


Josué Tonelli-Cueto

Curriculum Vitae

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Areas of mathematical interest

- Numerical algorithms
- Computational algebraic geometry
- Condition-based complexity
- Random geometry

Positions

- Oct/2020 **FSMP Postdoctoral Fellow**, *OURAGAN team, Inria Paris & IMJ-PRG*, Paris, France.
Sep/2022 Mentors: Fabrice Rouillier, Elias Tsigaridas
Feb/2020 **Postdoctoral researcher**, *OURAGAN team, Inria Paris & IMJ-PRG*, Paris, France.
Sep/2020 Mentors: Fabrice Rouillier, Elias Tsigaridas

Education

- Jan/2017 **Dr. rer. nat. Mathematik**, *Technische Universität Berlin*, Germany, *Summa Cum Laude*.
Nov/2019 Thesis *Condition and Homology of Semialgebraic Sets*
Supervised by Peter Bürgisser and Felipe Cucker in the framework of the Berlin Mathematical School
Oct/2014 **M.Sc. Mathematik**, *Technische Universität Berlin*, Germany, *1.0*.
Mar/2017 Thesis *On the Complexity of some Null-Cone Membership Problems* supervised by Peter Bürgisser
In the framework of the Berlin Mathematical School
Oct/2009 **Licenciatura en matemáticas**, *University of the Basque Country*, Spain, *9.86*.
Jul/2014 With *Best Student Record* and *First Prize in the End of Studies Spanish National Awards*

Grants & Awards

Research fellowships and scholarships

- Oct/2020 **FSMP Postdoctoral Fellowship**, *2020 Call, "Interactions" program*.
Sep/2022 Awarded by the Fondation Sciences Mathématiques de Paris
Jan/2017 **BMS Doctoral Fellowship**.
Dec/2019 Funded by the Einstein Foundation Berlin withing F. Cucker's Einstein Visiting Fellowship
Oct/2014 **Scholarship of "la Caixa" for graduate studies in Europe**, *2014 Call*.
Jul/2017 Funded also by the German Academic Exchange Service (DAAD)
Nov/2013 **Collaboration Scholarship for the academic year 2013-2014**.
Jun/2014 Funded by the Basque Government
Working with Gustavo Adolfo Fernández Alcober on *pro-p groups and p-adic analytic groups* at University of the Basque Country
Jul/2013 **Research Introduction Scholarship of the JAE Program**.
Sep/2013 Funded by the Consejo Superior de Investigaciones Científicas (CSIC)
Working with Andrei Jaikin-Zapirain on *Class Field Theory* at Instituto de Ciencias Matemáticas (ICMAT)

Awards

- Jul/2019 **SIAM Student Travel Award**, *SIAM Conference on Applied Algebraic Geometry 2019*.
Jun/2019 **Special Award to Young Researchers presenting Posters**, *MEGA2019*.
One out of three awards
Jul/2018 **First Prize in the End of Studies Spanish National Awards**, *Spanish Government*.
Jun/2015 **End of Degree Extraordinary Award of the Licenciatura en matemáticas**, *University of the Basque Country*.

- Oct/2013 **Honor Mention in the modality “Popular science work. Media”, 14th Ciencia en Acción.**
Together with Ricardo Grande for the Mathematics Students' Magazine *πkasle*
- 29/Nov/2012 **III Awards to students who best spread the image of the University of the Basque Country.**
1st prize in the category of science with Ricardo Grande for the Mathematics Students' Magazine *πkasle*
1st prize in the category of social sciences and legal studies with my fellow teammates for winning the IV University Debate League of the G9 Group
- Feb-Mar/2012 **Winner in the IV University Debate League of the G9 Group, Oviedo, Spain.**
As part of the team of the University of the Basque Country
- Jun/2011 **Special Mention in the Contests of Works about Sophia Kovalevskaya, University of the Basque Country.**
For doing a calligram about Sophia Kovalevskaya

Publications

Preprints

- [1] P. Bürgisser, F. Cucker, and J. Tonelli-Cueto. Computing the Homology of Semialgebraic Sets. II: General formulas. March 2019. arXiv:1903.10710.
- [2] F. Cucker, A. A. Ergür, and J. Tonelli-Cueto. On the Complexity of the Plantinga-Vegter Algorithm. April 2020. arXiv:2004.06879. Journal version of [5].

