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On the Lagrangian structure of the discrete isomonodromic and isospectral dynamics

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Abstract

Using the generalization of the Moser–Veselov approach to the integrability of discrete dynamical systems we study a class of discrete integrable systems generated by the re-factorization transformations of rational matrix functions on the Riemann sphere. Our main result is that such systems are Lagrangian and, in the 2-pole case, we give an explicit formula for the Lagrangian function. One natural framework in which such systems appear is the theory of isomonodromic transformations of linear difference equations. It was shown by A. Borodin that in some cases these transformations reduce to the difference Painlevé equations. We consider in detail one such example that results in dP-V showing that dP-V can be written in the Lagrangian form.