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Difference Discrete Variational Principles, Euler-Lagrange Cohomology and Symplectic, Multisymplectic Structures I: Difference Discrete Variational Principle

GUO Han-Ying,[1] LI Yu-Qi,[1] WU Ke[1,2] and WANG Shi-Kun[3]

[1] Institute of Theoretical Physics, Academia Sinica, P.O. Box 2735, Beijing 100080, China
[2] Department of Mathematics, Capital Normal University, Beijing 100037, China
[3] Institute of Applied Mathematics, Academy of Mathematics and System Sciences, Academia Sinica, P.O. Box 2734, Beijing 100080, China
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Abstract: In this first paper of a series, we study the difference discrete variational principle in the framework of multi-parameter differential approach by regarding the forward difference as an entire geometric object in view of noncommutative differential geometry. Regarding the difference as an entire geometric object, the difference discrete version of Legendre transformation can be introduced. By virtue of this variational principle, we can discretely deal with the variation problems in both the Lagrangian and Hamiltonian formalisms to get difference discrete Euler-Lagrange equations and canonical ones for the difference discrete versions of the classical mechanics and classical field theory.

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