HANNAH R. KERNER

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EDUCATION

Arizona State University *Aug 2015-Aug 2019*
Exploration Systems Design, Ph.D.

University of North Carolina at Chapel Hill *Jan 2015-May 2015*
Computer Science, M.S. courses only

University of North Carolina at Chapel Hill *Aug 2011-Aug 2014*
Computer Science, B.S. *cum laude*

RESEARCH INTERESTS

Machine learning, deep learning, artificial intelligence, knowledge discovery, data mining, agricultural monitoring, food security, sustainability, earth science, remote sensing, robotic exploration, planetary science

RESEARCH AND WORK EXPERIENCE

University of Maryland College Park, MD
Assistant Research Professor *Sep 2019 - Present*

Developing new machine learning methods for applications in agricultural monitoring, food security, remote sensing, and planetary exploration. Additional roles: Science Team Member, Mars Science Laboratory (Curiosity).

Arizona State University Tempe, AZ
Graduate Research Assistant *Aug 2015 - Aug 2019*

Developed novel algorithms for facilitating planetary exploration for missions at Mars, the Moon, and Earth. Additional roles: Science Team Member, Mars Science Laboratory (Curiosity); Payload Downlink Lead, Mars Exploration Rover (Opportunity) Pancam instrument

NASA Jet Propulsion Laboratory Pasadena, CA
Research Intern *May 2018 - Aug 2018; Jan 2019 - Mar 2019*

Developed feature detection, change detection, and novelty detection approaches for remote sensing datasets in the Machine Learning and Instrument Autonomy (MLIA) group.

Planet, Inc. San Francisco, CA
Onboard Software Intern *May 2014 - Dec 2014; May 2015 - Aug 2015*

Developed flight code in C to operate the Dove 3U cubesats and python code for mission operations.

University of North Carolina at Chapel Hill Chapel Hill, NC
Undergraduate Research Assistant *Aug 2013 - May 2014*

Developed software to perform real-time collision-free navigation for micro air vehicles (quadcopters) in the GAMMA Research Group.

NASA Langley Research Center Hampton, VA
LARSS Intern *May 2013 - Aug 2013*

Developed the "judge's station," a publish/subscribe system to parse telemetry data, for the Unmanned Aerial Systems Airspace Operations Challenge (UAS AOC) NASA Centennial Challenge.

University of North Carolina at Chapel Hill Chapel Hill, NC
Undergraduate Research Assistant *Aug 2012 - May 2013*

Developed software for analyzing quality and properties of RNA-seq data in the Prins Lab.

NASA Goddard Space Flight Center Greenbelt, MD
Intern *May 2012 - Aug 2012*

Developed an iPad application for analyzing aerosol data collected by Earth-observing satellites.

NASA Langley Research Center Hampton, VA
INSPIRE Intern *May 2011 - Aug 2011*

Developed a system using Geoserver and OpenLayers to display data products from NASAs Earth-observing satellites in a user-friendly format.

SCHOLARSHIPS AND FELLOWSHIPS

Google Women Techmakers Scholarship (2018-2019)

CLAS Doctoral Fellowship for First-Generation College Graduates (2017-2018)

William A. Whitaker Scholarship (2011-2014)

Sallie Southall Cotten Scholarship (2011)

NC Air National Guard William M. Goyer Memorial Scholarship (2011)

GRANTS

NASA Planetary Data Archiving, Restoration, and Tools (PDART), "Collaborative Planetary Science Platform (CPSP): Enabling and Accelerating Planet-wide Scientific Analysis" (2019), proposed

NASA STTR Phase I, "Planetary-scale Surface Feature Detection and Mapping for Future Exploration Missions" (2019), $80,000

NASA JPL Strategic University Research Partnership (FY19), $60,000/yr

ASU Graduate College Travel Grant (Q2 and Q3 2018)

ASU Graduate and Professional Student Association Travel Grant (Jan 2017, Oct 2017, Sep 2018)

NASA STTR Phase I, "AstroCube: An Asteroid Prospecting CubeSat Mission" (2016), $125,000

Grace Hopper Conference Scholarship Grant (2014)

HONORS AND AWARDS

ASU College of Liberal Arts and Sciences Graduate Excellence Award (2019)

ASU College of Liberal Arts and Sciences Student Leader (2018)

ASU Graduate and Professional Student Association Outstanding Mentor Award (2018)

ASU School of Earth and Space Exploration "Exploration Systems Design Gearhead" Award (2017)

Space Frontier Foundation Service to the Frontier Award (2017)

Todd B. Hawley Award for Student Leadership (2015)

Square Code Camp Selectee (2014)

NASA Langley Summer Student App Contest, 2nd Place (2011)

