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RBF BASED SOLUTION FRAMEWORK FOR SOLVING MULTIPHYSICS AND MULTISCALE PROBLEMS

Structure of a new meshless solution framework for solving multiphysics and multiscale solid and fluid mechanics problems is presented. The physics on the macroscale is based on the continuum mechanics and on the microscale on the cellular automata principles. The solution procedure is defined on a set of nodes which can be non-uniformly distributed. The domain and boundary of interest are divided into overlapping influence areas. On each of them, the fields are represented by the radial basis functions collocation or least squares approximation on a related sub-set of nodes. The transition rules are defined for a set of nodes on the influence area in case of cellular automata modelling. The timestepping is performed in an explicit way. All governing equations are solved in their strong form, i.e no integrations are performed. The polygonisation is not present. The possible change of the shape of the domain is described by activation of additional nodes and by the movement of the boundary nodes through the computational domain, respectively. The solution can be easily and efficiently adapted in node redistribution and/or refinement sense, which is of utmost importance when coping with fields exhibiting sharp gradients Step by step benchmarking of the method is represented, followed by industrial examples such as casting, rolling, and heat treatment. The results of the new approach are compared with the analytical solutions, well documented benchmark solutions and commercial packages. The method turns out to be extremly simple to code, accurate, inclusion of the complicated physics can easily be looked over. The coding in 2D or 3D is almost identical.

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