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# Nonconvex Energy Functions: Applications in Engineering

## Preface

The field of Engineering problems involving nonconvex energy function has seen a considerable development in recent years. This is mainly due to the fact that new, very efficient, mathematical tools taken from Global Optimization and applied to this field, proved beneficial to the promotion of scientific thought and methodology in this area. Moreover open problems have been solved and entirely new categories of interesting questions in Applied Mechanics and in several branches of Engineering Sciences have been mathematically formulated, studied and / or numerically treated.

The nonconvex and possibly nonsmooth energy functions arise in engineering problems from the need of a more accurate description of the phenomenon under consideration. We can mention here, among others, the adhesive contact problem with debonding, the nonmonotone friction problem, the contact problem with a granural support, the behaviour of reinforced concrete structures in tension, the behaviour of fiber reinforced materials, the nonmonotone semipermeability problems in temperature control and hydraulics, the nonlinear flow problems in networks etc. The nonsmoothness of the energy functions leads to "generalized force"- "generalized velocity" diagrams which are nonmonotone and multivalued. Every "multivaluedness" corresponds to the transition from one "phase" to the next one. The global or local nonconvexity corresponds to instability effects which influence the behaviour of the system under study. The rational treatment of the nonconvexity and nonsmoothness of the energy function of an engineering system is thus necessary in order to correctly deal with the development and evolution of the free boundaries between the different phases of it. This is achieved both form the theoretical and the numerical point of view by applying the tools of nonsmooth, nonconvex Optimization like the generalized gradient, the quasidifferential etc. and the results of the theory of hemivariational inequalities which constitute generalization of the classical variational inequalities in the case of lack of convexity.

In order to promote research in the area we present to the readership of the Journal of Global Optimization this special issue featuring the theoretical and numerical aspects of problems in Engineering Sciences involving nonconvex energy functions.

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