

Contribution to the Detection and Recognition of Acoustic Signals Using Distributed Fiber-Optic Sensors and Coherent Reception

Project Acronym: TRACE

Laboratory: Lab-STICC (Laboratory of Sciences and Techniques of Information, Communication, and Knowledge), based in Brest, is a leading multidisciplinary research laboratory in Brittany. It brings together specialists in signal processing, telecommunications, computer science, and applied physics, and promotes strong collaborative projects with academic, industrial, and institutional partners. The laboratory provides a dynamic and stimulating research environment, particularly well suited for PhD students.

Funding: 50% of this PhD project is secured and funded by CREACH LABS (<https://www.creachlabs.fr>), a Brittany-based collaborative cybersecurity research hub uniting academic and institutional partners to support high-level scientific projects. The remaining 50% of funding is being finalized with identified partners; selected candidates will be regularly updated on its progress.

PhD Project Summary:

Optical fiber sensing systems leverage the fiber's sensitivity to environmental disturbances, which alter the backscattered light signal. This property enables the fiber to function as a distributed network of acoustic sensors, capable of detecting, locating, and characterizing events with adjustable spatial and temporal resolution [He2021]. However, this ability to intercept acoustic signals also poses a cybersecurity vulnerability, making it essential to master these technologies in order to develop effective protective measures.

This PhD project aims to analyze and optimize such systems for acoustic monitoring, focusing on sensitivity, frequency response, and signal-to-noise ratio. The innovation lies in integrating advanced telecommunications techniques and artificial intelligence to distinguish signals in complex environments. A detailed study of optical components will identify technological levers to enhance the precision and robustness of algorithms.

Key technical challenges include optimizing waveforms to improve sensitivity and resolution while mitigating noise and interference in dynamic environments. Signal degradation (Rayleigh fading, nonlinear effects) and the trade-off between range and resolution further complicate measurement reliability. To address these issues, several approaches will be considered: designing novel waveforms, evaluating coherent detection architectures, inserting reflectors to boost signal strength, advanced signal processing, and integrating AI for fine-tuned, adaptive analysis. Compatibility with existing infrastructure will also be considered.

[He2021] He, Z., & Liu, Q. (2021). Optical fiber distributed acoustic sensors: A review. *Journal of Lightwave Technology*, 39(12), 3671-3686.

Keywords:

Optical networks, Optical fiber sensing, Cyber-protection, Risk analysis, Acoustics, Signal processing, Artificial Intelligence.

Required Degree and Skills:

Education: Master's degree (or equivalent) in Signal Processing, Telecommunications, or Optics.

Experience: Strong background in signal processing, digital communications, telecommunications, or optoelectronics. Knowledge of AI, machine learning techniques.

Technical Skills: Proficiency in programming (especially Python or Matlab).

Additional Asset: Keen interest in experimental work.

Application Details and Contact:

Applications must include a CV, cover letter, academic transcripts, and letters of recommendation. Please note that shortlisted candidates will be invited for an interview.

Starting date: October 2026

Send all applications to:

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Application deadline: April 3, 2026.