# Finite Element Techniques for Computational Fluid Dynamics on the Connection Machine CM-5 System

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Z. Johan
K.K. Mathur
S.L. Johnsson
T.J.R. Hughes

TR-18-94

August 1994


Parallel Computing Research Group

Center for Research in Computing Technology
Harvard University
Cambridge, Massachusetts

To appear in *Proceedings of the International Conference on Computational Mechanics*, Washington, DC, July 1993.

# FINITE ELEMENT TECHNIQUES FOR COMPUTATIONAL FLUID DYNAMICS ON THE CONNECTION MACHINE CM-5 SYSTEM

Z. Johan†, K.K. Mathur†, S.L. Johnsson† and T.J.R. Hughes‡
†Thinking Machines Corporation
‡Division of Applied Mechanics, Stanford University

A finite element method for solving the three-dimensional compressible Euler and Navier-Stokes equations has been implemented on the Connection Machine CM-5 system using the data-parallel programming model. The Galerkin/least-squares formulation is used to discretize the fluid flow equations. An implicit iterative solution strategy based on the matrix-free GMRES algorithm is employed to converge to steady-state. Several issues related to parallel finite element methods will be addressed in this talk: First, a parallel implementation of the recursive spectral bisection algorithm will be presented. This algorithm is used to subdivide unstructured meshes. The subdomains are then mapped to the vector units of the CM-5 system. In turn, special communication routines take advantage of data locality to achieve high gather/scatter transfer rates. Second, we will describe parallel data structures built on both nodal and elemental sets. We will show that such data structures are ideal for the handling of several element types often found in finite element meshes. Finally, 3-D fluid flow problems solved on several CM-5 configurations will demonstrate the efficiency and the scalability of finite element techniques on the CM-5 system.

References

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