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Algebro-geometric models for the spaces of unparametrized paths

In several applications such as string theory, one has to deal with the spaces of paths or loops in a manifold X defined up to reparametrization. Such quotienting by reparametrization is usually quite difficult to perform. On the other hand, the holonomy of any connection along a path is obviously reparametrization invariant. This allows us to define an algebro-geometric object Π_X which can be considered as the formal neighborhood of X (punctual paths) in the space (groupoid) of reparametrization equivalence classes of paths in X. This is done by a version of Tannakian duality for the tensor category of vector bundles on X with not necessarily flat connections. In particular, $\mathcal{P}_X$, the Lie algebroid of the groupoid Π_X is the universal receptacle of "higher covariant derivatives of the curvature" of various connections. It can be considered as a noncommutative analog of the sheaf of vector fields. When X is a smooth projective variety, we establish a relation of Π_X with the moduli stack of stable curves of Kontsevich.