

# CV Abreviado Eduardo Sáenz de Cabezón Irigaray

## Part A. PERSONAL INFORMATION

First name	Eduardo		
Family name	Sáenz de Cabezón Irigaray		
Gender (*)	Male	Birth date (dd/mm/yyyy)	24/06/1972
Social Security, Passport, ID number	16567689F		
e-mail	esaenz-d@unirioja.es	URL Web: <a href="http://www.unirioja.es/cu/esaenz-d">www.unirioja.es/cu/esaenz-d</a>	
Open Researcher and Contributor ID (ORCID) (*)	0000-0002-5615-4194		

(\*) *Mandatory*

### A.1. Current position

Position	Associate Professor (Profesor Titular de Universidad)		
Initial date	17-12-2018		
Institution	University of La Rioja		
Department/Center	Mathematics and Computer Science	Faculty of Science and Technology	
Country	Spain	Teleph. number	(+34)941299691
Key words	Computer Algebra, Computational Topology, Computer Science, Commutative Algebra		

### A.2. Previous positions (research activity interruptions, indicate total months)

Period	Position/Institution/Country/Interruption cause
2012-2018	Profesor Contratado Doctor/Universidad de la Rioja /Spain
2008-2012	Profesor Ayudante Doctor/Universidad de la Rioja /Spain

### A.3. Education

PhD, Licensed, Graduate	University/Country	Year
Graduate in Mathematics	University of La Rioja/Spain	2001
Ph. D	University of La Rioja/Spain	2008

## Part B. CV SUMMARY

My research is focused on Combinatorial Commutative Algebra, in particular, I have studied monomial ideals, performing a deep theoretical study, developing algorithms to compute their structure and applying these results mainly in reliability theory. Monomial ideals are the main object at the intersection of commutative algebra and combinatorics. Through them we can establish relations between different areas of mathematics and model many phenomena in industrial and other applications. I made contributions in these three aspects: theory, computations and applications. My main theoretic contributions started in the homological structure of monomial ideals, and have recently focused on complicated objects such as Rees algebras or parametric filtrations, with a view towards algebraic geometry and topological data analysis. The algorithms I developed, in particular Mayer-Vietoris trees are implemented in the computer algebra system CoCoA and are used by the community to make homological computations on monomial ideals and simplicial complexes. The main area of application of my work has been to system and network reliability. I have developed, together with professor H.P. Wynn (London School of Economics) the area of algebraic

reliability, in which we have published 15 papers in relevant JCR journals including the main journals in reliability theory, "IEEE Transactions on Reliability", and "Reliability Engineering and System Safety". I have made contributions in a wide variety of areas, using very different techniques: An important result is the determination, in a joint work with B.H. Rounne, of the complexity class of Euler characteristic, a problem which was previously open. I have also conducted work on algebraic statistics (in particular in experimental design) and on complex networks (giving an algebraic measure of network robustness), in both cases using techniques from commutative algebra, and providing algorithms for the relevant computations. I have also developed models for arthropod development that are used in the context of integrated pest management in agriculture. I conducted research on Machine Learning applied to oceanography (together with Cristina Romera-Castillo, researcher at ICM-CSIC) and to learning technology (published in IEEE Transactions on Learning Technologies).

In the last years I have developed an intense work on communication of mathematics and science, which includes the publication on several books (among them "Inteligencia Matemática", now in its 22nd edition), a Youtube channel (Derivando, 1.46 million subscribers), delivered hundreds of talks all over the world and the conduction of a science show in the national television (Orbita Laika). I have received several national awards for this science communication work.

General indicators of quality of scientific production:

*Research productivity merits ("sexenios")*: 2 (2012, 2018)

*Citations*: 374 (Google Scholar)

*Papers in the top 25% citeScore Journals*: 50%

*h-index*: 12 (Google Scholar)

*Number of coauthors*: 40 (64% international collaborators)

The most relevant merits of my CV are:

41 publications with an anonymous peer review process. 28 of them are papers in journals indexed in JCR. I highlight the work published in IEEE Transactions on Reliability and in Reliability Engineering and System Safety (both Q1, the top journals on reliability theory), and five articles published in "Journal of Symbolic Computation", one of the most important journals in the field of Computational Algebra. Among them is the paper in which I resolved with B. H. Rounne the problem of the computational complexity of the Euler characteristic. Among the other 13 publications, 4 correspond to papers presented in ISSAC, the most important conference on Computer Algebra and maximum category A\* in the CORE conference list, and 5 correspond to chapters of books or journal editorials.

