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## CONTINUUM MULTI-SCALE MODELING OF FRACTURE IN CEMENTITIOUS-LIKE MATERIALS

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Two-scale computational modelling of materials is a subject of increasing interest in computational mechanics. When dealing with materials displaying a spatially smooth behaviour there is some consensus, and several approaches to the problem are available in the literature. For instance, the so-called FE<sup>2</sup> methods is nowadays one of the most popular approaches.

This work is an attempt to address this issue in the setting of the Continuum Strong Discontinuity Approach (CSDA) to material failure (Oliver, Huespe et al. 2002). The essentials of the method 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.
3. It is proven that homogenization of the RVE and failure-cell returns a macroscopic constitutive model (stress vs. strain) with the same format than classical inelastic strain-based phenomenological models. In addition, an internal-length arises from that homogenization procedure, and it is naturally determined by the size of the chosen RVE and the amount of activated material failure mechanisms at the microstructure, the macrostructure is equipped with finite elements with embedded regularized strain-localization and displacement-discontinuities.

It is worth nothing that using this method, complete insensitivity of the structural response with respect to the RVE size, the macro and micro FE meshes is achieved, also a consistent dissipation at both scales is preserved, and material failure properties like the fracture energy, are consistently up-scaled. The proposed approach has been validated and tested with a number of representative examples.