Réunion annuelle du GDR de topologie algébrique

Report of Contributions

https://indico.math.cnrs.fr/e/5722

Contribution ID: **1** Type: **not specified**

Topological adventures in neuroscience (1ère partie)

Tuesday, October 26, 2021 10:30 AM (1h 30m)

Over the past decade, research at the interface of topology and neuroscience has grown remarkably fast. Topology has, for example, been successfully applied to objective classification of neuron morphologies, to automatic detection of network dynamics, to understanding the neural representation of natural auditory signals, and to demonstrating that the population activity of grid cells exhibits toroidal structure, as well as to describing brain structure and function and analyzing the relationship between them in a novel and effective manner. In this series of lectures, I'll provide an overview of various promising recent applications of topology in neuroscience.

Presenter: HESS BELLWALD, Kathryn (EPFL)

Contribution ID: **5** Type: **not specified**

(Non-)formality of the Swiss-Cheese operads and variants

Wednesday, October 27, 2021 9:00 AM (50 minutes)

The usual Swiss-Cheese operad encodes triplets (A,B,f), where A is an algebra over the little disks operad in dimension n (i.e., an \mathsf{E}*n-algebra), B is an \mathsf{E}*{n-1}-algebra, and f : A \to Z(B) is a central morphism of E_n-algebras.

The Swiss-Cheese operad admits several variants and generalizations. In Voronov's original version, the morphism is replaced by an action A \otimes B \to B; in the extended Swiss-Cheese operad ESC_{mn}, the lower algebra is an \mathsf{E}*m-algebra for some m < n; and in the complementarily-constrained disks operad \mathsf{CD}*{mn}, the morphism is replaced by a derivation f + \epsilon \delta : A \to B[\epsilon].

In this talk, I will explain approaches to prove the (non-)formality of some of the variants of the Swiss-Cheese operad, including a joint work in progress with Renato Vasconcellos Vieira.

Presenter: IDRISSI, Najib (Université Paris Diderot / IMJ-PRG)

Contribution ID: **6** Type: **not specified**

Topological adventures in neuroscience (2ème partie)

Wednesday, October 27, 2021 10:30 AM (1h 30m)

Over the past decade, research at the interface of topology and neuroscience has grown remarkably fast. Topology has, for example, been successfully applied to objective classification of neuron morphologies, to automatic detection of network dynamics, to understanding the neural representation of natural auditory signals, and to demonstrating that the population activity of grid cells exhibits toroidal structure, as well as to describing brain structure and function and analyzing the relationship between them in a novel and effective manner. In this series of lectures, I'll provide an overview of various promising recent applications of topology in neuroscience.

Presenter: HESS BELLWALD, Kathryn (EPFL)

Contribution ID: **7** Type: **not specified**

Algebraic models for classifying spaces of fibrations

Wednesday, October 27, 2021 2:00 PM (50 minutes)

For a simply connected finite CW-complex X, we construct a tractable model for the rational homotopy type of the classifying space Baut(X) of the topological monoid of self-homotopy equivalences of X, aka the classifying space for fibrations with fiber X.

The space Baut(X) is in general far from nilpotent, so one should not expect to be able to model its rational homotopy type by a dg Lie algebra over Q as in Quillen's theory. Instead, we work with dg Lie algebras in the category of algebraic representations of a certain reductive algebraic group associated to X.

A consequence of our results is that the computation of the rational cohomology of Baut(X) reduces to the computation of Chevalley-Eilenberg cohomology of dg Lie algebras and cohomology of arithmetic groups with coefficients in algebraic representations. Our results also simplify and generalize certain earlier results of Ib Madsen and myself on Baut(M)
for highly connected manifolds M.

This is joint work with Tomas Zeman.

Presenter: BERGLUND, Alexander

Contribution ID: **8** Type: **not specified**

Higher Lie theory

Wednesday, October 27, 2021 3:30 PM (50 minutes)

This talk will cover the recent complete treatment of the long-term research programme between Lie theory, deformation theory, and rational homotopy theory that originates in the works of Quillen, Deligne, and Sullivan. I will settle the integration theory of homotopy Lie algebras with algebraic infini-groupoids that give rise to explicit higher Baker—Campbell—Hausdorff formulas. A direct application will provide us with a new form of rational homotopy theory which holds in a much more general context than the previous ones. (Joint work with Daniel Robert-Nicoud availble at ArXiv:2010.10485.)

