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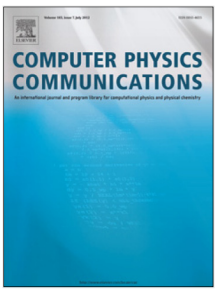

A parallel finite element procedure for contact-impact problems using edge-based smooth triangular element and GPU

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A Parallel Finite Element Procedure for Contact-impact Problems Using Edge-based Smooth Triangular Element and GPU

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Abstract:

The edge-smooth finite element method (ES-FEM) can improve the computational accuracy of triangular shell elements and the mesh partition efficiency of complex models. In this paper, an approach is developed to perform explicit finite element simulations of contact-impact problems with a graphical processing unit (GPU) using a special edge-smooth triangular shell element based on ES-FEM. Of critical importance for this problem is achieving finer-grained parallelism to enable efficient data loading and to minimise communication between the device and host. Four kinds of parallel strategies are then developed to efficiently solve this ES-FEM based shell element formulas, and various optimization methods are adopted to ensure aligned memory access. Special focus is dedicated to developing an approach for the parallel construction of edge systems. A parallel hierarchy-territory contact-searching algorithm (HITA) and a parallel penalty function calculation method are embedded in this parallel explicit algorithm. Finally, the program flow is well designed, and a GPU-based simulation system is developed, using Nvidia's CUDA. Several numerical examples are presented to illustrate the high quality of the results obtained with the proposed methods. In addition, the GPU-based parallel computation is shown to significantly reduce the computing time.

Key words: Smooth finite element; GPU computing; Parallel computing; Contact-impact simulation

1 Introduction

With the development of computing methods and computer technology, finite

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