Nolan R. Bonnie

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Education

University of Colorado, Boulder   **August 2022 - Present**
Ph.D. Student in Computer Science   GPA: 4.00
Advisor: Dr. Orit Peleg
Research Areas: Complex Systems, Computer Vision, Physics of Living Systems
Interdisciplinary Quantitative Biology Certificate Program

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

Research Statement

I study complex systems, specifically using computational models to understand the intrinsic emergent physical patterns of swarm intelligence and identifying how methods of information transfer in networks contribute towards intelligent systems. I have worked my whole career in interdisciplinary science, which allows me the ability to generalize my computational skills to new problems very quickly. I'm capable of jumping into any problem requiring computer vision, object detection & tracking, ML / DNNs, analysis of messy data, or network analysis.

Publications and Presentations

Martin, O. & **Bonnie, N. R.**, Barendregt, N. W., Peleg, O. (2024). "Revisiting Winfree's Firefly Machine: Experiments with Synchronous Arrays of *Photuris frontalis* Fireflies" at **Dynamics Days**, Denver, Colorado, January 2025.

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

Bonnie, N. R., Hernández-Paniagua, I. Y., Dabdub, D. (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.

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

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

∗ Order is Alphabetical

Computational Skills

Programming languages: Python, R, Matlab, SQL, C++, Bash, HTML, CSS, Java, JavaScript, Fortran 77.
Libraries & Frameworks: Apache Spark / PySpark, OpenCV, PyTorch, Tensorflow, scikit-learn, numpy, pandas, ggplot, matplotlib

Awards

NSF GRFP Honorable Mention	2023
R&D 100 International Award Winner (Project ATHENA)	**2022**
NSF NRT Fellow	2022 - 2023
Distinguished Anteater Award	2020 - 2021
UCI UROP Fellow	2019 - 2020
Facebook-Udacity PyTorch Scholarship Recipient	2018 - 2019
UCI Campuswide Honors Collegium	2017 - 2021

Graduate Research

Infrared Computer Vision   **Winter 2022 - Present**

- Currently developing computer vision framework to track individual fireflies with lab-developed infrared (IR) imaging techniques
- Obtained 800GB of infrared firefly data through summer 2023 field experiments
- Current implementations involve convolutional neural networks (CNNs), OpenCV image processing, clustering, and Gaussian mixture models

Stereo Calibration Free Spatial Reconstruction   **Fall 2023 - Winter 2024**

- Wrote software to generate spatial-temporal firefly swarm reconstructions from stereo videos
- Utilized individual firefly flashes to approximate optimal fundamental matrices

Network Analysis of Excitable Properties in Synchronous Fireflies   **Summer 2023 - Present**

- Designing large-scale experiment on *Photuris frontalis* swarms to understand emergent physical properties of their synchronization
- Analysis methods include degree distribution, modularity, percolation sensitivity, eigenvalue centrality, Markov chains, causal inference

Principal Component Analysis (PCA) of *Photuris Forresti* Flash Modes   **Fall 2023 - Present**

- Collected stereo field recordings of male *P. forresti* flash-chains to create high-resolution spatiotemporal reconstructions
- Applying principal component analysis (PCA) to characterize stereotypic spatial flash patterns and investigate potential signaling structures within flash-chains.

Quantification of Spontaneous Neuron Synchronization   **Fall 2023 - Present**

- Working with Professor Chris Link to analyze spontaneous synchronization of WTC11 ipscs
- Replicated mouse model result showing that individual neuron periodicity averages to group synchronous period in our human neuron cultures
- Implementing new algorithm to differentiate individual neuron electrical wavelength signature from a single electrode

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.

Uncommon Expertise

Non-visible light computer vision, 360 video computer vision, spatial-temporal 3D reconstruction, AI planning systems, big-data anomaly detection, physics of living systems

Leadership and Teaching

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   **Winter 2018 - June 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   **Winter 2018 - Fall 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: 16 years of piano, 9 years of guitar.
Volunteering: Colorado League certified high school mountain biking coach, 5 years.