A Parallel Module for Multiblock Structured Grids in JASMIN and its Applications*

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Abstract. Multiblock structured grids is widely used in numerical simulations with complex geometries. Multiblock structured grids can provide the geometrical flexibility and retain a low computational cost. However, high performance computations of large-scale realistic applications using multiblock structured grids technique under distributed memory systems face several communication challenges. A proper method that specifies the connectivity among so many blocks of structured grids may be a challenge in large-scale simulations. A proper communication schedule among a large number of subdomains may be another challenge. To solve the communication challenges broadly existing in multiblock structured grids parallel computing, a parallel module for multiblock structured grids computing has been designed and implemented in JASMIN infrastructure. The parallel module consists of a blocks' relationship description algorithm and a unified communication schedule. Meanwhile, by encapsulating parallel computing strategies, such as distributed storage, data communications, etc. and providing standard interfaces, this module can help user conveniently realize multiblock structured grids parallel computing. According to our test results, applications based on this module can be run efficiently on thousands of processor cores, which prove the module's satisfying parallel computing performance.

Keywords. Multiblock structured grids, communication challenge, parallel module, JASMIN

1. Introduction

For numerical simulations in complex geometries, multiblock structured grids can be used. Multiblock structured grids, which are a serious of structured grids, allow for complex geometries to be sub-divided into logically rectangular blocks. These blocks meet point-to-point on block boundaries without any intersections. One example of multiblock structured grids with eight blocks is illustrated in Figure 1. Multiblock structured grids can provide the geometrical flexibility and retain a low computational cost.

Multiblock structured grids are frequently used in, for example, aerodynamical computations[1-2], flows around ships [3], and atmosphere simulations [4], among

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