Presenter: VALLETTE, Bruno

Contribution ID: **9** Type: **not specified**

Integration of curved homotopy Lie algebras

Wednesday, October 27, 2021 4:20 PM (40 minutes)

The integration procedure which associates an infinity-groupoid to a (complete) homotopy Lie algebra dates back to Hinich and Getzler. Recently, a new method was developed by Robert-Nicoud and Vallette: it relies on the representation of the Getzler functor with a universal object and the use of the recent progresses of the operadic calculus. The goal of this talk is to generalize their procedure to curved homotopy Lie algebras, which are this time to be encoded by curved cooperads. This is a new type of algebraic structures which come naturally equipped with infinite summations without an underlying topology. We will explain how to integrate this new type of objects, generalizing the above cases, and their relationship with rational homotopy theory and deformation theory. In particular, they provide us with rational models for non-pointed nilpotent spaces.

Presenter: ROCA LUCIO, Victor

Contribution ID: **10** Type: **not specified**

A-infinity structures on almost complex manifolds

Thursday, October 28, 2021 9:00 AM (50 minutes)

Dolbeault cohomology is a fundamental cohomological invariant for complex manifolds. This analytic invariant is connected to de Rham cohomology by means of a spectral sequence, called the Frölicher spectral sequence. In this talk, I will explore this connection from a multiplicative viewpoint: using homotopy-theoretical methods, I will describe how products (and higher products) behave in the Frölicher spectral sequence. Then, I will review an extension of the theory to the case of almost complex manifolds and talk about some open problems in geometry that may be addressed using homotopy theory.

Presenter: CIRICI, Joana

Contribution ID: **11** Type: **not specified**

Higher algebra of A-infinity algebras and the n-multiplihedra

Thursday, October 28, 2021 10:30 AM (40 minutes)

In this talk, I will introduce the notion of n-morphisms between two A-infinity algebras. These higher morphisms are such that 0-morphisms corresponds to A-infinity morphisms and 1-morphisms correspond to A-infinity homotopies. I will then prove that the set of higher morphisms between two A-infinity algebras provide a satisfactory framework to study the higher algebra of A-infinity algebras : this set defines in fact a simplicial set, which has the property of being a Kan complex whose homotopy groups can be explicitly computed.

If time permits, I will finally show how the combinatorics of n-morphisms between A-infinity algebras are encoded by new families of polytopes, which I call the n-multiplihedra and which generalize the standard multiplihedra. They are constructed from the standard simplices and multiplihedra, by lifting the Alexander-Whitney map to the level of simplices. The combinatorics arising in this context are moreover conveniently described in terms of overlapping partitions.

Presenter: MAZUIR, Thibaut

Contribution ID: **12** Type: **not specified**

La diagonale des opéraèdres / The diagonal of the operahedra

Thursday, October 28, 2021 11:20 AM (40 minutes)

Nous présentons une nouvelle famille de réalisations des opéraèdres, une famille de polytopes qui codent les opérades à homotopie près comprenant l'associaèdre et le permutoèdre. En se servant des techniques récemment développées par N. Masuda, A. Tonks, H. Thomas et B. Vallette, nous définissons une approximation cellulaire de la diagonale pour cette famille de polytopes de même que le produit tensoriel d'opérades à homotopie près pour lequel nous donnons une formule explicite.

We study a new family of realizations of the operahedra, a family of polytopes encoding operads up to homotopy, which include the associahedra and the permutohedra. Using techniques recently developed by N. Masuda, A. Tonks, H. Thomas and B. Vallette, we define a cellular approximation of the diagonal of this family of polytopes and define the tensor product of operads up to homotopy with an explicit formula.

Presenter: LAPLANTE-ANFOSSI, Guillaume

Contribution ID: **13** Type: **not specified**

Integrability of derived complex spaces

Thursday, October 28, 2021 2:00 PM (50 minutes)

Since the Newlander-Nirenberg integrability theorem in 1957, the description of complex manifolds through integrable almost complex structures provided many far reaching applications ranging from deformation theory to Hodge theory for example.With the rise of derived geometry during the last decade, and more recently of derived analytic geometry, comes naturally the following question: is there a fully homotopy coherent analogue of this integrability notion suitable for derived complex objects? We will explore this question through an approach inspired by operad theory. This is joint work in progress with Joan Millès.

Presenter: YALIN, Sinan

Contribution ID: **14** Type: **not specified**

Autour de l'action de membranes

Tuesday, October 26, 2021 4:00 PM (40 minutes)

Étant donnée une ∞-opérade cohérente O, on peut munir l'espace des extensions de l'identité d'une structure canonique de O-algèbre, à valeurs dans la catégorie des cocorrespondances. Cette action a été introduite par Toën puis adaptée par Mann–Robalo en vue d'applications aux invariants de Gromov–Witten. J'exposerai une généralisation de cette construction, couvrant le cas des ∞-opérades colorées ou munies de l'action d'un groupe topologique. Enfin, je mentionnerai quelques applications possibles en topologie des cordes.

