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MODELING OF HETEROGENEOUS MATERIALS USING A MESOSCOPIC SCALE FINITE ELEMENT ANALYSIS

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This work presents a two-dimensional meso-scale model that captures some features of the mechanical behavior of heterogeneous material. First, it intends to describe the behavior of a metallic material using Von Mises elasto-plastic model with linear strain hardening. In rupture stages, some microcracks are created. Therefore, it is adopted a modified cohesive fracture model in order to simulate the cracking process until complete failure. Also, the mechanical behavior of a porous metallic composite material is investigated. The Representative Volume Element consists of elastic inclusions or cavities idealized as circular shapes placed into the metallic matrix in order to investigate the behavior of the RVEs. The interface zone, surrounding the inclusions, is modeled by means of cohesive contact finite elements in order to capture the effects of phase debonding and interface crack closure/opening [1]. The same cohesive contact finite elements are used to model the cracking process on the matrix. In the other hand, linear 3-noded triangle elements are used to model the matrix and inclusions. All simulations in this section have been performed by employing the computational homogenization under the plane stress assumption in small strain regime. The average stress is obtained by imposing the macro-strain over the RVE and subsequently solving the microscopic initial boundary value problem for the defined boundary condition assumed. The analyses are performed under two different boundary conditions: linear and periodic boundary displacement fluctuations.

Our main goal here is to show a computational homogenization-based approach [2] as an alternative to complex macroscopic constitutive models for the mechanical behavior of the ductile porous materials using a finite element procedure within a purely kinematical multi-scale framework. In summary, the proposed homogenization-based model is found to be a suitable tool for the identification of macroscopic constitutive response of this kind of material.

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