and non-governmental organisations. Within this rich consortium, NEWFOCUS will train experts to accompany related European industries for the standardisation and commercialisation of the OWC technology.

Name of the project: *Fibre Nervous Sensing Systems (FINESSE)*

Webpage of the project: *http://itn-finesse.eu/*

Funding entity and duration: *European Union's Horizon 2020, 48 months*

Summary of the project: *FINESSE (FIbre NErvous Sensing SystEms) is a collaborative research and training network, gathering together 26 European universities, research centers and indus-*

trial partners with complementary expertise with the ultimate vision of a widespread implementation of distributed optical fibre sensor systems for a safer society.

The objective behind FINESSE (FIbre Nervous Sensing SystEms) is to mimic the nervous system of living bodies by turning man-made and natural structures into objects that are sensitive to external stimuli owing to advanced distributed fibre-optic sensor technology, with the objective to either give early warning in case of possible danger or occurrence of damage, or to optimise the operation of the structure to allow for a sustainable use of natural resources and assets. Enabling such functionalities will greatly contribute to realizing a safe, secure and energy efficient Europe, which is an identified societal concern.

Name of the project: *Devices in Multicore/modE Novel Selected fIbres for Optical Networks and sensor applications (DIMENSION)*

Webpage of the project:

Funding entity and duration: *Ministerio de Ciencia e Innovación and the European Regional Development Fund (ERDF), 36 months*

Summary of the project: *The DIMENSION Project aims to develop novel devices and techniques based on multicore/multimode fibres and in-fibre gratings that can lead to systems with unprecedented performance, in order to meet the requirements of the ever increasing need of bandwidth and cost per bit reduction in optical networks and also for sensor applications. In doing so it addresses several challenges. In particular, it mainly targets the challenge Digital economy and society. Optical networks based on SDM techniques and advanced remote sensor systems are instrumental to sustain the concept of internet of things, which lies at the heart of future internet. Specifically, radio-over-fiber transmission and SDM fibres are a key enabler of 5G mobile systems and networks but also of the concept of smart cities where citizens are permanently connected to services via wireless devices. In this last context, the advanced metrology techniques combining fiber optics and wireless systems are also fundamental as they can provide a low-cost solution to continuous monitoring of civil structures and environmental monitoring. The main technical objectives are: to develop concepts and benefits of space multiplexing for processing of analog and digital photonic signals and to support networking and new technologies for 5G front-hauling; to show that SDM technology can bring benefits to traditional applications that can take advantage for the inherent parallelism SDM devices/fibres like in selected microwave applications including filtering, optical beamforming, generation of train of pulses and arbitrary waveform generation to design and fabricate novel sensors using SDM technologies and to widen the range of application of optical fibre sensors; to implement novel fibre based spectroscopic measurement techniques for the characterization of sources that emit very weak signals.*

Name of the project: *Broadband HYbrid Silicon Nitride Photonic Integrated CircuitS (BHYSINPICS)*

Webpage of the project:

Funding entity and duration: *Ministerio de Ciencia e Innovación, 36 months*

Summary of the project: *Integrated photonics has experienced exponential growth in the last 10 years, thanks to the research, development and commercial exploitation of generic technologies, which allow complex photonic systems into a single micro-chip. These technologies cover different parts of the spectrum, depending on the properties of the materials used in manufacturing, for different applications, in the visible (VIS), near (NIR) and mid infrared (MIR) wavelength ranges. However, there is no broadband technology platform, that allows light guiding over VIS, NIR and MIR. Even if it existed, the problem of hybridization with other active technologies, to enable the incorporation of sources and light detectors, would not be solved either. Together with the two previous aspects, the increasing complexity of photonic integrated circuits (PICs) requires advanced characterization methods, beyond those traditionally used. This project aims at researching and developing technologies, manufacturing and design processes, alongside the associated characterization methods, to address these three challenges: i) a passive photonic integration platform covering VIS, NIR and MIR, ii) advanced characterization methods and iii) micro-fabrication processes for hybridization with active technologies.*

Name of the project: *Energy eFficient hybrid Optical networks for indoor Communications And Lighting (FOCAL)*

Webpage of the project:

