

Samuel Courville

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SCIENTIFIC GOAL

Advance our understanding of how the solar system formed, search for extra-terrestrial life, and help send humans to Mars by designing the future of planetary geophysics spacecraft instruments.

EDUCATION

M.S. COLORADO SCHOOL OF MINES CENTER FOR WAVE PHENOMENA, GEOPHYSICS
Golden, CO | Dec 2019

- Advisor: Dr. Paul Sava
- Thesis Title: Toward Orbital Seismology: Theory for speckle noise reduction in laser Doppler vibrometer measurements on distant rough surfaces
- GPA: 4.0 / 4.0 – summa cum laude

B.S. COLORADO SCHOOL OF MINES GEOPHYSICAL ENGINEERING
Golden, CO | May 2017

- Senior Thesis: Autonomous roving exploration system, a Mars active source seismic acquisition concept
- Minor in Computer Science
- Dean's List (All Semesters)
GPA: 4.0 / 4.0 – summa cum laude

RESEARCH EXPERIENCE

PLANETARY SCIENCE INSTITUTE | RESEARCH ASSOCIATE
May 2019 - | Lakewood, CO

- Member of the "SWIM" team, assisting an effort to globally map subsurface water ice on Mars. See <https://swim.psi.edu/>
- Assisting the MRO SHARAD operations team by using numerical modeling to link geologic models to data returned from MRO's SHARAD instrument. See <https://www.psi.edu/SHARAD>
- Designing instrumentation and methodology for active source seismic surveying on the Moon and Mars via a concept called ARES, the autonomous roving exploration system.

CENTER FOR WAVE PHENOMENA | RESEARCH ASSISTANT
August 2017 – Dec 2019 | Golden, CO

- Studying the application of laser Doppler vibrometry to detect seismic signals remotely on asteroid and planetary surfaces from orbit.
- Research assistant to Dr. Paul Sava at the Colorado School of Mines
- Funded by NASA PICASSO grant

LUNAR AND PLANETARY INSTITUTE | SUMMER INTERN

Summer 2017 | Houston, TX

- Determined the density of Schrodinger Basin's peak ring of mountains on the Moon using GRAIL gravity data
- Worked with planetary scientists at LPI and NASA's Johnson Space Center
- Selected as one of 14 summer interns from hundreds around the world

NASA'S PLANETARY GEOLOGY AND GEOPHYSICS UNDERGRADUATE RESEARCH PROGRAM | SUMMER INTERN

Summer 2016 | Golden, CO

- Studied the thermal properties of 171 dune fields on Mars in search of water ice using thermal emission spectrometer data from the Mars Odyssey Mission
- Worked with scientists from the Planetary Science Institute and Southwest Research Institute
- Funded by NASA grant

UNDERGRADUATE RESEARCH FELLOWSHIP | APP DEVELOPER

Spring 2016 - Spring 2017 | Golden, CO

- Began development on a virtual reality mobile app to aid in the viewing of 3D geophysical data
- Developed in Android Studio using Java and OpenGL
- Shared my knowledge with a junior undergraduate student who took over the project following my graduation

COLORADO SPACE GRANT CONSORTIUM DEMOSAT PROGRAM, PIKES PEAK COMMUNITY COLLEGE | TEAM MEMBER

Spring 2014 | Colorado Springs, CO

- Worked on a team to test the effect of high altitude radiation on skin cells using a high altitude weather balloon
- Required the construction of a size limited module and sensors programmed using Arduino
- Participated at age 17

TEACHING EXPERIENCE

TEACHING ASSISTANT | GEOPHYSICAL INVERSION – COLORADO SCHOOL OF MINES

Spring 2019 & Fall 2019 | Golden, CO

Teaching assistant to Dr. Paul Sava for a geophysical inversion course, GPGN409. Responsibilities include: teaching class when Dr. Sava is away, holding office hours, tutoring students, creating assignments, and grading.

