2002 Vol.37 No.3 pp.257-264 DOI:

Difference Discrete Variational Principles, Euler-Lagrange Cohomology and Symplectic, Multisymplectic Structures III: Application to Symplectic and Multisymplectic Algorithms

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
(Received: 2001-6-6; Revised:)

Abstract: In the previous papers I and II, we have studied the difference discrete variational principle and the Euler-Lagrange cohomology in the framework of multi-parameter differential approach. We have gotten the difference discrete Euler-Lagrange equations and canonical ones for the difference discrete versions of classical mechanics and field theory as well as the difference discrete versions for the Euler-Lagrange cohomology and applied them to get the necessary and sufficient condition for the symplectic or multisymplectic geometry preserving properties in both the Lagrangian and Hamiltonian formalisms. In this paper, we apply the difference discrete variational principle and Euler-Lagrange cohomological approach directly to the symplectic and multisymplectic algorithms. We will show that either Hamiltonian schemes or Lagrangian ones in both the symplectic and multisymplectic algorithms are variational integrators and their difference discrete symplectic structure-preserving properties can always be established not only in the solution space but also in the function space if and only if the related closed Euler-Lagrange cohomological conditions are satisfied.

PACS: 02.30.Xx. 02.70.-c, 11.10.Ef
Key words: discrete variation, Euler-Lagrange cohomology, symplectic algorithm, multisymplectic algorithm

[Full text: PDF]

Close