SPECIAL ISSUE OF JOURNAL OF OPTIMIZATION THEORY AND APPLICATIONS

TITLE: **Calculus of Variations in Mechanics and Related Fields**

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MOTIVATIONS

Continuum mechanics, intended as a collective name for a set of interconnected classical field theories, is a stimulating playground for calculus of variations. In turn, problems emerging in mechanics suggest the need of new abstract analytical developments; the impulse to the analysis of polyconvex energies, determined by nonlinear elasticity, is a paradigmatic example. In addition, variational techniques allow us to interpret in unusual way even processes, avoiding direct recourse to time. In fact, by calling upon minimization of functionals, we instinctively refer to equilibrium configurations corresponding to the minimizers of some energy, rather than processes. However, we may select a sequence of states into a process and imagine passing from a step to another by minimizing a certain functional. This is De Giorgi's idea of minimizing paths; it requires the subsequent analysis of the limit obtained by letting to zero the distance between subsequent steps, often the most difficult analytical aspect. Moreover, we may look at a motion of a certain classes of bodies as geodesics over an appropriate space, as in the case of perfect simple fluids and the Lie group of volume-preserving diffeomorphisms. Also, measures may parameterize sets of possible shapes for a body (simple or complex it be) and a minimization principle selects admissible configurations for certain energies and the imposed conditions. In this view, e.g., vector-valued measures admitting a generalized notion of curvature (namely, varifolds) play a crucial role in parameterizing the class of possible fractured shapes of a body. They enter a generalized form of Griffith's energy, which includes curvature effects. The minimization of such an energy allows us to select the (possibly fractured) shape of a body, determined by boundary and initial conditions. It result a variegate variational view on crack nucleation, a dissipative process, indeed. Moreover, besides fracture nucleation, other dissipative phenomena, such as plasticity, damage, pseudo-elasticity, admit variational descriptions even in terms of gradient flows. All these examples offer at least a direct perception of variety and richness of the scenario hosting the meeting between mechanics and calculus of variations.

With this proposed special issue, we aim at portraying an overview of recent research trends on this matter, with results opening future work.

Calculus of variations in mechanics and related fields
This special issue of JOTA collects papers on recent trends in the variational description of classes of mechanical phenomena and related analytical techniques. It includes primarily invited contributions but is also open to free submissions.

Specific topics of interest are (but not limited to)

- Calculus of Variations
- Regularity Theory
- Nonlinear elasticity
- Shape Optimization
- Gradient Flows
- Mechanics of Complex Materials
- Control and Dynamical Systems

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