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Variational and quasivariational solutions for quasilinear equations with gradient constraint

We prove existence of solution for evolutionary variational and quasivariational inequalities defined by a first order quasilinear operator and a variable convex set, characterized by a constraint on the absolute value of the gradient (which, in the quasi-variational case, depends on the solution itself). The only required assumption on the nonlinearity of this constraint is its continuity and positivity. The method relies on an appropriate parabolic regularization and suitable a priori estimates. Uniqueness of solution is proved for the variational inequality. We also obtain existence of stationary solutions, by studying the asymptotic behaviour in time.

We shall illustrate a simple "sand pile" example in the variational case for the transport operator were the problem is equivalent to a two-obstacles problem and the solution stabilizes in finite time. Further remarks about these properties of the solution will be presented.

This is a joint work with Jos Francisco Rodrigues.