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HUMANITARIAN ENGINEERING AT MINES

Quarterly Newsletter of the Colorado School of Mines Humanitarian Engineering Program

PROGRAM UPDATES

Dr. Kevin Moore
Humanitarian Engineering Executive Director

It has been a whirlwind of activity this semester in the Humanitarian Engineering Program! Faculty and students in our program were enormously busy researching, teaching, studying, talking about, and doing Humanitarian Engineering, all over the planet! In the graduate arena, we welcomed our newest cohort of Humanitarian Engineering and Science master's degree students while our continuing students were busy completing practicum and thesis projects and presenting their work in numerous national and international conferences. Our undergraduate program continues to provide students with a chance to augment their majors through our two undergraduate minors and design engineering focus areas (Engineering for Community Development and Leadership in Social Responsibility) and through extra-curricular participation in our HE student clubs (Mines Without Borders and Socially Responsible Scientists and Engineers). Another highlight of the semester for our 11 current and former Shultz Scholars still on campus was the chance to attend a small group luncheon with Chuck Shultz '61 and his daughter Julie King '86. It was inspiring for our students to hear Chuck's story about why he supports the HE program. Finally, I'll mention that our HE faculty have also been busy, going out and about to spread the word about HE. By my count, each our six core HE Program faculty attended at least two conferences this term and several attended more, often accompanied by our grad students. You can read below for some details about my own conference activities at the World Engineering Education Forum in Cape Town, South Africa, where I led a panel on the body of knowledge in programs like HE. In closing, we have been blessed with so much opportunity this past fall in the HE program, with the chance to interact with great colleagues, wonderful students, alumni, donors, and friends, and with the promise of making engineering truly humanitarian. We are grateful for these opportunities and, while we look forward to rejuvenation over the holidays, we also look forward to the promise of the future.

Happy holidays and season's greetings
- Kevin

P.S. - SAVE THE DATE: As a teaser, please mark your calendar for September 27-28, 2023, when we will be holding a Humanitarian Engineering 20th Anniversary Celebration on the Colorado School of Mines Campus (yes! that's right! 20 years and counting!).

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GRADUATE RECOGNITION

As we bid farewell to 2022, we want to to celebrate the accomplishments of the recent Humanitarian Engineering Program graduates, including students being recognized for their leadership and research in Humanitarian Engineering! (Please see the Student Spotlight section for more details.)

Undergraduate Students

- **Melanie (Lanie) Breckenridge** (December): Engineering for Community Development (ECD) minor
- **Allison Palmer** (December): Bachelor of Science in Engineering (BSE) with an Engineering for Communities focus area

Graduate Students

- **Whitney Fitzpatrick** (December): MS Humanitarian Engineering & Science – Environmental Engineering Non-Thesis
- **Casey Gibson** (August): MS Humanitarian Engineering & Science – Environmental Engineering Thesis
- **Nicholas Yavorsky** (August): MS Humanitarian Engineering & Science - Environmental Engineering Thesis

Please extend your congratulations and well wishes to our recent grads!

STUDENT SPOTLIGHT

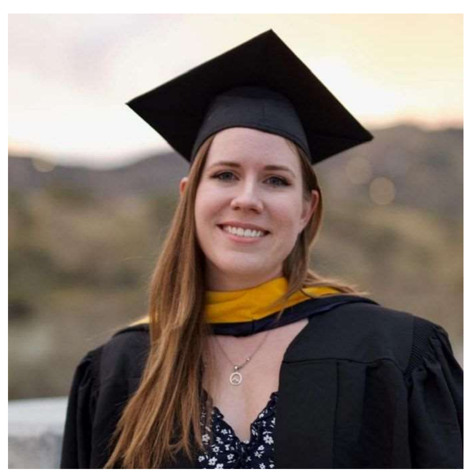
Undergraduate Distinction for Leadership in Humanitarian Engineering
Lanie Breckenridge *- Metallurgical & Materials Engineering with an ECD minor*
The folks at HE at Mines have been absolutely wonderful and while it’s not my

“major” department, it has been my home department from the start. Working here, learning here, and creating here has been a solace from the rest of the hectic times at Mines. I haven’t met someone in HE I didn’t like! I’m going to be heading up to Fort Collins, CO to live with my partner while they finish their degree and after that we have plans to serve in Peace Corps together.