CO-ADVISOR | JEFFCO EXECUTIVE INTERNSHIP PROGRAM – PLANETARY SCIENCE INSTITUTE

Summer 2019 | Lakewood, CO

Co-advised Blake Maly and Daniel Havlat on Radar data analysis projects, which led to AGU abstract submissions.

TUTOR | PROGRAMMING CONCEPTS – COLORADO SCHOOL OF MINES

Spring 2016 | Golden, CO

Tutored students for an introduction to programming class (C++): CSCI261

RESEARCH PROPOSALS

2019	Pending	Co-I NASA PSTAR – Planetary Science Institute Automating rover-based geophysical sounding methods for planetary exploration
2016-2017	Awarded	Undergraduate Research Fellowship – Colorado School of Mines Virtual reality geophysical data viewer for mobile phones
2017	Rejected	NASA NESSF Fellowship Development of an autonomous roving exploration system for active source seismic surveys on Mars

AWARDS AND HONORS

2019	Career Development Award - Lunar and Planetary Institute.
2017	Outstanding Graduating Senior – Colorado School of Mines Geophysics
2017	Presenter Travel Grant – Colorado School of Mines Graduate Student Government
2015	Chevron Petrotechnical Support Scholarship
2012	Mayor’s 100 teens, for community service and academic achievement – Colorado Springs, CO

SOCIETIES

2017	National	Society of Exploration Geophysicists
2016	top 12%ile	Tau Beta Pi Engineering Honor Society
2016	National	American Geophysical Union
2016	National	European Association of Geochemistry
2012	3.5 GPA+	Phi Theta Kappa Honor Society

WORKSHOPS/SEMINARS

PLANETARY SCIENCE SUMMER SEMINAR | PROJECT MANAGER / CAPTURE LEAD Aug 2019 | Jet Propulsion Laboratory in Pasadena, California

- Created a NASA New Frontiers class spacecraft mission concept for visiting the next interstellar object and answer the questions:
 - do other solar systems have the ingredients for life, and can they be transferred from one star system to another?
 - Do objects from other solar systems resemble objects in our solar system?
 - Can we determine what star system the object originated from?
- Voted to be the project-manager/capture-lead by the class of 18 students. Responsibilities included:
 - Presenting a 70 minute mock proposal pursuant to NASA’s New Frontiers announcement of opportunity,
 - Managing and integrating each student’s engineering subsystem task into a coherent spacecraft concept,
 - Working with the Principal Investigator to ensure our science payload answers our proposed science objectives.

WORKSHOP IN GEOLOGY AND GEOPHYSICS OF THE SOLAR SYSTEM |

ATTENDEE

Summer 2018 | Petnica, Serbia

- A multi-disciplinary workshop covering a wide range of topics related to the formation, structure and dynamics of the Solar System bodies

- Designed for PhD students
- Lectures conducted by planetary scientists from around the world

GEOPHYSICS FIELD CAMP – COLORADO SCHOOL OF MINES | ASSISTANT STUDENT PROJECT MANAGER

Summer 2016 | Pagosa Springs, CO

- A four week field program designed to give hands on experience with all geophysical methods, focused on studying the geothermal system at Pagosa Springs, CO
- Was voted to be one of two project managers out of the class of 50+ students
- Oversaw the completion of a 200+ page report detailing the camps findings:
<https://geophysics.mines.edu/field-camp/>

