

1. Introduction: Supercomputers in Computational Fluid Dynamics	1
2. Computer Architectures	6
2.1 The Basic Computer Systems	7
2.2. The CRAY-1 Series	11
2.3. The CDC CYBER 205	18
3. Vectorization of FORTRAN Programs	25
3.1 Implementation of Serial Programs on Vector Computers	25
3.2 Vectorization on the CRAY-1	32
3.3 Vectorization on the CDC CYBER 205	40
4. Vectorization of a Sample Program on Different Vector and Parallel Computers	50
4.1 Vectorization on the CRAY-1	56
4.2 Vectorization on the CDC CYBER 205	56
4.3 Vectorization on HITACHI's S9 with IAP	59
4.4 Vectorization on the ICL DAP	62
4.5 Parallelization on DENELCOR's HEP	66
5. Restructuring of Basic Linear Algebra Algorithms	71
5.1 Basic Vector Operations	71
5.2 Matrix Multiplication for Banded Matrices	77
5.3 Gaussian Elimination for the Solution of Algebraic Systems with Full Matrices	81
5.4 Linear and Nonlinear Recurrences	88
6. Iterative Methods for a Model Problem	100
6.1 Jacobi Type Methods	102
6.2 Gauss-Seidel Type Methods	107
6.3 Group Iterative Methods	111

7. Vectorization of Simple Numerical Algorithms	117
7.1 Polynomial Evaluation	117
7.2 The Power Method for the Computation of the Largest Eigenvalue of a Matrix	120
7.3 Cyclic Reduction	121
7.4 Systems of Nonlinear Equations	125
7.5 Runge-Kutta Time-Stepping Methods for Systems of Ordinary Differential Equations	129
7.6 An Explicit Superstep Method for the Solution of Parabolic Differential Equations	133
7.7 Finite Difference Smoothing	136
8. References to Chapters 1 to 7	140
8.1 Vector and Parallel Algorithms	140
8.2 Further Applications	154
9. Vectorization of Algorithms in Computational Fluid Dynamics on the CRAY-1 Vector Computer	157
9.1 MacCormack's Methods and Vectorization W. Kordulla	157
9.2 Vectorization of the Implicit Beam and Warming Scheme B. Mueller	172
9.3 Vectorization of an Implicit Finite Difference Method for the Solution of the Laminar Boundary-Layer Equations D. Schwaborn	195
9.4 Vectorization of the Galerkin-Method R. Kessler	217
9.5 Vectorization of the Direct Monte-Carlo Simulation E. Meiburg	235