Yérali Carolina del Carmen Gandica López Ph.D in Physics

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The backbone of my scientific line is to contribute to analysing social and economic interactions through theories of complex systems and critical phenomena. My methodology applies tools and concepts from statistical mechanics to real data, searching for and understanding emerging socio-economic phenomena, e.g. ubiquity, the origin of power laws (scale invariance) and the effects of extremely high correlation, which in physics is called criticality. In the social context, this means that an individual action can achieve country-size dimensions. Such systems need to be analysed not from their specific details but from their relevant variables, which in the age of massive data helps to analyse efficiently instead of inspecting more and more data.

Research lines

Complex Systems - Critical Phenomena - Network's Science - Computational Social Sciences.

Qualifications

Maître de conférences. N 22229318758. Section 29. (France).

Professeur des universités. N 24128318758. Section 28. (France).

ANECA: Qualification Profesor contratado and Profesor Universidad Privada. (Spain).

Sexenios: 1ero: 2009-2015. (Spain).

Current Position

Assistant Professor.

Department of Economic Analysis and Quantitative Economics,

Faculty of Economic and Business Sciences,

Universidad Autónoma de Madrid.

Nationality

Venezuelan and Belgian.

Education

Diplomas

HDR, France.

Habilitation à diriger des recherches (Habilitation to Supervise Research). Dissertation: **A Complex Systems approach to the emergence of socio-economic phenomena.** Place: Laboratoire de Physique Théorique et Modélisation (LPTM). CY Cergy Paris Université. The manuscript can be found at: https://hal.science/tel-03502898/document.

PhD in Physics, 2006-2012

Physics Center, Venezuelan Institute for Scientific Research (IVIC). Caracas, Venezuela

Thesis: "Statistical Mechanical Study of Several Models in Complex Networks".

Master's & Bachelor degrees. Licenciatura in Physics,

Universidad Simón Bolívar (USB). Caracas, Venezuela

Thesis: "Determinism and randomness in financial time series".

Other studies

Licenciatura in Sociology (BAC+3),

Universidad Central de Venezuela (UCV). Caracas, Venezuela.

Electronic Engineering,

1993-1998

2009-2012.

1999-2005

Universidad Simón Bolívar (USB). Caracas, Venezuela

Previous Positions

Assistant Professor

Feb-Jul 2025

Department of Applied Mathematics. Escuela Politécnica Superior, Universidad Antonio de Nebrija, Madrid, Spain.

Associate Professor 2023-2025

Department of Mathematics. Valencian International University (VIU). Spain.

Assistant Professor (Enseignant-Chercheur Contractuel)

2019-2022

International Bachelor in Data Science and attached to the Department of Physics. Laboratory of Theoretical Physics and Modeling (LPTM). CY-Cergy Paris University France.

Associate Scientific Researcher

Jan 2018-Dec 2018

Centre for Operations Research and Econometrics (CORE) & Institute of Information and Communication Technologies, Electronics and Applied Mathematics (ICTEAM). Université catholique de Louvain - Louvain-la-Neuve - Belgium.

Postdoctoral Researcher

2016-2017

Department of Business. CeReFiM and naXys. University of Namur, Belgium.

Postdoctoral Researcher

2014-2016

Department of Mathematics. University of Namur, Belgium.

Postdoctoral Researcher

2012-2014

Centre for Computational Physics. Department of Physics. Univ. Coimbra, Portugal.

Scientific Stays

- Visiting Fellow. Universidad Pontificia de Valparaiso, Chile. 5-23 August 2024.
- Visiting Fellow. Complexity Institute. Nanyang Technological University (NTU). Singapore. Jan - Apr 2019.
- Santa Fe Institute's 2008 Complex Systems Summer School. Bariloche, Argentina. December 2008.
- Universidad Autónoma de México. Supervisor: Marcelo del Castillo Mussot. May Jun, 2008.
- Instituto Mediterraneo de Estudios Avanzados (IMEDEA). University of Baleares Islands. España.
 Supervisors: Maxi San Miguel and Víctor Eguiluz. Jan Feb 2007.

