

Eric Cawi

Curriculum Vitae

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Education

- 2015–2020 **PhD. in Systems Science and Mathematics**, *Washington University in St. Louis*, St. Louis, MO, GPA: 3.72.
degree conferred January 10, 2021
- 2011–2015 **B.S. Electrical Engineering and Applied Mathematics**, *George Mason University*, Fairfax, VA, GPA: 3.9.

Honors and Awards

- 2020 **2019-2020 Outstanding Assistant to the Instructor Award**, *Preston M. Green Department of Electrical and Systems Engineering*.
Awarded for teaching excellence.
- 2015–present **McDonnell International Scholars Academy**, *Washington University in St. Louis*.
Funding lasts maximum five years
- 2015–present **Graduate Research Fellow**, *National Science Foundation*.
Funding for three out of the next five years
- 2015 **Outstanding Academic Achievement Award**, *George Mason University ECE Department*.
- 2015 **Mary K. Cabell Outstanding Mathematics Student Award**, *George Mason University Mathematics Department*.
- 2015 **Outstanding Project Award**, *George Mason University Volgenau School of Engineering*.
- 2014 **Outstanding Project Award**, *George Mason University Volgenau School of Engineering*.
- 2012 **Schwartztein Best Freshman Research Paper Award**, *George Mason University*.
- 2011–2015 **University Scholars Program**, *George Mason University Honors College*.
Full tuition merit-based scholarship
- 2011 **Anthony Colosi Scholarship**, *Anthony Colosi Memorial Fund for Science*.

Journal and Conference Publications

- 1 A. C. Tukpah, E. Cawi (Co-First), L. Wolf, A. Nehorai; L. Cummings-Vaughn, "Development of an Institution Specific Readmission Risk Prediction Model for Real-Time Prediction and Patient-Centered Interventions", to appear in *Journal of General Internal Medicine*, 2021.

- 2 E. Cawi, P.S. La Rosa, and A. Nehorai, "Conditions for Separability of Machine Learning Workflows", submitted, Journal of Artificial Intelligence Research, 2020.
- 3 E. Cawi, P. S. La Rosa, and A. Nehorai, (2019) "Designing machine learning workflows with an application to topological data analysis," PLOS ONE, Vol. 14, No. 12, pp. 1-26, Dec. 2019.
- 4 Srinivasan, S., Cawi, E., Hyman, J., Osthus, D., Hagberg, A., Viswanathan, H, and Srinivasan, G. (2019) Physics-Informed Machine Learning for Backbone Identification in Discrete Fracture Networks. Computational GeoSciences, pp 1-16, 2020.
- 5 S. Srinivasan, E. Cawi, J. Hyman, H. Viswanathan, G. Srinivasan, "Preserving network connectivity during system reduction of fracture networks via machine-learning", in 2020 Computational Methods for Water Resources.
- 6 Cassidy, A., Cawi, E., and Nehorai, A., "A model for decision making under the influence of an artificial social network". IEEE Transactions on Computational Social Systems, 5(1), 220-228.
- 7 Agcayazi, M. T. , Cawi, E., Jurgenson, A., Ghassemi, P., and Cook, G., "ResQuad: Toward a semi-autonomous wilderness search and rescue unmanned aerial system". In 2016 International Conference on Unmanned Aircraft Systems (pp. 898-904),2016.

Presentations

- 2018 **Gerontological Society of America Annual Meeting, Boston, MA,** Poster.
Institution-Specific Readmission Risk Assessment Models to Embed into EMR for Automated Real Time Prediction
- 2018 **Mentors in Medicine 2018 Conference, Washington University in St. Louis,** Oral.
Developing an Automated, Real-Time Readmission Risk Prediction Model
- 2016 **McDonnell Academy International Symposium, University of Queensland, Brisbane,** Poster.
Computational Methods for Choosing Urban Planning Strategies
- 2015 **Volgenau School of Engineering Undergraduate Research Celebration, George Mason University,** Keynote Presentation.
Search and Rescue Operations with Unmanned Aerial Vehicles
- 2015 **National Council on Undergraduate Research, Eastern Washington University,** Poster.
Search and Rescue Operations with Unmanned Aerial Vehicles
- 2015 **C4I Seminar Series, George Mason University,** Oral.
Autonomous Navigation for an Unmanned Aerial Vehicle in Search and Rescue Operations
- 2014 **Volgenau School of Engineering Undergraduate Research Celebration, George Mason University,** Poster.
Mapscore: A portal for scoring probability maps