Funding entity and duration: *Ministerio de Ciencia e Innovación, 36 months*

Summary of the project: *The Project consists on the definition of the architecture of an indoor hybrid wired and wireless optical network based on VLC communications (Fi2VLC) to provide coverage and 5G services in residences and offices. Full characterization of hybrid POF and VLC links with improved capacity and flexibility, also including different multiplexing techniques will be addressed. Electro-optical transceivers based on low cost commercially available LEDs will be designed to transmit digital modulation*

formats such as OFDM, QPSK, CAP, 16QAM, etc. and adaptive modulations to adjust the transmission capacity to the actual demand in a multiuser scenario. The Project also includes the experimental characterization of the networks (QoS, BER, SNR) using the developed technologies (multiplexing, adaptive modulations and multiuser access) for service transmission and the implementation of software-defined Fi2VLC networks for energy efficient operation. Finally, the techno-economical evaluation of the implemented solutions will assess their viability in short term 5G networks.

Name of the project: *UPVFAB Technopole*

Webpage of the project: *https://www.fab.upv.es/*

Funding entity and duration: *Generalitat Valenciana and the European Regional Development Fund (ERDF), 24 months*

Summary of the project: *It's an infrastructure acquisition project to upgrade and retrofit. The new action continues the previous infrastructure project ("Micro-manufacturing for photonics, electronics and chemistry" GVA/IDIFEDER/2018/042, 2018-2020). The infrastructure is at the class 100/10000 (ISO 5 / 7) 500 m^2 micro-fabrication pilot line / clean room* (www.fab.upv.es). *More specifically, it is intended to complement the installation with the following equipment:*
1) (Deposition) Sputter for cylindrical samples, 2) (Attack) Wet banks and attack tanks for samples and wafers up to 6 inches, 3) (Attack) Extraction and neutralization systems for wet banks and attack tanks, 4) (Metrology) FTIR equipment with microscope for sample analysis. 5) (Post-process) Microscopic transfer equipment by priming chips from 2-4 inches wafers to 6 inches wafers. The general objective is to develop new technological processes in the work areas of the proposing groups (ITEAM, ITQ, CI2B), specifically: I) integrated photonics, II) integrated catalytic membranes and III) electro-chemical devices.

UPVFAB Technopole facilities

mmWave Vector Network Analyser available at PRL laboratory thanks to the GVA and the ERDF funding

Name of the project: *Advanced Instrumentation for World Class Microwave Photonics Research (IDIFEDER/2018/031)*

Webpage of the project:
https://www.prl.upv.es/services/advancedinstrumentation/

Funding entity and duration: *Generalitat Valenciana and the European Regional Development Fund (ERDF), 36 months*

Summary of the project: *The Photonics Research Labs (PRL) has thoroughly enlarged and improved through this project the equipment and instrumentation available in its facilities due to the procurement of a last generation infrastructure for i) 5G systems analysis and characterization, ii) comprehensive vector analysis of the radiofrequency response of optical devices, techniques and means of transmission used in MWP and modulated up to millimeter bands, iii) the phase characterization of the frequency response of different optical components such as integrated chips and short distance optical fiber devices, iv) the recoating of the optical fiber devices built by the Photonics Research labs, mainly based on cavities made by Bragg devices inscribed into the core. As a result, the PRL has consolidated its world reference position in the field of Microwave Photonics, which will be still strengthened and complemented by the specific objectives pursued by the ERDF infrastructure project "Instrumentation for World Class Microwave And Programmable Photonics Research" (IDIFEDER/2020/032) during the next two years.*

2.- RESEARCH RESULTS

2.1.- FEATURED PUBLICATIONS

Title, Authors, Name of the publication, pages, year: *"High-Capacity 5G Fronthaul Networks Based on Optical Space Division Multiplexing", S. Rommel, D. Perez-Galacho, J. M. Fabrega, R. Muñoz, S. Sales and I. Tafur Monroy, IEEE Transactions on Broadcasting 65 (2), pp. 434-443, 2019*

Brief summary of the paper*: This paper discusses the introduction of SDM with multi-core fibers in the fronthaul network as suggested by the blueSpace project, regarding both digitized and analog radio-over-fiber fronthaul transport as well as the introduction of optical beamforming for high-capacity millimeter-wave radio access. Analog and digitized radio-over-fiber are discussed in a scenario featuring parallel fronthaul for different radio access technologies, showcasing their differences and potential when combined with SDM.*

