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Multisymplectic Geometry and Noether Symmetries for the Field Theories and the Relativistic Mechanics

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Abstract : The problem of symmetries in field theory has been analyzed using geometric frameworks, such as the multisymplectic models by using in particular the multivector field formalism. In this paper, we expand the vector fields associated to infinitesimal symmetries which give rise to invariant quantities as Noether currents for classical field theories and relativistic mechanic using the multisymplectic geometry where the Poincaré-Cartan form has thus been greatly simplified using the Second Order Partial Differential Equation (SOPDE) for multi-vector fields verifying Euler equations. These symmetries have been classified naturally according to the construction of the fiber bundle used. In this work, unlike other works using the analytical method, our geometric model has allowed us firstly to distinguish the angular moments of the gauge field obtained during different transformations while these moments are gathered in a single expression and are obtained during a rotation in the Minkowsky space. Secondly, no conditions are imposed on the Lagrangian of the mechanics with respect to its dependence in time and in qⁱ, the currents obtained naturally from the transformations are respectively the energy and the momentum of the system.

Keywords : conservation laws, field theories, multisymplectic geometry, relativistic mechanics
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