

Contrats doctoraux 2026

Titre du projet de thèse : Physical modeling of signal degradation and digital signal processing for data transmission over multi-core optical fibers

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Résumé du projet de thèse (en 20 lignes maximum) :

Fiber-optic telecommunications have seen rapid technological advances over the past few decades, enabling increasingly efficient use of the transmission medium, single-mode fiber. The main advances have been: (i) wavelength-division multiplexing technologies, allowing hundreds of wavelength channels to coexist within a single single-mode fiber; (ii) the optical fiber amplifier, enabling a considerable extension of the transmission range through optical regeneration of attenuated signals; (iii) and, more recently, coherent communication technologies, which constitute a constellation of instrumental and digital technologies. Coherent transmitters encode data onto a light field by modulating the degrees of freedom of amplitude, phase, and polarization, while coherent receivers detect these same degrees of freedom via heterodyne detection, followed by high-speed sampling and digitization. Advanced digital signal processing (DSP) is applied before and after transmission to minimize most signal degradation. Coherent communication technology is now approaching the physical limits of data transmission capacity in a single-mode fiber (approximately 100 Tb/s in the C-band using erbium-doped fiber amplifiers).

As part of the PEPR “PLEIADES” project (2025–2029), the PhLAM laboratory is collaborating with Télécom Paris to study the propagation medium considered most suitable for replacing single-mode fiber in new fiber-optic communication networks: multi-core fiber. This solution would increase fiber capacity by opening new spatial channels (one per core), but at the cost of introducing a new type of degradation: intercore crosstalk. The project’s objective is to measure and model this degradation, as well as to develop DSP schemes to mitigate it.

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Remarques/commentaires supplémentaires :