Presenter: POURCELOT, Hugo

Contribution ID: **16** Type: **not specified**

Homotopically inflexible algebras

Friday, October 29, 2021 9:00 AM (50 minutes)

An oriented closed connected d-manifold is inflexible if it does not admit selfmaps of unbounded degree. In addition, if for every oriented closed connected d-manifold M ′ the set of degrees of maps M′ ⟶ M is finite, then M is said to be strongly inflexible. The first examples of simply connected inflexible manifolds have been constructed by Arkowitz and Lupton using Rational Homotopy Theory. However, it is not known whether simply connected strongly manifolds exist, problem that is related to Gromov's question on functorial semi-norms on homology. In this talk, using Sullivan models, we present a method that proves the failure of strongly inflexibility for all but one of the existing inflexible manifolds. This is a joint work with Vicente Mu˜noz and Antonio Viruel.

Presenter: COSTOYA, Cristina

Contribution ID: **17** Type: **not specified**

A simplicial approach to the sheaf theoretic construction of intersection cohomology

Tuesday, October 26, 2021 4:45 PM (40 minutes)

Intersection (co)homology is a way to enhance classical (co)homology, allowing us to use a famous result called Poincaré duality on a large class of spaces known as stratified pseudomanifolds. There is a theoretically powerful way to arrive at intersection (co)homology by a classifying sheaves that satisfy what are called the Deligne axioms.

Parallel to this, it is common knowledge in algebraic topology that simplicial structures make for good representations of topological spaces. There is a successful way to construct a simplicial intersection (co)homology exposed in the works of D. Chataur, D. Tanré and M. Saralegi-Araguren, but a simplicial manifestation of the Deligne axioms has remained under shadows until now.

This exposition draws on constructions made by these authors, showing a simplicial manifestation of the Deligne axioms. We begin by exposing the classical theory, then presenting a construction of simplicial sheaves and a statement of simplicial Deligne axioms that work for the different simplicial structures, to finally focus on simplicial complexes, with which we can successfully arrive into a way to construct simplicial intersection (co)homology.

This exposition summarizes the results obtained during my PhD thesis under the guidance of professor David Chataur.

Presenter: CEA, Sebastian

Contribution ID: **18** Type: **not specified**

On the centre of crossed modules of groups and Lie algebras

Friday, October 29, 2021 10:30 AM (40 minutes)

Crossed modules are algebraic models of homotopy 2-types and hence have \pi_1 and \pi_2 . We propose a definition of the centre of a crossed module whose essential invariants can be computed via the group cohomology H^i (\pi_1, \pi_2). This definition therefore has much nicer properties than one proposed by Norrie in the 80's.

Presenter: PIRASHVILI, Mariam

Contribution ID: **20** Type: **not specified**

Genus zero modular operad & Grothendieck-Teichmüller group's avatar

Tuesday, October 26, 2021 2:00 PM (40 minutes)

Presenter: COMBE, Noémie

Contribution ID: **21** Type: **not specified**

Mapping class group representations via Heisenberg homology

Tuesday, October 26, 2021 2:45 PM (40 minutes)

Presenter: PALMER-ANGHEL, Martin

Contribution ID: **22** Type: **not specified**

Minimal models for graphs-related operadic algebras

Presenter: OBRADOVIC, Jovana

Contribution ID: **23** Type: **not specified**

Floyd's manifold is a conjugation space

Thursday, October 28, 2021 3:30 PM (40 minutes)

Presenter: SCHERER, Jérôme

Contribution ID: **24** Type: **not specified**

Model structures and spectral sequences

Friday, October 29, 2021 11:10 AM (50 minutes)

Model categories give an abstract setting for homotopy theory, allowing study of different notions of equivalence. I'll discuss various categories with associated functorial spectral sequences. In such settings, one can consider a hierarchy of notions of equivalence, given by morphisms inducing an isomorphism at a fixed stage of the associated spectral sequence. I'll discuss model structures with these weak equivalences for filtered complexes, for bicomplexes and for multicomplexes. I will talk about joint work with subsets of: Joana Cirici, Daniela Egas Santander, Xin Fu, Ai Guan, Muriel Livernet and Stephanie Ziegenhagen, as well as reporting on some work of my student James Brotherston.

Presenter: WHITEHOUSE, Sarah (University of Sheffield)