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New Approach on Discretization Methods for Mesoscopic Study of Concrete structures

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This paper presents a study for modelling concrete in mesoscopic level by different discretization methods with in-house program CaeFem. Based on heterogeneous structure of concrete, different levels are considered to investigate different effects of crack propagation and crack arresting. Mesoscopic level has been chosen which let us to model different component of concrete like mortar and aggregate separately.

Discretization method will play significant role in analysis since we assumed concrete as a composite material. Finite element method has been used as common discretization methods. However, usual FEM will bring dependency of the discretization on geometry of each component in model. This is only possible with irregular meshes with basically degraded accuracy. Furthermore, excessively fine discretizations occur to picture the random mesoscopic geometry. Such drawbacks are already evident in 2D but tighten in 3D. Thus, the paper aims at decoupling of mesoscopic geometry and discretization.

New discretization methods have been developed which are quite new with high potential of flexibility. Three methods, regardless of geometry and topology of inclusions, which are FEM method with regular mesh, Element Free Galerkin method and Isogeometric method are studied in these paper. These methods have new philosophy of solving problems with fast algorithms and help of different approaches.

Several analysis cases regarding nonlinearity in material properties are considered. Sensitivity analysis is performed based on different discretization methods in CaeFem for the reference cases. The resultant behaviours are compared and verified versus obtained results from a commercial FEM-program DIANA.

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