Papers

- [3] P. Bürgisser, F. Cucker, and J. Tonelli-Cueto. Computing the Homology of Semialgebraic Sets. I: Lax Formulas. *Foundations of Computational Mathematics*, 20(1):71–118, 2020. On-line from May of 2019. (arXiv:1807.06435).
- [4] P. Bürgisser, A. A. Ergür, and J. Tonelli-Cueto. On the Number of Real Zeros of Random Fewnomials. *SIAM J. Appl. Algebra Geom.*, 3(4):721–732, 2019. (arXiv:1811.09425).
- [5] F. Cucker, A. A. Ergür, and J. Tonelli-Cueto. Plantinga-Vegter Algorithm Takes Average Polynomial Time. In *Proceedings of the 2019 on International Symposium on Symbolic and Algebraic Computation*, ISSAC '19, pages 114–121. ACM, New York, 2019. (arXiv:1901.09234).

Other

- [6] J. Tonelli-Cueto. *Condition and Homology in Semialgebraic Geometry*. Doctoral thesis, Technische Universität Berlin, Dec. 2019. <http://dx.doi.org/10.14279/depositonce-9453>.

Talks and other presentations

Conference presentations

- Feb/2020 **Beyond Gaussians in the probabilistic analysis of condition numbers in algebraic geometry**, *Milestones Conference of the Thematic Einstein Semester on Algebraic Geometry*, Berlin, Germany.
- Jan/2020 **Computing the homology of semialgebraic sets in weak single exponential time**, *V Congreso de Jóvenes Investigadores la RSME*, Castelló, Spain.
- Jan/2020 **Real zeros of random fewnomials**, *V Congreso de Jóvenes Investigadores la RSME*, Castelló, Spain.
- Oct/2019 **On zeros of random fewnomials (2 talks)**, *Research Workshop on Random Real Algebraic Geometry*, Güzelyurt, Northern Cyprus.
- Oct/2019 **What is the probabilistic analysis of a condition number?**, *Opening Conference of the Thematic Einstein Semester on Algebraic Geometry*, Berlin, Germany.
- Aug/2019 **Average minus Weak Complexity equals Adaptive algorithms**, *Complexity of numerical computation: A conference in honor of Felipe Cucker*, Berlin, Germany.
- Jul/2019 **Plantinga-Vegter takes average polynomial time**, *ISSAC 2019*, Beijing, China.
- Jul/2019 **Farewell to Weyl: Condition-based analysis with a Banach norm in numerical algebraic geometry**, *SIAM Conference on Applied Algebraic Geometry 2019*, Bern, Switzerland.

- Jun/2019 **Numerical Computation of Homology Groups of Closed Semialgebraic Sets**, *Workshop MEGAR 2019: Effective Methods in Real Algebraic Geometry*, Madrid, Spain.
- May/2019 **How many zeros does a random fewnomial system have?**, *2nd BYMAT Conference*, Madrid, Spain.
- Feb/2019 **How many zeros does a random fewnomial system have?**, *7th BMS Student Conference*, Berlin, Germany.
- Jan/2019 **On Zeros of Random Fewnomials (5 talks)**, *Random Real Algebraic Geometry Workshop*, Nesin Matematik Köyü, Turkey.
- May/2018 **Computing the Homology of Closed Semialgebraic Sets**, *1st BYMAT Conference*, Madrid, Spain.
- Feb/2018 **The Niyogi-Smale-Weinberger Approximation Theorem**, *6th BMS Student Conference*, Berlin, Germany.
- Nov/2017 **Computing the Homology of General Semialgebraic Sets**, *Workshop "Algebra meets Numerics: Condition and Compleity"*, Berlin, Germany.
- Jul/2017 **Random real Schubert Calculus and lines on surfaces**, *Workshop "Reading Group on Real Algebraic Geometry"*, Leipzig, Germany.
- Feb/2017 **The shadow of the hidden combinatorics of completely positive operators on Polynomial Identity Testing**, *5th BMS Student Conference*, Berlin, Germany.

