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Skew-Symmetric Prolongations of Lie Algebras and Applications

We study the skew-symmetric prolongation of a Lie subalgebra $\mathfrak{g} \subseteq \mathfrak{so}(n)$, in other words the intersection $\Lambda^3 \cap (\Lambda^1 \otimes \mathfrak{g})$. We compute this space in full generality. Applications include uniqueness results for connections with skew-symmetric torsion and also the proof of the Euclidean version of a conjecture by Figueroa-O'Farrill and Papadopoulos concerning a class of Plücker-type embeddings. We also derive a classification of the metric k-Lie algebras (or Filipov algebras), in positive signature and finite dimension. Next we study specific properties of invariant 4-forms of a given metric representation and apply these considerations to classify the holonomy representation of metric connections with vectorial torsion, that is with torsion contained in $\Lambda^1 \subseteq \Lambda^1 \otimes \Lambda^2$.

Keywords: Skew-symmetric prolongation, connection with skew symmetric, vectorial torsion.

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