The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5 – 9 June 2022, Oslo, Norway

# Performance and Scalability of the CFD Solver CODA

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**Key Words:** *Computational Fluid Dynamics, Aerospace, High Performance Computing.*

Computational fluid dynamics (CFD) simulations are an integral part of the aerospace design process. Not only do they allow to reduce cost and time of aerospace development by omitting unnecessary prototyping, wind tunnel experiments and real flight tests, but allow a more in-depth insight into components and systems. Especially for future aircraft design that is driven by step-changing technology, new design principles and, consequently, non-linear effects in flight characteristics, high-fidelity CFD simulations are indispensable to provide reliable insight into aircraft aerodynamics.

CODA is a CFD solver for the solution of the Reynolds-Averaged Navier-Stokes equations on unstructured grids based on second-order finite-volume and higher-order Discontinuous-Galerkin (DG) discretization. The implementation addresses the efficient utilization of current and upcoming high performance computing (HPC) systems as well as emerging technologies such as GPUs. CODA is being developed in a joint effort between the German Aerospace Center (DLR), the French Aerospace Lab (ONERA) and Airbus and is one of the key next-generation engineering applications represented in the European Centre of Excellence for Engineering Applications (EXCELLERAT).

We share our efforts and experiences in evaluating performance and scalability of CODA and the subsequent improvements during and with the help of the EXCELLERAT project. An integral part of the improvements is the development and integration of the Sparse Linear Systems Solver (Spliss) [1] into CODA for implicit time integration methods. Spliss aims to provide a linear solver library that, on the one hand, is tailored to requirements of CFD applications but, on the other hand, independent of the particular CFD solver. Focusing on the specific task of solving linear systems allows for integrating more advanced, but also more complex, hardware-specific optimizations, while at the same time hiding this complexity from the CFD solver. One example is the usage of GPUs. We evaluate results of CODA with Spliss on an AMD HPC system and Nvidea GPU clusters to study correctness and performance on these architectures.

## REFERENCES

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