NOTABLE COURSEWORK - COLORADO SCHOOL OF MINES

GRADUATE

Seismic Wavefield Imaging - GPGN658

- Final Project: Wavefield imaging with moving receivers

Space Resource Fundamentals - EGGN598

- Final Project: Asteroid Prospecting Explorer (APEX) concept

Laser Physics - PHGN480

- Final Project: Designing a long range laser vibrometer

Sparse Signal Processing - EENG509

- Final Project: Compressive sensing of seismic data

Parallel Computing - CSCI563

- Final Project: Parallelized wave equation solver

UNDERGRADUATE

Overview of Martian Geology and Rock Properties

- Self designed course, independent study

Advanced Electromagnetic Methods - GPGN420

- Projects: Numerical modeling of EM surveys

Advanced Gravity and Magnetic methods - GPGN411

- Projects: Numerical modeling of gravity and magnetics

Cryptography - CSCI474

- Final Project: Quantum cryptography

Digital Signal Processing - GPGN404

Algorithms - CSCI406

Geodynamics and Geology - GPGN471

SKILLS

PROGRAMMING & SOFTWARE

- Java
- Matlab
- Python
- L^AT_EX
- C and C++
- Android Studio
- OpenGL
- MySQL
- ArcGIS
- Linux (command line / bash)

EQUIPMENT COMPETENCIES

- EM sounding instruments
- Ground penetrating radar
- Seismometers and geophones
- Gravimeters
- Magnetometers
- Laser optics
- Laser Doppler vibrometer
- Differential GPS (DGPS)
- Oscilloscopes
- Standard chemistry lab equipment

PUBLICATIONS

Courville S. W., and Sava P. C. (2020) Speckle noise attenuation in orbital laser vibrometer seismology. *Acta Astronautica*. Volume 172, Pages 16-32, ISSN 0094-5765, <https://doi.org/10.1016/j.actaastro.2020.03.016>.

Courville S. W. (2019). *Toward Orbital Seismology: Theory for speckle noise reduction in laser Doppler vibrometer measurements on distant rough surfaces* (Master's thesis). Colorado School of Mines, Golden, CO. Available here: <http://newton.mines.edu/paul/theses/SamCourvilleMSc.pdf>

Moore K., Courville S. W., et. al. (in review, draft available on request) Bridge to the stars: A mission concept to an interstellar object. *Planetary and Space Science*.

Courville S. W., Perry M. R., and Putzig N. E. (submitted, draft available on request) Lower bounds on the thickness and dielectric constant of dust layers within the North Polar Layered Deposits of Mars from radar forward modelling. *Planetary Science Journal*

CONFERENCE ABSTRACTS

LUNAR SURFACE SCIENCE WORKSHOP 2020

Courville S. W., Putzig N. E., Sava P. c., Perry M. R., Mikesell T. D. (2020) ARES and Artemis: The Autonomous Roving Exploration System for Active Source Seismology on the Moon. In *Lunar Surface Science Workshop*, Abstract #5055.

LPSC 2020

Courville S. W., Putzig N. E., Sava P. c., Perry M. R., Mikesell T. D. (2020) ARES: the autonomous roving exploration system for active source seismology on the Moon and Mars. In *Lunar and Planetary Science 51*, Abstract #2623.
Eposter link: <https://www.hou.usra.edu/meetings/lpsc2020/eposter/2623.pdf>

Courville S. W. and the 31st PSSS team (2020) Bridge to the stars: a mission concept to an interstellar object. In *Lunar and Planetary Science 51*, Abstract #1766.
Eposter link: <https://www.hou.usra.edu/meetings/lpsc2020/eposter/1766.pdf>

Perry M., Courville S. W., Putzig N., Morgan G., Bain Z., Baker D., Bramson A., Dundas C., Hoover R., Hornisher D., Nelson G., Nerozzi S., Pathare A., Petersen E, Sizemore H., Campbell B., Mastrogiuseppe M., Mellon M., Smith I. (2020) Subsurface Water Ice Mapping (SWIM) on Mars: Overview and Methods In *Lunar and Planetary Science 51*, Abstract #2645.

Putzig N., Morgan G., Bain Z., Baker D., Bramson A., Courville S. W., Dundas C., Hoover R., Hornisher D., Nelson G., Nerozzi S., Pathare A., Perry M., Petersen E, Sizemore H., Campbell B., Mastrogiuseppe M., Mellon M., Smith I. (2020) Subsurface Water Ice Mapping (SWIM) on Mars to Support In Situ Resource Utilization In *Lunar and Planetary Science 51*, Abstract #2648.