Title, Authors, Name of the publication, pages, year: *"Multi-Core Optical Fibers with Bragg Gratings as Shape Sensor for Flexible Medical Instruments", F. Khan, A. Denasi, D. Barrera, J. Madrigal, S. Sales and S. Misra, IEEE Sensors Journal 19 (14), pp. 5878-5884, 2019.*

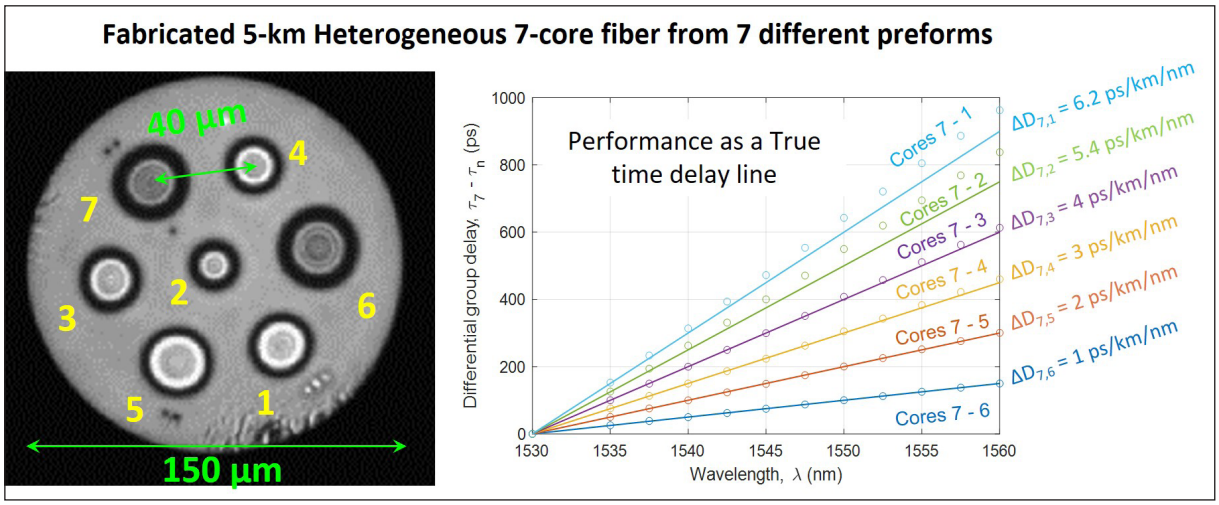
Brief summary of the paper: *This paper presents a technique to reconstruct the shape of a flexible instrument in three-dimensional Euclidean space based on data from fiber Bragg gratings (FBGs) that are inscribed in multi-core fibers. Its main contributions are the application of several multi-core fibers with FBGs as shape sensor for medical instruments and a thorough presentation of the reconstruction technique.*

Title, Authors, Name of the publication, pages, year: *"Open-Access Silicon Photonics Platforms in Europe", A. Rahim, P. Muñoz, D. Domenech et al., IEEE Journal of Selected Topics in Quantum Electronics 25 (5), pp. 1-18, 2019*

Brief summary of the paper: *Fabless enterprises rely on the open-access silicon photonics-based technologies for their product development. In the last decade, a diverse set of open-access technologies with medium and high technology readiness levels have emerged. This paper provides a review of the open-access silicon and silicon nitride photonic IC technologies offered by the pilot lines of European research institutes and companies. The paper also highlights upcoming features of these platforms and discusses how they address the long-term market needs.*

Title, Authors, Name of the publication, pages, year*: "Si3N4 photonic integration platform at 1 µm for optical interconnects", X. Hu, M. Girardi, Z. Ye, P. Muñoz, A. Larsson, and V. Torres-Company, Optics Express 28 (9), pp. 13019-13031, 2020.*

Brief summary of the paper: *In this work, we show the first passive Si3N4 platform in the 1-µm band (1030-1075 nm) with an equivalent loss < 0.3 dB/cm, which is compatible with the system requirements of high-capacity interconnects. The waveguide structure is optimized to achieve simultaneously single-mode operation and low bending radius, and we demonstrate a wide range of high-performance building blocks, including arrayed waveguide gratings, Mach-Zehnder interferometers, splitters and low-loss fiber interfaces.*



Viewgraph of the fabricated heterogeneous 7-core multicore fiber and corresponding performance as a True Time Delay Line, European Project InnoSpace.

