Lie algebroid approach to torsions on certain gauge-like prolongations

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The r-th principal (or gauge-natural) prolongation $W^r P$ of a principal bundle $P(M, G)$ is the fiber product of the r-th order frame bundle $P^r M$ of M and the r-th jet prolongation $J^r P$ of P. This is a principal bundle over M and its Lie algebroid satisfies $L(W^r P) = J^r(LP)$, where LP means the Lie algebroid of P. The torsion of a principal connection on $W^r P$ can be defined either as the covariant exterior differential of the canonical one-form of $W^r P$ or, equivalently, by using the bracket of $J^r(LP)$. For every fiber product preserving bundle functor F on the category of fibered manifolds and their morphisms with local diffeomorphisms as base maps, we constructed similarly a principal bundle $W^F P$, which can be called a gauge-like prolongation of P. In the case $F = J^r$, $W^F P$ coincides with $W^r P$. An analogous problem concerning torsions of connections on $W^F P$ for some special types of F will be discussed in the lecture.