TEACHING EXPERIENCE

Featured lectures for CSE 571: Artificial Intelligence, Coursera.org (Arizona State University MCS)

Algebra 1A and GED Math, Fall 2018, Adobe Mountain School, Deer Valley, AZ

Intro to Exploration, Spring 2018, Eyman Prison, Florence, AZ

CS for People Who Don't Know CS (Yet!), Spring 2015, UNC Chapel Hill, Chapel Hill, NC[1]

Intro to Programming (COMP 110), Spring 2014, UNC Chapel Hill, Chapel Hill, NC

Intro to Scientific Programming (COMP 110), Fall 2013, UNC Chapel Hill, Chapel Hill, NC

Stars and Galaxies, 2012-2014, NC Science Olympiad, Phillips Middle School, Chapel Hill, NC

PUBLICATIONS

Dissertation, Theses, Books, and Book Chapters

1. **Machine Learning on Mars: A New Lens on Data from Planetary Exploration Missions.**
   Hannah Kerner. Ph.D. Dissertation in Exploration Systems Design, Arizona State University, 2019.
2. **Machine Learning for Planetary Science.**
   Editors: Klaus Michael Aye, Mario D'Amore, Joern Helbert, and Hannah Kerner. *Elsevier Science and Technology Books*, 2020 (in prep).
3. **Autonomous Navigation for Micro-Air Vehicles Using Reciprocal Velocity Obstacles.**
   Hannah Kerner. B.S. Honors Thesis in Computer Science. UNC Chapel Hill, 2014.

Journal Articles

1. **Comparison of Novelty Detection Methods for Multispectral Images in Rover-Based Planetary Exploration Missions.**
   Hannah Kerner, Kiri Wagstaff, Brian Bue, Danika Wellington, Sammie Jacob, Jim Bell, and Heni Ben Amor. In preparation for *Data Mining and Knowledge Discovery*. Planned submission: August 2019.
2. **Analysis of Active Neutron Measurements from the Mars Science Laboratory Dynamic Albedo of Neutrons Instrument: Intrinsic Variability, Outliers, and Implications for Future Investigations.**
   Hannah Kerner, Craig Hardgrove, Sean Czarnecki, Travis Gabriel, Igor Mitrofanov, Maxim Litvak, Anton Sanin, and Denis Lisov. Under review at *Journal of Geophysical Research: Planets*, 2019.
3. **Deep Learning Methods Toward Generalized Change Detection on Planetary Surfaces.**
   Hannah Kerner, Kiri Wagstaff, Brian Bue, Patrick Gray, Jim Bell, and Heni Ben Amor. Accepted in *Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 2019.
4. **Context-Dependent Image Quality Assessment of JPEG-Compressed Mars Science Laboratory Mastcam Images using Convolutional Neural Networks.**
   Hannah Kerner, Heni Ben Amor, and Jim Bell. *Computers and Geosciences*, 118, pp. 109-121, 2018.
5. **Demosaicing Enhancement using Pixel-Level Fusion.**
   Chiman Kwan, Bryan Chou, Li-Yun Kwan, Jude Larkin, Bulent Ayhan, Jim Bell, and Hannah Kerner. *Signal, Image and Video Processing*, 12(4), pp. 749-756, 2017.

Referreed Conference Papers

1. **Novelty Detection for Multispectral Images with Application to Planetary Exploration.**
   Hannah Kerner, Danika Wellington, Kiri Wagstaff, Jim Bell, and Heni Ben Amor. *Innovative Applications of Artificial Intelligence (IAAI/AAAI), 2019.*

Technical Reports and Unrefereed Papers

[1]Supported by Google and National Center for Women and Information Technology (NCWIT)

1. **Robotics and Autonomous Driving.**
   Hannah Kerner, Alan Kuntz, Jeffrey Ichnowski, and Michael North. 2015.

Abstracts and Posters

1. **Toward Generalized Change Detection on Planetary Surfaces with Deep Learning.**
   Hannah Kerner, Kiri Wagstaff, Brian Bue, Patrick Gray, Jim Bell, and Heni Ben Amor. American Geophysical Union (AGU) Fall Meeting, San Francisco, CA, 2019.

2. **Comparison of Novelty Detection Methods for Multispectral Images from the Mastcam Instrument Onboard Mars Science Laboratory.**
   Hannah Kerner, Kiri Wagstaff, Brian Bue, Danika Wellington, Sammie Jacob, Jim Bell, and Heni Ben Amor. 3rd Planetary Data Workshop, Flagstaff, AZ, 2019.

