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HIGH PERFORMANCE PARALLEL COMPUTING OF FULL VEHICLE AERODYNAMICS SIMULATION INCLUDING PRE- AND POST-PROCESSING

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In applied computational fluid dynamics conducted in the industry, automobile aerodynamic analysis using full vehicle models is one of the categories dealing the most complicated geometry. The required computational grid resolution is on the order of millimetres or less and always requires large computational resources. At the same time, it is required to constantly obtain solutions quickly from the requirements of a schedule of the design process.

The parallel algorithm using hierarchical grid system has been applied to achieve high parallel computation efficiency on the incompressible flow solver. And the topology-independent immersed boundary method has been proposed to accelerate the pre-processing on the massively parallel environment. This method made the entire pre-process working time firster down to the level of minutes, using MPI+OpenMP hybrid parallelization eliminating the manual work which required several days in the conventional methods, correcting the surface imperfections of CAD data to generate computational grids. Then the strongly coupled in-situ visualization of the flow solver has been adopted to parallelize the post-processing using libsim (VisIt) library. The post-processing time has been reduced seconds order per frame, and approx. 30% increase of computational time was observed in full vehicle aerodynamics case.

In this presentation, we introduce and discuss about details of the numerical scheme and result examples applied to the full vehicle aerodynamics analysis.

REFERENCES

[1] K. Onishi, S. Obayashi, K. Nakahashi, and M. Tsubokura, Use of the Immersed Boundary Method within the Building Cube Method and its Application to Real Vehicle CAD Data. In 21st AIAA Computational Fluid Dynamics Conference. American Institute of Aeronautics and Astronautics, Sandiego, CA, 2013.

[2] K. Onishi, N. Jansson, R. Bale, W.H. Wang, C.G. Li, and M. Tsubokura, A Deployment of HPC Algorithm into Pre/Post-Processing for Industrial CFD on K-computer, SC17, Denver, CO, 2017.

[3] K. Onishi, Y. Ando, K. Nakasato, M. Tsubokura, Evaluation of an Open-grill Vehicle Aerodynamics Simulation Method Considering Dirty CAD Geometries, SAE World Congress Experience, Detroit, MI, 2018.