Building-Multi-Block Hybrid Approach of Structured/Unstructured Zonal Grid for Calculating Compressible flows

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ABSTRACT

In this paper, an efficient approach for calcualting flow around complex geometry is presented. The target is to perform a large scale computation on available personal computer environment in a laboratory. Our interest is the simulation of the flow around high speed vehicles.

Generally, this type of simulation is of large scale and requires usually a super-computer. In this paper, a simulation of large scale is challenged on a laboratory-class computer instead of the super-computer. In order to realize the large scale computation on the laboratory computer, there exist some issues to be overcome. One of the issues is flexibility to the geometry. Although the geometry about a high speed vehicle, such as F1 machine or MotoGP machine, is very complex, the grid system should be desirable to be generated without any further complexity. The other issues are, perhaps, the limit of available memory size and CPU power. For today뭘computer environment of the laboratory, a dual CPU machine is available. Thus we may assume an environment of a SMP machine of dual CPU as well l as small PC cluster.

In order to perform the large scale computation on laboratory computer effectively, the "Building-Multi-Brock and Block-Decomposition" method[1][2] is adopted. Furthermore, the unstructured grid system as well as the structured grid system is simultaneously combined and used zonally in this paper. The structured grid system is very efficient in the viscous regions and can simulate with relatively small amount of memory, while the unstructured grid system is sufficiently favaroble to complex geometry. In addition, the method incorporates hybrid system of governing equations attaining further efficiency, in which the Euler and the Navier-Stokes equations are selected according to the flow physics for each block. The blocks governed by the Navier-Stokes equation are located just around the bodies. The Navier-Stokes region is surrounded by the blocks governed by the Euler equations. Thus, the CPU time can be saved by selecting suitable size of the Navier-Stokes and the Euler regions.

As for the parallel implementation, the MPI as well as Open MP tools are simultaneously used. For the shared memory, the Open MP tool is used. While the MPI tool is used for PC cluster. In the present computation, the PC cluster of dual CPU machine is used and the MPI and OpenMP are simultaneously used.

REFERENCES

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