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Carlos Argáez García

Curriculum Vitae

Profile

I am an applied mathematician with expertise in numerical and functional analysis, differential equations, and scientific computing. I am an enthusiastic and experienced teacher and supervisor who has lectured multiple courses and successfully supervised undergraduate students. I strive to be a team player and take on my share of administrative tasks.

Academic Appointments

Oct 2022 – current **Research Specialist**, *Mathematics*, Marine and Freshwater Research Institute, Iceland.

Jan 2017 – Sept 2021 **Research Specialist**, *Mathematics*, University of Iceland, Iceland.

Aug 2016 – Dec 2016 **Postdoctoral researcher**, *Department of Mathematics*, University of Reykjavik, Iceland.

Jun 2014 – Jun 2016 **Research specialist**, *Department of Chemistry*, University of Iceland, Iceland.

Education

2009–2013 **Ph.D**, *Mathematics*, School of Mathematics, Dublin Institute of Technology, Ireland.
Grant provided by Science Foundation Ireland

2003–2008 **B.Sc.**, *Physics*, Science School, National Autonomous University of Mexico, Mexico.

Grants

2019 **Watanabe Scholarship**, *Mathematics*, Watanabe Trust Fund, Iceland.

2009–2013 **Postgraduate grant**, *Mathematics*, Dublin Institute of Technology, Science Foundation Ireland, Ireland.

2007–2008 **Grant for undergraduate thesis**, *Physics*, PAPIIT, National Autonomous University of Mexico, Mexico.

Supervision

Currently **Mr. Rodrigo Emanuel Camas Maay**, *Undergraduate advisor*, Application of Lyapunov's second method to physical and chemical research, Merida Technological Institute, Mexico.

Currently **Mr. Jonatan Estevez**, *Undergraduate advisor*, Mathematical problems within applied computational chemistry research, National Autonomous University of Mexico, Mexico.

2020 **Mr. Manuel Alejandro Dzul Gallareta**, *Undergraduate advisor*, Computational aspects of the Schrödinger equation (BSc awarded), Autonomous University of Yucatan, Mexico.

Funded Visiting Positions

Sep 2019 – Oct 2019 **Visiting Research Fellow**, *Mathematics/Dynamical Systems*, Prefectural University of Hiroshima, Japan.

Jan 2014 – Feb 2014 **Visiting Research Fellow**, *Mathematical Physics/chemistry*, Aalto University, Finland.

Jul 2013 – Aug 2013 **Visiting Research Fellow**, *Mathematical Physics*, Sussex University, United Kingdom.

Jan 2009 – Aug 2009 **Visiting research fellow**, *Computational physics*, Autonomous University of Morelos, Mexico.

Jun 2008 – Nov 2008 **Visiting research fellow**, *Computational chemistry*, University of Turin, Italy.

Jun 2009 – Nov 2009 **Visiting Research Fellow**, *Computational Physicalchemistry*, University of Turin, Italy.

Conference organisation

Organised the following conferences and workshops:

2019-2021 **Seminars organiser**. Department of Mathematics, University of Iceland, Iceland.

Jul 2020 **Session organiser**. *CTDE 2020, Special Session on Control Theory and Differential Equations, ICINCO*, Online.

Jul 2019 **Session organiser**. *CTDE 2019, Special Session on Control Theory and Differential Equations, ICINCO*, Prague, Czech Republic.

Jul 2018 **Session organiser**. *CTDE 2018, Special Session on Control Theory and Differential Equations, ICINCO*, Porto, Portugal.

Thesis

1. C. Argáez García, *Rigorous Mathematical Results on Nonlinear Equations Arising in Quantum Chemistry*, Ph.D. thesis, School of Mathematical Sciences, Dublin Institute of Technology, 2013.

Teaching

2019 **Numerical linear algebra**, *University of Iceland*, Iceland, I convened and lectured this course keeping three main aims: the theory behind topics, the application and the coding. That allowed a very rounded course in which I managed to show how to apply the related mathematical theory, using computer programming, to solve problems.

2019 **Fourier analysis**, *University of Iceland*, Iceland, I convened and lectured this course that introduced students to Fourier analysis topics in pure and applied maths. Along with covering applied topics on the resolution of problems, I covered both the pure and applied material and I had overall responsibility for the course and assessment.

2018 **Fourier analysis**, *University of Iceland*, Iceland, As before, I convened and lectured this course that introduced students to Fourier analysis topics in pure and applied maths. Along with covering applied topics on the resolution of problems, I covered both the pure and applied material and I had overall responsibility for the course and assessment.

2017 **Numerical linear algebra**, *University of Iceland*, Iceland, I was in charge of marking the homework assignments and answering the students' questions.