Allison Palmer – *BSE with Community Development focus area*

Allison Palmer graduated this December from the BSE (Design Engineering) Program with a focus in Community Development and a minor in Public Affairs with McBride Honors Program. During her time at Mines and in Humanitarian Engineering, Allison was a Shultz Scholar and a 2020 PIRE Responsible Mining Resilience Communities Project Scholar. She took multiple HE courses, engaged in her HE-based Capstone Senior Design Project, and created a framework for an "Engineering for Community Development Lead" in EWB projects as part of her BSE Practicum. Additionally, at Mines, Allison was a McBride Honors Program Student Director and student, a member of Mines Little Theatre, a Peer Mentor, a member of the Blue Key National Honor Society, and a member of the Society of Women Engineers. After graduation, Allison plans to find a position in and explore the field of biophilic and sustainable design in the built environment. She wants to thank all of her HE and EDS faculty, staff, mentors, and peers for gifting her with a strong support system and encouraging her to follow all of her interests. Allison looks forward to being an involved and supportive HE, EDS, and Mines alumnus!

<u>Outstanding Graduate Student in Humanitarian Engineering and Science</u>



Casey Gibson*, for her thesis “Theorizing the ‘social’ in sociotechnical, community-based engineering: Incorporating a rapid assessment procedure in educational and field-based studies on Colombian artisanal and small-scale gold mining.”*

Casey Gibson conducted her master’s research in Andes, Antioquia, Colombia – a rural region dominated by coffee farming but with an expanding artisanal and small-scale gold mining sector. She integrated principles of environmental engineering with methodologies from anthropology and community-based research to qualitatively assess the environmental risks locals faced from both the mining and farming sectors. Casey also researched engineering education- designing, implementing, and evaluating a workshop to teach anthropological field methods to undergraduate engineering students. She recently accepted a full-time position as an Associate Program Officer at the National Academy of Engineering in Washington D.C. where she will be responsible for supporting the NAE with “an emphasis on cultural, ethical, social, and environmental responsibility in engineering and related activities in systems engineering approaches to complex policy matters.” One of her special efforts will be putting together programming related to engineering and social/environmental justice.

Whitney Fitzpatrick*, for her practicum at Project Canary on the plugging and abandonment of orphan oil and gas wells in the United States.*

This semester I completed my HES Master’s practicum on orphaned and abandoned wells with a Denver-based climate tech start up called Project Canary. I worked with the Chief Environmental Justice officer and other Project Canary employees to create prioritization and educational tools to address orphan wells, especially in urban and populated areas. We helped to create the Fellow Environmental Partners US Orphan Well Map documenting orphan wells with social and environmental overlays. After graduation I will be continuing my work at Project Canary as a Customer Success Manager and will continue my work with the internal environmental justice group. I will be working with our clients to deploy and install continuous methane emissions monitors on oil and gas operations and helping them interpret and make use of the data to address fugitive emissions in real time.

HE PROJECTS

Dr. Mark Orrs | Teaching Associate Professor
Engineering, Design, & Society Department

EDNS 401: Project for People

Each Fall semester, the course "EDNS 401: Projects for People" is offered as a way for humanitarian engineering minors and other Mines students to gain hands-on, project-based experience in the field of human-centered design. This year, six projects were offered, four of which were for the first time in partnership with the work of graduate students from the Humanitarian Engineering and Science (HES) Masters Program. Read more about each project below!

<u>E-waste recycling in Argentina</u>
Two teams were formed to help solve two separate challenges related to e-waste recycling in Buenos Aires, Argentina, as part of HES student Sofia Schlezak's work: one related to alternatives to burning of copper wires and the other related to safely disposing of Cathode Ray Tubes (CRTs) from discarded television sets. Pictured below is part of an educational document created by students in the class to help local Argentinians safely and properly recycle their CRTs.

<u>Water Access for the Unhoused in Portland, Oregon</u>
Another team tackled the challenge of providing increased access to clean water for the unhoused populations of Portland, Oregon, as part of HES student Emma Chapman's work. After extensive stakeholder engagement, the student team designed the prototype below as a possible solution for NGOs working with the unhoused:

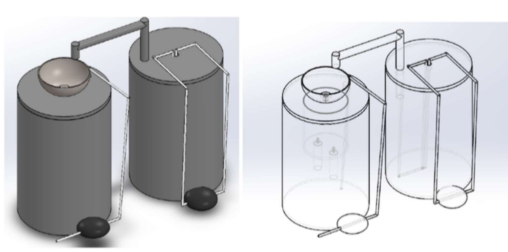
<u>Concrete recycling in Colombia</u>
Another team partnered with HES student Jaime Styer to help further her work related to ergonomic methods for breaking down, sorting and recycling concrete for women in Colombia. The team designed and tested a pulley system for crushing the concrete that can be adopted by individuals in Colombia using locally available materials to more quickly and easily break down used concrete in need of disposal.

