Symmetries for the Ablowitz-Ladik hierarchy: II. Integrable discrete nonlinear Schrödinger equation and discrete AKNS hierarchy

Da-jun Zhang, Shou-ting Chen

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In the paper we continue to consider symmetries related to the Ablowitz-Ladik hierarchy. We derive symmetries for the integrable discrete nonlinear Schr\"odinger hierarchy and discrete AKNS hierarchy. The integrable discrete nonlinear Schr\"odinger hierarchy are in scalar form and its two sets of symmetries are shown to form a Lie algebra. We also present discrete AKNS isospectral flows, non-isospectral flows and their recursion operator. In continuous limit these flows go to the continuous AKNS flows and the recursion operator goes to the square of the AKNS recursion operartor. These discrete AKNS flows form a Lie algebra which plays a key role in constructing symmetries and their algebraic structures for both the integrable discrete nonlinear Schr\"odinger hierarchy and discrete AKNS hierarchy. Structures of the obtained algebras are different structures from those in continuous cases which usually are centerless Kac-Moody-Virasoro type. These algebra deformations are explained through continuous limit and \textit{degree} in terms of lattice spacing parameter h.

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