Awards & Honors

- 2019 Poster Award: NATURE Sustainability. Conference on Complex Systems (CCS 2019).
- 2016 Full Grant by the organising committee to attend the Statphys'26 in Lion, France.
- 2008 Santa Fe Institute's Grant for attending the Complex Systems Summer School 2008.
- 2007 Qualification Researcher A. Program to Stimulate Researching. Fonacit. Venezuela.
- 2006 Scholarship of Excellence for doing PhD studies. Fondo Nacional de Ciencia, Tecnología e Innovación (FONACIT). Caracas, Venezuela.
- 2005 Prize: Outstanding dissertation for Licenciatura in Physics Thesis Dissertation.

Grants

- 2022 **PI of the project** "Signs of criticality in social explosions". Funded by Labex MME-DII, under the CY Initiative of Excellence program (France) [5 kE].
- 2020 Partner of the project "Regional and global economic integration of Ethiopia in the 21st century" funded by the University of Gent (Belgium), within the NASCERE program, providing funding for 1 PhD.
- 2018 **PI of the project** "Study of the conditions needed for the occurrence of criticality on Social systems". Funded by the Complexity Institute. Nanyang Technological University (NTU) (Singapore), providing a 3-month visiting fellowship.

Languages

- English: Advanced.
- French: C1. Certificate from the Centre de Langue Française (CLF) CY Cergy-Paris University.
- Portuguese: B2. Certificate from the Language Centre (FLUC) Coimbra University.
- Spanish: Native language.

PhD students

• Tekilu Tadesse, "Regional and global economic integration of Ethiopia in the 21st century". Dept. Economics & Dept. Physics and Astronomy. Ghent University. Belgium (co-supervised with Luis E. C. Rocha). 2021 - 2024.

MSc students

- Claudia Enrique. Creation and analysis of retweet networks during different events. Master in Artificial intelligence. Valencian International University. Spain. Jan- May 2025.
- Sergi Puigmal Miranda. Blurring of personal information (tattoos and faces) in images and videos (Deep learning). Master in Artificial intelligence. Valencian International University. Spain. Sep 2024 - March 2025.
- Magda Del Pilar Santa Fajardo. "Manifestaciones sociales en torno al d\u00eda internacional de la mujer 2018". Master in Artificial intelligence. Valencian International University. Spain. May
 Sep 2024.
- Francisco Ruas Faro Viana. "Manifestaciones sociales: un análisis estructural". Master in Artificial intelligence. Valencian International University. Spain. Jun - Sep 2024.
- David Hernández. "Modelos de formación de opinión en redes scale-free. Master in Big Data. Valencian International University. Spain. Apr Oct 2024.
- Manuel Suárez. "Autosimilitud en movimientos sociales". Master in Artificial intelligence. Valencian International University. Spain. Apr Oct 2024.
- David Baena. "Efecto de la dinámica durante la formación de la red en un modelo de propagación de culturas. Master in Big Data. Valencian International University. Spain. Apr - Sep 2024.
- David André Villamil, "Análisis dinámico de preferencias a través de Wikipedia. Master in Artificial intelligence. Valencian International University. Spain. Apr Aug 2024.
- Manuel Arriaza, "Semantic-Temporal Analysis of Social Manifestations". Master in Artificial intelligence. Valencian International University. Spain. May - Nov 2023.
- Daniel Rico, "Social manifestations: Some entropic measures, structure in communities and networks". Master in Big Data. Valencian International University. Spain. May Sep 2023.
- Fien Goetmaeckers, "Continuous Opinion Dynamics on Bilayer Temporal Networks". Dept. Economics & Dept. Physics and Astronomy. Ghent University. Belgium (co-supervised with Luis E. C. Rocha). Sep 2020 May 2021.
- Rémi Perrier. "Effect of the limit of attention on the Axelrod Model". LPTM. Phys. Dep. CY Cergy Paris Université. France. (co-supervised with Laura Hernández) Mar Jun 2020.

