Combined coherent radar/lidar system on chip

F. Falconi[(a)], M. Malik[(a)], M. Scaffardi[(b)], C. Porzi[(a)], F. Scotti[(b)], G. Parca[(c)], L. Ansalone[(c)], P. Ghelfi[(b)], A. Bogoni[(a,b)]

[a] TeCIP - Scuola Superiore Sant'Anna - [2] Photonic Network National Laboratory – CNIT
[B] CNIT – National Photonic Networks Laboratory, Via Moruzzi 1, 56124 Pisa, Italy
[C] ASI – Italian Space Agency, Via del Politecnico snc, 00133 Roma, Italy

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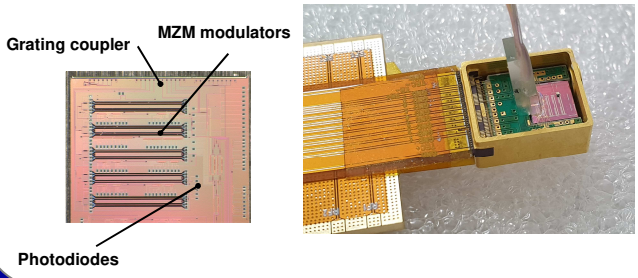
Abstract:

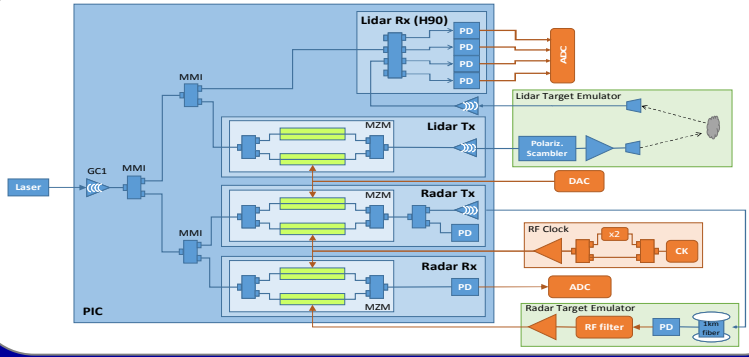
This work reports the first realization of a combined radar&lidar system based on silicon-on-insulator photonic integrated circuit (PIC). The software-defined architecture comprises a frequency-flexible and simultaneous multi-band radar operation and RF communications, and an advanced lidar with coherent detection for range and velocity measurements and optical communications. Both systems are implemented within a single chip, allowing a coherent radar and lidar parallel data acquisition in order to take advantage of their complementary characteristics. Moreover, radar and lidar subsystems are able to share the same optical source and digital electronics unit, allowing for an ultimate reduction of size, weight, and power consumption, thus making the proposed architecture suitable for the most stringent applications .

Photonic Integrated Circuit

Small footprint ~25mm²

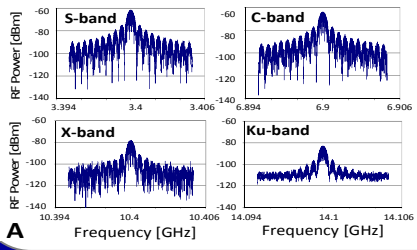


System architecture

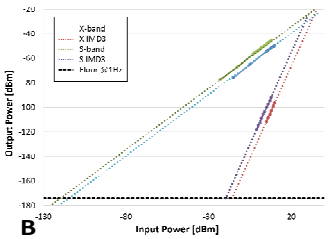


RADAR / RF communications

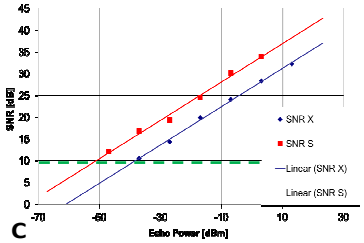
Multiband RF generation



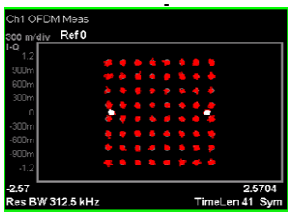
System SFRD



RADAR sensitivity

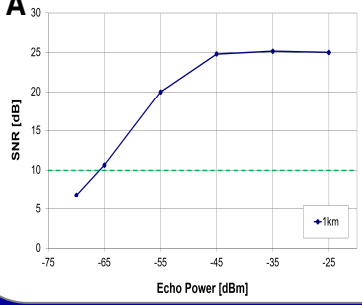


X-Band communications

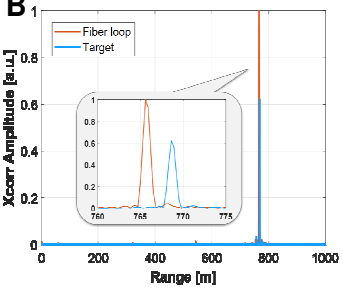


LIDAR / Optical communications

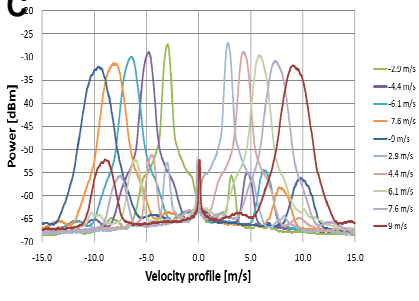
Lidar sensitivity



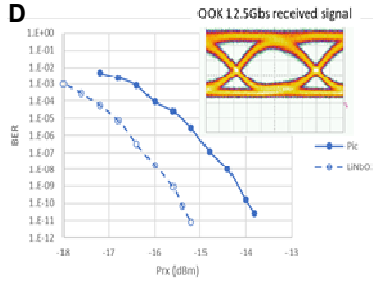
Lidar range resolution



Lidar Doppler detections



Optical communications



Conclusions:

In this paper, we have presented the first realization of a photonic-integrated combined radar&lidar system in SOI that can also been exploited for RF/optical communications. The PIC includes in a single ultra-compact integrated device a frequency-flexible radar/RF communication transceiver, and an advanced lidar/optical communication transceiver with coherent photonic detection for range and velocity measurement. Here we have presented the results of the tests that have been run separately on the radar and lidar subsystems directly on the bare PIC. The tests clearly show, on the one hand, the very large frequency flexibility and good sensitivity and linearity of the PIC radar subsystem, and on the other hand, the resolution in both range and velocity of the PIC lidar subsystem. In conclusion, the breakthrough PIC architecture presented here combining radar&lidar functionalities in a single tiny device, shows potential for enabling a new category of surveillance devices for complex observations in complex environments .

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