Application of Mixed Meshless Solution Procedures to Deformation Modeling in Gradient Elasticity

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ABSTRACT

Recently, many modern scientific research investigations are concerned with accurate deformation modeling with the application of a higher-order continuum, utilized to capture phaenomena that cannot be accurately described by using classical continuum models. In elasticity, these phenomena include modeling of size effects, strain localization and stress singularity problems [1]. A numerical solution of the material deformation of the higher-order continuum is today often obtained by employing strain gradient models, and is in that case governed by fourth-order differential equations. Finite element method (FEM) formulations used for solving such problems are often very complicated and have a large number of nodal unknowns, even for the mixed discretization strategies [2]. In this contribution, meshless solution strategies are utilized as an alternative to FEM since the meshless shape functions of any order can be constructed in an easy manner and the formulations for gradient elasticity can have fewer nodal unknowns [3]. In order to further lower the continuity requirements on the approximation functions, the Mixed Meshless Local Petrov Galerkin (MLPG) methods [4,5] are used and applied for modeling the deformation of homogeneous materials. In certain cases the governing equations of gradient elasticity can be even solved as an uncoupled sequence of two sets of second-order differential equations [6]. The application and the performance of the presented solution procedures are demonstrated using appropriate numerical examples.

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