3. **Analysis of Intrinsic Variability and Outliers in Pulsed Neutron Data using the Mars Science Laboratory Dynamic Albedo of Neutrons Instrument.**
   Hannah Kerner, Craig Hardgrove, and Sean Czarnecki. 50th Lunar and Planetary Science Conference, The Woodlands, TX, 2019.[2]

4. **Novelty Detection for Multispectral Images with Application to Planetary Exploration.**
   Hannah Kerner, Danika Wellington, Kiri Wagstaff, Jim Bell, and Heni Ben Amor. IMA Workshop on Recent Advances in Machine Learning and Computational Methods for Geoscience, University of Minnesota, 2018.[3]

5. **Change Detection on Mars: A Deep Learning Approach.**
   Hannah Kerner, Kiri Wagstaff, Brian Bue, and Heni Ben Amor. Women in Machine Learning Workshop at *Advances in Neural Information Processing Systems (NIPS)*, 2018.[4]

6. **Novelty Detection for Multispectral Planetary Images.**
   Hannah Kerner, Danika Wellington, Kiri Wagstaff, Jim Bell, and Heni Ben Amor. *American Geophysical Union (AGU) Fall Meeting*, 2018.[5]

7. **Autonomous Mapping of Surface Features on Mars.**
   Mark Wronkiewicz, Hannah Kerner, and Tanya Harrison. *American Geophysical Union (AGU) Fall Meeting*, 2018.

8. **Context-dependent image quality assessment of JPEG compressed Mars Science Laboratory Mastcam Curiosity images using convolutional neural networks.**
   Hannah Kerner, Jim Bell, and Heni Ben Amor. *American Geophysical Union (AGU) Fall Meeting*, 2017.[6]

9. **Detecting and characterizing compression-related artifacts in Mars Science Laboratory Mastcam images.**
   Hannah Kerner, Jim Bell, and Heni Ben Amor. *48th Lunar and Planetary Science Conference*, 2017.[7]

10. **The Lunar Polar Hydrogen Mapper (LunaH-Map) CubeSat Mission.**
    Hannah Kerner, Craig Hardgrove, Jim Bell, Igor Lazbin, Robert Amzler, Alessandra Babuscia, Zachary Burnham, James Christian, Anthony Colaprete, Ahmet Deran, Darrell Drake, David Dunham, Anthony Genova, Austin Godber, Erik Johnson, Jack Lightholder, Derek Nelson, Mark Robinson, Richard Starr, Stephen West, and Bobby Williams. *30th Annual AIAA/USU Conference on Small Satellites*, 2016.

Opinion Articles

1. **Our path to Mars needs to look beyond launch.** *Houston Chronicle*, 2016.

2. **Space Technology Can Help Sustain Earth.** *Scientific American*, 2016.

3. **The Next Generation of Next-Generation Activities.** *Space News*, 2015.

4. **What's the Point? The Real Reason Scientists Study Space.** *Space.com*, 2015.

[2]Participation funded by the ASU Graduate College.
[3]Participation funded by the University of Minnesota Institute for Mathematics and its Applications.
[4]Participation funded by Women in Machine Learning.
[5]Participation funded by the ASU Graduate College and Graduate and Professional Student Association.
[6]Participation funded by the Graduate and Professional Student Association.
[7]Participation funded by the Graduate and Professional Student Association.

5. **The Space Destination Debate Gets Us Nowhere—Literally.** *Space.com*, 2015.
6. **The B-Word.** *Planet Pulse*, 2015.
7. **It's Not Them, It's You: Why Top Tech Talent Isn't Going to the Space Industry.** *Via Satellite*, 2015.

