

GREG FURLICH

Research Scientist

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8 years expertise in remote sensing research with a specialization in:

- image classification, segmentation, and generation with machine learning
- radiometric event reconstruction and analysis
- data fusion for object detection, tracking, and state estimation
- signal processing
- algorithm development

EDUCATION

Doctorate of Philosophy, Physics

2014 - 2020

Master of Science, Physics

2014 - 2018

University of Utah, Salt Lake City, UT

Bachelor of Science, Physics

2010 - 2014

Michigan Technological University, Houghton, MI

Magna Cum Laude

Minors: Mathematical Sciences and German

SKILLS

Programming Languages: [Python \(Keras, TensorFlow, Numpy, Scipy, Pandas, Pyroot\)](#) [MATLAB](#) [C](#) [C++](#) [CERN ROOT](#)

Development Environments: [Jupyter Notebooks](#) [Linux VMs \(AWS EC2\)](#) [HPCs \(Slurm and PBS schedulers\)](#) [GPU](#) [Kubeflow](#)

Remote Sensing Data Sources: [GOES](#) [Landsat](#) [Sentinel](#) [SRTM](#)

Markup Languages: [HTML](#) [CSS](#) [\$\text{\LaTeX}\$](#) [Markdown](#) Foreign Languages: [German](#)

Miscellaneous: Strong analytic and problem solving experience, exceptional verbal and written communication skills, and collaborative finesse.

RESEARCH EXPERIENCE

Research Scientist Sr.

Jan 2021 - Present

**Lockheed Martin Space Systems,
APEX (Advanced Programs and Exploitations)**

- Signal processing, algorithm development, data fusion, object detection, object tracking, and object state estimation
- Synthetic radiometric scene generation
- Super resolution, image-to-image translation, and style transfer with Generative Adversarial Networks (GANs), image segmentation with UNETs and FCNs, object classification with Convolution Neural Networks (CNNs).
- Selected as a Recognized Technical Talent for technical contributions within first year.
- Generated intellectual property which was awarded and protected as a trade secret.

RESEARCH EXPERIENCE CONTINUED

Graduate Research Assistant in Cosmic Rays

2014 - 2020

Telescope Array (TA) Cosmic Ray Observatory, Institute of High Energy Astrophysics,
Department of Physics and Astronomy, University of Utah

Research Advisor: Douglas Bergman

Thesis : Observation of the GZK Suppression with the Telescope Array Fluorescence Telescopes and Deployment of the Telescope Array Expansion

- Analyzed 10 years of monocular fluorescence data to create a Cosmic Ray Energy Spectrum. Raw cosmic ray event data were analyzed by reconstructing event geometry and energy. The event information was aggregated into a large database to produce the event energy distribution. The aperture of the detectors in monocular mode was calculated through Monte Carlo thrown events over TA and simulating the response of the detectors.
- Analyzed the significance of the Greisen–Zatsepin–Kuzmin (GZK) Suppression at the highest energies of cosmic rays in the 10 year cosmic ray spectrum. Analyzed other features that give insight into cosmic ray populations or propagation effects.
- Classified weather over TA with the fluorescence detector photomultiplier tube baselines to create false color images of the detectors' field of view. Videos of these snapshots were then used as inputs in a Recurrent Convolution Neural Network (RCNN) model constructed with Keras machine learning framework to determine clear weather data for further cosmic ray analysis.
- Analyzed the preliminary data from the new fluorescence detectors for the expansion of TA known as TAx4 into a preliminary Cosmic Ray Energy Spectrum and compared to previous results to gauge the new detector's abilities.
- Created composite satellite maps in Python with site geographic information overlays of TA using data from the Landsat 8 satellite pulled from Amazon Web Services. Created topographical and shaded relief maps in Python with site geographic information overlays using Shuttle Radar Topography Mission data (SRTM).
- Built, tested, and deployed the system of fluorescence telescopes for TAx4.
- Field team leader charged with the safety of field crew and overseeing the deployment of the new surface detectors to their field site for TAx4.
- Maintained and operated current surface and fluorescence detectors for cosmic ray event data collection.
- Analyzed fluorescence detector's sensitivity to energy and development of cosmic ray event interactions in the atmosphere through Monte Carlo simulation. The reconstructed event information were analyzed by being binned into histograms and fitted using ROOT data analysis framework.
- Linux systems administrator of the Telescope Array's data server and computational clusters at the University of Utah for 2 years.

