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JOB OFFER – POST-DOCTORAL

SANTANA Project: Advanced parallel linear solvers for the CFD simulation software CODA

OFFER INFORMATION

Reference: 2024-CKE-01
Location: 42 Avenue Gaspard Coriolis – 31057 Toulouse
Team: ALGO
Contact person: KRUSE Carola and MOHANAMURALY Pavanakumar

Period: 1 year - from: 01/09/2024
Salary: 40 K€/year (gross)
Level of education required: PhD or equivalent

Key words: Multigrid, preconditioners, Implicit RANS, Newton-Krylov solvers

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HOSTING TEAM - ALGO

The Algo-COOP team at CERFACS conducts research in the fundamentals of high performance simulation. 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 under 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 subspace recycling techniques over time steps and deflation techniques to overcome convergence blocking. Recently randomized linear algebra has shown promise in efficiently solving implicit RANS equations using Newton-Krylov methods and will be investigated in this project for its feasibility in CODA. 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 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, high performance computing.
- Knowledge of preconditioners 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 carola.kruse@cerfacs.fr and mpkumar@cerfacs.fr, applications are open until 25/08/2024.

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