

New Identities for Differential-polynomial Structures built from Jacobian Determinants

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The Nambu-determinant Poisson brackets on \mathbb{R}^d are expressed by the formula

$$\{f, g\}_d(\mathbf{x}) = \varrho(\mathbf{x}) \cdot \det(\partial(f, g, a_1, \dots, a_{d-2})/\partial(x^1, \dots, x^d)),$$

where a_1, \dots, a_{d-2} are smooth functions and x^1, \dots, x^d are global coordinates (e.g., Cartesian), so that $\varrho(\mathbf{x}) \cdot \partial_{\mathbf{x}}$ is the top-degree multivector.

For an example of Nambu-Poisson bracket in classical mechanics, consider the Euler top with $\{x, y\}_3 = z$ and so on cyclically on \mathbb{R}^3 .

Independently, Nambu's binary bracket $\{-, -\}_d$ with Jacobian determinant and $d-2$ Casimirs a_1, \dots, a_{d-2} belong to the Nambu (1973) class of N -ary multi-linear antisymmetric polyderivational brackets $\{-, \dots, -\}_d$ which satisfy natural N -ary generalizations of the Jacobi identity for Lie algebras.

In the study of Kontsevich's infinitesimal deformations of Poisson brackets by using 'good' cocycles from the graph complex, we detect case-by-case that these deformations preserve the Nambu class, and we observe new, highly nonlinear differential-polynomial identities for Jacobian determinants over affine manifolds. In this talk, several types of such identities will be presented.

(Work in progress, joint with M.-Jagoe Brown, F.-Schipper, and R.-Buring; special thanks to the Habrok high-performance computing cluster.)

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