Abstract

This thesis consists of four papers on the topics of free loop spaces, Koszul duality and A_∞-algebras.

In Paper I we consider a definition of differential operators for noncommutative algebras. This definition is inspired by the connections between differential operators of commutative algebras, L_∞-algebras and BV-algebras. We show that the definition is reasonable by establishing results that are analoguous to results in the commutative case. As a byproduct of this definition we also obtain definitions for noncommutative versions of Gerstenhaber and BV-algebras.

In Paper II we calculate the free loop space homology of $(n-1)$-connected manifolds of dimension of at least $3n-2$. The Chas-Sullivan loop product and the loop bracket are calculated. Over a field of characteristic zero the BV-operator is determined as well. Explicit expressions for the Betti numbers are also established, showing that they grow exponentially.

In Paper III we restrict our coefficients to a field of characteristic 2. We study the Dyer-Lashof operations that exist on free loop space homology in this case. Explicit calculations are carried out for manifolds that are connected sums of products of spheres.

In Paper IV we extend the Koszul duality methods used in Paper II by incorporating A_∞-algebras and A_∞-coalgebras. This extension of Koszul duality enables us to compute free loop space homology of manifolds that are not necessarily formal and coformal. As an example we carry out the computations for a non-formal simply connected 7-manifold.