2010–2012 **Mathematics for computer sciences, Mathematics for Physics with Medical Physics & Bioengineering, Mathematics for Physical Sciences**, *Dublin Institute of Technology*, Ireland, I was in charge of marking the homework assignments and answering the students' questions.

2010 **Mathematics for engineering students**, *Dublin Institute of Technology*, Ireland, This was a mathematics course on algebra, trigonometry, analytical geometry, differential and integral calculus for engineering students. I convened and lectured this course with great passion to encourage the students to learn. I was responsible both for the teaching as well as the examinations.

Review Service

In 2020 I participated as a reviewer in *Advances in Difference Equations* and in the *American Control Conference*. In the years 2018 and 2019, I participated as a reviewer to the proceedings of the conferences *ICINCO* and *SIMULTECH*. For the latest I also reviewed proceedings in 2017. In 2019 I reviewed papers for the conference *CDC*. Finally, in the years 2020 and 2019, I have written reviews to papers in *Mathematical Reviews*.

Selected Talks, Presentations and Conferences

2022 Numerical methods for the study of dynamic systems, Higher Technological Institute of Martinez de la Torre, Mexico, online because of COVID-19 pandemia.

2022 Lyapunov Functions: Numerical Techniques and Stability Analysis, CICB 2021 TecNM, Mexico, online because of COVID-19 pandemia.

2021 WendlandXool: Simplified C++ code to compute Wendland functions, NODYCON 2021, online because of COVID-19 pandemia.

2021 Statistical analyses of an iterative algorithm class for dynamical systems, NODYCON 2021, online because of COVID-19 pandemia.

2021 LyapXool, ENSPM2021, online because of COVID-19 pandemia.

2020 Evaluation of Lyapunov Function Candidates Through Averaging Iterations, ICINCO 2020, online because of COVID-19 pandemia.

2019 Critical tolerance evolution: Classification of the chain-recurrent set, DSTA 2019, Lodz, Poland.

2019 Middle Point Reduction for the Chain-recurrent set, SIMULTECH 2019, Prague, Czechia.

2019 Clustering Algorithm for Generalized Recurrences using Complete Lyapunov Functions, ICINCO 2019, Prague, Czechia.

2019 Improved estimation of the chain-recurrent set, ECC19, European Control Conference, Naples, Italy.

2019 Numerical Methods for Dynamical Systems, Prefectural University of Hiroshima, Hiroshima, Japan.

2019 Numerical Methods for Dynamical Systems: Stability analysis, National Autonomous University of Mexico, Mexico City, Mexico.

2018 Computation of complete Lyapunov functions for three-dimensional systems, 57th IEEE Conference on Decision and Control (CDC), Miami, U.S.

2018 Numerical Methods for Dynamical Systems: understanding the dynamics of real applications, University of Puerto Rico, San Juan, Puerto Rico.

2018 Complete Lyapunov Functions: Algorithms to avoid trivial solutions, Waterford Institute of Technology, Waterford, Ireland.

2018 Iterative construction of Complete Lyapunov functions, 8th International Conference on Simulation and Modeling Methodologies, Oporto, Portugal.

2017 Computational smoothing of complete Lyapunov functions, Icelandic Mathematical Society conferences: Stærðfræði á Íslandi 2017, Bifröst, Iceland.

2017 Searching activation energies, Academic Centre of Sciences and Technology, Sisal, Autonomous University of Mexico, Mexico.

2017 Numerical improvements in methods to find first order saddle points on potential energy surfaces, Mathematical and Numerical Methods for Time-Dependent Quantum Mechanics - from Dynamics to Quantum Information, Oaxaca, Mexico.

2017 Analysing dynamical systems towards computing complete Lyapunov functions, 7th International Conference on Simulation and Modeling Methodologies, Madrid, Spain.

2017 Breeding new methods for finding first order saddle points, Finding proper preconditioners for Davidson Algorithms, Dublin Institute of Technology, Ireland.

2016 Nonlinear equations in Quantum Chemistry, School of Mathematics, Autonomous University of Yucatan, Mexico.

2014 Nonlinear equations in Quantum Chemistry: rigorous mathematical results, Group seminar, Center for Research and Advanced Studies, Mexico.

2013 Elliptic Problems in Quantum Chemistry, University of Turin, Italy.

2012 Quantum Chemistry: Elliptic Variational Problems with Nonlocal Operators, School of Mathematics, Dublin Institute of Technology, Ireland.

2012 Elliptic Variational Problems with Nonlocal Operators, Workshop on Interactions between Dynamical Systems and PDEs, Polytechnic University of Catalonia, Spain.

2008 Solutions to the quasi-relativistic multi-configurative Hartree-Fock type equations, Mini-Symposium on Analysis and PDEs, Uppsala University, Sweden.