Project Data Analyst

2019

College of Computing, University of Utah

- Collaborated on a College of Computing PhD Candidate's thesis project by analyzing air quality data with Python and Pandas DataFrames to query, aggregate, and present data in infographical plots in a quick fashion during face-to-face interviews with study participants.
- Aggregated outside data of local weather conditions and Air Quality Index through web application programming interfaces to give prospective to study participants about their collected home air quality data.

Contributions are noted in:

Exploring the Personal Informatics Analysis Gap: 'There's a Lot of Bacon', Jimmy Moore, Pascal Goffin, Jason Wiese, Miriah Meyer, IEEE Transactions on Visualization and Computer Graphics (VIS), 95-105, doi:10.1109/TVCG.2021.3114798, 2021

An interview method for engaging personal data, Jimmy Moore, Pascal Goffin, Jason Wiese, Miriah Meyer, The Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT), 5(4): 1-28, doi:10.1145/3494964, 2021.

Research Assistant in Cosmic Rays

2013 - 2014

Department of Physics, Michigan Technological University

Research Advisor: Brian Fick

Senior Research Project: Preliminary Search for Exotic Events in the Auger Cosmic Ray Observatory Surface Detector Data

- Conducted a preliminary search for exotic particle events in the Pierre Auger Cosmic Ray Observatory surface detector data by identifying possible delayed development features in the cosmic ray's interaction in our atmosphere.

RESEARCH EXPERIENCE CONTINUED

Research Assistant in Nanofabrication

2011 - 2012

Department of Physics, Michigan Technological University

Research Advisor: Yoke Khin Yap

- Analyzed growth parameters for Boron Nitride Nanotubes and Vertically Aligned Multi-Walled Carbon Nanotubes in a Chemical Vapor Deposition method.
- Adapted Chemical Vapor Deposition synthesis method to a scanning thermal source for greater growth yield.

PUBLICATIONS

Sub-Pixel Localization of Objects Using Multiple Spectral Bands, M. Gupta, J. Chan, M. Krouss, [G. Furlich](#), P. Martens, M. Chan, M. L. Comer, E. J. Delp, IEEE Aerospace Conference, 2022, *accepted*

Observation of the GZK Suppression with the Telescope Array Fluorescence Telescopes and Deployment of the Telescope Array Expansion, [Greg Furlich](#), Thesis, University of Utah, April 2020

Constraints on the diffuse photon flux with energies above 10^{18} eV using the surface detector of the Telescope Array experiment, R.U. Abbasi et al. (Telescope Array Collaboration), *Astropart. Phys.* **110** (2019)

Testing a Reported Correlation between Arrival Directions of Ultra-high-energy Cosmic Rays and a Flux Pattern from nearby Starburst Galaxies using Telescope Array Data, R.U. Abbasi et al. (Telescope Array Collaboration), *ApJ* **867** 2 (2018)

The Cosmic-Ray Energy Spectrum between 2 PeV and 2 EeV Observed with the TALE detector in monocular mode, R.U. Abbasi et al. (Telescope Array Collaboration), *ApJ* **865** 74 (2018)

Evidence of Intermediate-scale Energy Spectrum Anisotropy of Cosmic Rays $E \geq 10^{19.2} \text{ eV}$ with the Telescope Array Surface Detector R.U. Abbasi et al. (Telescope Array Collaboration), *ApJ* **862** 91 (2018)

Depth of Ultra High Energy Cosmic Ray Induced Air Shower Maxima Measured by the Telescope Array Black Rock and Long Ridge FADC Fluorescence Detectors and Surface Array in Hybrid Mode, R.U. Abbasi et al. (Telescope Array Collaboration), *ApJ* **858** 76 (2018)

Gamma-ray Showers Observed at Ground Level in Coincidence With Downward Lightning Leaders, R.U. Abbasi et al. (Telescope Array Collaboration), *Journal of Geophysical Research: Atmospheres* **123** (2018)

Increasing the Yield of Boron Nitride Nanotubes in a CVD Method, [Greg Furlich](#), Michigan Space Grant Consortium, Michigan in Space **14** (2012)

PROCEEDINGS AND PRESENTATIONS

Recent measurement of the Telescope Array energy spectrum and observation of the shoulder feature in the Northern Hemisphere, D. Ivanov, D. Bergman, [G. Furlich](#), R. Gonzalez, G. Thomson and Y. Tsunesada, Proceedings of Science 395 (ICRC2021), 341, 37th International Cosmic Ray Conference, Berlin, Germany, July 2021

