Identification of heterogeneous elastoplastic behaviors using constitutive equation gap method

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ABSTRACT

Cohesive zones models are commonly used in numerical simulations to take into account the onset and the propagation of microcracks leading to the fracture of materials. Their numerical implementation in finite element schemes is based on embedding surface traction-separation law between two adjacent bulk elements. The traction between two neighboring elements is linked to the corresponding opening by a cohesive relationship.

The objective of the work reported here is to extend the approach developed in [1, 2] to identify the shape and parameters of the cohesive zone models in metal matrix composites with brittle inclusions and adapt this method to the study of initially heterogeneous material (*e.g.* graded metals or ceramics).

To treat these applications where mechanical fields are heterogeneous, local stress fields are to be estimated in addition to conventional kinematic fields to build the energy balance associated with the transformation. Here we propose to estimate these fields by an identification method using kinematic and thermal data from imaging. The proposed method is based on the minimization of a functional associated with the error in constitutive relation (Constitutive equation gap method) [3]. In its classical (mechanical) formulation, this functional depends on two sets of parameters: the stress field and the mechanical material properties (elasticity, plasticity, damage).

We show here that the identification procedure is capable to estimate the stress fields and material properties for elastic and elastoplastic behavior. The method was applied on noisy measured displacement fields to assess its robustness in the case of elastic behavior. The method is now being extended to damageable plasticity. The introduction of a second (calorimetric) term in the functional, related to the heat sources is also examined.

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