

# Alex Jurgens

University of California, Davis  
Complexity Sciences Center

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## Current position

*Graduate Student Researcher*, Complexity Sciences Center

## Research Interests

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

## Education

2021 *Expected:* PhD in Physics, University of California, Davis  
2017 M.S. 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-Present University of California, Davis  
*Graduate Student Researcher*  
Developed methods of finding the entropy rate of non-unifilar hidden Markov models. Studied the fractal dimension of the attractor of hidden Markov models in development of the statistical complexity dimension. Investigated information anatomy of printed English text.

2015-2017 University of California, Davis  
*Teaching Assistant*  
Lead “discussion-lab” sessions for the innovative Physics 7 Series.

2016 University of California, Davis  
*H-bar Organizer*  
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 Si<sub>3</sub>N<sub>4</sub>.

## Honors & Awards

- 2020 Ling-Lie Chau Physics Graduate Student Fellowship  
2019 Information Scholar - Telluride Research Science Center  
2019 UC Davis Diversity Travel Grant  
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

### SUBMITTED

- 2019 Venegas-Li, A., & Jurgens, A., & Crutchfield, J. (2019), "Measurement-Induced Randomness and Structure". arXiv:1908.09053  
2020 Jurgens, A., & Crutchfield, J. (2020), "The Functional Thermodynamics of Finite-State Maxwellian Ratchets".

### IN PREPARATION

- 2020 Jurgens, A., & Crutchfield, J. (2020), "Shannon Entropy Rate of Hidden Markov Processes".  
2020 Jurgens, A., & Crutchfield, J. (2020), "Infinite Complexity of Finite State Hidden Markov Processes".

### TALKS

- 2020 Jurgens, A. (2020 March) "The Functional Thermodynamics of Finite-State Maxwellian Ratchets". APS March Meeting 2020 [Conference Canceled].  
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 Si<sub>3</sub>N<sub>4</sub>”. 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.