

Can quasi-static evolutions of perfect plasticity be derived from brittle damage evolutions?

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Abstract

This talk addresses the question of the interplay between relaxation and irreversibility through evolution processes in damage mechanics, by inquiring the following question: can the quasi-static evolution of an elastic material undergoing a process of plastic deformation be derived as the limit model of a sequence of quasi-static brittle damage evolutions ?

This question is motivated by the static analysis led in [1], where the authors have shown how the brittle damage model introduced by Francfort and Marigo (see [4]) can lead to a model of (Hencky) perfect plasticity. Problems of damage mechanics being rather described through evolution processes, it is natural to extend this analysis to quasi-static evolutions, where the inertia is neglected. We consider the case where the medium is subjected to time-dependent boundary conditions, in the one-dimensional setting. The idea is to combine the scaling law introduced in [1] with the quasi-static brittle damage evolution introduced in [3] by Francfort and Garroni, and try to understand how the irreversibility of the damage process will be expressed in the limit evolution.

Surprisingly, the interplay between relaxation and irreversibility of the damage is not stable through time evolutions. Indeed, depending on the choice of the prescribed Dirichlet boundary condition, the effective quasi-static damage evolution obtained may not be of perfect plasticity type.

References

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