Fast Algorithms for Parallel Architectures

Final Report

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March 12, 1990

1. Introduction

This is the final report for ARO contract DAAL03-86-G-0029. This report covers the period from 1 Jul 86 - 30 Sept 89. We briefly summarize our progress for this period and indicate personnel supported and publications produced as a result of this contract.

2. Work Completed

Our work on Fast Algorithms for Parallel Architectures led us to investigate methods for computing all eigenvalues and eigen vectors of a summetric tridiagonal matrix on a distributed-memory MIMD ~~multiporcessor~~. We have studied only those techniques having the potential for both high accuracy and significant large-grained parallelism. These include the QL method or Cuppen's divide and conquer method based on rank-one updating to compute both eigenvalues and eigen vectors, bisection to determine eigenvalues, and inverse iteration to compute eigen vectors.

The methods were compared with respect to computation time, communication time, parallel speedup, and accuracy. Experiments on an iPSC hypercube multiprocessor revealed that Cuppen's method is the most accurate approach, but bisection with inverse iteration is the fastest and most parallel. Because the accuracy of the latter combination is determined by the quality of the computed eigen vectors, the factors influencing the accuracy of inverse iteration were examined. This included, in part, statistical analysis of the effects of a starting vector with random components. These results were used to develop an implementation of inverse iteration producing eigen vectors with lower residual error and better orthogonality than those generated by the

EISPACK routine TINVIT. We have also adapted methods for the symmetric tridiagonal eigenproblem to the related problem of computing the singular decomposition (SVD) of a bidiagonal matrix.

3. Scientific Personnel Supported

Elizabeth Jessup (received Ph.D. June 1989)

4. Publications Supported by this Contract

Parallel Solution of the Symmetric Tridiagonal Eigenproblem,
Elizabeth R. Jessup, YALEU/DCS/RR-728