PART FOUR

AUTOMATIC GRID GENERATION, ADAPTIVE METHODS, AND COMPUTING TECHNIQUES

Automatic grid generation techniques have contributed significantly toward the application of computational fluid dynamics in large-scale industrial problems. Without such techniques the most accurate numerical schemes may fail to prove their full potential or effectiveness. Automatic grid generation in complicated geometries such as those of a complete aircraft is now considered a routine exercise and an important part of CFD projects.

There are two types of grid generation: structured and unstructured. In structured grids, all grid lines are oriented regularly in either two or three directions so that coordinate transformations of curvilinear lines result in a square or cube for two-dimensional or three-dimensional problems, respectively. In unstructured grids, however, there are no such restrictions, but at the expense of more complicated computer programming. Once the automatic grid generation is completed, a challenging task still remains – an adaptive mesh in which the most suitable mesh distributions are achieved to obtain the most accurate solution. This can be made possible by placing finer meshes in regions where gradients of variables are high. Furthermore, computing techniques including domain decomposition, multigrid methods, and parallel processing, among others, play an important role for the success of CFD projects.

We shall examine these and other subjects in Part Four. Structured grid generation is discussed in Chapter 17, unstructured grids in Chapter 18, adaptive methods for structured and unstructured grids in Chapter 19, and computing techniques in Chapter 20.