Implicit grid-based and meshless MPM formulations

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ABSTRACT

Traditionally, MPM algorithms use a fixed Eulerian background grid and a set of moving Lagrangian material points. While the first is used to perform the finite element calculation, the latter stores the historical variables throughout the calculation.

In the present paper, two different implicit MPM formulations are presented and their performances are compared with traditional FEM benchmarks solutions. The first one uses a classical fixed background grid, which is deformed and reset at every time step. The second one uses a purely Lagrangian meshless approach.

The latter represents the application of the MPM idea to the case in which both the nodes and the material points are considered as Lagrangian. Differently from the grid-based algorithm, the position of the nodes evolves through the whole simulation, so that the nodes preserve their history and can be used to store historical variables. The meshless MPM algorithm represents a very natural generalization of a traditional grid-based one [1].

The practical implication of using Lagrangian nodes is that it is never needed to project quantities from the material points to the nodes. The price paid for such simplification is, however, that the shape functions need to be considered in a purely meshfree fashion so to handle arbitrary variation in the relative position of the nodes.

The grid based and the meshless MPM codes presented are implemented in the Kratos Multiphysics environment [2] and used for the resolution of some typical numerical examples to assess the features of such techniques.

REFERENCES

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