Peer Reviewed Journal Publications

14. C. Argáez, P. Giesl, S. Hafstein, *Eigenpairs for the analysis of complete Lyapunov functions*, Complexity, 2022.
13. J. Estévez-Jácome, C. Argáez, R. Ramirez, B. Alcántar-Vázquez, *CO2 adsorption on PEHA-functionalized geothermal silica waste: kinetic study and quantum chemistry approach*, Reaction Chemistry & Engineering, 2022.
12. C. Argáez, M.J. Cánovas, J. Parra, *Calmness of linear constraint systems under structured perturbations with an application to the path-following scheme*,Set-Valued and Variational Analysis, 2021.
11. P. Giesl, Z. Langhorne, C. Argáez, S. Hafstein, *Computing complete Lyapunov functions for discrete-time dynamical systems*, Discrete and Continuous Dynamical Systems Series B **26** (2021), no. 1, 299–336.
10. P. Giesl, C. Argáez, S. Hafstein, H. Wendland, *Minimization with differential inequality constraints applied to complete Lyapunov functions*, Mathematics of Computation. pp. 1-23. ISSN 0025-5718, 2021.
9. C. Argáez, P. Giesl, S.F. Hafstein, *Update (2.0) to LyapXool: Eigenpairs and new classification methods*, SoftwareX **12** (2020), 100616, ISSN 2352-7110.
8. C. Argáez, J.-C. Berthet, H. Björnsson, P. Giesl, S.F. Hafstein, *LyapXool - a program to compute complete Lyapunov functions*, SoftwareX **10** (2019), 100325, ISSN 2352-7110.
7. C. Argaez, M. Melgaard, *Ground state solutions to Hartree-Fock equations with magnetic fields*, Appl. Anal. **97** (2018), no. 14, 2377–2403.
6. M. Plasencia Gutiérrez, C. Argáez, H. Jónsson, *Improved Minimum Mode Following Method for Finding First Order Saddle Points*, J. Chem. Theory Comput. **13** (2017), no. 1, 125–134.
5. C. Argaez, M. Melgaard, *Minimizers for open-shell, spin-polarised Kohn-Sham equations for non-relativistic and quasi-relativistic molecular systems*, Methods and Applications in Analysis, **23** (2016), no. 3, 269–292.
4. C. Argaez, M.Melgaard, *Existence of a minimizer for the quasi-relativistic Kohn-Sham model*, Electronic Journal of Differential Equations **2012** (2012), Article 18, 1–20.

3. C. Argaez, M.Melgaard, *Solutions to quasi-relativistic multi-configurative Hartree-Fock equations in quantum chemistry*, Nonlinear Analysis: Theory, Methods & Applications *75* (2012), 384–404. Addendum and erratum, Nonlin. Anal. TMA **75** (2012), 3274–3275.
2. C. Argáez, E. Batta, J. Mansilla, C. Pijoan, P. Bosch, *The origin of black pigmentation in a sample of Mexican prehispanic human bones*, Journal of Archaeological Science **38** (2011), 2979–2988.
1. E. Batta, C. Argáez, J. Mansilla, C. Pijoan, P. Bosch, *On yellow and red pigmented bones found in Mayan burials of Jaina*, Journal of Archaeological Science **40** (2013), 712–722.

Springer Chapters

4. C. Argáez, P. Giesl, S. F. Hafstein, *Complete Lyapunov Functions: Determination of the Chain-recurrent set using the Gradient*, In: Simulation and Modeling Methodologies, Technologies and Applications Series: Advances in Intelligent Systems and Computing 1260 eds. M. Obaidat, T. Ören, and F. De Rango, Springer 2021. pp. 104–12.
3. C. Argáez, P. Giesl, and S.F. Hafstein, *Iterative Construction of Complete Lyapunov Functions: Analysis of Algorithm Efficiency*, In: Simulation and Modeling Methodologies, Technologies and Applications Series: Advances in Intelligent Systems and Computing 947 eds. M. Obaidat, T. Ören, and F. De Rango, Springer 2020. pp. 83-100.
2. C. Argáez, P. Giesl, and S.F. Hafstein, *Complete Lyapunov Functions: Computation and Applications*, In: Simulation and Modeling Methodologies, Technologies and Applications. Series: Advances in Intelligent Systems and Computing 873 eds. M. Obaidat, T. Ören, and F. De Rango, Springer 2019. pp. 200–221.
1. C. Argáez, P. Giesl, and S.F. Hafstein, *Computational approach for complete Lyapunov functions*, In: Dynamical Systems in Theoretical Perspective. Series: Springer Proceedings in Mathematics and Statistics 248 ed. J. Awrejcewicz, Springer 2018. pp. 1–11.

