Parallel and Adaptive Methods for Fluid-Structure-Interactions

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Abstract The new flow solver Quadflow, developed within the SFB 401, has been designed for investigating flows around airfoils and simulating the interaction of the structural dynamics and aerodynamics. This article addresses the following issues arising in this context. After identifying proper coupling conditions and settling the well-posedness of the resulting coupled fluid-structure problem, suitable strategies for successively applying flow and structure solvers needed to be developed that give rise to a sufficiently close coupling of both media. Based on these findings the overall efficiency of numerical simulations hinges, for the current choice of structural models, on the efficiency of the flow solver. In addition to the multiscale-based grid adaptation concepts, proper parallelization concepts are needed to realize for such complex problems an acceptable computational performance on parallel architectures. Since the parallelization of dynamically varying adaptive discretizations is by far not straightforward we will mainly concentrate on this issue in connection with the above mentioned multiscale adaptivity concepts. In particular, we outline the way the multiscale library has been parallelized via MPI for distributed memory architectures. To ensure a proper scaling of the computational performance with respect to CPU time and memory, the load of data has to be well-balanced and communication between processors has to be minimized. We point out how to meet these requirements by employing the concept of space-filling curves.

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