3rd-year Scientific stage of BSc students

• Julien Assuied, "Wikipedia Editing Preferences: A dynamic study". Bachelor in Data-Science. CY Cergy Paris Université. France. Apr - Aug 2021.

Jury Membre

- PhD Thesis defense by Bart De Clerck, "Identifying online misinformation and disinformation spreading using graph theory". Faculty of Economics and Business Administration. Ghent University, Belgium. Jun 2024.
- PhD Thesis defense by Tan Jinin Liang, "The community-degree graph model and its implications on epidemic spread in social networks". School of Physical and Mathematical Sciences. Nanyang Technological University, Singapore. May 2024.
- Ph.D. thesis defence by Maroua Messaoudi, "Theoretical and experimental study of non-local interactions on the spatio-temporal organization of plant ecosystems". Physics Dept. Université libre de Bruxelles (ULB), Belgium. January 2022.
- Some 20 Master's theses.

- Journal of Physics: Complexity.
- Advances in Complex Systems.
- Applied Network Science.

- Scientific Reports.
- Entropy.
- Physica A.

Research proposals reviewer

• The Dutch Research Council (NWO). The Netherlands, 2023.

Editors Records

• Special Issue "Social Phenomena: Mathematical Modeling and Data Analysis". Journal Mathematics.

https://www.mdpi.com/journal/mathematics/special_issues/Soc_Phenom_Math_Model_Data_Anal

• Special Issue "Complex Systems Approach to Social Dynamics". Journal Entropy. https://www.mdpi.com/journal/entropy/special_issues/Social_dynamics.

Program Committees

• International School and Conference on Network Science (Netsci). Editions 2023 - present.

• Conference on Complex Systems (CCS).

Editions 2022 - present.

 International Conference on Complex Networks and their Applications.

Editions 2017 - present.

Organisation of Scientific Events

- Main organiser of the Third Satellite Workshop Criticality on networks and socio-economic systems, at the Conference on Complex Systems (CCS 2024) in Exeter, UK. September 2024. (https://yerali.github.io/criticalitysystems3/).
- Main organiser of the Second Satellite Workshop **Criticality on networks and socio-economic systems**, at the Conference on Complex Systems (CCS 2021) in Lyon, France. October 2021. (https://yerali.github.io/criticalitysystems2/).
- Main organiser of the Satellite Workshop Criticality on networks and socio-economic systems, at the Conference on Complex Systems (CCS 2019) in Singapore. October 2019. (https://yerali.github.io/criticalitysystems/).
- Co-organiser of the satellite 4th Workshop on Statistical Physics of Financial and Economic Networks, at the NetSci19 conference in Burlington, USA. May 2019. (https://sites.google.com/view/spfen2019/home)
- Main organiser of the satellite workshop **SpaceNet**, at the Conference on Complex Systems (CCS 2018) in Thessaloniki, Greece. September 2018.
- Main organiser of the satellite **BURSTINESS in Human Behaviour and other Natural Phenomena**, at the Conference on Complex Systems (CCS 2016) in Amsterdam, The Netherlands. September 2016.

Invited Seminars

- A structural study of social demonstrations Physics Department. Potsdam University. Potsdam, Germany. 21 Jun 2024.
- Signs of criticality in social explosions at the Networks Seminars. Mathematical Institute, Oxford University. Oxford, UK. 24 Jan 2023.
- Social explosions: some percolating properties. Complexity Lab Barcelona (CLabB) seminars at Universitat de Barcelona Institute of Complex Systems (UBICS). Barcelona, Spain. 12 Dec 2022.
- A complex systems approach to the emergence of socio-economic phenomena. Laboratoire d'Informatique (LIP6). Sorbonne Université. Team Complex Networks. Paris, France. 3 Feb 2022.

Societies

- Complex Systems Society (CSS): Member of the Council.
- Network Science Community (NetSci) Society.
- Statistical Physics Community.
- Sigma Xi, The Scientific Research Honor Society.

Courses taken

Fundamentals of Supervised learning with a focus on Deep Learning. Organized by the Belgian Interuniversity Attraction Poles on "Dynamical Systems, Control and Optimization" (DYSCO). It took place at UCLouvain (Louvain-la-Neuve) on October 29-31, 2018.

