Nolan R. Bonnie

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Education

University of Colorado, Boulder **August 2022 - Present**
Ph.D. Computer Science Expected Defense: **Fall 2027**
Advisor: Dr. Orit Peleg
Research Areas: Complex Systems, Collective Behavior, Computer Vision, Spatial Representation
Interdisciplinary Quantitative Biology Certificate Program

University of California, Irvine **September 2017 - June 2021**
B.S. in Mathematics, Specialization in Data Science, Campus Honors Program

Publications and Presentations

O. Martin†, **N. R. Bonnie**†, J. Gorman, S. Henriquez, R. Vasith, R. Sarfati, O. Peleg (2026). "FlashFinder: A Cloud GoPro-tocol for Lampyrid Flash Pattern Analysis" [in prep].

D. L. Chase, D. Zhu, M. Kathait, H. Robertson, J. Shah, S. Harrer, G. Nave, **N. R. Bonnie**, O. Peleg (2026). "3D Imaging of Honeybee Swarm Assembly and Disassembly" Integrative and Comparative Biology, Volume 66, 2026.

N. R. Bonnie†, O. Martin†, D. B. Larremore, O. Peleg (2026). "Individual contributions to collective intelligence: spontaneous role specialization in synchronous fireflies" at **APS Global Physics Summit**, Denver, Colorado, March 2026.

N. R. Bonnie†, O. Martin†, D. B. Larremore, O. Peleg (2026). "Complete signal detection reveals emergent role specialization in collective behavior networks" at **COSYNE**, Lisbon, Portugal, March 2026.

N. R. Bonnie, O. Martin, L. Faust, O. Peleg (2025). "Drawing with light: spatiotemporal signals of discrete light flashes in firefly swarm" at **APS Global Physics Summit**, Anaheim, California, March 2025.

O. Martin†, **N. R. Bonnie**†, N. W. Barendregt, O. Peleg (2025). "Revisiting Winfree's Firefly Machine: Experiments with Synchronous Arrays of *Photuris frontalis* Fireflies" at **Dynamics Days**, Denver, Colorado, January 2025.

N. R. Bonnie, V. E. Urias, et al., (2022). Multiple patents filed with Sandia National Laboratories, currently under review & O.U.O.

N. R. Bonnie, I. Y. Hernández-Paniagua, D. Dabdub (2022). A Longitudinal Quantification of the Ozone Weekend Effect in the South Coast Air Basin of California [Available upon request]. Computational Environmental Sciences Laboratory, University of California, Irvine.

N. R. Bonnie (2020). Adversary Emulation with Planning AI. Poster presentation at the Sandia National Laboratories 2020 Student Intern Cyber/CS Symposium. July 2020, Online.

∗ **N. R. Bonnie**, K. Ebding, C. Harrell, A. Kothapalli, S. Sabetan, G. Watson (2018). Virtualized Integrated Network Monitoring System. Poster presentation at the Sandia National Laboratories 2018 Student Intern Cyber/CS Symposium. July 2018, Livermore, California.

† These authors contributed equally to this work, ∗ Order is alphabetical

Awards

APS DBIO Image Contest Honorable Mention	2025
CU Boulder GPSG Grant	2025
Dynamics Days Travel Award	2024
NSF GRFP Honorable Mention	2023
NSF Integrated Data Science Fellow	2022 - 2023
R&D 100 International Award Winner (Project ATHENA)	**2022**
Distinguished Anteater Award	2020 - 2021
UCI UROP Fellow	2019 - 2020
Facebook-Udacity PyTorch Scholarship Recipient	2018 - 2019
UCI Campuswide Honors Collegium	2017 - 2021

Computational Skills

Programming languages: Python, R, MATLAB, SQL, C++, Bash, HTML, CSS, Java, JavaScript, Fortran 77.
Libraries & Frameworks: PyTorch, TensorFlow, Apache Spark / PySpark, OpenCV, CuPy, scikit-learn, SciPy, NumPy, Pandas, plotly, ggplot, matplotlib

Graduate Research

I have three main goals as a scientist. 1) Utilize computational tools and machine learning for the betterment of humanity and the scientific community. 2) Push the boundaries of computational intelligence and develop new AI methods in accordance with biological principles. 3) Advance our ability to align artificial intelligence with human values.

