High-level Parallel Programming Tools for Finite Element Analysis

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Automatic generation of sequential and parallel programs can bring the power of modern computers to more engineers and scientists. The project investigated parallel code generation and automatic derivation of parallel finite element routines. Software packages GENCRAY, a code translator producing Cray Fortran, and PIER, a finite element code derivation system, have been constructed as research tools.
Statement of the Problem Studied

Improved operating environments and powerful parallel programming tools are vital to realizing the full potential of modern parallel processors. Under this project, we studied the automatic generation of parallel programs in the important application area of finite element analysis (FEA). A software system is built to derive the required formulas and procedures through symbolic computation. These formulas and parallel procedures are then fabricated, through a code generator into parallel code to run on a given parallel processor.

The project involves two related areas:

1. Parallel code generation – A portable code generator written in C (Lex/Yacc) to produce parallel code for the Warp, Encore/Sequent computers, that can be used from any symbolic computation system.

2. Automatic derivation of parallel finite element routines – A Common Lisp based package for the automatic mapping of finite element computations on the Warp, Encore/Sequent parallel processors and for deriving parallel procedures to be translated by the code generator into routines readily executed on the target machine.

Summary of the Most Important Results

Good progress has been made towards the overall goal of automating the generation of sequential and parallel codes for finite element analysis and in making the code generation software system easier to use. The free-standing code translator GENCRAY has been completed and a paper appeared in ACM/TOMS. The implementation and testing of the PIER software system, with special emphasis on text-book style input handling has been accomplished. Dr. Naveen Sharma finished his Ph.D. in this area.
List of All Publications and Technical Reports


Scientific Personnel

Project personnel include Simon Gray, Naveen Sharma, Paul S. Wang (P.I.), and Syuzanna Zakharova.

Dr. Sharma finished his Ph.D. in the Fall of 1992. He left Kent to work for industry (Xerox Research, Rochester, N.Y.) The other graduates students are still making progress in their Ph.D. degree programs.