Training in teaching

- Becoming a teacher in leadership training today (Formation de formateurs: Etre formateur en CFA aujord'hui). Octuber 5-6 and November 14 (2023).
- Serious games to dynamise lessons. Micro-credential at Valencian internation university. Instructor: Dr. Marcos Antón. March, 2025.
- Preparation of valid, reliable and unbiased exams: following Bloom's taxonomy. Instructor: Javier Tortajada. April, 2025.

Main Courses Taught

Nebrija Universidad

2025-Present

• Data Science. Third-year students. Applied Mathematics Department.

Valencian International University

2023-Present

- Temporal Series. Third-year students. Mathematics Department.
- Data Mining. Fourth-year students. Mathematics Department
- Advanced Statistics. Master in Big Data.

CY Cergy Paris Université

2019-2022

- Python and Monte Carlo methods to Master 1 students. Physics Department.
- Problems Session of Quantum Physics: 3rd-yr students. Physics Department.
- Modern Physics: Main course and session of problems. Physics Department. Ingeniery school. CY-Tech.
- Agent-Based modelling and Networks Science: 4th-yr students. Bachelor in Modelling and Data Science.
- Information Theory: 3rd-yr students. Bachelor in Modelling and Data Science.

Tutorials

- Introduction to Network Science:
 - 5th International Conference on Computational Social Science (IC²S²) 2019. The Netherlands, 17 July 2019.
- Introduction to Network Science and Social-related models:
 - Universidad Pontificia de Valparaiso, Chile. 5-23 August, 2024.
 - Nanyang Technological University (NTU). Singapore, 7-8 March 2019.

Grants Applications

- 1. Title: What is the effect of the firms' heterogeneity on the phase transitions that happened as a consequence of the global financial crisis? to: ANR- Agence Nationale de Recherche (National Research Agency in France). Role: Principal Researcher. Submitted in 2021 and selected to the second stage.
- 2. Title: Diversity, temporality, and geography of the phenomena of knowledge cascade (Geo-diverknowledge). To ERC Consolidator Grant 2023. Role: Principal Researcher.

Publication List

(Last ten years. Complete list at https://yerali.github.io/publications.html)

Works in Progress

- 31 "Self-similarity in social movements". Manuel Suárez, Mariángeles Serrano and Yérali Gandica.
- 30 "Dynamic analysis of human preferences through Wikipedia". David André Villamil and Yérali Gandica.

Preprints

- 29 Tekilu Tadesse, Jemal Abafita, Yerali <u>Gandica</u> and Luis E C Rocha, "Economic Integration of Africa in the 21st Century: Complex Network and Panel Regression Analysis". (https://arxiv.org/abs/2410.21019).
- 28 David Hernández, Guillaume Deffuant and Yérali <u>Gandica</u>. "Bounded confidence dynamics generates opinion cascades on a growing scale-free network". https://arxiv.org/pdf/2506.02669.