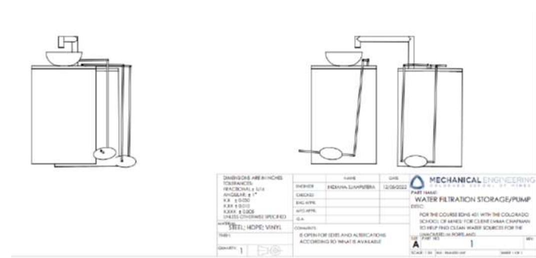
<u>Automated Mobility Platforms</u>
This team of students partnered with colleagues from NREL to further develop the concept of utilizing Automated Mobility Platforms (AMPs) through the application of transporting passengers with reduced mobility (PRM) between different points within the setting of an airport. Their paper, Automated Mobility Platforms: Systems Evaluation of Sustainability, Efficiency, and

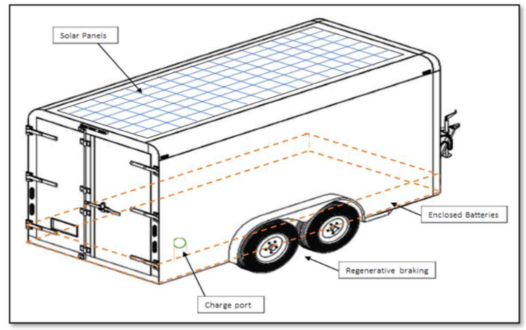
Integration in Airports, has been accepted for presentation at the ASCE International Conference on Transportation and Development in Austin, Texas, this summer (https://www.asce-ictd.org/).

Leaf Blowers

Our final team set out to help accelerate the transition from gas-powered lawn and garden equipment, particularly 2-stroke engine gas leaf blowers, to electric sources. It is estimated that these 2-stroke engines emit more than 299 times the hydrocarbons of a pick-up truck. Below is a design the team developed for landscaping companies to be able to more conveniently recharge and power their electric equipment when not in use in the field.







FACULTY FOCUS

Dr. Jessica Smith | Professor
Engineering, Design, & Society Department

Beginning January 1, Professor Jessica Smith will be stepping down from her role as Director of the Humanitarian Engineering & Science program to begin a Dean's Fellowship, working with Dr. Terri Hogue, Dean of Earth & Society Programs at Mines. During the fellowship, Jessica will be leveraging her long-term research on energy and society to continue building Mines' profile on ESG, social license, and energy justice – all key themes for the HE program. "I'm really proud of how strong our graduate program has become," she said. "I'm looking forward to amplifying Mines' already existing expertise in these areas, helping to create new connections, and establishing an intellectual community of practice," she said. Specific activities may include generating resources for STEM faculty to recognize and strengthen the inherent ESG and justice dimensions of their research, leading an interdisciplinary reading group, and hosting a speaker series to cement Mines' position as a national thought leader in the social impact of STEM.

Professor Smith had a busy fall, including being named a Kavli Fellow by the National Academy of Sciences; providing a lecture on the "mine of the future" for the National Academies of Sciences, Engineering, and Medicine; being named the incoming Editor-In-Chief of the journal *Engineering Studies*; contributing to a Chemical and Engineering News podcast on the environmental and social justice challenges of lithium production; and co-authoring a roadmap for the co-design of more just wind energy facilities in the journal *Joule*, a top journal for energy research worldwide.

HE RESEARCH

Humanitarian Geophysical Investigations
Dr. Richard Krahenbuhl | Research Associate Professor, Geophysics

In this issue, we focus on HE faculty research at the intersection of geosciences and humanitarian engineering. Dr. Richard Krahenbuhl, Associate Director of the Humanitarian Engineering and Science (HES) graduate program and Research Associate Professor in Geophysics, has recently secured two humanitarian geophysics-related grants: **Integrated Archaeo-geophysical Investigations at Huacas de Moche – Peru's Cultural Heritage Site [Phase 2 Expansion]** and **Geophysical Remote Sensing Investigations at the Teller Indian Boarding School: Phase 2 Expansion**, described briefly here.

After a successful Phase 1 project demonstrated the strength of geophysical investigations at an archaeological site of significant value to Universidad Nacional de Trujillo in Peru (UNT), this follow-up expansion project, **Integrated Archaeo-geophysical Investigations at Huacas de Moche**, seeks to integrate geophysical and archaeological research at the well-known Huacas de Moche site in Trujillo, Peru. Huacas de Moche is the most significant archaeological site and leading tourist attraction in the region, related to the Moche culture (c. 100-850 AD). This project aims at tackling pivotal realms of site activities, which involve research, teaching and tourism, by having direct and indirect impacts on the community of Trujillo. The project's goals are threefold: new research and tourism opportunities; landscape preservation; and Universidad Nacional de Trujillo faculty and student training. This project will significantly improve the scientific understanding of this Peruvian Cultural Heritage site and help revitalize funding into the local economy by opening new areas of research and disseminating the importance of geophysics in the understanding and preservation of past and present landscapes. Dr. Krahenbuhl is joined on this project by Drs. Jessica Smith and Jeffrey Shragge, both part of the HES faculty team, as well as colleagues at Denver Museum of Nature & Science and UNT.

