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Poster Characterization of representation up to homotopy of double groupoids pp.: 1–4

Characterization of Representation up to Homotopy of Double Groupoids

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Abstract

In this paper, we introduce the concept of representation of double Lie groupoids and characterize them by Lie groupoid cohomology and using this result to introduce representations up to homotopy of double Lie groupoids.

Keywords: Double Lie groupoid, Representation up to homotopy, Lie groupoid cohomology, gauge-equivalent.
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1 Introduction

The theory of representation of Lie groupoids is extend by Gracia-Saz and Mehta, [2] and we would like to extend their results on double Lie groupoids.

Let $G \underset{s}{\overset{t}{\rightrightarrows}} M$ be a Lie groupoid, let $G^{(0)} := M$, and $G^{(p)}$ be the manifold consisting of composable p-tuples of elements of G, where $p > 0$, i.e.

$$G^{(p)} := \{(g_1, \cdots, g_p) : s(g_i) = t(g_{i+1})\}.$$

There is a coboundary operator $\sigma : C^p(G) \to C^{p+1}(G)$ on the space of $\mathbb{R}$-valued smooth groupoid cochains $C^p(G) := C^\infty(G^{(p)})$, which introduced by C. Arias Abad and M. Crainic, [3]. We know that $\sigma^2 = 0$, and then the cohomology of the complex $(C^\bullet(G), \sigma)$ is known as the smooth groupoid cohomology of G.

For $E \to M$ and $F \to M$ as a vector bundles, the space of smooth groupoid p-cochains with values in E and the space of transformation p-cochains from E to F is introduced in [2, 3].

Definition 1.1. [2] A E-valued cochain is called normalized if it vanishes whenever at least one of its arguments is a unite.

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