Julian Antolin Camarena

Curriculum Vitae

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Education

- **PhD** in theoretical and computational physics and optics, 2019, University of New Mexico.
  Adviser: *Sudhakar Prasad*
  Dissertation: Electromagnetic analysis of bidirectional reflectance from roughened surfaces and applications to surface shape recovery
- **MS** in physics (theoretical foundations of quantum mechanics), 2008, Auburn University.
  Adviser: *Eugene Oks*
  Thesis: Application of Generalized Hamiltonian Dynamics to Modified Coulomb Potential.
- **BS** in physics, 2006, mathematics minor, The University of Texas at El Paso.

Work Experience

- **July 2025 - present:** Assistant Professor in the Department of Mathematics at The University of Wisconsin-Eau Claire.
- **January 2025 - May 2025:** Co-instructor for graduate Generative Artificial Intelligence in the School of Electrical, Computer, and Energy Engineering at The Arizona State University.
- **September 2024 - present:** Postdoctoral Research Fellow at the School of Electrical, Computer, and Energy Engineering at The Arizona State University.
  - Theoretical and mathematical development of generative models, especially diffusion models.
  - Stochastic dynamical systems modeling of generative diffusion models.
  - Geometric approaches to generative diffusion models.
- **January 2024 - September 2024:** Postdoctoral Research Fellow at the Department of Physics at The Arizona State University.
  - Computer vision-based approaches to bioimaging and microscopy superresolution and tissue-scale transcriptomics.
  - Bayesian methods for quantitative bioimaging
  - AI methods for time series forecasting with applications to finance and molecular dynamics.
  - Blurred image deconvolution with deep learning.
  - Physics-Informed Neural Networks for learning drift and diffusion terms in stochastic differential equations.
- **January 2022 - January 2024:** Applied Artificial Intelligence Research Scientist at Point72 Asset Management
  - Developed statistical and deep neural network anomaly/rare event detection algorithms for financial time series
  - Developed statistical, ML, and deep neural network algorithms for time series forecasting
  - Research into novel ML/AI methods for time series modeling and forecasting in finance and macroeconomics

  - LLM research and applications, including API programming
  - Co-authored AI-themed publications for internal dissemination

- **May 2020 - December 2021:** Oak Ridge Associated Universities Postdoctoral Fellow.
  - Deep learning, machine learning, and control-theoretic approaches to modeling player policy rollouts (trajectories) for mobile navigation game
  - Deep inverse reinforcement learning for learning reward structures in human-autonomy teaming
  - Stochastic modeling of player policy rollouts (trajectories) and reward functions

- **Spring 2020:** Research assistant. Artificial intelligence and machine learning video game player modeling for Busy Beeway game being developed by the Tapia Lab at UNM

- **Spring 2019:** Research assistant. Molecular dynamics and stochastic modeling of biomolecular dynamics with application to the DockIt! video game being developed in the Tapia Lab at UNM.

- **Fall 2011 - Fall 2012:** Lecturer at the Universidad Autónoma de Ciudad Juárez, Mexico. Courses taught: electricity and magnetism for engineering students, differential equations and an undergraduate-level introductory course in quantum optics, and introductory classical and quantum information theory.

- **Fall 2012 - Fall 2014:** Research assistant. Regularization of statistical inverse problems, and bayesian bioimaging superresolution. UNM.

- **August 2008 - May 2010:** Teaching assistant. Laboratory instruction, grading. UNM.

- **Fall 2008 - Spring 2011:** Teaching assistant for courses including quantum computation, statistical mechanics, mathematical methods in physics, and electrodynamics I and II, UNM.

- **August 2006 - August 2008:** Teaching assistant. Laboratory instruction. Auburn University.

- **Summer 2005:** Research Experience for Undergraduates awardee. Numerical exploration of chaotic dynamical systems and their properties at The Georgia Institute of Technology.

- **Spring 2005 and Fall 2005 - Summer 2006:** Physics lab instructor for first year physics students, teaching assistant, and grader.

Publications

Published Papers

1. Esther Rodriguez, Monica Welfert, Samuel McDowell, Nathan Stromberg, Julian Antolin Camarena, Lalitha Sankar , "CORAL: Disentangling Latent Representations in Long-Tailed Diffusion," `arXiv:2506.15933 [cs.LG]`

2. Miquel Noguer i Alonso, Alberto Bueno Guerrero, Julián Antolín Camarena, Quantitative Portfolio Optimization: Advanced Techniques and Applications, Wiley. January 29, 2025.