Excitability in Networks & Individual Contributions to Collective Behavior

- Exploring individual effects on collective synchrony
- Collected and processed data from large array firefly experiments over several years
- Project analysis involves computer vision, network analysis, mathematical modeling, and techniques from neuroscience and information theory

Software Pipeline for 3D Spatiotemporal Reconstructions of Firefly Swarms

- Created multiple tools for a software pipeline that aggregates and automatically processes citizen science firefly video data
- Contributions: Automated firefly detection, GoPro 360 to MP4 stitching, and optimized 3D spatiotemporal reconstruction pose estimation methods

Global DNN model for Firefly Flash Detection

- Training autoencoder models on vast datasets of firefly video data to identify flashes from noise
- Currently working to generalize the model to perform detection regardless of firefly species

Improved Methods for Spatiotemporal Synchrony Quantification in Multi-Agent Systems

- Identified critical spatial and temporal biases in multi-agent synchrony quantification techniques
- Developed methods for detecting and identifying synchronization in a new species

Intentional Information Embedding in Spatial Signals

- Performing novel spatial analysis of firefly flash signals to identify stereotypic patterns
- Utilizing 3D PCA methods to understand spatial information in different species

Modeling Multi-Agent Communication as Excitable Media

- Imposed topological restrictions to collective communication which prohibit the onset of synchrony
- Using methods from non-linear dynamics to model information flow in the network

Relevant Work Experience

Sandia National Laboratories – R&D S&E, Cybersecurity **July 2020 - August 2022**

- Full-time Member of the Technical Staff with D.O.E. Q Clearance
- Developed a novel generalized planning AI with applications to cyber-emulytics (used for ATHENA)
- Name on multiple patents filed from AI planning work (submissions are OUO until USPTO approval)
- Engineered new big-data (6 PB) analysis methods for detailed network traffic data. Time series data consisted of several qualitative fields requiring NLP
- Developed scalable anomaly detection tools

Sandia National Laboratories – Cybersecurity R&D Intern **June 2018 - September 2018**

- Managed a 7-person team working on a high-priority research project
- Project was an innovative proof of concept, and changed the way government servers are protected.
- Created synthetic data for a cybersecurity project that used AI to detect cyber attacks.

Leadership and Teaching

Teaching Assistant for CSCI 4308 *Senior Capstone Project* **Fall 2025**
Teaching Assistant for CSCI 4622 *Machine Learning* taught in Python **Spring 2025**
Teaching Assistant for CSCI 1300 *Starting Computing* taught in C++ **Fall 2023**
Undergraduate Mentoring at Fort Lewis College in Durango Colorado **Winter 2023**
Instructor at Sandia Labs for *Introduction to R and Machine Learning* **Summer 2021**
Discussion Leader for *Introduction to Machine Learning* **Winter 2019**
UCI Engineering Student Council **Fall 2017 - Spring 2018**

Undergraduate Research

Undergraduate Research Study in Data Science and Computing **2018 - 2021**

- Selected by Professor Donald Dabdub to participate in 4 quarters of individual research study.
- Studied various topics related to data science and computation, such as: Scientific computing, scientific visualization, programming in R, data analysis, big data, machine learning, and neural networks.
- Applied graduate level statistical learning techniques to real world prediction problems, and used the basis of what I learned to conduct research in atmospheric chemistry

Undergraduate Research Study in Mathematics **2018 - 2020**

- Participated in research groups led by professors Chris Davis, Shuhao Cao, and Knut Solna
- Studied research topics related to: computational algorithms, optimization, graph theory, discrete mathematics, deep neural networks, and machine learning.

Other Interests

Classical music: 17 years of piano, 9 years of guitar.
Volunteering: Colorado League certified high school mountain biking coach, 5 years.
Photography: Portfolio found at nolanbonnie.com/photography