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Lagrangian multiform structure of KP type systems

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The notion of Lagrangian multiforms was introduced in [1] to provide a variational formalism for systems integrable in the sense of multidimensional consistency (MDC). Initially set up for integrable systems in 1+1 dimensions (Lagrangian 2-forms) and 1+0 dimensions (Lagrangian 1-forms, cf. [3]), the first example of a 2+1-dimensional/3-dimensional case (Lagrangian 3-forms) was established in the fully discrete, [2], and fully continuous case, [4], of the KP system. Semi-discrete KP systems were so far not covered, and the fully discrete case was mainly related to the bilinear form of KP, not the more natural nonlinear KP form. In this talk I will give a brief review of the ideas behind the Lagrangian multiform theory, and present an arguably more natural multiform description of the KP systems which covers all cases from fully discrete to fully continuous. Furthermore, I will discuss their reductions to lower-dimensional systems, including the already established 1-form structure of the (discrete and continuous-time) Calogero-Moser system, cf. [3].

References

[1] S. Lobb and F.W. Nijhoff, "Lagrangian multiforms and multidimensional consistency" *J. Phys. A: Math Theor* **42**, 454013 (2009).

[2] S. Lobb, F.W. Nijhoff and G.R.W. Quispel, Lagrangian multiform structure for the lattice KP system, *J. Phys. A: Math. Theor.* **42** 472002 (2009).

[3] S. Yoo-Kong, S. Lobb and F.W. Nijhoff, "Discrete-time Calogero-Moser systems and Lagrangian 1-form structure", *J. Phys. A: Math. Theor.* **44** 365203 (2011).

[4] D. Sleigh, F.W. Nijhoff and V. Caudrelier, "Lagrangian multiforms for Kadomtsev-Petviashvili (KP) and the Gel'fand-Dickey hierarchy", *Int. Math. Res. Notices* Vol. 2021, 1–41 (2021).

[5] F.W. Nijhoff, "Lagrangian multiform structure of discrete and semi-discrete KP systems", in preparation.