A New Adaptive Element Free Galerkin Algorithm Based on the Background Mesh*

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Abstract

In this work we present an adaptive element free Galerkin procedure based on background mesh for meshless methods using MLS. It comprises a cell energy error estimate and a local domain refinement technique. The error estimate differs from conventional point wise approaches in that it evaluates error based on individual cells instead of points. In this technique, each node is assigned a scaling factor to control local nodal density and achieve high efficiency in domain refinement. Refinement of the neighborhood of a node is accomplished simply by adjusting its scaling factor. Some challenging problems are discussed to show that the proposed adaptive procedure is effective, efficient and convergent.

Keywords: Meshless methods, Adaptive Element Free Galerkin (EFG) method, A posteriori error estimate, Moving Least Squares (MLS) approximation, Crack problem.
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1 Introduction

The Element Free Galerkin (EFG) method [2, 3] may be regarded as an alternative to the finite element method especially for problems with discontinuities, e.g. crack propagation problems. The EFG method differs from the FEM by using the Moving Least Squares (MLS) approximation. In practical implementations, EFG formulation requires a background mesh for domain integration.

A posteriori error estimates, initiated in [1], are computable quantities in terms of the discrete solution and known data that measure the actual discrete errors without the knowledge of exact solutions. They are essential in designing algorithms for mesh refinement which optimize the computation. The ability of error control and the asymptotically optimal approximation property make the adaptive finite element methods attractive for complicated physical and industrial processes.

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