HANNAH R. KERNER

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EDUCATION

Arizona State University *Aug 2015-Aug 2019* (Expected)
Exploration Systems Design, Ph.D.
Advisors: Dr. Jim Bell, Dr. Heni Ben Amor

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*
Thesis title: *Autonomous Navigation for Micro-Air Vehicles using Reciprocal Velocity Obstacles*
Advisor: Dr. Dinesh Manocha

RESEARCH INTERESTS

Machine learning, deep learning, artificial intelligence, knowledge discovery, data mining, planetary science, remote sensing, and space exploration

RESEARCH EXPERIENCE

Bell Research Group & Interactive Robotics Laboratory Arizona State University
Graduate Research Assistant *Aug 2015 - Present*

Develop novel algorithms for novelty detection, change detection, and quality analysis and evaluate them using data from active science investigations at Mars.
Additional roles: Science Team Member, Mars Science Laboratory *Curiosity*; Payload Downlink Lead, Mars Exploration Rover *Opportunity* Pancam

Machine Learning and Instrument Autonomy Group NASA Jet Propulsion Laboratory
Intern Researcher *May 2018 - Aug 2018; Jan 2018 - Mar 2018*

Developed new neural network architectures to support change and feature detection in planetary science image data sets, such as orbital images of Mars collected by the HiRISE and CTX cameras.

Lunar Polar Hydrogen Mapper (LunaH-Map) Arizona State University
Flight Software and Systems Engineer *Nov 2015 - May 2017*

Developed initial designs and requirements for flight software and electrical power subsystems for the LunaH-Map 6U spacecraft, scheduled to launch in June 2020.

GAMMA Research Group UNC Chapel Hill
Undergraduate Research Assistant *Aug 2013 - May 2014*

Developed software to perform real-time collision-free navigation for micro air vehicles (quadcopters).

Prins Lab UNC Chapel Hill
Undergraduate Research Assistant *Aug 2012 - May 2013*

Developed software for analyzing quality and properties of RNA-seq data.

WORK EXPERIENCE

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

Developed approaches to feature detection, change detection, and novelty detection in Mars image datasets.

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.

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.

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 Scholar (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 JPL Strategic University Research Partnership (FY19-FY20)

ASU Graduate College Travel Grant (Q2 2018)

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

STTR Phase II, "Technologies for Planetary Compositional Analysis and Mapping," Participant (2017)

STTR Phase I, "AstroCube: An Asteroid Prospecting CubeSat Mission," Participant (2016)

Grace Hopper Conference Scholarship Grant (2014)

HONORS AND AWARDS

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

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

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

CS for Non-CS People (Yet), Spring 2015, UNC Chapel Hill, Chapel Hill, NC

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

Intro to Scientific Programming (COMP 110), Fall 2014, 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. **Enhancing Planetary Exploration and Data Discovery with Machine Learning.**
   Hannah Kerner. Ph.D. Dissertation in Exploration Systems Design, Arizona State University, 2019 (planned).

2. **Machine Learning for Planetary Science.**
   Editors: Klaus Michael Aye, Mario D'Amore, Joern Helbert, and Hannah Kerner. *Elsevier Science and Technology Books*, 2019 (planned).

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. **Change Detection for Surface Features on Mars.**
   Hannah Kerner, Kiri Wagstaff, Brian Bue, and Patrick Gray. *Transactions on Geoscience and Remote Sensing*, in preparation.

2. **Statistical Analysis and Anomaly Detection for Neutron Die-away Measurements from the Dynamic Albedo of Neutrons (DAN) on Mars Science Laboratory *Curiosity*.**
   Hannah Kerner, Sean Czarnecki, and Craig Hardgrove, in preparation.

3. **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.

4. **High-Resolution Regional Digital Elevation Models and Derived Products from MESENGER MDIS NAC Images.**
   Madeleine Manheim, Megan Henriksen, Mark Robinson, Hannah Kerner, Bradley Karas, Kirs Becker, Elpitha Howington-Kraus, Matthew Chojnacki, Sarah Sutton, and David Blewett. Submitted to *Planetary Mapping: Methods, Tools for Scientific Analysis and Exploration*, special issue of *JGR/Earth and Space Science*.

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

Abstracts and Posters

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

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

3. **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.

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

5. **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. **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. **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.

5. **The Space Destination Debate Gets Us NowhereLiterally.** *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

1. "Novelty Detection for Multispectral Planetary Images." American Geophysical Union (AGU) Fall Meeting, Washington, DC, December 2018.

2. "Machine Learning on Mars." Google Scholar Retreat, Mountain View, CA, August 2018.

3. "Enhancing JPL's Mission Science Planning and Data Discovery Capabilities with Machine Learning." Presented to the NASA Jet Propulsion Laboratory Machine Learning and Instrument Autonomy Group, Pasadena, CA, August 2018.

4. "SAMMIE: Selections based on Autoencoder Modeling of Multispectral Image Expectations – Novelty Detection in Mastcam Multispectral Images." Presented to the NASA Jet Propulsion Laboratory Machine Learning and Instrument Autonomy Group, Pasadena, CA, July 2018.

5. "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.

6. "Neural Networks and Planetary Science." Third Planetary Data Workshop, Flagstaff, AZ, June 2017.

7. "Detecting and Characterizing Compression-Related Artifacts in Mars Science Laboratory *Mastcam* Images." 48th Lunar and Planetary Science Conference (LPSC), The Woodlands, TX, February 2017.

8. "Planetary Exploration, Machine Intelligence, and Gender Bias." CU Cafe, Boulder, CO, April 2016.

SERVICE

Conference Service

- Co-convened "Machine Learning in Planetary Science: Introductions and Applications (P025) session at 2018 American Geophysical Union Fall Meeting

- Co-convened "Rise of Machine Learning: Salvation for Planetary Science in Times of Increasing Data Volume and Complexity (P13G) session at 2017 American Geophysical Union Fall Meeting

Arizona State University

- Co-Chair, Women in Science Program, School of Earth and Space Exploration, 2018-Present

- Member, Colloquium Committee, School of Earth and Space Exploration, 2015-Present

- President, Devil Divers (SCUBA), Arizona State University, 2018-Present

- Volunteer Instructor, ASU Prison Education Program, 2018-Present

Professional Service

- Co-founder, Spectra, an effort to improve the representation of women in public speaking, 2017-Present

- Member, Board of Directors, The Science Line, 2016-Present

- Member, Board of Advisors, Students for the Exploration and Development of Space USA, 2015-Present

- Chair, Students for the Exploration and Development of Space USA, 2013-2015

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

Reviewing

- Reviewer, Women in Machine Learning Workshop, co-located with Advances in Neural Information Processing Systems (NIPS) 2018

Mentorship

- Mentor, SEDS-USA Business Pitch Competition, 2018

- Mentor, ASU Phoenix CubeSat Mission, 2016-2017

Additional Service

- Volunteer Instructor, Girls Who Code, Maie Bartlett Heard K-8 School, 2016-Present

- Precinct Committeeperson (appointed), Hollis Park Precinct, Maricopa County, 2017-Present

CERTIFICATIONS

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

FCC Ham Radio Technician License

Red Cross Adult First Aid (CPR/AED)