

JOB OFFER – POST-DOCTORAL

Advanced parallel linear solvers for the CFD simulation software CODA

OFFER INFORMATION

Reference: ALGO-2025-CK-02

Team: ALGO

Location: 42 Avenue Gaspard Coriolis – 31057 Toulouse

Contact person: KRUSE Carola

Period: 1 year - from: 01/11/2025

Salary: 40 K€/year (gross)

Level of education required: PhD or equivalent

Key words: Preconditioners, Implicit RANS, Newton-Krylov solvers, Multigrid, HPC, modern C++

CERFACS

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HOSTING TEAM - ALGO

The Algo team conducts research in the fundamentals of high-performance simulation. This includes a wide range of topics in applied mathematics, such as scalable algorithms in numerical linear algebra, iterative and direct algorithms for large linear systems, novel methods for solving partial differential equations, data assimilation, optimisation, uncertainty quantification and scientific machine learning.

CONTEXT

This research project will investigate iterative solvers for use in the software suite **CODA** developed by Airbus, Onera and DLR in the **SANTANA** project. CODA is a CFD solver for aircraft design and it features innovative algorithms as well as advanced software technology concepts dedicated to HPC. The Spliss library, used in CODA to handle linear algebra problems, provides an excellent framework for parallel computing. However, the high number of iterations currently observed for the block-Jacobi preconditioned Newton-Krylov solver clearly indicates that further improvements are necessary. In this project, we will carefully analyze and identify bottlenecks using the mathematical structure of the system and its HPC implementation.

MISSION

There is a wide range of algorithmic choices in the literature that can enable algorithmic improvements and hence faster and more robust convergence. These include advanced domain decomposition techniques as well as modern multi-level and multi-grid methods, possibly combined with modern low-density direct methods. While these algorithms can serve as efficient preconditioners, we will also explore advanced Krylov subspace techniques, including, e.g., subspace recycling techniques over time steps and deflation techniques to overcome convergence blocking. The selected improved solvers will be integrated into the CODA tool, possibly based on interfacing with existing libraries. The post-doc researcher in this position is expected to collaborate closely with other researchers working on the same project at Cerfacs, Airbus and the joint team Inria-industry Concace.

DESIRED PROFILE

- PhD defended less than 3 years ago.
- PhD related to one or more of the following fields: applied mathematics, fluid dynamics, computer science, iterative solvers, numerical linear algebra, high performance computing,
- Knowledge of preconditioners applied to large-scale problem,
- Proficiency in programming languages modern C++ and Python,
- Familiarity with HPC environments and performance optimization.

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