Title, Authors, Name of the publication, pages, year: *"True-Time Delay Line based on dispersion-flattened 19-core Photonic Crystal Fiber", S. Shaheen, I. Gris Sánchez and I. Gasulla, IEEE Journal of Lightwave Technology, early access, 2020.*

Brief summary of the paper: *A novel design of a tunable True-Time delay line based on a multicore Photonic Crystal Fiber is proposed. It enables simultaneous transport and processing of microwave photonic signals over a broad radiofrequency processing range. Independent group delay behavior in 19 different cores characterized by a constant differential group delay between cores provides TTDL operation on 19 signal samples. The 19-core PCF structure allows tailoring the chromatic dispersion range between 1.5 and 31.2 ps/nm·km, which translates into a very broad microwave signal processing range from a few up to tens of GHz. This work advances the state-of-the-art of a TTDL based on SDM technology by increasing the number of samples and microwave processing range.*

Title, Authors, Name of the publication, pages, year: *"Demonstration of distributed radiofrequency signal processing on heterogeneous multicore fibres", S. García, M. Ureña and I. Gasulla, 45th European Conference on Optical Communication (ECOC 2019), Dublin, Ireland, 2019.*

Brief summary of the paper: *We experimentally demonstrate for the first-time to our knowledge distributed radiofrequency signal processing performed by a heterogeneous multicore fibre link. A trench-assisted 7-core fibre, where each core presents a different chromatic dispersion behaviour, is custom-engineered to operate as a 2D sampled true time delay line.*

Title, Authors, Name of the publication, pages, year: *"M-QAM transmission over hybrid microwave photonic links at the K-band", D. Nguyen, J. Bohata, J. Spacil, D. Dousek, M. Komanec, S. Zvanovec, Z. Ghassemlooy, B. Ortega, Optics Express 27 (23), pp. 33745-33756, 2019.*

Brief summary of the paper: *Two experimental configurations of a hybrid K-band (25 GHz) microwave photonic link (MPL) are investigated for seamless broadband wireless access networks. Experimental configurations consist of optical fiber, free-space optics (FSO) and radio frequency (RF) wireless channels.*

Title, Authors, Name of the publication, pages, year: *"Seamless 25 GHz transmission of LTE 4/16/64-QAM signals over hybrid SMF/FSO and wireless link", D.Nguyen, J. Bohata, M. Komanec, S. Zvanovec, B. Ortega, Z. Ghassemlooy, Journal of Lightwave Technology 37 (24), pp. 6040-6047, 2019.*

Brief summary of the paper: *The authors propose and experimentally demonstrate a photonics-assisted converged radio-over-fiber (RoF), radio-over-free-space optics (RoFSO) and millimeter-wave (MMW) wireless transmission system for use in broadband wireless access (BWA) networks.*

Title, Authors, Name of the publication, pages, year: *"Programmable Integrated Photonics", J. Capmany and D. Pérez, Oxford University Press, 2020.*

Brief summary of the paper: *This book provides the first comprehensive, up-to-date and self-contained introduction to the emergent field of Programmable Integrated Photonics (PIP). It covers both theoretical and practical aspects, ranging from basic technologies and the building of photonic component blocks, to design alternatives and principles of complex programmable photonic circuits, their limiting factors, techniques for characterization and performance monitoring/control, and their salient applications both in the classical as well as in the quantum information fields.*

Title, Authors, Name of the publication, pages, year: *"Programmable Photonic Circuits", W. Bogaerts, D. Pérez, J. Capmany et al., Nature, 586, pp. 207–216, 2020.*

Brief summary of the paper: *This paper covers possible applications of this emerging technology in linear matrix operations, quantum information processing and microwave photonics, and examine how these generic chips can accelerate the development of future photonic circuits by providing a higher-level platform for prototyping novel optical functionalities without the need for custom chip fabrication.*

2.2.- PATENTS

Capmany Francoy, José; Pérez-López, Daniel; Dasmahapatra, Prometheus. "Methods, Systems, And Apparatus for Multipurpose Multicore Programmable Photonic Processor", P202030736. 16 July 2020.

Capmany Francoy, José; Pérez-López, Daniel. "Dispositivo Fotónico Integrado de Matriz Cuántica de Puertas Fotónicas Programables en Campo, Dispositivo Quántico y Circuitos Programables", P201931123. 18 December 2019.

