PARALLEL ALGORITHM FOR CHIMERA GRID ASSEMBLY WITH IMPLICIT HOLE CUTTING METHOD

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Summary. A novel parallel Chimera grid assembly strategy is proposed. This method takes account of hole cutting process load balance and flow solver process load balance, and could minimize global communications.

1 INTRODUCTION

The numerical simulation of moving boundary problems is a hot and difficult issue in aeronautical and astronomical subjects. In order to attain precise unsteady aerodynamic characteristics, high quality grid considering aerodynamic interference among different components must be well designed and generated. Chimera grid method\cite{1,2} divides the computing region into some independent sub-regions with overset relationships. This method can reduce the degree of difficulty of mesh generating and save the time of simulation. So it is widely used in the simulation of moving boundary problems and complex engineering objects. But the establishment of precise grid connectivity relationships for the overset grid is a time consuming and daunting task. Lee and Baeder\cite{3} presented a different approach to solve the overset grid connectivity problem, which named implicit hole cutting(IHC). In contrast to the conventional method, this approach is a cell selection process based on the criterion of cell size when comparing the grid overlapping regions, which is more convenient and robust. However, the difficulty of parallelization limits the further application of this method.

2 PARALLEL STRATEGY OF CHIMERA GRID ASSEMBLY

The parallelism problem of IHC method involve both load balance and communication. The IHC process is inherently poorly load balanced, some blocks intersect more blocks than others and thus require more searchers than others. And the distribution of blocks in parallel computation process is mainly rest with the block size of calculation. Meanwhile, the grid cell status (calculated or interpolated) need to be gathered and updated in every time steps, the increasing computational scale result in a more serious requirements on global communication of unsteady numerical simulations. Hence, we need to find a compromise
between hole cutting process load balance and flow solver process load balance, and minimize global communications.

We offer concept of overset weight coefficient. For the grids with no overset relationship, the weight coefficient is 1; and for the overset regions of n object grid, each grid of same region has weight coefficient of 1/n. The spitted block sizes are in proportion to the overset weight coefficient. When distributing grid blocks to different nodes, we first get the rough overset relationship between blocks based on bounding boxes, then send the blocks in same coordinate position to a node. The load of different nodes is basic balanced and most communications would be avoided.

3 CONCLUSIONS

Based on the IHC method, this paper presents a novel parallel Chimera grid assembly strategy. Figure 1 shows the effect of implicit hole cutting for the ANF model[7]. Result of parallel effect and analysis will also be presented.

![Figure 1](image)

**FIGURE 1.** Overset grid for the Basic Finner model after implicit hole cutting (a), section of symmetry (b), section perpendicular to the direction of inflow

REFERENCES