3. Julián Antolín Camarena, Paul Campitelli, Pedro Pessoa, Banu Ozkan, Steven Presse, MamBayes: Probabilistic Long-Horizon Time Series Forecasting by Combining Mamba SSM and Bayesian Neural Networks, DRAFT IN PROGRESS.

4. Noguer i Alonso, Miquel and Antolín Camarena, Julián, Physics-Informed Neural Networks (PINNs) in Finance (October 10, 2023). Available on SSRN at `http://dx.doi.org/10.2139/ssrn.4598180`.

5. T. Adamson, J. Antolín Camarena, L. Tapia, and B. Jacobson, Optimizing Low Energy Pathways in Receptor-Ligand Binding with Motion Planning, IEEE International Conference on Bioinformatics and Biomedicine (IEEE BIBM 2019), DOI:`10.1109/BIBM47256.2019.8983169`

6. J. Antolín, Z. Yu, S. Prasad, Optical Estimation of the 3D Shape of a Solar Illuminated, Reflecting Satellite Surface, AMOS Conf. 2016, https://amostech.com/TechnicalPapers/2016/Poster/Prasad.pdf.

7. B. Mederos, R. A. Mollineda, J. Antolín Camarena, Reconstruction of noisy signals by minimization of non-convex functionals, Nonlinear Analysis Real World Applications, Elsevier, Dec 2016, https://doi.org/10.1016/j.nonrwa.2016.05.007

8. J. Antolín Camarena, E. Oks, Application of the Generalized Hamiltonian Dynamics to a Modified Coulomb Potential, International Review of Atomic and Molecular Physics (IRAMP), 2010, https://www.auburn.edu/cosam/departments/physics/iramp/1_2/camarena_oks.pdf

9. J. Antolín Camarena, Generalized Hamiltonian Dynamics: Application to a Perturbed Coulomb Potential, Lambert Academic Press, Saarbrücken, Germany, May 2010.

Areas of Expertise and Research Interests

- **Data Science:** Time series, unstructured, and big data
- **Artificial Intelligence and Machine Learning:** Applications to quantitative finance, physics, biology, and molecular dynamics. Physics-informed machine learning, generative AI, geometric machine learning, mathematical and conceptual foundations.
- **Generative AI:** Diffusion models, geometric diffusion, guidance in diffusion models, LLMs.
- **Deep Learning:** Analysis of architectures (*e.g.* Mamba State Space Models, Transformers, RNN family) and activation functions through numerical experimentation and quantitative analysis. Physics-Informed and Bayesian Neural Networks. Novel cost functions through prior information and regularization.
- **Time Series Analysis, Modeling, and Forecasting:** Classical models of the SARIMA family. Machine learning modeling (*e.g.,* XGBoost, Gaussian processes).
- **Stochastic Modeling and Simulations:** SDE models of time series through diffusion estimation, Monte Carlo sampling, and simulation-based inference
- **Mathematical Physics and Applied Mathematics:** Electromagnetic scattering and image formation, inverse problems in imaging, information theory, information geometry, entropy, and dynamical systems, quantitative finance, and portfolio optimization.

Research and Teaching Experience

- **Spring 2025 semester:** Co-instructor for graduate Generative Artificial Intelligence in the School of Electrical, Computer, and Energy Engineering at The Arizona State University.
- **February 2024 - present**
  - UNet-based architectures for tissue-scale transcriptomics from terabyte-scale image data.
  - Mamba SSM and Bayesian Neural Networks for long-horizon, probabilistic time series forecasting.
  - Blurred image deconvolution with deep learning.
  - Physics-Informed Neural Networks for learning drift and diffusion terms in stochastic differential equations.
- **January 2022 - January 2024**
  - Artificial intelligence, machine learning, and deep learning for time series analysis and modeling.
  - Machine and deep learning for anomaly detection in time series.

- Heavy-tailed distributions and rare events in time series.
- Large language models and generative AI.

- **May 2020 - December 2021**
  - Artificial intelligence, machine learning, and deep learning computational and theoretical approaches to understanding human-computer interactions and human-autonomy systems.

- **January 2020 - May 2020**
  - Research assistant. Artificial intelligence and machine learning video game player modeling for Busy Beeway mobile game being developed by the Tapia Lab at UNM.
  - Objective: Use player data to model a human player's motivations during gameplay to further the psychological understanding of human decision-making.

