Nonsmooth Lagrangian Mechanics

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We use variational techniques to approach the problem of rigid-body dynamics with impact. The smooth Lagrangian mechanics is extended to the nonsmooth context and symplecticity, conservation of the extended Lagrange 1-form and a version of the Noether's theorem are derived.

Based on the Veselov theory of discrete mechanics, we develop a symplectic-momentum preserving variational integrator which exactly captures the impact and which is perfectly consistent with the continuous theory. We test the algorithm on two selected examples and recover the excellent long-time stable energy behavior typical of variational methods.