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Fast Transient Workflow for External Automotive Aerodynamic Simulations

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Abstract : In recent years the demand for rapid innovations in the automotive industry has led to the need for accelerated simulation procedures while retaining a detailed representation of the simulated phenomena. The project's aim is to create a fast transient workflow for external aerodynamic CFD simulations of road vehicles. The geometry used was the SAE Notchback Closed Cooling DrivAer model, and the simulation results were compared with data from wind tunnel tests. The meshes generated for this study were of two types. One was a mix of polyhedral cells near the surface and hexahedral cells away from the surface. The other was an octree hex mesh with a rapid method of fitting to the surface. Three different grid refinement levels were used for each mesh type, with the biggest total cell count for the octree mesh being close to 1 billion. A series of steady-state solutions were obtained on three different grid levels using a pseudo-transient coupled solver and a k-omega-based RANS turbulence model. A mesh-independent solution was found in all cases with a medium level of refinement with 200 million cells. Stress-Blended Eddy Simulation (SBES) was chosen for the transient simulations, which uses a shielding function to explicitly switch between RANS and LES mode. A converged pseudo-transient steady-state solution was used to initialize the transient SBES run that was set up with the SIMPLEC pressure-velocity coupling scheme to reach the fastest solution (on both CPU & GPU solvers). An important part of this project was the use of FLUENT's Multi-GPU solver. Tesla A100 GPU has been shown to be 8x faster than an Intel 48-core Sky Lake CPU system, leading to significant simulation speed-up compared to the traditional CPU solver. The current study used 4 Tesla A100 GPUs and 192 CPU cores. The combination of rapid octree meshing and GPU computing shows significant promise in reducing time and hardware costs for industrial strength aerodynamic simulations.

Keywords : CFD, DrivAer, LES, Multi-GPU solver, octree mesh, RANS
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