An incremental-secant mean-field homogenization scheme for elasto-plastic and damage-enhanced elasto-plastic composite materials

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This paper presents an incremental secant mean-field homogenization process for composite materials made of elasto–plastic constituents, which can exhibit damage. In this formulation, the residual stress and strain states reached in the phases upon a fictitious elastic unloading, are considered as starting point to apply the secant method. The mean stress fields in the phases are then computed using isotropic secant tensors, which are naturally used to define the Linear Comparison–Composite.

The method, remains simple in its formulation, is applied on various problems involving elastic, elasto–plastic and perfectly–plastic phases, to demonstrate its accuracy compared to other existing MFH methods. The method is particularly attractive when the damaging process is accounted for in the matrix phase. Indeed, during the damaging process of one phase, the secant method can account for the resulting unloading of the other phase, ensuring an accurate prediction of the scheme, when compared to direct numerical simulations.