Connor Robertson

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Education

PhD - Applied Mathematics *August '18 - Present*
New Jersey Institute of Technology

B.S. - Applied and Computational Mathematics *August '11 - May '18*
Brigham Young University

Research Experience

Data-driven discovery of governing equations for active nematics *September '19 - Present*
Research Assistant - New Jersey Institute of Technology - Newark, New Jersey
Advisors: Travis Askham, Anand Oza

Discovering the governing partial differential equation of an active nematic system directly from experimental video. Includes image processing, numerical differentiation of noisy data, sparse regression, symbolic generation of differential terms, continuum models of active nematic and liquid crystal systems, and pseudospectral PDE simulations.

Forecasting bacterial growth and interaction via recurrent neural networks *June '21 - June '22*
Research award - Oak Ridge National Laboratory - Oak Ridge, Tennessee
Mentor: Miguel Fuentes-Cabrera

Using images of mutant and natural bacterial strains from the researchers at Oak Ridge National Lab, modified PredRNN recurrent network architecture to model and predict population and colony growth. Quantified quality of fit via various image and biological metrics. Included immage processing, recurrent neural network architecture, and accelerating agent-based modeling approaches.

Water main break prediction for city utilities *March '18 - December '18*
Cofounder - Coventina LLC - Provo, Utah

Developed machine learning toolkit used to forecast water main breaks for public works departments. Research and development comprised of data collection from varied public and private sources, cleaning, imputation, regression analysis, tree-based model tuning, validation, and balance of physical models and machine learning predictions.

Determining optimal new facility location via network theory *March '17 - May '18*
Research Assistant - Brigham Young University - Provo, Utah

Undergraduate research team focused on applying mathematical concepts to new problems in society and industry. Projects include: Use of network theory and Markov Chains for facility location problems in operations research and utilizing statistical modeling to optimize infrastructure decisions for water access in developing countries.

Developing computational math curriculum *September '17 - May '18*
Project Assistant - Brigham Young University - Provo, Utah

Editing and writing academic programming assignments in Python and managing lab computers and servers. Assignments include curriculum on: web scraping, serialization, noSQL, parallel processing techniques, quasi-newton optimization, and Arnoldi method for eigenvalue and eigenvector numerical computation.

Conference Participation

Talk: Data-driven continuum modeling of active nematics via sparse identification of nonlinear dynamics — *Nov '22*
APS DFD - Indianapolis, Indiana

Poster: Data-driven discovery of PDEs for active nematic systems — *Oct '22*
NAI-NJIT Chapter Workshop - Newark, New Jersey

Chair: Machine Learning and Optimization Seminar — *Fall '22*

Talk: Data-driven continuum modeling of active nematics via sparse identification of nonlinear dynamics — *March '22*
APS March - Chicago, Illinois

Talk: Neural networks for function approximation and data-driven modeling — *October '21*
Department of Mathematical Sciences: Machine Learning and Optimization Seminar - NJIT, Newark, New Jersey

Poster: Discovering governing equations of an active nematic system using PDE-Find — *August '20*
GAMM Juniors' Summer School - Magdeburg, Germany (virtual)

Poster: Aligning Self-Propelling Particles in Non-trivial Domains — *May '19*
Frontiers in Applied and Computational Mathematics - Newark, New Jersey

Talk: Facility location using Markov chains — *March '18*
CPMS Student Research Conference - Brigham Young University - Provo, Utah

Talk: Efficiency of Water Distribution in Water Poor Areas of the World — *July '17*
Student Days - SIAM Annual Meeting - Pittsburgh, Pennsylvania

Honors and Awards

Graduate Student Research Award (SCGSR) - Department of Energy — *2021*

Ahluwalia Doctoral Fellowship - Deparment of Mathematical Sciences (NJIT) — *2021*

(Honorable mention) NSF Graduate Research Fellowship Program — *2020*

Teaching Experience

Teaching Assistant - New Jersey Institute of Technology - Newark, New Jersey
Math 110, 111, 238 - Precalculus and calculus
Math 340, 391 - Numerical Methods and Linear Algebra
Math 631 - Graduate Linear Algebra

Qualifications and Skills

Programming

In order of experience: Python, Julia, Matlab, Mathematica, R, C++

Educational projects: Markov Chain Monte Carlo, differentiation of noisy data, sparse basis pursuit and regression, recurrent neural networks for image prediction, pseudo-spectral PDE solvers, markov chains for NLP, optimization (Simplex method, Newton's method, varieties of gradient descent, etc.), simple facial recognition, implementation of numerical solvers for ODES, and various applications of machine learning algorithms

Publications

Performing Video Frame Prediction of Microbial Growth with a Recurrent Neural Network. arXiv (2022). https://doi.org/10.48550/arXiv.2205.05810

Investigating the growth of an engineered strain of Cyanobacteria with an Agent-Based Model and a Recurrent Neural Network. bioRxiv (2021). https://doi.org/10.1101/2021.10.11.463942

Using Survey Data and Mathematical Modeling to Prioritize Water Interventions in Developing Countries. Water Resource Management (2021). https://doi.org/10.1007/s11269-020-02761-8

Professional Associations

Member - Society for Industrial and Applied Mathematics (SIAM) *2017-Present*
Student Chapter Vice President (NJIT)

Member - American Physical Society (APS) *2022-Present*