# Spliss: Transparent Integration of Heterogenous HPC Architectures into CFD Solvers and Applications

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## ABSTRACT

Solving linear equation systems is an integral part of implicit methods in computational fluid dynamics (CFD). It affects their numerical robustness as well as their computational efficiency. The efficient solving of large linear systems that result from the discretization of the Reynolds-averaged Navier-Stokes equations (RANS) in CFD methods requires algorithms that are well adapted to the specific numerical problems, which is usually not covered by generic solver libraries. The Sparse Linear System Solver (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. Spliss enables the execution of the computationally intensive linear solver on GPUs in a transparent way. This way, the CFD solver can leverage GPUs without the necessity of any code adaption.

We share our efforts and experiences in evaluating performance and scalability of Spliss using CODA as an example. CODA is a CFD solver for aircraft aerodynamics developed by DLR, ONERA, and Airbus, and one of the key next-generation engineering applications represented in the European Centre of Excellence for Engineering Applications (EXCELLERAT). We evaluate first results on an AMD HPC system and a GPU cluster to study correctness and performance.