Invited seminar talks

- 02/May/2019 **Computing the Homology of Semialgebraic Sets in Weak Exponential Time**, *Algebra Seminar of the "Groups, Topology and Applications" Research Group*, U. of the Basque Country.
- 11/Apr/2019 **Condition meets Computational geometry: The Plantinga-Vegter algorithm case**, *Colloquium of the Graduiertekolleg "Facets of Complexity" (GRK 2434)*, Freie Universität Berlin.
- 16/Jan/2018 **Computing the Homology of Semialgebraic Sets**, *Oberseminar des Institut für Algebra und Geometrie*, Otto von Guericke Universität Magdeburg.
- 09/Jan/2017 **Sobre la complejidad de algunos problemas de pertenencia al cono nulo**, *Seminario del Departamento de Matemáticas*, University of the Basque Country. [In Spanish].

Posters

- Jun/2019 **Computing the Homology Groups of Closed Semialgebraic Sets in Weak Exponential Time**, *MEGA 2019: Effective Methods in Algebraic Geometry*, Madrid, Spain.
Awarded one of the three Special Awards to Young Researchers presenting Posters
- Feb/2019 **Computing the Homology Groups of Semialgebraic Sets**, *2nd Graduate meeting on Applied Algebra and Combinatorics*, Leipzig, Germany.
- Feb/2019 **Computing the Homology Groups of Semialgebraic Sets in Weak Exponential Time**, *Congreso Bienal de la Real Sociedad Matemática Española 2019*, Santander, Spain.
- Aug/2018 **Computing the Homology Groups of Semialgebraic Sets**, *Summer School on Numerical Computing in Algebraic Geometry*, Leipzig, Germany.
- Jun/2018 **Polynomial Identity Testing and the Combinatorics of Completely Positive Operators**, *Qmath Masterclass on "Tensors: Geometry and Quantum Information"*, Copenhagen, Denmark.
- Jun/2018 **Computing the "Shape" of Semialgebraic Sets**, *Symposium "Bridging European Science II"*, Berlin, Germany.

Others

- 07/Dec/2018 **What is the best voting system?**, *"What is...?" Seminar*, Berlin Mathematical School.
- 29/Jun/2018 **What are semialgebraic sets in context?**, *"What is...?" Seminar*, Berlin Mathematical School.
- 30/Jun/2017 **What are BPP, RP and the other probabilistic complexity classes?**, *"What is...?" Seminar*, Berlin Mathematical School.
- 27/Jan/2017 **What is the length of a potato?**, *"What is...?" Seminar*, Berlin Mathematical School.

05/Feb/2016 **What is an Origami Constructible Number?**, “*What is...?*” Seminar, Berlin Mathematical School.

Organized activities

May/2016 **“What is...?” Seminar**, Berlin Mathematical School.

Dec/2019 Student organized seminar where a new concept, idea or object is introduced each week
Organization, web-design and video management

21-26/Oct/2019 **Research Workshop on Random Real Algebraic Geometry**, Güzelyurt, Northern Cyprus.
With Alp Bassa, Turgay Bayraktar, Özgür Kiisel and Ferit Öztürk

9-12/Jul/2019 **Minisymposium Numerical methods for structured polynomial system solving**, SIAM Conference on Applied Algebraic Geometry 2019.
With Alperen A. Ergür, Pierre Lairez and Gregorio Malajovich

21-23/Feb/2019 **6th BMS Student Conference**, Berlin Mathematical School.
With Héctor Andrade Loarca, Qiao Luo, Brent Moran and Yuya Tokuta

Teaching experience

Apr/2018 **Effective Algebraic Geometry Seminar**, Technische Universität Berlin, Berlin, Germany.

Jul/2018 Organized together with Peter Bürgisser and Alperen Ali Ergür

Oct/2013 **Private Remedial Teacher**, Centro de Estudios INTEC, Bilbao, Spain.

