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M. Buliga
Inst. of Mathematics, Romanian Academy, P.O. Box 1-764, 014700 Bucharest, Romania
Marius.Buliga@imar.ro

G. de Saxcé
Lab. de Mécanique, UMR CNRS 8107, Université des Sciences et Technologies de Lille, Cité Scientifique, 59655 Villeneuve d'Ascq, France
gery.desaxce@univ-lille1.fr

C. Vallée
Lab. de Mécanique des Solides, UMR 6610 - UFR SFA-SP2MI, Bvd. M. et P. Curie, Téléport 2 - BP 30179, 86962 Futuroscope-Chasseneuil, France
vallee@lms.univ-poitiers.fr

Existence and Construction of Bipotentials for Graphs of Multivalued Laws

Based on an extension of Fenchel inequality, bipotentials are non smooth mechanics tools, used to model various non associative multivalued constitutive laws of dissipative materials (friction contact, soils, cyclic plasticity of metals, damage).
Let X, Y be dual locally convex spaces, with duality product $\langle \cdot, \cdot \rangle : X \times Y \to \mathbb{R}$. Given the graph $M \subset X \times Y$ of a multivalued law $T \colon X \to 2^Y$, we state a simple necessary and sufficient condition for the existence of a bipotential b for which M is the set of (x, y) such that $b(x, y) = \langle x, y \rangle$.
If this condition is fulfilled, we use convex lagrangian covers in order to construct such a bipotential, generalizing a theorem due to Rockafellar, which states that a multivalued constitutive law admits a superpotential if and only if its graph is cyclically monotone.

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