- 2013 **MARCUS Conference**, *Sweet Briar College*, Oral.
Uncertainty Quantification for the Soil-Carbon System using Monte Carlo and Generalized Polynomial Chaos Approaches
- 2013 **OSCAR Summer Celebration of Research**, *George Mason University*, Poster.
Uncertainty Quantification for the Soil-Carbon System using Monte Carlo and Generalized Polynomial Chaos Approaches
- 2013 **GMU Undergraduate Math Conference**, *George Mason University*, Oral.
Paleoclimatology and Climate Field Reconstruction
- 2013 **Joint Math Meetings**, *San Diego, CA*, Oral, Poster.
Paleoclimatology and Climate Field Reconstruction
- 2012 **JSUMS Conference**, *James Madison University*, Oral.
Paleoclimatology and Climate Field Reconstruction
- 2012 **National Search and Rescue Conference**, *Lake Tahoe, NV*, Oral.
Mapscore: A portal for scoring probability maps
- 2012 **Washington Search and Rescue Conference**, *Lake Tahoe, NV*, Oral.
Mapscore: A portal for scoring probability maps
- 2012 **Virginia Search and Rescue Conference**, *Lynchburg, VA*, Oral.
Mapscore: A portal for scoring probability maps

Experience

Research

- May 2020-September 2020 **Decision Sciences Emerging Talent Summer Program**, *Decision Sciences, Smart Operations, Bayer Crop Sciences*.
Developed concepts of equality and conditions for scalability in workflows with MSE loss by formalizing the concepts of equivalent workflows and separability. Worked directly with team lead on fundamental research, and created slide decks exploring Automated vs. Augmented Intelligence, presented work to team and leads. Presented doctoral and internship work to Decision Sciences teams and leads.
- 2015-January 2021 **Graduate Research Scholar**, *Preston M. Green Department of Electrical and Systems Engineering, Washington University in St. Louis*.
- Conducted doctoral research in the areas of machine learning, statistics, and data analytics. The topic of my dissertation is the design and optimization of machine learning workflows using Machine Learning Morphisms, a fundamental building block designed to encompass steps such as pre-processing, feature extraction, and model training.
 - Built a machine learning model using topological data analysis to improve predictions of 30-day Hospital Readmissions in collaboration with Barnes Jewish Hospital. This model has a superior accuracy, ROC AUC, and sensitivity than the standard LACE Score. Presented at presented at the Gerontological Society of America Annual Meeting 2018, in Boston, MA.
 - Designed a module to assign projects to abandoned urban lots, maximizing the Triple Bottom Line Score while considering cost, physical requirements, and local legal codes.
 - Mentored Undergraduate Research Projects on matrix completion for historical temperature records, cloud recognition, and exploring the impact of interventions on 30-Day Hospital Readmissions.
- May 2018 - August 2018 **Research Fellow**, *Applied Machine Learning Summer School, Los Alamos National Laboratory*.
Developed machine learning algorithms to identify backbone networks in Discrete Fracture Networks. Features were created by extracting graph theoretic and physical properties of paths through the network, and models were trained to identify backbone paths.
- 2014-2015 **Research Assistant**, *Dr. Charles Twardy*.
Developing maps using ArcGIS and Python predicting lost person behavior for use in wilderness search and rescue scenarios by fitting distribution parameters to case data. Current map is a diffusion based model where the diffusion coefficient is a function of elevation and terrain. Cross-validated the lognormal and log-cauchy distributions to compare their relative effectiveness.
- 2014- 2015 **Senior Design Project**, *George Mason University ECE Department*.
Developed path planning algorithms using probability maps and Matlab optimization packages to control the trajectory of an unmanned aerial vehicle for use as an autonomous search and rescue unit. Optimized the probability of finding the target given predictive model with local hill climbing algorithms. Tuned the controller's navigation algorithms. Worked in a team of four students.
- 2013 **Research Assistant**, *George Mason University URSP Program*.
Performed Uncertainty Quantification on parameters in the Soil –Carbon system for peat deposits using Monte Carlo and General Polynomial Chaos methods. Served as the primary researcher with a mentor in the Mathematics Department.

2012-2013 **Research Assistant**, *George Mason University URCM Program*.
Approximated historical temperatures using the Singular Value Decomposition on a training temperature dataset, tree ring growth indexes, and CO2 measurements. Performed cross validation and created error bars on the resulting dataset. Served one of two primary researchers under a faculty and graduate student mentor.

2011-2012 **Research Assistant**, *George Mason University C4I Center*.
Developed maps using ArcGIS and Python predicting lost person behavior for use in wilderness search and rescue scenarios. Probabilities were assigned based on distance, elevation, and terrain according to statistics from the International Search and Rescue Incident Database. Assisted in live incident during the 2012 VASAR conference by creating distance rings, elevation, and linear feature (roads, rivers, etc) models.

