

Alex Jurgens

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Complexity Sciences Center

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Current position

2021-
Present

Postdoctoral Researcher

University of California, Davis

Using modern theories of information and structure in complex systems, developed new signal analysis tools to analyze the informational, semantic, functional and social communications within humpback whale populations.

Research Interests

complex systems, information theory, stochastic dynamical systems, stochastic processes & modeling, nonlinear dynamics, chaotic systems, symbolic dynamics, bioacoustics, natural language processing

Education

2021 PHD in Physics, University of California, Davis

2015 B.S. in Physics, Marietta College

Summa cum laude

Capstone award

2015 B.S. in Mathematics, Marietta College

Summa cum laude

Academic Experience

2015-2021 University of California, Davis

Graduate Student Researcher

Developed methods of finding the entropy rate of hidden Markov processes. Studied the fractal dimension of the attractor of hidden Markov models in development of the statistical complexity dimension.

2015-2017 University of California, Davis

Teaching Assistant

Lead “discussion-lab” sessions for the innovative Physics 7. Organized drop-in tutoring for upper division physics courses with volunteer physics graduate students.

2014 École normale supérieure Paris-Saclay

iREU Intern

Interned at the Quantum and Molecular Photonics Laboratory (LPQM) as part of the international REU program in optics based out of the University of Michigan. Modeled and fabricated photonic crystals with two-beam interference.

2013 SLAC National Laboratory

SULI Intern

Interned at Linac Coherent Light Source (LCLS) as part of the Department of Energy SULI program. Designed and fabricated a tool to ease temporal cross-correlation of x-ray and optical laser pulses using transient changes in optical transmission of Si₃N₄.

Work Experience

2020-2021 Irrational Capital, LLC

Head of Data Science

Developed and implemented research program at a qualitative-data based hedge fund. Worked with portfolio risk managers to design and execute research-based trading strategies.

Honors & Awards

2020 Ling-Lie Chau Physics Graduate Student Fellowship

2019 Information Scholar - Telluride Research Science Center

2019 UC Davis Diversity Travel Grant

2016, 2018 UC Davis Graduate Program Fellowship

2016 UC Davis Graduate Program Fellowship

2015 Phi Beta Kappa

2014 Theodore Bennett Memorial Prize in Mathematics - Marietta College

2014 Omnicron Delta Kappa

2013 Sigma Pi Sigma

2013 Kappa Mu Epsilon

2011-2015 Dean's High Honor's List - Marietta College

2011-2015 Trustee Scholarship – Marietta College

Publications & Talks

PUBLICATIONS

2021 Jurgens, A., & Crutchfield, J. (2021), “Divergent Predictive Memory: The Statistical Complexity Dimension of Stationary, Ergodic Finite-State Hidden Markov Processes”. *Chaos*, 31, 083114, 2021.

2021 Jurgens, A., & Crutchfield, J. (2021), “Ambiguity Rate of Hidden Markov Processes”. *Physical Review E* 104 (6), 064107, 2021.

2021 Jurgens, A., & Crutchfield, J. (2021), “Shannon Entropy Rate of Hidden Markov Processes”. *J. Stat. Phys.*, 183 (2), 1-18, 2020.

2020 Jurgens, A., & Crutchfield, J. (2020), “The Functional Thermodynamics of Finite-State Maxwellian Ratchets”. *Phys. Rev. Research*, 2(3):033334, 2020.

2020 Venegas-Li, A., & Jurgens, A., & Crutchfield, J. (2019), “Measurement-Induced Randomness and Structure in Controlled Qubit Processes”. *Phys. Rev. E*, 102(4):040102(R), 2020.

WORKSHOP PROCEEDINGS

2017 Jurgens A., Kraay A., Weissman J., Dong J., Pangallo M., Wu S., Stopnitzky S., Zhan S.H., Gurevich Y., & Liu Y. (2017), “Quantifying and comparing ‘memory’ in biological, ecological, physical, and socio-economic systems”. Sante Fe Institute Complex Systems Summer School 2017 Proceedings.

TALKS

2021 Jurgens, A. (2021 November) “Chaos, Randomness, and Structure: Modeling Complex Systems”. Invited speaker at Marietta College Fall Physics Colloquium

2021 Jurgens, A. (2021 July) “Information Processing Surfaces of Maxwellian Information Engines”. TSRC Workshop “Information Engines at the Frontiers of Nanoscale Thermodynamics”.

2021 Jurgens, A. (2021 March) “The Functional Thermodynamics of Finite-State Maxwellian Ratchets”. APS March Meeting 2021.

2019 Jurgens, A. (2019 September) “Randomness, Structure and Complexity: Measuring Memory in Complex Systems”. Invited talk at Oak Ridge National Lab.

- 2019 Jurgens, A. (2019 August) “Exact Functional Thermodynamics For Arbitrary Maxwellian Demons”. Contributed talk at 2019 workshop on “Information engines at the frontiers of nanoscale thermodynamics”.
- 2019 Jurgens, A. (2019 January) “Entropy Rate and Statistical Complexity Dimension of Hidden Processes”. Contributed talk at 2019 Dynamics Days.
- 2013 Jurgens, A. & Schlotter, B. (2013 August). “Improving ease of temporal cross-correlation of x-ray and optical laser pulses using transient changes in optical transmission of Si₃N₄”. Presentation at the end of the 2013 SULI program hosted by SLAC National Laboratory in Menlo Park, CA.

POSTERS

- 2018 Jurgens, A. & Crutchfield, J. (2018 January) “Information Anatomy of Printed English”. Poster session presented at 2018 Dynamics Days.
- 2015 Jurgens, A. & McKay, C. (2015 April). “Nonlinear normal modes in the double and triple pendulum”. Poster session presented at the 2015 Annual Spring Meeting of the APS Ohio-Region Section, Kent, OH.
- 2014 Jurgens, A. & Hobson, R. (2014 August). “Modeling and fabrication of photonic crystals with two-beam interference”. Poster presented at the end of the 2014 iREU Program hosted by University of Michigan in Paris, France.