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    The motivation for using adaptive methodologies is to control and optimize the computational process, to use a posteriori error estimates to optimize meshes and spectral orders of approximation. Such orchestrated meshing can produce exponential rates of convergence, thereby allowing complex simulations to be done using orders-of-magnitude fewer unknowns than standard methods.

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Hp-ADAPTIVE FINITE ELEMENT METHODS FOR TIME DEPENDENT PROBLEMS WITH APPLICATIONS TO STRESS WAVES IN SOLIDS

FINAL PROGRESS REPORT

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The University of Texas at Austin

August, 1996

U.S. ARMY RESEARCH OFFICE

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THE UNIVERSITY OF TEXAS AT AUSTIN

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Statement of Problem Studied

The general goals of this project included the development of new, high-order, adaptive methods for the computer simulation of stress-wave propagation phenomena in solid mechanics, particularly elastodynamics. The motivation for using adaptive methodologies is to control and optimize the computational process, to use a posteriori error estimates to optimize meshes and spectral orders of approximation. Such orchestrated meshing can produce exponential rates of convergence, thereby allowing complex simulations to be done using orders-of-magnitude fewer unknowns than standard methods.

Summary of Results

This project has led to a number of completely new and powerful methods for the computer simulation of complex problems, including, in particular, problems of wave propagation. These include the following:

- High-Order Multistage-Taylor Galerkin Methods. These represent one of the only new unconditionally stable high-order time integration schemes developed in decades. They are designed to overcome a well-documented deficiency of splitting methods: the loss of time accuracy due to splitting of boundary conditions.
- A Posteriori Error Estimation Methods. New techniques for the estimation of error in numerical approximations of wave problems in two space dimensions have been developed; theorems have been established to guarantee that rigorous error bounds are possible.
- Adaptive methods. Local error estimates provide data for adaptively changing mesh sizes and spectral orders to optimize hp meshes and accelerate convergence.
- Parallel Discontinuous Methods. A surprisingly parallelizable scheme based on Discontinuous Galerkin methods has been developed and tested on model problems.
- Clouds: A New family of Meshless Methods. Error estimates and preliminary results on the mathematical foundations of a new type of meshless technique for solving partial differential equations have been established.

List of Publications


Participating Scientific Personnel

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