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Discrete Dirac Structures and Variational Discrete Dirac Mechanics.

We construct discrete Dirac structures by considering the geometry of symplectic maps and their associated generating functions, in a manner analogous to the construction of continuous Dirac structures in terms of the geometry of symplectic vector fields and their associated Hamiltonians. We demonstrate that this framework provides a means of deriving implicit discrete Lagrangian and Hamiltonian systems, while incorporating discrete Dirac constraints. In particular, this yields implicit nonholonomic Lagrangian and Hamiltonian integrators.

We also introduce a discrete Hamilton–Pontryagin variational principle on the discrete Pontryagin bundle, which provides an alternative derivation of the same set of integration algorithms. In so doing, we explicitly characterize the discrete Dirac structures that are preserved by Hamilton–Pontryagin integrators. In addition to providing a unified treatment of discrete Lagrangian and Hamiltonian mechanics in the more general setting of Dirac mechanics, it provides a generalization of symplectic and Poisson integrators to the broader category of Dirac integrators. (Received August 30, 2008)