Peer review articles

- 27 Yérali <u>Gandica</u> and Guillaume Deffuant, "Bounded confidence model on growing populations". Advances in Complex Systems, 2450009 (2024). doi.org/10.1142/S0219525924500097.
- 26 Daniel Rico and Yérali <u>Gandica</u>, "An entropic analysis of social demonstrations". Entropy 2024, **26**(5), 363 (2024). doi.org/10.3390/e26050363.
- 25 Mariano G. Beiró, Ning Ning Chung, Lock Yue Chew and Yérali <u>Gandica</u>, "Signs of criticality in social explosions". Sci Rep 14, 3263 (2024). doi.org/10.1038/s41598-024-53657-1.
- 24 F. Zarei, Y. Gandica, and L. E C Rocha, "Bursts of communication increase opinion diversity in the temporal Deffuant model". Sci Rep 14, 2222 (2024). doi.org/10.1038/s41598-024-52458-w.
- 23 Julien Assuied and Yérali Gandica, "Detection and effect of social events on Wikipedia data-set for studying human preferences". Frontiers in Big Data. Sec. Data Science 6, 1077318 (2023). DOI: 10.3389/fdata.2023.1077318.
- 22 Rémi Perrier, Yérali <u>Gandica</u> and Laura Hernández, "The consequences of hesitation: Axelrod model with intrinsic noise". PLoS ONE **16**(11): e0259295 (2021). DOI: 10.1371/journal.pone.0259295.
- 21 Yérali <u>Gandica</u>, J. Stephen Lansing, Stefan Thurner, Ning Ning Chung and Lock Yue Chew, "Bali's ancient rice terraces: A Hamiltonian approach". **Phys. Rev. Lett. 127**, 168301 (2021). DOI: 10.1103/PhysRevLett.127.168301.
- 20 Yérali <u>Gandica</u>, Sophie Béreau and Jean-Yves Gnabo, "A multilevel analysis of financial institutions' systemic exposure from local and system-wide information". Sci Rep **10**, 17657 (2020). DOI: 10.1038/s41598-020-74259-7.
- 19 Petter Holme and Yérali <u>Gandica</u>, "The free and freer XY models". Phys. Rev. E **101**, 032311 (2020). DOI: 10.1103/PhysRevE.101.032311.
- 18 Yérali <u>Gandica</u>, Adeline Decuyper, Christophe Cloquet, Isabelle Thomas and Jean-Charles Delvenne, "Measuring the effect of node aggregation on community detection". **EPJ Data Sci. 9**, 6 (2020). DOI: 10.1140/epjds/s13688-020-00223-0.
- 17 Yérali <u>Gandica</u>, "Population's preferences through Wikipedia edits". 2018 Fifth International Conference on Social Networks Analysis, Management and Security (SNAMS): 278-283, (2018). DOI: 10.1109/SNAMS.2018.8554724.
- 16 Yérali <u>Gandica</u>, Marco Geraci, Sophie Béreau and Jean Yves Gnabo. "Fragmentation, integration and macroprudential surveillance of the US financial industry: Insights from network science." PLoS ONE 13(4): e0195110 (2018). DOI: 10.1371/journal.pone.0195110.
- 15 Floriana Gargiulo and Yérali <u>Gandica</u>, "The Role of Homophily in the Emergence of Opinion Controversies". Journal of Artificial Societies and Social Journal of Artificial Societies and Social Simulation (JASSS) **20**(3)8 (2017) DOI: 10.18564/jasss.3448.
- 14 Floriana Garguilo, Yérali <u>Gandica</u> and Timoteo Carletti, "Emergent dense suburbs in a Schelling metapopulation model: a simulation approach". Advances in Complex Systems 20 No. 1 (2017) DOI: 10.1142/S0219525917500011.
- 13 Yérali <u>Gandica</u>, João Carvalho, Fernando Sampaio dos Aidos, Renaud Lambiotte and Timoteo Carletti, "Stationarity of the interevent powerlaw distributions". PLoS ONE **12**(3): e0174509 (2017). DOI:10.1371/journal.pone.0174509.
- 12 Yérali <u>Gandica</u>, Renaud Lambiotte and Timoteo Carletti, "What can Wikipedia tell us about the global or local measurements for burstiness?". Proceeding for the 10 th International AAAI Conference on Web and Social Media (ICWSM16) Vol. 10 No. 2 (2016) DOI: 10.1609/icwsm.v10i2.14839.
- 11 Mustapha Tlidi, Yérali <u>Gandica</u>, Giorgio Sonnino, Etienne Averlant and Krassimir Panajotov, "Extrems events in the far from equilibrium Brusselator model with delay feedback". Entropy **18**, 64 (2016) DOI:10.3390/e18030064.

