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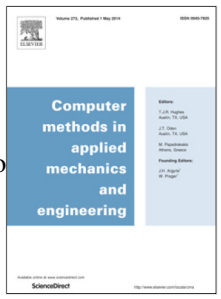

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Coupling of FEM meshes with Peridynamic grids

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Abstract

The paper presents an effective and accurate way to couple FEM meshes to peridynamic grids and uses it to solve 1D, 2D and 3D problems in static and dynamic conditions. Crack propagation with crack branching problems are also solved. An adaptive algorithm is presented which allows to transform FEM nodes into peridynamic nodes. In this way a new computational technique is produced which equips standard FEM with the capability to effectively and efficiently describe 3D problems with crack propagation phenomena.

1. Introduction

The accurate description of large structures, which under complex loads can be affected by different levels of damage in their various parts, may require the capability to couple different computational methods. The ubiquitous presence of cracks in many structures, in particular in aerospace engineering, still represents a challenge for the engineer who wants to simulate the full structural life cycle. Cracks do not satisfy the basic underlying hypothesis of Classical Continuum Mechanics (CCM) i.e. the continuity of the domain where the problem is defined. Many scientists have tried to equip CCM based methods, in particular the Finite Element Method (FEM), with the capability to simulate crack propagation: interface-elements with CZM [1], X-Fem [2], element erosion [3] and phase field theory [4] are probably the most popular approaches, but all of them present some drawbacks [5]. In recent years, Peridynamics based computational methods have been proposed to solve crack propagation problems. Peridynamics (PD) is a non-local continuum theory, based on integro-differential equations, which does not assume spatial differentiability of displacement fields [6][7][8] and introduces the concept of structural damage for a material point. Another non-local theory based on integral equations, but not equipped with a damage concept, can be found in [9]