



Offer #2025-08695

Post-Doctoral Research Visit F/M Low-Rank Compression Algorithms for H-matrices

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

Level of experience : Recently graduated

About the research centre or Inria department

The Inria center at the University of Bordeaux is one of the nine Inria centers in France and has about twenty research teams.. The Inria centre is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative SMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute...

Context

This project will be carried out within the framework of CONCACE, a joint Inria-Industry team involving Airbus, Cerfacs and Inria, focusing on the theme of composability applied to high-performance computing.

For wave propagation simulations in electromagnetics or acoustics, Airbus makes extensive use of H-matrix solvers to solve surface integral formulations. These techniques use a hierarchical partitioning of the physical object under consideration (e.g. an aircraft) to produce a hierarchical partitioning of the (dense) matrix of the linear system. Most of the matrix blocks thus created are numerically low-rank, and can therefore be stored in compressed form, occupying much less memory space.

The H-matrix solver enables us to store these blocks, use them for matrix-vector products and factorize the matrices in our problems while keeping them in this storage format. This is a crucial tool for modeling certain aircraft physics. The development of the h-matrix library is the fruit of a collaboration since 2010 between Airbus and Inria, it is in C++ and uses the task-based programming paradigm with the StarPU execution engine. The proposed topic will lead to further development of this h-matrice tool, in collaboration with the industrial partner.

Assignment

The aim of this 2-year mission - co-funded by Airbus and Inria - is to work on low-rank compression algorithms, which are a fundamental building block of the H-matrix approach. There is a huge variety of algo's fulfilling this role, between classical approaches (SVD, ACA, CUR, ID, ...), randomized variants, reconciliations between these methods and other usual algo's (ACA is for instance a way to rewrite LU), ... Today, H-matrix contains only a few of these algorithms. The aim of the post-doc is :

- enrich the available choice of low-rank compression algo ;
- implement them in a composable way, so that they can be used in the h-matrice library as well as in any other software library;
- to know for each algo its range of effectiveness, in terms of input data (size), target machine (CPU, GPU), precision, execution time, etc.
- be able to dynamically select the most suitable algo at runtime.

As the H-matrices tools at Airbus and Concace are halfway between industry and academic research, the aim of the research within this mission is to identify the most efficient numerical techniques and pass them on to industry for implementation in design offices.

Main activities

To do this, the various stages of this post-doc will be :

- clarify this diversity of algorithms, identifying the strengths and weaknesses of each, and isolating those that are truly innovative;
- explore and extend the most promising variants (such as geometry-based ACA);
- to implement the most useful methods in the ComposyX software library, the composable linear algebra tool of the Concace project serving to consolidate our work;
- Publication (articles, conferences) of the theoretical and practical results of this work

Skills

- Linear algebra, algorithms, parallelism
- C, C++, Python programming
- Writing articles, oral presentations
- Ability to alternate collaborative work and autonomy

Language: French or English

Benefits package

- subsidized meals
- partial reimbursement of public transport costs
- possibility of partial teleworking and flexible organization of working hours
- professional equipment available (videoconferencing, loan of computer equipment...)
- access to vocational training
- social security coverage

Remuneration

The gross monthly salary will be 2788€ (before social security contributions and monthly withholding tax)

General Information

- **Theme/Domain** : Distributed and High Performance Computing
Scientific computing (BAP E)
- **Town/city** : Talence
- **Inria Center** : [Centre Inria de l'université de Bordeaux](#)
- **Starting date** : 2025-09-01
- **Duration of contract** : 2 years
- **Deadline to apply** : 2025-05-31

Contacts

- **Inria Team** : [CONCACE](#)
- **Recruiter** :
Sylvand Guillaume / Guillaume.Sylvand@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

The keys to success

For this position, you'll need a good grounding in linear algebra (matrices, vectors, basic algo such as LU, cholesky, SVD, QR, etc.), as well as a good feel for C++ and Python programming. You must be interested in bibliographical research, the analysis of existing algorithms or the design of new ones, the efficient implementation of all this in a pre-existing software framework (which is both complex and demanding), and finally the desire to see your work put to practical use in industry in Airbus design offices.

The position will preferably be based at the Inria center at the University of Bordeaux.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

If you are interested by this job, please could you apply on website jobs.inria with the following documents :

- CV
- Cover letter
- recommandation letters

Defence Security :

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position

situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :

As part of its diversity policy, all Inria positions are accessible to people with disabilities.