Nanophotonics structures for signal processing in Radar systems

Jérôme Bourderionnet, Sylvain Combrié, Alfredo De Rossi

Thales Research & Technology, 1 avenue Augustin Fresnel, Palaiseau, France
jerome.bourderionnet@thalesgroup.com

Abstract

Photonics is now part of the heart of modern radar systems, with already hundreds of optical links implemented in latest generation radars for analog and/or digital signal transportation from the antenna elements to the processing unit. Beside signal transportation, a decisive objective for radar and communication systems is to exploit photonics properties to perform more complex functions [1].

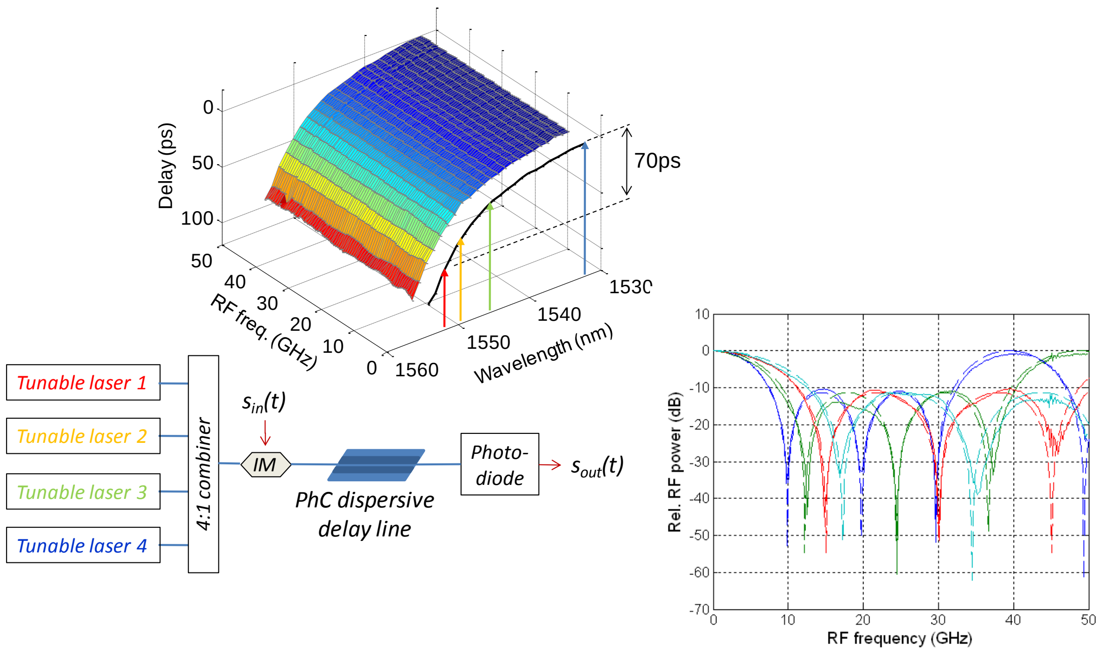
Photonics has proved for years its remarkable potential for manipulations of optically carried microwave signals, such as delaying, weighting, routing or sampling. Followed a considerable amount of implementations of microwave photonics signal processing [2]. A crucial functionality in a signal processing scheme is the microwave signal delaying, which is simply the physical implementation of the Z-transform [3]. A tunable delay line is achieved either by changing the light path length, for instance using chirped Bragg grating and tunable laser [4], or by exploiting a change in group index associated to a very strong dispersion. The last method is the most promising option towards integrated photonics signal processors, especially for radar front-end applications where lightweight, small volume and low consumption are mandatory.

Photonic crystal waveguide delay lines have recently reached performance levels, either in the available delay, the RF bandwidth, or losses standpoint that make these objects compatible with radar application requirements, and with a technological maturity that allows their integration in complex devices [5].

References

[1] J. Capmany, D. Novak, Nature Photonics, **1** (2007), pp. 319–330.
[2] J. Capmany, B. Ortega, D. Pastor, *J. Lightw. Technol.*, **24** (2006) pp. 201-229.
[3] Candy, J. V., *Signal processing, the modern approach,* McGraw-Hill, 1988.
[4] T.X.H. Huang, X. Yi, R.A. Minasian, *Optics Express,* **19** (2011), pp. 6231-6242.
[5] J. Sancho, J. Bourderionnet, J. Lloret, S. Combrié, I. Gasulla, S. Xavier, S. Sales, P. Colman, G. Lehoucq, D. Dolfi, J. Capmany, A. De Rossi, *Nature Communications*, **3** (2012), pp. 1075.

Figures



4 taps tunable MWP filter with a 1.5mm long III-V PhC waveguide dispersive delay line. Tunability demonstration with FSR from 40 to 70GHz by wavelength set tuning [5].