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Book Review

Flow Simulation with High-Performance Computers II

Edited by Ernst H. Hirschel, Verlag Vieweg, Wiesbaden, Germany, 1996, 576 pp., $91.00

The papers presented in this volume are the result of work sponsored by the Deutsche Forschungsgemeinschaft (German Research Society) between 1989 and 1995 under a "Priority Research Program" for "Flow Simulation with High-Performance Computers." (Earlier results from this program were presented in Vol. 38 of the series.) They therefore offer an interesting comparison with U.S. work sponsored by various federal agencies under the High Performance Computing and Communication initiative. As a broad generalization, the German program has funded smaller teams, with less emphasis on achieving new interdisciplinary applications and rather more on basic algorithm development. Another difference is that the German initiative has been strongly slanted toward problems of aerospace interest.

All 35 of the projects funded under this initiative are reported here. They have been grouped under three major headings, and each grouping appears with a brief introduction. M. Schäfer reviews the 13 papers devoted to Fluid Simulations with Massively Parallel Systems. Five papers on Direct and Large-Eddy Simulation of Turbulence are reviewed by C. Härtel, and 17 papers on Mathematical Foundations, General Solution Techniques, and Applications by M. Meinke. The papers in the latter two sections do of course refer to coding issues, sometimes in considerable depth, but many will be of interest in the broader context of finding effective discrete representations of fluid flow. Because of this, much of the volume can be regarded as one essentially devoted to innovative computational fluid dynamics. All papers are in English, and the standard of presentation is generally high.

Also included is a brief report on a workshop to which 10 of the groups in the Priority Research Program contributed, together with 7 others. The focus of the workshop was laminar flow past a cylinder. In two dimensions the test cases involved a circular cylinder in a channel. The Reynolds number was either 20 (steady flow) or 100 free oscillations), and a case with a time-dependent entry flow was included. For three-dimensional calculations, the cylinder was taken to span a tunnel of finite breadth, whose sidewall boundary layers could influence the flow. In the three-dimensional tests, both circular- and square-section cylinders were considered.

Each group was permitted to use a fine grid of their own choice, and most conducted a mesh-refinement study. A good clustering of results was achieved, at least in two dimensions, from a variety of methods (mostly specific to incompressible flow) but the resources consumed to achieve a good result were very different. The organizers attempt some preliminary conclusions on gridding (adaptive grids do not necessarily do better than grids constructed "by hand"), spatial differencing (high order pays off), and iteration technique (multigrid is preferred). Experimental data have been obtained, and the contest apparently remains open to all interested researchers.

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