

Parallel Computing of a Reproducing Kernel Particle Method with Closed Form Shape Functions

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ABSTRACT

In terms of effectiveness, Reproducing Kernel Particle Methods (RKPM), among meshfree methods, have demonstrated its great suitability for structural analysis. This paper presents applications of a RKPM to elasto-dynamical problems after a review of meshfree methods and an introduction to the RKPM. Different from those commonly used shape functions without the Kronecker delta property, new RKP shape functions satisfying the Kronecker delta property are adopted. The effect on accuracy is studied, based on results by using different shape functions.

A geometry-based domain partitioner is developed, and used in parallel computing of the meshfree method. The integration points but not particles are partitioned, in order to achieve higher computing performance. A structure vibration problem in mechanical engineering is analyzed as an illustrative case. The effectiveness and performance with different partitions are then studied, and the comparison of the meshfree method with finite element methods is presented. The computation model and corresponding results are illustrated in Figures 1 to 4.

The parallel simulations are conducted on an SGI Onyx3900 supercomputer and a Dawning TC4000L PC cluster with MPI message passing statements used for all communications among partitions on different processors. The numerical computation shows that: 1) New closed form shape functions led to more accurate results than those functions without the Kronecker delta property; 2) Geometric-based partitioning methods are fast and can give excellent load balance; and 3) Instead of partitioning particles, higher performance can be achieved if integration points are partitioned.

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Fig. 1. Meshfree discretization

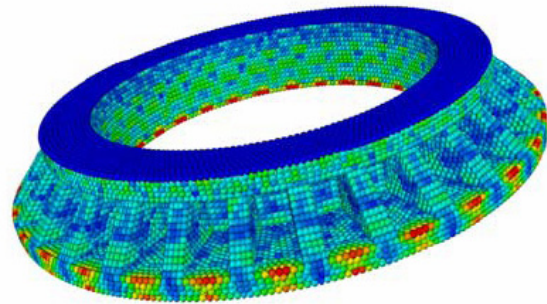


Fig. 2. Structure dynamics response at Step 4

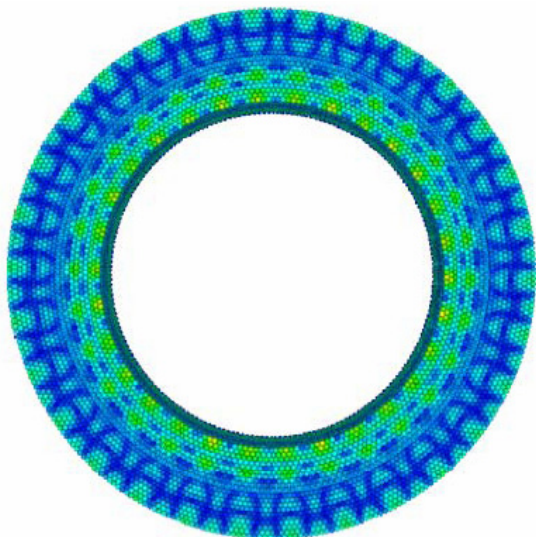


Fig. 3. Dynamics response of the bottom panel at Step 1

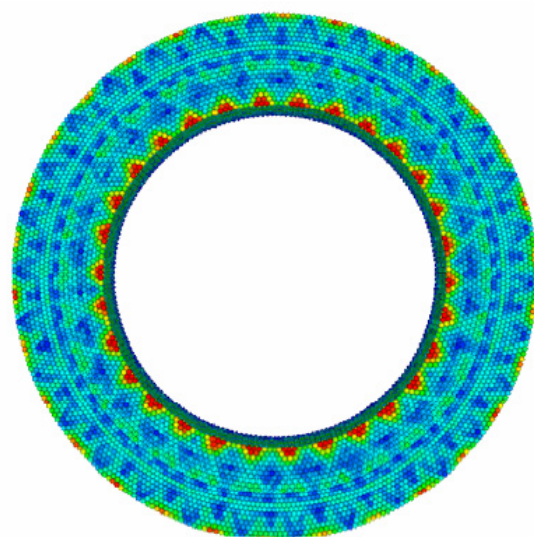


Fig. 4. Dynamics response of the bottom panel at Step 9