- **Spring 2019**
  - Research assistant. Molecular dynamics and stochastic modeling of biomolecular dynamics with application to the DockIt! video game being developed in the Tapia Lab in the Computer Science department at UNM.
  - Spearheaded the initiative to use stochastic differential equations (Itô diffusions) and dynamic Markov bridges for long-time simulations.

- **Spring 2015 - October 2019**
  - Research assistant. Development of a novel global, nonlinear, alternating optimization algorithm for parameter estimation in shape recovery from noisy images.
  - Full electromagnetic scattering analysis of intensity imaging of randomly rough perfectly conducting surfaces. UNM.

- **Fall 2014**
  - Research assistant. Bayesian modeling and machine learning applied to quantitative bioimaging superresolution. UNM.

- **August 2012 - present**
  - Research assistant. Analysis of regularization of statistical inverse problems in signal and image analysis, maximum entropy, and other physics-based random field texture modeling methods. UNM.

- **August 2010 - May 2011**
  - Research assistant. Numerical analysis of regularization in image analysis. UNM.

- **May - July 2009**
  - Research assistant. Analytical modeling of one-dimensional combustion through piecewise linearization of nonlinear reaction-diffusion equations. UNM.

- **January - May 2009**
  - Independent studies course. Numerical studies of stochastic differential equations in the modeling of the continuous quantum measurement process of a qubit. UNM.

- **May - July 2005**
  - Summer research program at The Georgia Institute of Technology. Numerical analysis of nonlinear dynamics and chaotic trajectories of the Rössler system.

- **Spring 2005 and Fall 2005 - Summer 2006**
  - Physics lab instructor for first year physics students
  - Teaching assistant
  - Grader

Skills

- Python
- Matlab
- Machine Learning
- Deep Learning
- Generative Diffusion Models
- LLMs
- Cloud Services

Talks, Posters, and Conferences

- **Session Chair and Organizer:** *Artificial Intelligence and Machine Learning in Science*, Special Section at the SIAM Conference on Data Science 2024 (MDS2024), Atlanta, GA, October 24, 2024.
- *The natural relationship between information theory and physics: From entropy and statistical physics to geometry.* Invited talk at the University of Texas at El Paso physics colloquium, El Paso, TX, December 3, 2021.
- *Stochastic Simulation and Molecular Dynamics*, invited talk, Universidad Autónoma de Ciudad Juárez, Ciudad Juárez, México, September 12, 2019.
- *Faster STORM with compressed sensing*, UNM, September 25, 2014.
- *Tutorial on FRAME: Filter, Random Fields, and Maximum Entropy*, invited talk at CQuIC, UNM, November 20, 2013.
- *Introduction to Neural Networks*, Universidad Autónoma de Ciudad Juárez, Ciudad Juárez, México, April 25, 2012
- *Complex Systems*, Universidad Autónoma de Ciudad Juárez, Ciudad Juárez, México, March 20, 2012.
- *Entanglement and Quantum Paradoxes*, Universidad Autónoma de Ciudad Juárez, Ciudad Juárez, México, September 28, 2011.
- Lecture series on Quantum Optics, Universidad Autónoma de Ciudad Juárez, Ciudad Juárez, México, April 2011.
- APS Texas Section Fall Meeting, October 2008, The University of Texas at El Paso, El Paso, TX Talk: *Application of Generalized Hamiltonian Dynamics to Modified Coulomb Potential*
- APS Texas Section Fall Meeting, October 2005, University of Houston, Houston, TX Talk: *Chaos in the Rössler system*
- Research Experience for Undergraduates Research Expo. The Georgia Institute of Technology, July 2005. Talk: *Chaos in the Rössler system*
- APS Texas Section Spring Meeting, April 2004, Tarleton State University, Tarleton, TX Poster: *What is a Geowall?*
- Society for the Advancement of Chicanos and Native Americans in the Sciences (SACNAS) Fall 2003 Meeting, October 2003 Albuquerque, NM Poster: *What is a Geowall?*

Peer Review

1. IEEE Robotics and Automation Letters, 2024.
2. IEEE International Conference on Robotics and Automation 2022.
3. IEEE International Conference on Robotics and Automation 2020.
4. IEEE Robotics and Automation Letters, 2021
5. IEEE Robotics and Automation Letters, 2020.
6. Academia Letters, 2021.