Quasi-static evolution problems in plasticity with softening

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Resumen

In plasticity theory the term softening refers to the reduction of the yield stress as plastic deformation proceeds. We deal with this problem in the quasi-static case, in the framework of small strain associative elasto-plasticity. The presence of a nonconvex term due to the softening phenomenon requires the extension of a variational framework proposed by Mielke to the case of a nonconvex energy functional. In this problem the use of global minimizers in the corresponding incremental problems is not justified from the mechanical point of view. We analyze a different selection criterion for the solutions of the quasi-static evolution problem, based on a viscous approximation. In view of the nonconvexity of the problem, taking the limit as the artificial viscosity parameter tends to zero leads to a weak formulation of the problem in a space of Young measures. Moreover, since the growth exponent of the energy is one, we need a suitable notion of generalized Young measure in order to deal with concentration effects. Finally, the classical notion of total variation of a time-dependent function on a time interval has to be extended to time-dependent families of Young measures. This enables us to define, in this generalized context, a notion of dissipation, which plays a crucial role in Mielke's variational approach. Some examples show that smooth initial data may lead, after a critical time, to a Young measure solution with concentration phenomena. These results have been obtained in collaboration with Antonio DeSimone, Maria Giovanna Mora and Massimiliano Morini.