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Photonic Integrated Wireless Systems: A New Platform Enabled by Silicon Nano-Antennas

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Photonic integrated circuits (PICs) promise to open new avenues in high-performance computing, biosensing or optical beamforming, amongst others. Current PICs rely on the use of guided interconnects, hampering the creation of flexible and reconfigurable networks-on-a-chip and preventing the far-field light-matter interaction for many sensing applications. Here we propose a novel on-chip silicon antenna that, in contrast to their plasmonic counterparts, exhibits an ultra-high directivity (>100), low losses, low reflections and a broadband response. These nanoantennas are the main building blocks of a new wireless photonic platform that solves the aforementioned problems, widening the range of achievable integrated photonic functionalities. The studied antennas consist of inverted-taper silicon strips with additional structures behaving as directors. They were modelled via Huygens' Principle and fabricated over silicon-on-insulator wafers, assuring CMOS compatibility. As main applications we experimentally demonstrate the first on-chip wireless data-streaming link, with a speed as high as 160 Gbit·s-1 over a distance of 100 µm, an electrically controlled antenna-array beam-steering device and an ultra-compact (with a footprint several orders of magnitude smaller than previous versions) lab-on-a-chip antenna-based microflow cytometer able to classify microparticles of several sizes. This work shows the potential of the proposed wireless platform, providing much more flexible and reconfigurable optical interconnects and architectures as well as boosting new applications in the field of nanoscale applications and photonic integrated circuitry.

Biography:

Sergio Lechago received the Engineering Master's Degree in Telecommunications (2014) from the Universitat Politecnica de Valencia (UPV), Spain, and is currently finishing his PhD on Silicon photonic nanoantennas. Sergio has thorough experience in the design and characterization of Si photonic devices, including wireless on-chip systems as well as nanolithographic fabrication techniques carried out at clean rooms. Sergio is collaborating in several FP7 and H2020 European projects, including FP7-ICT-PHOXTROT and the H2020-FET-HPC EXANEST. Sergio has authored or co-authored publications in relevant international conferences and high impact journals (Nature's Light Science and Applications, Optics Express, Optics letters or Journal of optics).