Peer Reviewed Proceedings

13. C. Argáez, P. Giesl, S.F. Hafstein, *WendlandXool: Simplified C++ Code to Compute Wendland Functions*, In: Lacarbonara, W., Balachandran, B., Leamy, M.J., Ma, J., Tenreiro Machado, J.A., Stepan, G. (eds) Advances in Nonlinear Dynamics. NODYCON Conference Proceedings Series. Springer, Cham. 2021, pp. 465–474.
12. C. Argáez, P. Giesl, S.F. Hafstein, *Statistical Analysis of an Iterative Algorithm Class for Dynamical Systems*, In: In: Lacarbonara, W., Balachandran, B., Leamy, M.J., Ma, J., Tenreiro Machado, J.A., Stepan, G. (eds) Advances in Nonlinear Dynamics. NODYCON Conference Proceedings Series. Springer, Cham. 2021, pp. 453–464.
11. C. Argáez, P. Giesl, S.F. Hafstein, *Comparison of Different Radial Basis Functions in Dynamical Systems*, In: Proceedings of the 11th International Conference on Simulation and Modeling Methodologies, Technologies and Applications (SIMULTECH), 2021, pp. 394–405.
10. C. Argáez, P. Giesl, S.F. Hafstein, *Evaluation of Lyapunov Function Candidates Through Averaging Iterations*, In: Proceedings of the 17th International Conference on Informatics in Control, Automation and Robotics (ICINCO), 2020, pp. 734–744.
9. C. Argáez, P. Giesl, S.F. Hafstein, *Critical tolerance evolution: Classification of the chain-recurrent set*, In:Proceedings of the 15th International Conference on Dynamical Systems: Theory and Applications (DSTA), Volume: Mathematical and Numerical Aspects of Dynamical System Analysis, Lodz, Poland, 2019, pp. 21–32.
8. C. Argáez, P. Giesl, S.F. Hafstein, *Middle Point Reduction of the Chain-recurrent Set*, In: Proceedings of the 9th International Conference on Simulation and Modeling Methodologies, Technologies and Applications (SIMULTECH), Prague, Czech Republic, 2019, pp. 141–152.
7. C. Argáez, P. Giesl, S.F. Hafstein, *Clustering Algorithm for Generalized Recurrences using Complete Lyapunov Functions*, In: Proceedings of the 16th International Conference on Informatics in Control, Automation and Robotics (ICINCO), Prague, Czech Republic, 2019, pp. 138–146.
6. C. Argáez, P. Giesl, S.F. Hafstein, *Improved estimation of the chain-recurrent set.* In: Proceedings of the 18th European Control Conference (ECC), Napoli, Italy, 2019, pp. 1622–1627.
5. C. Argáez, P. Giesl, S.F. Hafstein, *Computation of Complete Lyapunov Functions for Three-Dimensional Systems.* In: Proceedings of the 57rd IEEE Conference on Decision and Control (CDC), Miami Beach, FL, USA, 2018, pp. 4059–4064.
4. C. Argáez, P. Giesl, S.F. Hafstein, *Iterative Construction of Complete Lyapunov Functions*, In: Proceedings of the 8th International Conference on Simulation and Modeling Methodologies, Technologies and Applications (SIMULTECH), Porto, Portugal, 2018, pp. 211–222.
3. P. Giesl, C. Argáez, S.F. Hafstein, H. Wendland, *Construction of a Complete Lyapunov Function using Quadratic Programming*, In Proceedings of the 15th International Conference on Informatics in Control, Automation and Robotics (ICINCO), Porto, Portugal, 2018, pp. 560–568.

2. C. Argáez, S. Hafstein, P. Giesl, *Wendland Functions: A C++ Code to Compute Them*, In: Proceedings of the 7th International Conference on Simulation and Modeling Methodologies, Technologies and Applications (SIMULTECH), Madrid, Spain, 2017, pp. 323–330.
1. C. Argáez, P. Giesl, S. Hafstein, *Analysing Dynamical Systems: Towards Computing Complete Lyapunov Functions*, In: Proceedings of the 7th International Conference on Simulation and Modeling Methodologies, Technologies and Applications (SIMULTECH), Madrid, Spain, 2017, pp. 134–144.

Other work experience

2014-2016 **Cluster administrator**, *Chemistry Department*, University of Iceland, Iceland.

Computer skills

Intermediate SQL, JAVA

Advanced C++, C#, MATLAB, FORTRAN, PYTHON, HTML, BASH

Experience administrating computer clusters.

Computer packages

Advanced Regional Ocean Modeling System (ROMS)

Intermediate Gaussian, Crystal

Languages

English Proficient knowledge

Icelandic Intermediate knowledge

Italian Good knowledge

Yucatec Maya Intermediate knowledge

Spanish Mother tongue