Participation in 19 research projects, 8 of them were national and 2 were funded by the European Union.

75 contributions in national and international conferences, 13 of them by invitation. Plenary speaker at 9 conferences, highlighting the meeting "Algebraic Statistics", held in Chicago (USA) in May 19th to 22nd 2014, and the conference "Algebraic Method in Experimental Design" held at the Newton Institute in Cambridge (UK), October 26th to 27th 2011. I organized a minisymposium in the ICIAM congress, the main conference on applied and industrial mathematics.

I have a 21 years scientific career at the University of La Rioja as Associate Lecturer, Lecturer and as Associate Professor ("Profesor Titular de Universidad"). This includes the supervision of one PhD thesis (Patricia Pascual-Ortigosa), of two on-going thesis at the Universidad de La Rioja, and one at the Universidad de La Laguna.

## **Part C. RELEVANT MERITS**

## C.1. Publications

Most relevant publications from January 2014:

- J. Divasón, F. J. Martínez-de-Pisón, A. Romero, E. Sáenz-de-Cabezón, 2023, Artificial Intelligence Models for Assessing the Evaluation Process of Complex Student Projects, *IEEE Transactions on Learning Technologies* 16(5): 694-707.
- R. Iglesias, E. Sáenz-de-Cabezón, 2022, Cellular Structure of the Pommaret-Seiler resolution for quasi-stable ideals, *Applicable Algebra in Engineering, Communications and Computing*
- Bigatti, A., Pascual-Ortigosa, P., Sáenz-de-Cabezón, E., 2021, A C++ Class for multi-state algebraic reliability computations, *Reliability Engineering and System Safety*, 213 (107751)
- Mohammadi, F., Pascual-Ortigosa, P., Sáenz-de-Cabezón, E., Wynn, H., 2020, Polarization and depolarization of monomial ideals with application to multi-state system reliability, *Journal of Algebraic Combinatorics* 51(4): 617-639
- Pascual-Ortigosa, P., Sáenz-de-Cabezón, E., Wynn, H., 2020, Algebraic reliability of multi-state k-out-of-n systems, *Probability in the Engineering and Informational Sciences*, 2021, 35(4), pp. 903–927
- Mohammadi, F., Sáenz-de-Cabezón, E., Wynn, H., 2018, Efficient multicut enumeration of k-out-of-n:F and consecutive k-out-of-n:F systems, *Pattern Recognition Letters* 102: 82-88
- Mohammadi, F., Sáenz-de-Cabezón, E., Wynn, H., 2017, Types of signature analysis in reliability based on Hilbert series, *Journal of Symbolic Computation* 79:140-155
- Mohammadi, F., Sáenz-de-Cabezón, E., Wynn, H., 2016, The algebraic method in tree percolation, *SIAM Journal on Discrete Mathematics* 30(2): 1193-1212
- Sáenz-de-Cabezón, E., Wynn, H., Hilbert functions in design for reliability (2015), *IEEE Transactions on Reliability* 64(1): 83-93

## C.2. Congress

Conference: MEGA2021, Tromso (Norway) - Virtual. Date: June 7th to 11th 2021.

Contribution: "Cellular structure of the Pommaret-Seiler resolution for quasi-stable ideals".

Authors: E. Sáenz-de-Cabezón, R. Iglesias. Type of contribution: Contributed talk.

Conference: ISSAC2019, Beijing (China) Date: July 15th to 18th 2019. Contribution:

"Monomial resolutions for efficient computation of simplicial homology". Authors: A. Bigatti, E. Sáenz-de-Cabezón. Type of contribution: Contributed talk.

Conference: MMR2019, Hong-Kong. Date: June 3rd to 7th 2019. Contribution: "Algebraic analysis of multi-state system reliability". Authors: F. Mohammadi, P. Pascual-Ortigosa, E. Sáenz-de-Cabezón, H. Wynn. Type of contribution: Contributed talk.

