Dr. Matthew G. Hogan
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Education

B.S.	(Physics)	University of California (Santa Cruz), 2012.
M.S.	(Physics)	Colorado State University (Fort Collins), 2014.
Ph.D.	(Physics)	Colorado State University (Fort Collins), 2019.

Areas of Expertise

Dr. Hogan is a Research Scientist at NorthWest Research Associates (NWRA), joining NWRA in 2020 after obtaining his doctorate in physics in 2019. Dr. Hogan began in the NWRA Monterey office, and after a two-year hiatus with NWRA, has rejoined the firm in its Boulder office. He performs contract research and software development expertise in the realm of electromagnetic wave propagation in the ionosphere. He is the primary developer for the NWRA Automated Point Extraction (APEx) program which uses image-processing and analytical ray-tracing to extract traces from ionogram. He is proficient in multiple programming languages including C, C++, Python, Julia, and Fortran in Windows, Linx, and Unix operating systems. His background includes machine learning, computer-vision techniques, and data science.

During his hiatus with NWRA, Dr. Hogan was a data science consultant working in the technology sector. His role at KPMG included consulting the design of a Microsoft Azure cloud-based, AI-assisted computer-vision monitoring system applicable in a warehouse setting. His programmatic implementation included GPU-support for AI-processing, multi-processing algorithms, and CI/CD workflow hosted on GitHub. His subsequent role at Lightning eMotors, a business-to-business electric vehicle (EV) company, was to collaborate with EV engineers to diagnose and predict EV failures using in-house telemetrics data. His other responsibilities included improving existing data pipelines and migrating analytics tasks to AWS.

Dr. Hogan received his master's and doctoral degree in high energy, long-baseline neutrino physics from Colorado State University (Fort Collins) with participation in large, multinational scientific collaborations. His master's thesis was on machine learning techniques to select particular neutrino interaction topologies in a novel liquid-argon detector for the proposed "Long-Baseline Neutrino Experiment" (LBNE), now the "Deep Underground Neutrino Experiment" (DUNE). His dissertation research regarded constraining experimental and cross-sectional model parameters that directly impact the measurement of theoretical neutrino oscillation parameters in the "Tokai to Kamioka" (T2K) experiment. His technique to measure and constrain T2K model parameters was a high-dimensional likelihood maximization estimation fit with constraints to enforce generality and prevent overfitting. Using a previously unexploited, in-house data set, his dissertation 1) demonstrated the utility of the new data set to constrain existing deficiencies and 2) provided an alternative and consistent prediction of the flagship measurements. His expertise in the field of high energy physics includes machine learning, parameter fitting, numerical modeling, data acquisition, hands-on electronics monitoring, and water-cooling systems.

Dr. Hogan's educational background includes a bachelor's degree (Dean's Honors) in physics and mathematics minor from the University of California (Santa Cruz) with an emphasis on astrophysics. His senior thesis was a measurement of extra-galactic blazars in the optical spectrum with flaring timescale estimates. His specialties include computational physics, programming in multiple languages (IDL, Mathematica, Java, and C), stellar physics, and mechanics of planetary systems.

Key Professional Accomplishments

- Development of new trace-extraction techniques and implementing ionospheric models for oblique-propagation ionograms
- Demonstrated that disadvantaged RF receivers can achieve high accuracy geolocation (error less than 10km) by utilizing skywave and over-the-horizon propagation from known transmitters.
- Bootstrap engineering a video analysis data pipeline with CI/CD workflow on Microsoft Azure cloud.
- Utilized high-performance computing resources to conduct a high-dimensional, maximum likelihood model estimate with theoretical and real experimental data.
- Trained machine learning algorithms to reject particular neutrino interactions in a detector based on observed topological information.

Selected Publications and Reports

Hogan, M. (2023) Sporadic E Predictive Model. SBIR Proposal F233-0009–0531. NWRA.

T2K Collaboration (2020) 'Constraint on the matter-antimatter symmetry-violating phase in neutrino oscillations', Nature, 580(7803), pp. 339–344. Available at: https://doi.org/10.1038/s41586-020-2177-0.

LBNE Collaboration (2013) 'The Long-Baseline Neutrino Experiment: Exploring Fundamental Symmetries of the Universe', arXiv e-prints, p. arXiv:1307.7335. Available at: https://doi.org/10.48550/arXiv.1307.7335.

Fumagalli, M. et al. (2012) 'A search of CO emission lines in blazars: the low molecular gas content of BL Lac objects compared to quasars', Monthly Notices of the Royal Astronomical Society, 424(3), pp. 2276–2283. Available at: https://doi.org/10.1111/j.1365-2966.2012.21391.x.