May/2014 Linear algebra to math undergraduates and mathematics to non-math undergraduates
Approx. 156 hours of teaching

11-14/Feb/2014 **“Groups of units in complete discrete valuation rings” Course**, University of the Basque Country, Leioa, Spain.
4 hours of teaching

Nov/2012 **“P vs. NP and related topics” Seminar**, University of the Basque Country, Leioa, Spain.

May/2015 Organized together with Luis Martínez
30 hours of teaching

Popularization of Mathematics and Science

Projects and organized activities

Sep/2011 **Revista π kasle Aldizkaria**, Mathematics Students' Magazine.

Jul/2014 ISSN: 2174-9027 (digital) and 2255-5714 (printed)

Founder, together with Ricardo Grande

Member of the Editorial Committee. Cover designer and desktop publisher. Social media manager.

09&30/May/2014 **π kasle's Mathematics, Magic and Mystery Workshop**, U. of the Basque Country, Leioa, Spain.
Co-organizer, together with Ricardo Grande

23/Oct/2013 **π kasle's Martin Gardner Celebration of Mind**, U. of the Basque Country, Leioa, Spain.
Organizer

Articles

[7] J. Tonelli-Cueto. Emmy Noether, un retrato alfabético [Spanish] (Emmy Noether, an alphabetic portrait). Blog “*mujeres con ciencia*”, October 2015.

Other

06/Oct/2011 **Astronomia Emakunde/Con ‘A’ de Astrónomas Exhibition**, U. Basque Country, Bilbao, Spain.

11/Nov/2011 Tour guide

05-26/May/2011 **RSME-IMAGINARY BILBAO Exhibition**, U. of the Basque Country, Bilbao, Spain.
Tour guide

Service work

Apr/2015 **Student Vocal at the Committee of Evaluation of Degrees in the Area of Science**, Agency

Mar/2018 for Quality of the Basque University System (UNIBASQ), Vitoria, Spain.

Jan-Dec/2017 **BMS Student Representative**, *Berlin Mathematical School*, Berlin, Germany.
 Sep/2012 **Secretary**, *Mathematics Students' Association Epsilon-Delta*, Leioa, Spain.
 May/2013 Association of mathematics students of the University of the Basque Country

Activities

Research stays and visits

Jan/2020 **Research visit to Elias Tsigaridas**, *Paris*, France. (19-25/Jan).
 Dec/2019 **Research visit to Elias Tsigaridas**, *Paris*, France. (8-12/Dec).
 May/2019 **Research visit to Elias Tsigaridas**, *Paris*, France. (12-17/May).
 Mar-Apr/2019 **Research stay with Felipe Cucker**, *Hong Kong*, China. (15/Mar-01/Apr).
 Oct-Nov/2018 **Research visit to Nicolai Vorobjov**, *Bath*, England. (27/Oct-03/Nov).
 Oct/2018 **Research stay with Felipe Cucker**, *Tuleries d'Affiac*, France. (01-15/Oct).
 Apr/2018 **Research stay with Felipe Cucker**, *Hong Kong*, China. (10-28/Apr).
 Nov-Dec/2017 **Research stay with Felipe Cucker**, *Hong Kong*, China. (21/Nov-08/Dec).
 Jan/2017 **Research stay with Felipe Cucker**, *Hong Kong*, China. (13-26/Jan).