- 10 Yérali <u>Gandica</u> and Silvia Chiacchiera, "Nature of phase transitions in the 2D Axelrodlike coupled Potts models". Phys. Rev. E **93**, 032132 (2016). DOI: https://doi.org/10.1103/PhysRevE.93.032132.
- 9 Yérali <u>Gandica</u>, João Carvalho, Fernando Sampaio dos Aidos, Renaud Lambiotte and Timoteo Carletti, "Circadian patterns on Wikipedia edits". Proceedings of the 7th Workshop on Complex Networks, CompleNet (2016). DOI: //doi.org/10.1007/978-3-319-30569-122.
- 8 Yérali <u>Gandica</u>, Floriana Gargiulo and Timoteo Carletti, "Can topology reshape segregation patterns?" Chaos, Solitons and Fractals **90** (2016) 46–54. https://doi.org/10.1016/j.chaos.2016.02.024
- 7 Yérali <u>Gandica</u>, João Carvalho and Fernando Sampaio dos Aidos, "Wikipedia editing dynamics". Physical Review E **91**, 012824 (2015). 10.1103/PhysRevE.91.012824.
- 6 Yérali <u>Gandica</u>, Fernando Sampaio dos Aidos and João Carvalho, "The dynamic nature of conflict in Wikipedia". EPL **108**,18003 (2014) DOI:10.1209/0295-5075/108/18003.
- 5 Yérali <u>Gandica</u>, Tobias Schwartz, Orlando Oliveira and Rui Travasso, "Hypoxia in vascular networks: a complex system approach to unraveling the Diabetes paradox". PLoS ONE **9**, 11, e113165 (2014) DOI: https://doi.org/10.1371/journal.pone.0113165.

Oral Presentations (last five years)

- Exploring Modular-to-Nested Transitions in Social Demonstrations. International School and Conference on Network Science. 2-6 June 2025, Maastricht, the Netherlands.
- Cascades of opinion clusters in a growing scale-free network with homophily 3rd Meeting of the Spanish Chapter of the Complex Systems Society CS3. February 2025.
- An entropic study of social manifestations Conference on Complex Systems 2024: CCS'24 Exeter, UK. September 2024.
- A structural study of social demonstrations. Bridging Theoretical and Empirical Approaches to the Study of Social Dynamics. Paris, France. June 2024.
- An entropic study of social manifestations. 2nd Meeting of the Spanish Chapter of the Complex Systems Society CS3. February 2024.
- Temporal-Semantic Analysis of Social Manifestations. Manuel Arriaza and Yérali Gandica. Conference on Complex Systems (CCS 2023). Bahia, Brazil. October 2023.
- Bounded confidence models generate additional clusters when the number of agents is growing. Yérali Gandica and Guillaume Deffuant. French Regional Conference on Complex Systems (FRCCS 2023). Le Havre, France. June 2023.
- Bounded confidence models on growing SF networks. Eleventh International Conference on Complex Networks and Their Applications. Palermo, Italy. November 2022.
- Social explosions: Some percolating properties. Conference on Complex Systems (CCS 2022). Palma de Mallorca, Spain. October 2022.
- A percolating study of social explosions. French Conference on Complex Systems (FRCCS 2023). Paris, France. June 2022.
- Evidence of a common pattern in social explosions. French Regional Conference on Complex Systems (FRCCS 2021). Dijon, France. May 2021.
- Bali ancient rice terraces: A Hamiltonian approach. Workshop Theoretical and Mathematical Physics in Cergy-Paris, Singapore, and Warwick. ONLINE. July 2020.

Poster Presentations as presenter (last five years)

- Evidence of a common pattern in social explosions at the 3rd conference on Statistical Physics. Trieste, Italy. September 2021.
- Does aggregation preserve communities? International Conference on Network Science (Netsci). Rome, Italy. September 2020.
- Bali ancient rice terraces: A Hamiltonian approach Conference on Complex Systems (CCS 2019). Singapore. September 2019 (Poster Award).

Reference contacts

 Prof. Guillaume Deffuant.
 Université Clermont-Auvergne, INRAE, UR LISC, France.
 Email: guillaume.deffuant@inrae.fr. Prof. Floriana Gargiulo.
 Chargée de recherche CNRS- GEMASS-Groupe d'Etude des Méthodes de l'Analyse Sociologique de la Sorbonne. Sorbonne Université. France.

Email: floriana.gargiulo@cnrs.fr.