PhD position:
Theoretical and experimental study of optical solutions for analog-to-digital conversion of high bit-rate signals
Foton laboratory

Doctoral school: "Sciences de la Matière" (SDLM), Rennes1 University.
Pluridisciplinary subject with doctoral school "Matisse", Rennes1 University.

Laboratory:
Fonctions Optiques pour les Technologies de l'informatiON (UMR 6082 FOTON)
(http://foton.cnrs.fr/spip/)
École Nationale Supérieure des Sciences Appliquées et de Technologie (ENSSAT)
6, rue de Kerampont - BP 80518
22305 LANNION Cedex
France

Associated laboratory for this PhD
Computing ArchItectures with embedded RecoNfigurable resources (CAIRN IRISA – UMR 6074-INRIA) (http://www.irisa.fr/cairn/home_html)
École Nationale Supérieure des Sciences Appliquées et de Technologie (ENSSAT)
Same address as Foton

Team: PERSYST platform (http://www.persyst.fr/)

Supervisor: Jean-Claude Simon (dir.foton@enssat.fr)
Co-supervisor: Olivier Sentieys (olivier.sentieys@irisa.fr)
Conducted with Mathilde Gay (gay@enssat.fr)

Financing: Government grant

Start: 1st october 2011

Keywords: optical functions, high bit-rate components, high bit-rate signal characterisation, optical communications, laser, digital signal processing, digital communications.

Subject:
Multi-level modulation formats, commonly used in the field of radio-communications for spectral efficiency optimisation, appeared in the optical communications a few years ago: a real revolution of associated technologies is going. This reversal of optical telecommunication solution is mainly linked to the renewal of coherent detection which, thanks to breakthroughs in the field of electronic and digital signal processing, allows efficient receiver design for multi-level modulation formats. It must however solve a number of technological bolts which could find some photonics solutions. Particularly, electronic solutions for analog signal processing developed for radio-communications
are limited in bandwidth and in amplitude resolution when transposed to high bit rate optical communications where 400 Gigabit Ethernet is under discussion in the standardisation groups. The heart of the present work concerns the analog-to-digital conversion (ADC) as it is a key element of coherent receivers and we therefore propose to study direct optical-to-digital converters as an important advance for high-performance receivers. The combination of numerical and optical signal processing could indeed solve part of the challenge of new modulation formats bolts.

Main objective of the PhD work is thus to study both theoretically and experimentally high bit-rate optical sampling techniques allowing reducing by 100 times the timing jitter compared with electronic sampling techniques and thus enhancing the amplitude resolution of current ADC converters used in optical receivers. The PhD student will propose and implement some new solutions for optical sampling and will work on the implementation of new algorithms for signal synchronisation and correction techniques. The PhD work is thus located at the border between Physics (Photonics-Optical Telecommunication) and Information technologies (digital communications, digital signal processing).

Context:
This PhD will be co-supervised by the laboratory FOTON UMR 6082 and by the research team CAIRN from IRISA laboratory-UMR 6074 and INRIA centre. FOTON laboratory and particularly the PERSYST platform have a strong experimental expertise in the field of new photonic devices for analog-to-digital conversion at high bit rate. CAIRN team has expertise in the field of digital signal processing and integrated circuit design, which will together with FOTON allow the study of complex optoelectronic devices. Both teams are labelled A+ (highest ranking) by the AERES (French national evaluation agency for academic bodies).

This PhD work will contribute to strengthening the research activities of PERSYST, which takes part to many National and European projects. The potential of the components coming from these programs will be demonstrated in the frame of this work.

Main skills: The candidate will have a Master degree in the field of photonics, optoelectronics or optical communications, or will have an equivalent degree admitted by SDLM doctoral school. Knowledge in experimental physics, optoelectronics, transmission system, digital signal processing and digital communications will be appreciated. Ability to comply with team working conditions is mandatory.

NB: In his application, the candidate should provide a c.v., a motivation letter and at least one recommendation letter from his Graduate School or Master supervisor.