Telescope Array 10-Year Monocular Spectrum, Douglas Bergman, [Greg Furlich](#), Proceedings of Science 395 (ICRC2021), 339, 37th International Cosmic Ray Conference, Berlin, Germany, July 2021

Observation of the GZK Suppression with the Telescope Array Fluorescence Telescopes and Deployment of the Telescope Array Expansion, Thesis Defense, University of Utah, April 2020

Telescope Array FD Weather Classification using Machine Learning, [Greg Furlich](#), Proceedings of Science (ICRC2019) 261, 36th International Cosmic Ray Conference, Madison, WI, July 2019

Towards a Telescope Array 10 Year FD Monocular Energy Spectrum, [Greg Furlich](#), Douglas Bergman, Proceedings of Science (ICRC 2019) 260, 36th International Cosmic Ray Conference, Madison, WI, July 2019

Weather Classification using Machine Learning at the Telescope Array Cosmic Ray Observatory, APS April Meeting, Denver, CO, April 2019

Weather Classification using Machine Learning at the Telescope Array Cosmic Ray Observatory (Poster), Department of Physics and Astronomy Annual Symposium, University of Utah, Salt Lake City, UT, April 2019

Machine Learning Weather Classification with Fluorescence Detector Pedestal Data at the Telescope Array Cosmic Ray Observatory, APS Four Corners Meeting, University of Utah, Salt Lake City, UT, Oct. 2018

Machine Learning Weather Classification with Fluorescence Detector Pedestal Data at the Telescope Array Cosmic Ray Observatory, Graduate Research Seminar, University of Utah, Salt Lake City, UT, Oct. 2018

PROCEEDINGS AND PRESENTATIONS CONTINUED

Dark Nights and Desert Air: Understanding the Highest Energy Particles in the Universe, Great Basin Astronomy Festival, Great Basin National Park, NV, Sept. 2018

Tax4 Fluorescence Detection (Poster), Physics and Astronomy Symposium, University of Utah, Salt Lake City, UT, April 2017

Hosting Your Own Website from Home with a Raspberry Pi, Graduate Research Seminar, University of Utah, Salt Lake City, UT, Oct. 2017

Once More Unto the Breach: Advice from a Physics graduate Student, Physics Seminar, Weber State University, Ogden, UT, Feb. 2017

Peer Mentoring: Training and Supporting Physics TAs at the University of Utah (Poster), AAPT Idaho-Utah Section Meeting, Pocatello, ID, April 2016

Preliminary Search for Exotic Events in the Pierre Auger Cosmic Ray Observatory Data, Physics Senior Research Oral Presentations, Michigan Technological University, Houghton, MI, April 2014

AWARDS

Recognized Technical Talent, Lockheed Martin	Selected 2021
Departmental Scholar, Department of Physics, Michigan Technological University	2013
Sigma Pi Sigma, Physics Honor Society	Inducted 2013
Michigan Space Grant Consortium Recipient	2012

LEADERSHIP, MENTORING, AND OUTREACH

Research Mentor, Lockheed Martin

Sub-pixel localization and multispectral signal processing, Purdue University PhD Candidate 2021 - Present

Machine learning cloud segmentation in satellite imagery, United States Military Academy West Point Cadet 2021 - Present

Academic Senate, University of Utah

Member, Graduate Assembly Ad Hoc Committee 2019

College of Science, University of Utah

Member, College of Science Council 2017 - 2018

Member, College of Science Curriculum Committee 2017 - 2018

Member, College of Science College Student Council 2017 - 2018

Department of Physics and Astronomy, University of Utah

Chair, Graduate Student Advisory Council 2017 - 2018

Member, Graduate Student Advisory Council 2015 - 2019

Science Outreach

Volunteer, Physics Open House, Weber State University 2017, 2018, 2019

Volunteer, Science Day, University of Utah 2017, 2019

Volunteer and Speaker, Great Basin Astronomy Festival, Great Basin NP 2018

Society of Physics Students, Michigan Technological University Chapter

Treasurer 2012 - 2013

MEDIA COVERAGE

Keeping the Student Voice: Student Involvement in the Tenure Process, Katelyn Collett, The Daily Utah Chronicle, May 22, 2019

Pictured in Telescope Array Tax4 expansion work: Installation of surface particle detector begins in extreme cold (translated), Makio Nakamura, ICRR News, **104**, Winter and Spring 2019

PhD candidate sheds light on work of Millard County cosmic-ray observatory that's largest in Northern Hemisphere, Rhett Wilkinson, Millard County Chronicle Progress, Sept. 19, 2018