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Higher order Utiyama's theorem

Abstract: We prove higher order version of the Utiyama's theorem. To prove the Utiyama's theorem in order $r \geq 2$ we have to use auxiliary classical connections on base manifolds. We prove that any natural (invariant) operator of order r for principal connections on principal G -bundles and for classical connections on base manifolds with values in a $(1, 0)$ -order G -gauge-natural bundle factorizes through curvature tensors of both connections and their covariant differentials, where the covariant differential of curvature tensors of principal connections is considered with respect to both connections.