TECHNICAL PRESENTATIONS AND PUBLIC TALKS

1. "Artificial Intelligence on the Red Planet: A New Lens on Data from Mars." Burton Barr Central Library, Phoenix, AZ, June 2019.
2. "Machine Learning on Mars: A New Lens on Data from Planetary Exploration Missions." PhD defense, Arizona State University, Tempe, AZ, June 2019.
3. "Comparison of Novelty Detection Methods for Multispectral Images from the Mastcam Instrument Onboard Mars Science Laboratory." 3rd Planetary Data Workshop, Flagstaff, AZ, June 2019.
4. "Enhancing Mars Exploration by Prioritizing Interesting Observations with Machine Learning." NASA Jet Propulsion Laboratory Mars Forum, Pasadena, CA, March 2019.
5. "Novelty Detection for Multispectral Images with Application to Planetary Exploration." Innovative Applications of Artificial Intelligence (IAAI), 33rd AAAI Conference on Artificial Intelligence, Honolulu, HI, January 2019.
6. "Novelty Detection for Multispectral Planetary Images." Deep Learning for Geoscience, American Geophysical Union (AGU) Fall Meeting, Washington, DC, December 2018.
7. "Machine Learning on Mars." Google Scholar Retreat, Mountain View, CA, August 2018.
8. "Enhancing JPL's Mission Science Planning and Data Discovery Capabilities with Machine Learning." NASA Jet Propulsion Laboratory Machine Learning and Instrument Autonomy Group, Pasadena, CA, August 2018.
9. "SAMMIE: Selections based on Autoencoder Modeling of Multispectral Image Expectations – Novelty Detection in Mastcam Multispectral Images." NASA Jet Propulsion Laboratory Machine Learning and Instrument Autonomy Group, Pasadena, CA, July 2018.
10. "Context-Dependent Image Quality Assessment of JPEG-Compressed Mars Science Laboratory *Mastcam* Images using Convolutional Neural Networks." American Geophysical Union (AGU) Fall Meeting, New Orleans, LA, December 2017.
11. "Neural Networks and Planetary Science." Planetary Data Workshop, Flagstaff, AZ, June 2017.
12. "Detecting and Characterizing Compression-Related Artifacts in Mars Science Laboratory *Mastcam* Images." 48th Lunar and Planetary Science Conference (LPSC), The Woodlands, TX, February 2017.
13. "Planetary Exploration, Machine Intelligence, and Gender Bias." CU Cafe, Boulder, CO, April 2016.

SERVICE

Conference Service

- Session Chair, "Machine Learning for Planetary Science" (P022) session, American Geophysical Union (AGU) Fall Meeting, San Francisco, CA (2019)
- Session Co-chair, "Machine Learning in Planetary Science: Introductions and Applications" (P41D), American Geophysical Union (AGU) Fall Meeting, Washington, DC (2018)
- Session Co-chair, "Rise of Machine Learning: Salvation for Planetary Science in Times of Increasing Data Volume and Complexity" (P13G), American Geophysical Union (AGU) Fall Meeting, New Orleans, LA (2017)
- Conference Co-chair, NewSpace Europe Conference, Luxembourg City, Luxembourg (2017)

- Conference Chair, NewSpace Conference, San Jose, CA (2015)

Professional Service

- Member, Board of Directors, The Science Line, 2016-Present
- Member, Board of Advisors, Students for the Exploration and Development of Space USA, 2015-Present
- Executive Director, Space Frontier Foundation, 2015-2016
- Chair, Students for the Exploration and Development of Space USA, 2013-2015

Reviewing

- Journal Referee, *IEEE Transactions on Geoscience and Remote Sensing*, 2019
- Reviewer, Women in Machine Learning Workshop, co-located with Advances in Neural Information Processing Systems (NeurIPS), 2018
- Reviewer, NASA Frontier Development Lab, 2018

Advising and Mentoring

- Mentor, SEDS-USA Business Pitch Competition, 2018
- Mentor, Julia Odden, high school summer intern (ASU), 2017
- Mentor, ASU Phoenix CubeSat Mission, 2016-2017

Arizona State University

- Co-Chair, Women in Science Program, School of Earth and Space Exploration, 2018-2019
- Member, Colloquium Committee, School of Earth and Space Exploration, 2015-2019
- President, Devil Divers (SCUBA), Arizona State University, 2018-2019
- Volunteer Instructor, ASU Prison Education Program, 2018-2019

University of North Carolina at Chapel Hill

- Founder and President, UNC Women in Computer Science, 2012-2014
- President, UNC Students for the Exploration and Development of Space, 2013-2014
- Member, STAND-UNC (Genocide Intervention Network), 2011-2014

Additional Service

- Volunteer Instructor, Girls Who Code, Maie Bartlett Heard K-8 School, 2016-2019
- Precinct Committeeperson (appointed), Hollis Park Precinct, Maricopa County, 2017-2018

PROFESSIONAL ASSOCIATIONS

Member, Association for the Advancement of Artificial Intelligence (AAAI)
Member, American Geophysical Union (AGU)

CERTIFICATIONS

PADI Rescue Diver, Advanced Open Water Diver, and Open Water Diver

FCC Ham Radio Technician License (KM4BMS)

Red Cross Adult First Aid (CPR/AED)

REFERENCES

1. Dr. Jim Bell, Professor, Arizona State University, jim.bell@asu.edu, (480) 965-1044
2. Dr. Heni Ben Amor, Assistant Professor, Arizona State University, hbenamor@asu.edu, (480) 965-2253
3. Dr. Craig Hardgrove, Assistant Professor, Arizona State University, chardgro@asu.edu, (480) 727-2170
4. Dr. Kiri Wagstaff, Principal Researcher, Jet Propulsion Laboratory, kiri.l.wagstaff@jpl.nasa.gov, (818) 393-6393