Post-doctoral or research engineer proposal

Precision optimization in Distributed Acoustic Sensors

Background

The position is part of the ANR ANTIPASTI project: Innovative architectures for distributed acoustic fiber optic sensors led by Thales and the LIP6 laboratory.

The deployment of DAS (Distributed Acoustic Sensing) systems is rapidly expanding, both for civil and military applications. Currently, available DAS systems have spatial resolutions of a few meters and can interrogate long distances of deployed fiber. The spatial resolution of existing systems is limited by the width of the optical pulse used by the interrogator and sent into the fiber to detect and localize the acoustic disturbance. A Frequency Modulated Continuous Wave (FMCW) DAS interrogator is developed with unprecedented resolutions perfectly in line with the new needs expressed for a large range of applications. DAS interrogators generate a large quantity of raw data, that prevent real-time operation in use-cases where power consumption is a key parameter, such as embedded systems. The compactness, consumption and quantity of data generated are important obstacles to the miniaturization and embedding of a DAS system. In order to best meet the application requirements, the ANTIPASTI project offers an innovative and global approach to the numerical architectures in a DAS FMCW (algorithms, tunable numerical precision and energy efficiency) as well as their integration with novel optical units.

Research axes

The project aims to improve the processing block (1) in terms of algorithms (to ensure that the processing is efficient, in particular via its parallelization on GPUs) and computation functions correctly used and sized; (2) at the level of the implementation of software functions on computing cores with the best energy efficiency, with efficient data transport; and (3) at the level of numerical precision by implementing a mixed precision code for greater efficiency while guaranteeing the numerical stability of the results.

The proposed position essentially concerns this last axis, namely the reduction of the computing precision in order to be able to exploit embedded architectures more effectively and thus improve energy efficiency. This nevertheless carries a risk of numerical instability when reduced precision is used. The project will benefit from the numerical validation software CADNA[1] [1] and PROMISE[2] [2,3] developed at the LIP6 laboratory to enable a mixed

[1] http://cadna.lip6.fr
[2] http://promise.lip6.fr

precision implementation, in order to obtain better performance while guaranteeing the numerical stability of the computation.

Location

Sorbonne Université and its Computer Science lab LIP6 are settled on the Pierre & Marie Curie Campus in the Latin Quarter of Paris, France.

Salary

The gross salary per month (including national health insurance and employment insurance) varies from 2682 to 3701 euros depending on the experience.

Duration

1,5 year

Qualifications and skills

Candidates must have a PhD or a Master degree in Computer Science, Applied Mathematics or other relevant fields, with good programming skills. Good knowledge in C/C++ programming, high performance numerical computing, and computer arithmetic would be appreciated.

Application

Applications should be sent to Stef Graillat (Stef.Graillat@lip6.fr) and Fabienne Jézéquel (Fabienne.Jezequel@lip6.fr). They should include:

- a curriculum vitae;
- a motivation letter;
- at least two referees with their e-mail addresses;
- links to software contributions;
- if applicable, links to PhD thesis and publications.

References

1. High performance numerical validation using stochastic arithmetic. Eberhart, Pacôme, et al. 2015, Reliable Computing, Vol. 21, pp. 35-52.
2. S. Graillat, F. Jézéquel, R. Picot, F. Févotte, and B. Lathuilière. Auto-tuning for floating-point precision with discrete stochastic arithmetic. Journal of Computational Science, 36:101017, 2019.
3. F. Jézéquel, S. sadat Hoseininasab, and T. Hilaire. Numerical validation of half precision simulations. In 1st Workshop on Code Quality and Security (CQS 2021) in conjunction with WorldCIST'21 (9th World Conference on Information Systems and Technologies), Terceira Island, Azores, Portugal, 2021.