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Matsyuk, R. Ya. (UKR-AOS-A2)

Differential geometric mechanisms in Ostrohradskyj relativistic spherical top dynamics. (English, Russian, Ukrainian summaries)

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Summary: "Applications of the higher-order variational calculus to some classical models of a relativistic particle motion began in 1937 and continue today. The differential geometry of Ostrogradskiĭ's mechanics has been an object of renewed interest among contemporary mathematicians for the last three decades. In the present article, we demonstrate the work of some intrinsic tools of the formal theory of variational equations in application to one specific example, namely, the third-order evolution equation of a free relativistic top in three-dimensional space-time. The main goal is to introduce a combined approach of simultaneous utilization of symmetry principles and inverse variational problem considerations in terms of vector-valued differential forms. Next, some simple algorithm of transition from the autonomous variational problem to the variational problem in parametric form is established. The example solved completely shows the non-existence of a globally and intrinsically defined Lagrangian for the Poincaré-invariant and well-defined unique variational equation in the case in hand. The Hamiltonian counterpart in terms of the Poisson bracket is discussed too. The model appears to provide a generalized canonical description of a quasi-classical spinning particle governed by the Mathisson-Papapetrou equations in flat space-time."