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JOB OFFER – POST-DOCTORAL

Tools for the transformation and modernization of Legacy Codes : improving portability using LLMs

OFFER INFORMATION

Reference: COOP-25-AD-01.
Team: COOP

Location: 42 Avenue Gaspard Coriolis – 31057 Toulouse
Contact person: Antoine Dauptain et Mohamed Ghenai

Period: 1 year - from: 01/10/2025
Salary: 40 K€/year (gross)
Level of education required: Doctorat

Key words: AI, High Performance Computing (HPC), parallel programming, legacy code and new paradigms, code transformation, code translation, code generation, performance portability, gpu programming

CERFACS

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HOSTING TEAM - COOP

The COOP (Computing and Operational Practice) team aims to accelerate the adoption of best-practise techniques for scientific software on modern high-performance computing (HPC) architectures. Key research and development activities include: software portability, efficiency and scalability; mesh manipulation, adaptation and partitioning; industrial technology transfer; code analytics; machine learning and artificial Intelligence in HPC.

CONTEXT

Many HPC codes — especially in areas such as Computational Fluid Dynamics (CFD) — were originally developed decades ago and were tailored to the hardware and programming paradigms of their time. These so-called legacy codes remain scientifically valuable, but today's supercomputers, which feature multi-core CPUs, GPUs, and heterogeneous architectures, demand a new approach to code performance and portability.

Modernizing these codes is essential not only to unlock their full potential on current and future platforms, but also to ensure their long-term sustainability. This process offers an opportunity to rethink the way we design, refactor, and extend complex scientific software — blending the preservation of core scientific knowledge with cutting-edge programming models and tools.

The CERFACS COOP team is actively involved in this dual mission. On one side, we contribute to GPU porting projects (e.g., AVBP with OpenACC and OpenMP), and on the other, we explore transformative solutions like automated refactoring for Météo-France's ARPEGE model using tools such as LOKI.
As HPC architectures become increasingly diverse, manual optimization is no longer scalable. This is where new automated or semi-automated transformation workflows come in — driven by directive-based models

(OpenMP/OpenACC), portable performance libraries (e.g., Kokkos, CUDA), and even modern AI approaches, including Large Language Models (LLMs) and Retrieval-Augmented Generation (RAG).

The goal of this postdoctoral position is to develop tools and methods that not only help modernize existing codes, but also lay the groundwork for how tomorrow's HPC applications will be written, refactored, and optimized — accelerating both legacy and next-generation science.

MISSION

This postdoctoral position focuses on rethinking and modernizing the development and transformation of scientific HPC codes, with a particular emphasis on applications in Computational Fluid Dynamics (CFD).
The researcher will begin by auditing and analyzing candidate applications to understand their computational patterns and bottlenecks. A key objective is to assess and experiment with a wide range of emerging code transformation tools — including OMP-GPT, LASSI, HPC-Coder-v2, Aider, Cursor, and LOKI — and evaluate how these technologies can be applied to complex, real-world scientific codes.
At the core of this position is the integration of AI-based techniques, particularly Large Language Models (LLMs), into practical workflows for code restructuring, parallelization, and modernization. This includes exploring how LLMs can assist in translating between parallel programming paradigms (e.g., OpenMP ↔ OpenACC), inserting performance annotations, modularizing large monolithic kernels, and enhancing code readability and maintainability. Retrieval-Augmented Generation (RAG) techniques will also be investigated to enrich LLM reasoning with domain-specific knowledge from HPC documentation, manuals, and codebases.
Beyond tool usage, the postdoc will play an active role in **designing and building** a comprehensive, reproducible workflow for transforming scientific codes — from identifying compute-intensive regions, to selecting suitable parallelization strategies, to applying and validating transformations. The aim is to **create robust tools and methodologies** that can serve not only today's legacy codebases but also guide the development of **next-generation HPC applications**.
The role includes contributing to scientific publications, project deliverables, and open documentation, while also helping shape the long-term vision of AI-assisted HPC code development at CERFACS.

DESIRED PROFILE

- PhD defended less than 3 years ago.
- Strong skills in automation, artificial intelligence (AI), with a focus on Large Language Models (LLMs) and Retrieval-Augmented Generation (RAG) for code transformation.
- Solid knowledge of High-Performance Computing (HPC) and parallel programming models: OpenMP, OpenACC, CUDA, or modern frameworks like Kokkos.
- Experience working with large, collaborative scientific codes.
- Excellent organizational skills, with a demonstrated ability to work autonomously, manage priorities, and show rigor and responsiveness.
- Proficiency in software engineering tools and practices, including CI/CD workflows and collaborative development environments.

WHAT WE OFFER AT CERFACS

- Broad access to technology, a rich interpersonal environment, in-house skills recognized nationally and internationally.
- An inclusive and equitable work environment.
- A structure accessible to people with disabilities.
- A complementary health insurance scheme offering excellent health care coverage in addition to social security, with the possibility of enrolling family members (spouse and children).
- 6 weeks' annual leave (with the possibility of 22 extra days' leave per year linked to your choice of a 39-hour rather than 35-hour working week).
- Flexible working arrangements, with the possibility of working from home up to two days a week.

- A sustainable mobility package enabling employers to pay up to a maximum of 500 euros a year to cover the home-to-work travel costs of staff who cycle to work.

HOW TO APPLY ?

To apply, please send your CV and covering letter to dauptain@cerfacs.fr and ghenai@cerfacs.fr, applications are open until 30/09/2025.

See you soon at CERFACS!