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JOB OFFER – POST-DOCTORAL

SANTANA Project: Exploring algorithms for accelerating Newton-Krylov RANS convergence in CODA solver

OFFER INFORMATION

Reference: 2024-MPK-01
Team: ALGO
Location: 42 Avenue Gaspard Coriolis – 31057 Toulouse
Contact person: MOHANAMURALY Pavanakumar

Period: 1 year - from: 20/11/2024
Salary: 40 K€/year (gross)
Level of education required: PhD or equivalent

Key words: Randomized Linear Algebra, Implicit RANS, Newton-Krylov solvers, HPC

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HOSTING TEAM - ALGO

Within the Algo-COOP team, the Algo group 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 Onera, Airbus and DLR. 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/physical structure of the system and its HPC implementation.

MISSION

The linear solvers used for time integration interact with many of the ingredients of the overall algorithm, and a better understanding of these interdependencies is needed to consider an overall improvement in CODA's performance. We will systematically analyze the impact of the way linear systems are implemented (e.g. differentiation, integration of forces and source terms, linearization) the impact of line-search and CFL relaxation procedures on the convergence properties of linear systems, particularly for turbulence models. This will enable

us to identify algorithms that can be expected to converge rapidly. In addition to manual fine-tuning of algorithms and solver interfaces, we will explore the possibilities of exploiting randomized linear algebra techniques. This will enable us to exploit synergies with other research projects currently underway at CERFACS, where this axis is being explored in a related but different context. The post-doc researcher in this position is expected to collaborate closely with another researcher working on the same project.

DESIRED PROFILE

- You have defended your thesis less than 3 years from the date of this job offer.
- PhD in applied mathematics, fluid dynamics, computer science, iterative solvers, numerical linear algebra or high performance computing.
- Knowledge of pre-conditioners applied to large-scale problem
- Proficiency in programming languages C++ and Python.
- Familiarity with HPC environments and performance optimization.

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HOW TO APPLY ?

To apply, please send your CV and covering letter to mpkumar@cerfacs.fr, applications are open until 03/03/2025.

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