Attended conferences

27-28/Feb/2020 **Milestones Conference of the Thematic Einstein Semester on Algebraic Geometry**, *Zuse Institut Berlin*.
 27-31/Jan/2020 **V Congreso de Jóvenes Investigadores la RSME**, *Universitat Jaume I*.
 07-11/Oct/2019 **Opening Conference of the Thematic Einstein Semester on Algebraic Geometry**, *Freie Universität Berlin*.
 19-23/Aug/2019 **Complexity of numerical computation: A conference in honor of Felipe Cucker**, *Berlin-Brandenburgische Akademie der Wissenschaften*.
 15-18/Jul/2019 **ISSAC 2019**, *Beihang University*.
 09-13/Jul/2019 **SIAM Conference on Applied Algebraic Geometry 2019**, *Universität Bern*.
 21-22/Jun/2019 **Workshop MEGAR 2019: Effective Methods in Real Algebraic Geometry**, *Universidad Complutense de Madrid*.
 17-21/Jun/2019 **MEGA 2019: Effective Methods in Algebraic Geometry**, *Universidad Complutense de Madrid*.
 03-05/Jun/2019 **Noether Konferenz 2019: Wie kommt das Neue in die Welt?**, *Berlin*, Germany.
 20-24/May/2019 **2nd BYMAT Conference**, *Instituto de Ciencias Matemáticas (ICMAT)*.
 20-22/Feb/2019 **7th BMS Student Conference**, *Berlin Mathematical School*.
 18-20/Feb/2019 **2nd Graduate Meeting on Applied Algebra and Combinatorics**, *Max-Planck-Institut für Mathematik in der Naturwissenschaften (Leipzig)*.
 04-08/Feb/2019 **Congreso Biental de la Real Sociedad Matemática Española 2019**, *Universidad de Cantabria*.
 21-27/Jan/2019 **Random Real Algebraic Geometry Workshop**, *Nesin Matematik Köyü*.
 23-28/Sep/2018 **6th Heidelberg Laureate Forum**, *Heidelberg*.
 13-17/Aug/2018 **Summer School on Numerical Computing in Algebraic Geometry**, *Max-Planck-Institut für Mathematik in der Naturwissenschaften (Leipzig)*.
 18-22/Jun/2018 **QMath Masterclass on "Tensors: Geometry and Quantum Information"**, *University of Copenhagen*.
 04-08/Jun/2018 **Workshop "Optimization, Complexity and Invariant Theory"**, *Institute for Advance Studies (IAS)*.
 02/Jun/2018 **Symposium "Bridging European Science II"**, *Berlin*, Germany.
 07-09/May/2019 **1st BYMAT Conference**, *Instituto de Ciencias Matemáticas (ICMAT)*.
 06-07/Nov/2017 **Workshop "Algebra meets Numerics: Condition and Complexity"**, *Technische Universität Berlin*.