Conference: MMR2017, Grenoble (France). Date: July 3rd to 6th 2017. Contribution:

"Reliability measures for coherent systems based on lcm filtrations of monomial ideals".

Authors: F. Mohammadi, E. Sáenz-de-Cabezón, H. Wynn. Type of contribution: Contributed talk.

Conference: ACA2017, Jerusalem (Israel). Date: July 20th to 23rd 2017. Contribution:

"Monomial resolutions as a preprocessing for the computation of simplicial homology".

Authors: A. Bigatti, J. Heras, E. Sáenz-de-Cabezón. Type of contribution: Contributed talk.

Conference: MEGA2015, Trento (Italy). Date: June 15th to 19th 2015. Contribution: "Monomial ideals for survivors and signatures in reliability". Authors: F. Mohammadi, E. Sáenz-de-Cabezón, H. Wynn. Type of contribution: Contributed talk.

Conference: ACA2015, Kalamata (Greece). Date: July 18th to 22th 2015. Contribution: "Computing the homology of the lcm-filtration of a monomial ideal". Authors: F. Mohamamdi, A. Romero, E. Sáenz-de-Cabezón, H. Wynn. Type of contribution: Contributed talk.

Conference: Algebraic Statistics, Chicago (USA). Date: May 19th to 22nd 2014. Contribution: "Algebraic reliability". Authors: E. Sáenz-de-Cabezón. Type of contribution: Plenary talk.

### **C.3. Research projects**

Most relevant research projects from January 2014:

Project title: Homological methods in computer algebra: new trends and applications (PID2020-116641GB-100) Funding entity: Ministry of Science and Innovation Call: 2020 Participating entities: University of La Rioja, Université Joseph Fourier (Grenoble, France), London School of Economics (London, United Kingdom) Duration, from: 2021 to: 2024 Grant amount: 30 492€ Principal investigator: Eduardo Sáenz de Cabezón and Ana Romero. Type of participation: Principal Investigator

Project title: Computational algebra: formalization and applications to network reliability and biomedical image processing (MTM2017-88804-P) Funding entity: Ministry of Economy, Industry and Competitiveness Call: 2017 Participating entities: University of La Rioja, Université Joseph Fourier (Grenoble, France), London School of Economics (London, United Kingdom) Duration, from: 2018 to: 2021 Grant amount: 52 151€ Principal investigator: Eduardo Sáenz de Cabezón and Vico Pascual. Type of participation: Principal Investigator

Project title: Algorithmic homological algebra with applications to network reliability and biomedical image processing (MTM2013-41775-P) Funding entity: Ministry of Economy and Competitiveness Call: 2013 Participating entities: University of La Rioja, Université Joseph Fourier (Grenoble, France), London School of Economics (London, United Kingdom) Duration, from: 2014 to: 2017 Grant amount: € 8,110 Principal investigator: Eduardo Sáenz de Cabezón. Type of participation: Principal Investigator

### **C.4. Contracts, technological or transfer merits**

Title: Mathematical assessment for order formula Ref: OTEM 19073. Companies: IKEA, Tinkle Communications S.L. Principal Investigator: Eduardo Sáenz de Cabezón, Universidad de La Rioja. Duration, from: 01/08/2019 to: 31/10/2020 Contract amount: € 7000

Title: Mathematical assessment for Youtube channel Ref: OTEM 200122 Companies: Zeppelin Television S.A.U Principal Investigator: Eduardo Sáenz de Cabezón, Universidad de La Rioja. Duration, from: 22/01/2020 to: 31/12/2022 Contract amount: € 12140

Title: Mathematical assessment for TV programs Ref: OTEM 200204 Companies: K200 S.A.U. Principal Investigator: Eduardo Sáenz de Cabezón, Universidad de La Rioja. Duration, from: 04/02/2020 to: 28/01/2022 Contract amount: € 33 141

Patent: Title: Dispositivo de visualización de formas tridimensionales (Device for tri-dimensional shape visualization) Patent number: ES2379422B2 Author: Eduardo Sáenz de Cabezón Institution: Universidad de La Rioja Country: Spain Date: 09/2012