Bain Z., Putzig N., Morgan G., Baker D., Bramson A., Courville S. W., Dundas C., Hoover R., Hornisher D., Nelson G., Nerozzi S., Pathare A., Perry M., Petersen E, Sizemore H., Campbell B., Mastrogiuseppe M., Mellon M., Smith I. (2020) Subsurface Water Ice Mapping (SWIM) on Mars: Focused Study Regions In *Lunar and Planetary Science 51*, Abstract #2679.

AGU 2019

Courville S. W., Putzig N. E., Sava P. C., and Perry R. M. (2018) Preparing to image the Martian subsurface: planetary active-source seismology vs. radar, and the ARES concept. In *American Geophysical Union's Fall Meeting*, Abstract P44B-05. (talk)

Havlat D., Maly B. I., Courville S. W., Perry M. R., Bain Z. M., and Putzig N. E. (2018) Martian Dust Cover May Permit More Detailed Subsurface Discovery. In *American Geophysical Union's Fall Meeting*, Abstract P41C-3459.

Maly B. I., Havlat D., Bain Z. M., Perry M. R., Putzig N. E., and Courville S. W. (2018) The Northern Terminus of Ground-Ice Detections in Arcadia Planitia on Mars May Be Attributable to Surface Effects. In American Geophysical Union's Fall Meeting, Abstract P41C-3465.

LPSC 2019

Courville S. W. and Sava P. (2019) Speckle Noise in Orbital Laser Doppler Vibrometry. In Lunar and Planetary Science 50, Abstract #1720.
Eposter link: <https://www.hou.usra.edu/meetings/lpsc2019/eposter/1720.pdf>

Amos C., Putzig N., Perry R., Paulsson B., Thornburg J., Wylie M., Hardiman H., He R., Sava P., Courville S. W., Zacny K., Paulsen G., Mikesell T. (2019) Fiber Optic Geophones for Use in Planetary Subsurface Exploration. In Lunar and Planetary Science 50, Abstract #2623.

AGU 2018

Courville S. W., Putzig N. E., Sava P. C., Perry R. M., and Mikesell D. (2018) ARES: An Autonomous Roving Exploration System for Planetary Active-Source Seismic Data Acquisition. In American Geophysical Union's Fall Meeting, Abstract P54D-02. (eLightning)

LPSC 2018

Courville S. W., James P. B., and Kramer G. Y. (2018) Shallow Subsurface Investigations of Schrodinger Basin's Peak Ring Using Grail Gravity Field. In Lunar and Planetary Science 49, Abstract #1567. (oral)

Dwornik Award feedback from judges:

"A very dynamic speaker that kept the attention of the audience throughout the presentation."

"Good talk, you were very clear about what you were doing, why and how, and were to-the-point in answering questions."

"I really enjoyed reading your abstract. I think this is a great study. The implications were clear."

Hoover R. H., Robbins S. J., Putzig N. E., Fenton L. K., Hayward R., Courville S. W., et. al. (2018) Examining Thermal Inertia of Layered Ejecta Craters and Southern Hemisphere Dunes on Mars. In Lunar and Planetary Science 49, Abstract #1811. (poster)

LPSC 2017

Hoover R. H., Robbins S. J., Putzig N. E., Fenton L. K., Hayward R., and Courville S. W. (2017) Analysis of Thermal Inertia to Understand the Near-Surface Properties of Layered Ejecta Craters and Southern Hemisphere Dunes on Mars. In Lunar and Planetary Science 48, Abstract #1062. (poster)

AGU 2016

Courville S. W., Putzig N. E., Hoover R. H., and Fenton L. K. (2016) Thermophysical Variation within Dune Fields in the Southern Hemisphere of Mars. In American Geophysical Union's Fall Meeting, Abstract P21A-2073. (poster)