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FIELD OF FRAMES AS DYNAMICAL VARIABLE FOR NONLINEAR MODELS OF BORN-INFELD TYPE ON PRODUCT MANIFOLDS

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Abstract. We analyse a model based on the field of linear frames on an m-dimensional manifold M. The model is invariant under the natural action of $\mathrm{GL}(m,\mathbb{R})$. It results in a modified Born-Infeld-type nonlinearity of field equations.

In a special case corresponding to $M = G \times N$, where G is a semisimple Lie group acting freely and transitively on a manifold N, we find two families of solutions of the field equations. Constructing these solutions we exercise some concepts and notions related to the Lie groups theory, such as the left-invariant vector fields on G, the adjoint representation of G or the action of G on N.

1. Introduction

In [15]–[17] Sławianowski proposed an alternative model of gravitation, strictly speaking, some unifying field-theoretic system where geometrical (gravitational) degrees of freedom are described by components of the field of linear frames $\boldsymbol{E}$ on a "space time" manifold M of dimension m (the tetrad field if $m = 4$).

Commonly applied theories of gravitation with the field of frames as a primary dynamical field (i.e., a field subject to the variational procedure) e.g. the Einstein theory formulated in tetrad terms or the general metric-teleparallel theories [9], [11]–[13] are invariant under the natural action of pseudo-Euclidean subgroups $\mathrm{SO}(k, m-k)$ of $\mathrm{GL}(m,\mathbb{R})$ ($\mathrm{SO}(1,3)$ in the physical case where $m = 4$). Unlike this, the field of frames $\boldsymbol{E}$ in the approach suggested by Sławianowski is ruled by $\mathrm{GL}(m,\mathbb{R})$ rather than by its subgroup $\mathrm{SO}(k, m-k)$. This extension of the