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CONTINUUM MULTI-SCALE (FE^2) MODELING OF MATERIAL FAILURE IN CONCRETE-LIKE MATERIALS

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Two-scale computational modeling of materials is a subject of increasing interest in computational mechanics, particularly, two-scale computational modeling of *material failure* is more controversial, and exhibits additional complexity. Either if discrete approaches, or continuum approaches are used at the lower scale, the kinematic description of some, or both, scales cannot be considered smooth anymore, and the existence of the RVE can be questioned arguing that, in this case, the material loses the statistical homogeneity. A crucial consequence of this issue is the lack of objectivity of the results with respect to the size of the RVE. In (Drago and Pindera 2007) a recent attempt to overcome this flaw, for regularized non-local models, can be found This work is an attempt to address this issue in the setting of the Continuum Strong Discontinuity Approach (CSDA) to material failure, developed by the authors in the past (Oliver, Huespe et al. 2002).

The essentials of the proposed approach are:

1. At the macroscopic level, material failure is captured via strain-localization and finite elements with embedded regularized strong discontinuities.

2. A failure-cell at the microscopic scale, with the same size and topological properties than the RVE is associated to material points at the strain-localizing part of the macrostructure. This failure-cell is enriched with appropriated material failure mechanisms with, apparently, no restriction on their type. Though, for the sake of simplicity, cohesive-bands with a predefined position have been used in this work, there is no "a priori" limitation on using more sophisticated material failure mechanisms, e.g. arbitrarily propagating cracks or strong discontinuities. In contrast, this failure-cell is not claimed to be a RVE, in the sense of being statistically representative of any part of the macrostructure, although standard homogenization procedures are applied to it.

The proposed approach was validated and tested with a wide number of representative examples, one of them considered as a classical benchmark in concrete structures, this is the case of the Nooru-Mohammed test.

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