A momentum-energy integrator for nonholonomic dynamics

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Here we propose a geometric integrator for nonholonomic mechanical systems. It can be applied to discrete Lagrangian systems specified through a discrete Lagrangian $L_d\colon Q\times Q \to \mathbb{R}$, where Q is the configuration manifold, and a (generally nonintegrable) distribution $D \subset TQ$. A discretization of the constraints is not required for the proposed method. We show that the integrator preserves the discrete nonholonomic momentum map, and also that the constraints are preserved in average. We study in particular the case where $Q = G$ is a Lie group and the discrete Lagrangian and/or nonholonomic constraints have various invariance properties, and show that the method is also energy-preserving in some important cases.