- 13-19/Jul/2017 **FoCM 2017 Conference (Blocks B and C)**, *Universitat de Barcelona*.
- 03-07/Jul/2017 **Workshop “Reading Group on Real Algebraic Geometry”**, *Max-Planck-Institut für Mathematik in der Naturwissenschaften (Leipzig)*.
- 10/Jun/2017 **Workshop “Polynomial and Polytopes”**, *Technische Universität Berlin*.
- 22-24/May/2017 **Chow Lectures 2017**, *Max-Planck-Institut für Mathematik in der Naturwissenschaften (Leipzig)*.
- 13-17/Mar/2017 **BCAM Course “Quantum Information Theory”**, *Basque Center for Applied Mathematics*.
- 22-24/Feb/2017 **5th BMS Student Conference**, *Berlin Mathematical School*.
- 12-14/Dec/2016 **Workshop “Tensors: Algebra meets Numerics”**, *Max-Planck-Institut für Mathematik in der Naturwissenschaften (Leipzig)*.
- 18-22/Jul/2016 **7th European Congress of Mathematics**, *Technische Universität Berlin*.
- 17-19/Feb/2016 **4th BMS Student Conference**, *Berlin Mathematical School*.
- 26/Jul/2015 **Hilbert Bernays Summer School on Logic and Computation**, *Georg-August-Universität Göttingen*.
- 01/Aug/2015
- 13-17/Jul/2015 **2015 Santaló Summer School on “Number theory and arithmetic geometry”**, *Universidad Internacional Menéndez Pelayo*.
- 29/Jun/2015 **BMS Summer School 2015 on “Convex Geometry – discrete and computational”**, *Berlin Mathematical School*.
- 10/Jul/2015
- 02-06/Mar/2015 **Homological Algebra Workshop**, *Instituto de Ciencias Matemáticas (ICMAT)*.
- 18-20/Feb/2015 **3rd BMS Student Conference**, *Berlin Mathematical School*.
- 07-11/Jul/2014 **10th AIMS Conference on Dynamical Systems, Differential Equations and Applications**, *Madrid, Spain*.
Attended as student volunteer
- 30/Jun/2014 **First International Meeting of the Italian and Spanish Mathematical Societies**, *University of the Basque Country*.
- 04/Jul/2014
Attended as student volunteer
- 19-21/Feb/2014 **2nd BMS Student Conference**, *Berlin Mathematical School*.
- 01-26/Jun/2013 **VI Edición de la Escuela JAE de Matemáticas**, *Instituto de Ciencias Matemáticas (ICMAT)*.
- 23-29/Jul/2012 **XIII Encuentro Nacional de Estudiantes de Matemáticas**, *Murcia, Spain*.
- 01-21/Jul/2012 **2012 PCMI Summer Session “Geometric Group Theory”**, *IAS/Park City Mathematic Institute*.
- Sep-Dec/2011 **Curso de Teoría de Grafos aplicando el método de Moore**, *University of the Basque Country*.
- 03-23/Jul/2011 **2011 PCMI Summer Session “Moduli Spaces of Riemann Surfaces”**, *IAS/Park City Mathematic Institute*.
- 24/Jun/2011 **Coloquio RSME 2011: Las dos ideas de Sofía Kovalevskaya**, *University of the Basque Country*.
- 01-03/Jun/2011 **Jornadas RSME 2011: Los Problemas del Milenio**, *Universitat de Barcelona*.
- Other**
- 18-20/Sep/2017 **Science+ 2017, ERA Career Day Bilbao**, *University of the Basque Country*, Bilbao, Spain.
- 06/Jun/2016 **Slam the library #2 - Poetry Slam**, *University Library of the TU Berlin and UdK*, Berlin, Germany.
Participant under pseudonym *Iasafro Maesman* ending at 2nd place
- 10-04/Nov/2014 **Exhibition *Reflejos. Proyecto experimental entre artistas y poetas***, *Biblioteca Central de Cantabria*, Santander, Spain.
Participation with *Reflejo de Palabras* (Reflection of words) together with María Jesús Cueto Puente
- 25-27/Jun/2014 **Curso H.1 ¿Qué hay que enseñar hoy en la escuela?**, *XXXIII Summer Courses of the University of the Basque Country*, Donostia, Spain.
- 23-24/Jun/2014 **Workshop 6.1 “Once upon a time. . .” Techniques for Storytelling in English**, *XXXIII Summer Courses of the University of the Basque Country*, Donostia, Spain.
- 09/May/2014 **Curso “Cognición comprada entre chimpancés y humanos”**, Bilbao, Spain.

- Jan-Jun/2014 **Talentia Programme 2013-2014 of Bizkaia Talent**, Province of Biscay, Spain.
- 16/Oct/2013 **II. Simposio UNIBASQ. La Calidad del Sistema Universitario Vasco: La Perspectiva de los Usuarios**, Bilbao, Spain.
- 31/Aug/2012 **Poetry Recital at the opening of the exhibition *Proyecto Trait D'Union***, Observatorio del Arte, Arnauero, Spain.

Scientific Olympiads

- Oct/2009 **Gold Medal in the XIV Iberoamerican Olympiad of Physics**, *Santiago de Chile*, Chile.
- Apr/2009 **Silver Medal and Special McGraw-Hill Prize to the best resolution of the theoretical part in the XX Spanish Mathematical Olympiad**, *Pamplona*, Spain.
- Mar/2009 **Bronze Medal in the XLV Spanish Mathematical Olympiad**, *Sant Feliu de Guíxols*, Spain.

Languages

Spanish **Native**
English **C1**
Basque **A2-B1**
German **A2-B1**

References

- Peter Bürgisser, pbuerg@math.tu-berlin.de, Technische Universität Berlin.
- Felipe Cucker, macucker@cityu.edu.hk, CityU Hong Kong.
- Alperen Ali Ergür, aergur@cs.cmu.edu, Carnegie Mellon University.
- Marta Macho-Stadler, marta.macho@ehu.eus, University of the Basque Country