ICM-9303-53 The Pier Parallel FEA Program Generator, Naveen Sharma and Paul S. Wang.

ABSTRACT In this paper we describe a coupled symbolic-numeric approach for solving PDE-based mathematical models on sequential and parallel computers. PIER, an experimental software system that we are developing, synthesizes `F77` subroutines for finite element modeling directly from very-high level user input specifications. The system is being developed in Common Lisp and uses MAXIMA computer algebra system for symbolic mathematical computations.

PIER input syntax provide high-level statements to specify finite element *discretization* and methods for solving systems of equations. The user composes the finite element analysis process using MAXIMA input syntax and F77 statements along with these statements. Symbolic quantities for element formulation like shape functions, element equations etc. are automatically derived. The input model characteristics, derived formulae, desired solution methods, and the target machine knowledge are then used to generate numerical code for FEA solution steps.

The benefits of this approach include: 1) substantially reducing the time and effort required to solve mathematical models, 2) ability to solve models in higher-dimensions, and 3) automatic retargeting of numeric computations to multiple parallel architectures. Currently, we are applying the techniques developed in our research to the numeric solution of problems in computational liquid crystal physics and the theory of elasticity. Sequent shared-memory multiprocessor is the current target parallel computer.