RAMAN MUKUNDAN

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U.S. Citizen
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EDUCATION

University of New Hampshire 2020 - Present
Doctor of Philosophy in Physics

University of Colorado Boulder 2016 - 2019
Bachelor of Arts in Physics (*summa cum laude*)

RESEARCH

Geomagnetic Disturbance Modeling 2020 - Present
University of New Hampshire - Research advisor: Dr. Amy Keesee

Developing space weather forecasting models to predict geomagnetically induced currents (GICs) and to explain the spatially localized nature of ground-level magnetic perturbations. Implemented neural networks and other machine learning algorithms for high-cadence multivariate timeseries analysis.

Frontier Development Lab 2023
Trillium Technologies in partnership with NASA, Google Cloud, and NVIDIA

Elevated the DAGGER geomagnetic perturbation forecasting model to a higher Technology Readiness Level. Created the SHEATH model to forecast solar wind at L1 given only solar imagery. Used a variety of cloud platforms to train and integrate machine learning components in operational pipeline.

Neutron Ground Level Enhancement Analysis 2019
University of Colorado Boulder - Research advisors: Dr. Daniel Baker and Dr. Thomas Berger

Independently studied theoretical ground-level enhancement precursor signals in neutron monitor data. Applied solar physics, time series analysis, and machine learning techniques. As part of an honors thesis, wrote a final paper and defended a thesis before a committee. Awarded *summa cum laude*.

Variable Star Astronomy 2016 - 2019
University of Colorado Boulder - Research advisor: Dr. Guy Stringfellow

Conducted observations using 0.5m ARCSAT telescope at Apache Point Observatory. Used photometric and spectroscopic data in concert to study luminous blue variable stars and supernova impostors.

PEER-REVIEWED PUBLICATIONS

- Coughlan, M., Keesee, A., Pinto, V., **Mukundan, R.**, Marchezi, J. P., Johnson, J., Connor, H., & Hampton, D. (2023). Probabilistic forecasting of ground magnetic perturbation spikes at mid-latitude stations. Space Weather. https://doi.org/10.1029/2023sw003446
- Pinto, V. A., Keesee, A. M., Coughlan, M., **Mukundan, R.**, Johnson, J. W., Ngwira, C. M., & Connor, H. K. (2022). Revisiting the ground magnetic field perturbations challenge: A machine learning perspective. Frontiers in Astronomy and Space Sciences. https://doi.org/10.3389/fspas.2022.869740

CONFERENCE PRESENTATIONS AND INVITED TALKS

- Multiscale Geoeffectiveness Forecasting: Upgrading the DAGGER Pipeline, AGU Fall Meeting, December 2023, San Francisco, CA (poster)

- Characterizing the Spatial Scales of Localized Ground-Level Magnetic Perturbations, AGU Fall Meeting, December 2023, San Francisco, CA (poster)
- Investigating Localized Geomagnetic Storm Forecasting from Sun to Mud, UNH EOS Space Science Seminar, October 2023, Durham, NH **(invited)**
- A Regional dB/dt Forecast Using Deep Learning and Spherical Elementary Current Systems, GEM Summer Workshop, June 2023, San Diego, CA (poster)
- The Influence of Inner Magnetosphere Data on a Regional Geomagnetically Induced Current Forecasting Model, AGU Fall Meeting, December 2022, Chicago, IL (poster)
- Investigating Localized Geomagnetic Perturbations with a Spherical Elementary Current Systems Approach, GEM Summer Workshop, June 2022, Honolulu, HI (poster)
- Optimizing a Neural Network for Regional Forecasting of Ground Magnetic Perturbations Using Spherical Elementary Current Systems, Machine Learning in Heliophysics Conference, March 2022, Boulder, CO (poster)
- Forecasting Ground-Level Magnetic Perturbations Using a Spherical Elementary Current System Method, AGU Fall Meeting, December 2021, New Orleans, LA **(invited)**
- Forecasting Geomagnetically Induced Currents with a Global Machine Learning Model, GEM Summer Workshop, June 2021, held virtually (poster)

PROJECTS

2023 NASA Space Apps Challenge 2023

Participated in the NASA-run hackathon. Contributed to the "Develop the Oracle of DSCOVR" challenge with an automated approach to clean a problematic in-situ dataset, using it to virtualize another instrument through generative machine learning.

Colorado Space Grant Consortium: Project Chimera 2017-2018

Created a lightweight, low-cost stratospheric cosmic ray detector as part of a student-led team. Collaboratively designed and built a multi-channel CsI(Tl) scintillator, supporting hardware and software, and data analysis algorithms. This project was funded by an Undergraduate Research Opportunity Program (UROP) grant.

HONORS AND AWARDS

Professor James M. E. Harper Fellowship 2020

Graduate scholarship awarded by the University of New Hampshire Department of Physics and Astronomy for academic merit and strong research performance.

President Joseph A. Sewall Award 2016-2019

Undergraduate scholarship awarded by the University of Colorado Esteemed Scholars Program for extraordinary academic achievement.

SKILLS

Computer Languages	Python (SpacePy, SciPy,Pandas, scikit-learn, TensorFlow, PyTorch), C/C++, Java, HTML, LaTeX
Human Languages	English, French
Data Analysis	Spacecraft (GOES, DMSP, OMNI), ground magnetometers, cloud computing (GCP, NGC), predictive analytics
Other	Linux operating systems, Office suite, third degree black belt in karate