Guille Carrión Santiago

✉ g.carrionsantiago@uma.es • guillecarrion.github.io

April 19, 2024

Employment

Postdoctoral researcher — **Málaga**
Universidad de Málaga — *2023-*

Investigador predoctoral — **Barcelona**
Universitat Autònoma de Barcelona — *2018-2023*

Software developer — **Málaga**
Coritel, Accenture Grp. — *2016*

Education

Universidad de Málaga — **Málaga**
(BSc) Grado en Matemáticas — *2015*

Universidad de Málaga — **Málaga**
Master en Matemáticas — *2016*

Universitat Autònoma de Barcelona — **Barcelona**
(PhD) Doctorado en Matemáticas, Higher limits via homotopical algebra — *2023*

PhD Tesis

Higher limits via homotopical algebra — **Universitat Autònoma de Barcelona**
Advisor: Natàlia Castellana Vila y Antonio Díaz Ramos — *2023*

Abstract: This PhD thesis focuses on describing the higher limits of a functor using homotopical tools rather than the classical methods of Homological Algebra. This work focuses on functors over a filtered category in which every endomorphism is an isomorphism (EI-category) and takes values in modules. Firstly, two model category structures are presented in this category of functor: one suitable for contravariant functors and another for covariant functors. In this context, higher limits and colimits are described through fibrant and cofibrant replacements, respectively. Then, based on the combinatorial properties of these EI-categories, an explicit construction of both replacements is provided. In addition, variations of these replacements are presented to adapt them to the problem of study: describing vanishing bounds and ranks for the higher limits.

In the case of partially ordered categories (posets for short), it is shown that pseudo-projective property is equivalent to cofibrant in the covariant functors category described in this work. A notion of Mackey functor for posets is also introduced, inspired by the classical notion of Mackey functor for orbit categories. In this case, it is proven that Mackey functors with an additional notion of quasi-unit are cofibrant; therefore, their higher colimits vanish in positive degrees.

Using the combinatorial structure of the replacement and the presented computation tools, explicit vanishing bounds for the higher limits are proven. Using different strategies, these are described based on the geometry of the poset, local bounds of higher limits, and filtrations from atomic functors.

Finally, the case of higher limits of functors indexed on CL-shellable posets is studied in detail. These posets have the homotopy type of a wedge sum of spheres of the same dimension, so the higher limits in strictly positive degrees of a constant functor are concentrated in a single degree. Motivated by this particular case, a sufficient property for a functor is abstracted, which guarantees that its higher limits vanish for dimensions lower than the length of the poset. As an example of application, the case of the family of n-linear forms functors in hyperplane arrangements is described. (pdf: `https://guillecarrion.github.io/files/Tesis_Guille_Carrion.pdf`)

Teaching

Universitat Autnònoma de Barcelona **Barcelona**
teaching collaborator *2018–2019*
- Àlgebra lineal Grau en Matemàtiques, problem sessions . . . . . 15h.
- Càlcul Grau en Gestió Aeronàutica, problem sessions . . . . . 22h.

Universitat Autnònoma de Barcelona **Barcelona**
teaching collaborator *2019–2020*
- Àlgebra lineal Grau en Matemàtiques, problem sessions . . . . . 15h.
- Topologia Grau en Matemàtiques, seminar sessions . . . . . 12h.
- Àlgebra Grau en Enginyeria Informàtica, seminar sessions . . . . . 20h.
- Càlcul Grau en Enginyeria Informàtica, seminar sessions 10h

Universitat Autnònoma de Barcelona **Barcelona**
teaching collaborator *2020–2021*
- Càlcul Grau en Enginyeria Informàtica, seminar sessions . . . . . 10h.
- Àlgebra lineal Grau en Matemàtiques, problem sessions . . . . . 15h.
- Topologia Grau en Matemàtiques, problem and seminar sessions . . . . . 27h.

Universitat Autnònoma de Barcelona **Barcelona**
teaching collaborator *2021–2022*
- Àlgebra II Grau en Fisica, problem sessions . . . . . 21h.
- BSc thesis Grau en Matemátiques, Categories de models: l'axiomàtica de la teoria d'homotopia

Universitat Autnònoma de Barcelona **Barcelona**
teaching collaborator *2022–2023*
- BSc thesis Grau en Matemátiques, Topologia algebraica dels espais topologics finits

Contributed talks

Dpt. Matemàtiques UAB. Seminari de doctorands. **Barcelona**
Sisè Seminari de Teoria de Categories *January 2020*

I jornadas Topológicas Virtuales de la RET. **Online**
Approaching higher limits from homotopy theory, An introduction. *February 2021*

Opening Workshop of the IRP Higher Homotopical Structures. **Online**
Approaching higher limits from homotopy theory. *February 2021*

Ciclo junior de topología. **Online**
Límites superiores sin dolores de cabeza *May 2021*

Seminario InSeGTop, universidad de Málaga **Málaga**
Límites superiores via Álgebra homotòpica. *March 2022*

Métodos Categoricos y Homotopicos en Álg., Geom., Top. y An. funcional **Badajoz**
Límites superiores via Álgebra homotòpica. *Jun 2022*

EPFL Topology Seminar Fall 2022 **Lausanne**
Higher limits of functors via Homotopical Algebra *September 2022*

II encuentro RSME-Uma **Ronda**
Relative plus construction *December 2022*

VI Congreso de Jóvenes Investigadores de la RSME **Leon**
Cohomología de haces para CL-shellable posets *February 2023*

XI Encuentro de jóvenes topólogos **Alicante**
Relative plus construction *October 2023*

Publications

La homotopía de los complejos de cadenas **TEMat Monográficos**
Actas del VIII Encuentro de Jóvenes Topólogos *2021*

Relative plus construction **Expositiones Mathematicae**
with Jérôme Scherer *June 2023*

Preprints

Mackey functors for posets
with Antonio Díaz Ramos ***Arxiv:****2312.13989*

Work in progress

Acyclicity condition for CL-shellable posets
with Antonio Díaz Ramos

Vanishing bound for the higher limits over posets.

Languages

Spanish: Native *Native*

English: Average –

Catalan: Advanced *C1*

Computer skills

Python/SageMath: Average

Java: Average

Haskell: Average

GAP-system: Basic

SQL: Basic