Parallel Computations: 001 (Computational Techniques)

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Parallel Computations focuses on parallel computation, with emphasis on algorithms used in a variety of numerical and physical applications and for many different types of parallel computers. Topics covered range from vectorization of fast Fourier transforms (FFTs) and of the incomplete Cholesky conjugate gradient (ICCG) algorithm on the Cray-1 to calculation of table lookups and piecewise functions. Single tridiagonal linear systems and vectorized computation of reactive flow are also discussed.

Comprised of 13 chapters, this volume begins by classifying parallel computers and describing techniques for performing matrix operations on them. The reader is then introduced to FFTs and the tridiagonal linear system as well as the ICCG method. Different versions of the conjugate gradient method for solving the time-dependent diffusion equation are considered. Subsequent chapters deal with two- and three-dimensional fluid flow calculations, paying particular attention to the principal issues in designing efficient numerical methods for hydrodynamic calculations; the decisions that a numerical modeler must make to optimize chemically reactive flow simulations; and how to handle disk-to-core data transfer and storage allocation for the solution of the implicit equations for three-dimensional flows. The book also describes the time-split finite difference scheme for solving the two-dimensional Navier-Stokes equation for flows through slotted nozzles. Finally, the large-scale stimulation of plasmas, as carried out on a small computer with an array processor, is discussed.

This monograph should be of interest to specialists in computer science.

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