

Microwave photonics

This scientific activity aims at generating and stabilizing microwave signals on optical carriers. High-stability frequency references generation in the microwave range can indeed lead to applications such as optical distribution of clocks or analogic signals for all-optical radar processing. In parallel, the theoretic and experimental study of microwave photonics links - as the one inserted in most recent radar architectures - is another field of research. Lastly, this research field aims at designing new architectures for highly tunable opto-electronic oscillators.

The studies conducted in this domain are closely related to other research fields investigated by the team, such as **Laser dynamics**, **TeraHertz and metrology**, but also to some of our developments in **Advanced imaging**.

Programmable optical generation of radiofrequency & microwave signals

Microwave photonics links modeling

Modeling of microwave photonics links must rely on a thorough theoretical and experimental characterization for each component, active or passive, likely to be inserted in the photonics links used in new generation Thales radars. For each component, we have developed a physical model so as to evaluate the impact of the component on the radiofrequency/microwave characteristics (transfer function (amplitude and phase), intensity noise spectral density, phase noise, and non-linearities (compression point, IP3) on the whole RF spectrum (MHz-50GHz)). The software developed, which comprehends those models, is nowadays used in Thales divisions. It is regularly updated with new components or sub-systems, such as recently : low noise lasers, Raman amplifiers, or UTC photodiodes. Although these scientific developments cannot lead to publications for confidentiality reasons, they are the corner stone of a number of our current research activities since they make it possible to delineate future needs.

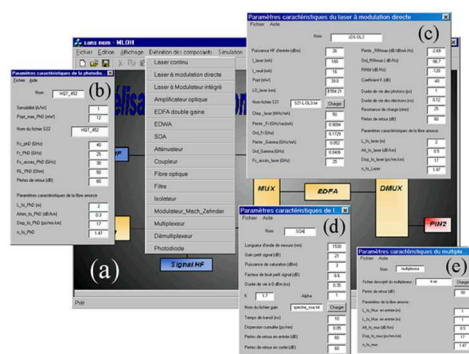


Fig. 2: Screenshot of the microwave photonics links simulation software.

Performances of microwave photonics links for analogic signals transmission

Hybrid oscillators with opto-electronic feedback semi-conductors bi-lasers

Optical control of antennas

Optical amplification

PhD theses (past / ongoing):

Antoine Rolland, « Oscillateurs ultrastables millimétrique et teraHertz par boucle à verrouillage de phase optoélectronique », 2013

Gwennaél Danion, « Oscillateur micro-onde à teraHertz ultra-stable », 2015

Lucien Pouget, « Contribution à l'augmentation des performances de liaisons optiques-hyperfréquences : non-linéarités et bruit »

Gael Kervella, « Circuits intégrés photoniques in InP pour la génération de signaux hyperfréquences », 2015

Thong Tien Pham, « Étude et conception d'antennes réseaux transmetteurs millimétriques à reconfiguration par voie optique »

Aurélien Thorette, « Structures de polarisation dans les lasers et réinjection : application à la génération de faisceaux opto-hyper »

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