S22-34

174761

98

ORIGINAL PAGE IS
OF POOR QUALITY

N89 - 14918

M 3116546

OVERLAPPING GRIDS FOR FLOW FIELD CALCULATIONS

by

Charles Wayne Mastin
Department of Mathematics and Statistics
Mississippi State University
Mississippi State, MS 39762

Many problems in computational fluid dynamics (CFD) involve the calculation of flow fields within or around complex geometric configurations. The flow solution is computed on a computational grid. The construction of the grid is one of the major difficulties in the application of CFD to the analysis of flow about actual aircraft configurations. Due to geometric complexity, the grid has to be constructed in simple subregions and then all of these subgrids have to be pieced together to form a complete grid for the entire flow field. The entire grid, which is called a composite grid because it is formed from many parts, may have subgrids which meet along their boundaries or which overlap on some common region. In either case, the computation of a flow field, using any numerical algorithm, will require the transfer of information between individual subgrids. The transfer of information is more difficult with overlapping grids.

Algorithms have been developed and tested for automating the transfer of information between two overlapping grids. Whenever information at a given point of one grid is needed, a search is made in the other grid to find a set of points close to the given point. Information on this set of points is then interpolated to provide the necessary information at the given point. In CFD problems, the information that must be exchanged between subgrids is either solution values or fluxes or both. The number and location of the interpolation points that must be found will depend on the numerical scheme used to compute the flow field and the desired accuracy of the interpolation formula. Efficient and robust search procedures have been developed for locating interpolation points. These methods can be used even if one grid moves independently of a second grid. A simple two-dimensional illustration that was used in testing the algorithm appears in Figure 1. The inner elliptical grid rotates in a fixed cartesian grid. A fluid enclosed by the inner ellipse and the outer rectangle is set in motion by the rotation of the ellipse. The success of overlapping grids in this simple problem raises the prospect of using overlapping grids to model flow about moving aircraft components such as propellers, flaps, and turbine blades.

ORIGINAL PAGE IS
OF POOR QUALITY

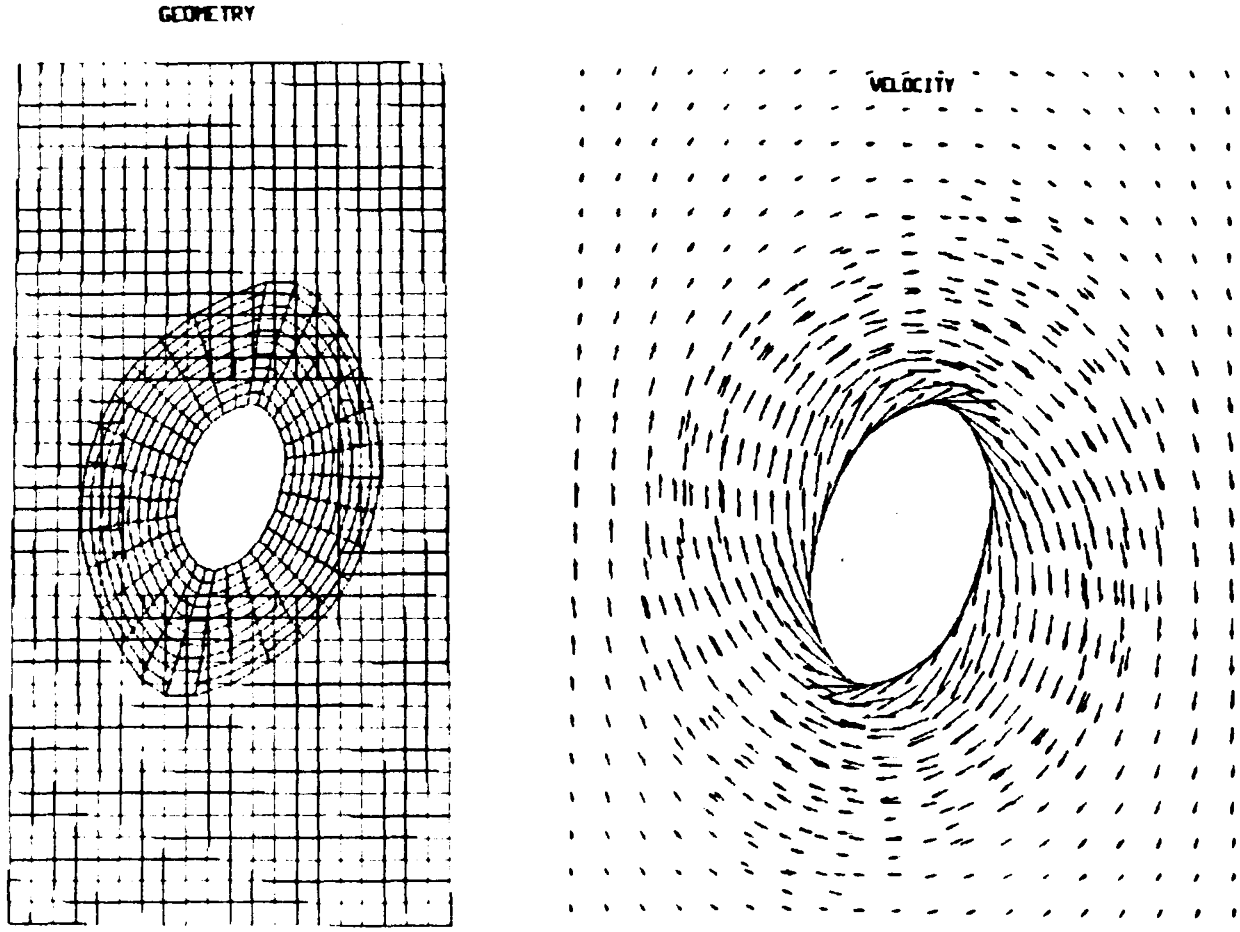

Figure 1. Grid and velocity vectors about rotating ellipse.