Teaching

2018-2020 **Graduate Teaching Assistant**, *Preston M. Green Department of Electrical and Systems Engineering, Washington University in St. Louis*.

Prepared class materials, graded homeworks and exams, held office hours for ESE 524 Detection and Estimation Theory. Also created and presented lecture materials to the class on real world applications of detection and estimation, as well as coordinating extra credit projects.

2019 **Capstone Project Mentor**, *Preston M. Green Department of Electrical and Systems Engineering*.

Assisted Prof. P. S. La Rosa in mentoring a team of three undergraduate students during their senior capstone project. Provided data, knowledge on machine learning algorithms and the project subject matter, and gave feedback on reports and presentations.

2016-2019 **Undergraduate Research Mentor**, *Preston M. Green Department of Electrical and Systems Engineering, Washington University in St. Louis*.

Mentored 3 undergraduate research projects, on matrix completion for temperature time series data, cloud image segmentation, and analyzing the impact of interventions on 30-Day Hospital Readmissions. The student working on the cloud image project won a department award for technical achievement.

2015 **Learning Assistant- Calculus III**, *George Mason University Mathematics Department*.

Developed Mathematica course content resulting in student-created art. Managed 3-D printing of the student labs, held regular office hours and exam review sessions.

2014 **Learning Assistant- Introduction to Partial Differential Equations**, *George Mason University Mathematics Department*.

Created MATLAB course content and exam review guides. Presented three full lectures, as well as holding regular office hours and exam review sessions.

Research Interests

Machine Learning.

Design, analysis, and optimization of machine learning workflows. Specifically the mathematical structure and joint optimization parameters across steps in the workflow

Statistical Signal Processing.

Detection and estimation of parameters, combining statistical, machine learning, and physical models.

Health Care Delivery.

Models for risk of clinical outcomes, as well as the effectiveness and design of interventions to improve outcomes.

Climate Science.

Modeling risk and interventions in climate systems.

Wilderness Search and Rescue.

Models of lost person behavior, as well as use of autonomous vehicles in search and rescue operations.

Skills

Machine Learning	Random Forests, Logistic Regression, AdaBoost, SVM, PCA, Topological Data Analysis
Signal Processing	Statistical Signal Processing, Detection and Estimation, DSP
Numerical Methods	Finite Differences, Runge-Kutta, Singular Value Decomposition, Spectral Method, Newton's Method, Local Hill Climbing with Random Restart, Cross Validation
Applied Mathematics	Ordinary and Partial Differential Equations, Linear Algebra, Control System Design, Path Optimization, Uncertainty Quantification
Computer Skills	R, Python, C, Arduino, MATLAB, Mathematica, Anaconda, Jupyter, ArcGIS, LaTeX, Microsoft Office Suite

Extracurricular Activities and Service

- 2015-present **McDonnell Scholar**, *Washington University in St. Louis*.
Participated in networking, service, and social activities in the McDonnell Academy.
- 2016-present **Department Recruitment**, *Washington University in St. Louis*.
Provided campus tours, meetings, and answered questions from prospective Ph.D. students in Electrical and Systems Engineering. In 2019 was the lead student coordinator.
- 2015-present **Student Co-Mentor**, *Washington University in St. Louis*.
Reviewed essays and provided advice to students applying for the NSF GRFP
- 2015 **Alumni Advisor**, *George Mason Honors College*.
Provided preliminary academic advising to freshmen at the Honors College Orientation.
- 2011–2015 **Honors College Spokesperson**, *George Mason Honors College*.
Promoted the Honors College in a local tv program, spoke on panels and manned tables at recruitment events. Promoted the Honors College at Alumni and local business events.
- 2014–2015 **Lead Volunteer - Water Table**, *National Ovarian Cancer Society 5K Run/Walk*.
Responsible for logistics and team of volunteers providing water to runners
- 2014–2015 **Developer**, *Student Run Computing and Technology*.
Assisted in development of Bookshare, a textbook exchange website.

References

Arye Nehorai, *Eugene and Martha Lohman Professor of Electrical and Systems Engineering*, Ph.D. Advisor.
nehorai@wustl.edu, 314-935-7520

Patricio S. La Rosa, *Bayer Company*, Research Collaborator and Mentor, Team lead.
patricio.larosa@bayer.com

Lenise Cummings-Vaughn, *WUSTL School of Medicine*, Research Collaborator.
lcummings@wustl.edu

Charles Twardy, Research Mentor.
ctwardy@gmail.com

Timothy Sauer, Research Mentor.
tsauer@gmu.edu, (703)993-1471

- **James Werstch**, Director, McDonnell Academy.
Jwertsch@wustl.edu