Capmany Francoy, José; Pérez-López, Daniel; Dasmahapatra, Prometheus. "Photonic Chip Equally-Oriented / Parallel Waveguide Mesh Arrangements and Programmable Circuits", P201930410. 09 May 2019.

iPronics team received by UPV rector José Mora

2.3.- AWARDS.

iPRONICS, iTEAM-PRL deep-Tech company, among the pioneering spin-offs worldwide in 2020

iPronics Programmable Photonics, *a spinoff from the Institute of Telecommunications and Multimedia Applications (iTEAM), has been selected as one of the spinoff companies to watch in the frame of the first edition of the Spinoff Prize, sponsored by Nature magazine and the German multinational Merck.*

The company intends to make the computational power of photonics commercially affordable. Its processors share a common hardware platform that is reconfigurable by software. This cost-effective solution enables the same hardware to be applied to limitless commercial applications.

iPronics' approach combines the best of both worlds and is called to radically change the way in which information, communication and processing systems have been conceived until now, because it seeks to cooperate with electronic systems and not compete with them. On top of this it adds a disruptive nature by breaking the barriers of access and use of complex photonic chips. In words of its co-founders, in a few years this product will be ready to be used by anyone, regardless of his/her technical background.

Nature and Merck have 44 selected spinoffs that translate original, high-quality scientific research into products and services that address market problems and are well positioned to make a positive impact on society. For iPronics, being on this list is a tremendous boost, even more so when the company has barely six months of existence, although the experience and professional career of the founding team comes from many years ago.

The company was founded as a spinoff of ITEAM Research Institute, Universitat Politècnica de València, in 2019 after multiple years of research. The founding team, José Capmany, Daniel Pérez López, Ivana Gasulla, Prometheus DasMahapatra, Eladio Crego, and Iñaki Berenguer, has pioneered the field of programmable photonics and developed the first general-purpose photonic processor capable of programming high-speed light signals on-chip with unprecedented flexibility.

The Spinoff Prize has been established by Nature Research in association with Merck, a leading German multinational in science and technology, to show and recognize global excellence in the commercialization of scientific research through the creation of spinoffs. Among the finalists, there are companies in sectors such as medicine, materials or digital technologies. (Source: iPronics)

Most distinguished Valencian woman researcher award ceremony.

Ivana Gasulla, researcher at the Photonics Research Labs, awarded as the best woman researcher in the Autonomous Community of Valencia.

Dr. **Ivana Gasulla**, researcher at the Institute of Telecommunications and Multimedia Applications (iTEAM) and a worldwide renowned scientist in the field of Microwave Photonics, was awarded the "Concepción Aleixandre" Prize as the most distinguished woman researcher in the Autonomous Community of Valencia. This acknowledgement was awarded during a ceremony in the city of Picanya last February.

The jury highlighted "her prolific career and the high impact of her research work in the design and development of new optical fibers that will increase transmission and processing capacity in fiber-wireless scenarios."

"I am really honored to receive this scientific award, specially at a time when less and less girls and young women take up a STEM (science, technology, engineering and mathematics) career. It is our joint responsibility to encourage girls and young women by leading the way", she said.

An extraordinary curriculum

Ivana Gasulla is a senior researcher (Ramon y Cajal Fellow) and deputy director for Dissemination and Promotion at the ITEAM Research Institute of the Universitat Politècnica de València (UPV).

Ivana Gasulla received the M.Sc. and the Ph.D. degrees from UPV, respectively, in 2005 and 2008. Her PhD thesis, focused on broadband radio over multimode fiber transmission, was recognized with the IEEE/LEOS Graduate Student Fellowship Award.

In 2012 she was awarded a Fulbright Fellowship to carry out research on spatial division multiplexing at Stanford University. Back to iTEAM in 2014, her current research interests encompass the application of multimode and multicore fibers to Microwave Photonics systems. The results of her work have led to more than 120 international publications, highlighting contributions to Nature Communications and Nature Photonics. She is a member of the Technical Program Committee of the most prestigious conferences in the field: European Conference on Optical Communications (ECOC), Optical Fiber Communication Conference (OFC) and IEEE International Topical meeting on Microwave Photonics (MWP), among others.

In 2017, she was awarded a prestigious ERC Consolidator Grant to develop new Space-Division Multiplexing technologies for emergent fiber-wireless communications through the project InnoSpace.