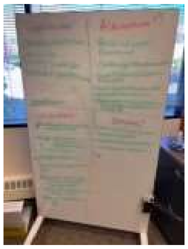
Dr. Krahenbuhl is also joined by Drs. Smith and Shragge as well as HES graduate student Sigourney Burch on the project **Geophysical Remote Sensing Investigations at the Teller Indian Boarding School: Phase 2 Expansion**. The Grand Junction Regional Center is located on a portion of the land that was part of a previous Federal Indian Boarding school known as the Teller Institute. There is an understanding that the location of burial sites for children who perished at the boarding school, during its time of operation, have been lost over the years. Phase 1 of the project was completed in 2022 focused on a sub-section of the Grand Junction Regional Center where archival research recommended a prioritized search area. Phase 2 of the collaborative project is developed to significantly expand the geophysical study beyond the limited focus region of Phase 1 surveys into the remaining areas of the Grand Junction Regional Center, guided by information from the current archival team, Colorado Department of Human Services, and the State Archaeologist.

An extensive residential center is believed to exist between the temple Huaca de la Luna and ancient palace Huaca del Sol. The extent and significance of this complex is poorly understood. Geophysical investigations are essential for assisting archaeologists in their efforts to fully understand the site, to inform or limit urban development, and thus preserve the archaeological landscape.

CREATE/STS Research Project

Dr. Elizabeth Reddy | Assistant Professor, Engineering, Design, & Society and Geophysics

The Collaborative Research and Education Architecture for Transformative Engagement with Science and Technology Studies (CREATE/STS) research


project is a three-year multi-institutional scale-up study organized around a collaborative multidisciplinary model for developing innovative pedagogies. The project involves Mines faculty and students in a series of workshops and discussions to foster new connections between people, new inspirations and practices in classrooms, and, finally, to produce research on how these things happen.

ALUMNI UPDATES

To stay in touch and get updates about the upcoming 20th anniversary celebration in September 2023, we encourage you to join our alumni network on LinkedIn! If you are interested in the alumni network and haven't already joined, we invite you to connect with HE on LinkedIn (https://www.linkedin.com/in/humanitarian-engineering-mines/) and send a note expressing your interest so we can add you.

We look forward to connecting with you!

EVENTS HIGHLIGHTS

This was a very busy fall for the HE Program! We had a variety of exciting speakers on campus and our HE faculty and students were especially active in spreading the word about HE outside the Mines community.

Humanitarian Engineering Speaker Series
HE partnered with EDS and other groups across campus to host several incredible speakers this fall.

Dr. Erin Cech, Associate Professor of Sociology, University of Michigan, Ann Arbor, Michigan
THE TROUBLE WITH PASSION: HOW SEARCHING FOR FULFILLMENT AT WORK FOSTERS INEQUALITY
October 28, 2022
Dr. Cech shared the research in her recent book *The Trouble with Passion* that

takes a critical lens to the “passion principle” ideal that appeals to many college students and college-educated workers. Although passion-seeking seems like a promising option for individuals hoping to avoid drudgery in their labor force participation, Dr. Cech explores its dark side: reinforcing socio-economic disadvantages and occupational inequality among career aspirants and workers and reproducing an exploited, overworked white collar labor force. Her findings have implications for cultural notions of “good work” popular in STEM specifically and the workforce broadly and raise difficult questions about what it means when becoming a dedicated labor force participant feels like an act of self-fulfillment.

Luisa Payan, Head of the School of Social Innovation and the Academic Director of the Parque Científico de Innovación Social (PCIS) of Corporación Universitaria Minuto de Dios, Bogota, Colombia
SOCIAL INNOVATION: METHOD, CASE STUDIES, AND EXPERIENCES OF HOW SCIENTISTS AND ENGINEERS CAN WORK WITH COMMUNITIES FROM AN ASSET-BASED PERSPECTIVE
November 2, 2022
Ms. Payan presented the Social Innovation Route, a method for turning ideas into social innovations, emphasizing how innovation can be a vehicle for social transformation especially in the lives of the world’s most vulnerable people. Created by PCIS, this method was developed from decades of community development experiences in Colombia from a university with one of the strongest commitments to improving the livelihoods of impoverished people. During the presentation, participants learned about the Social Innovation Route, its differential factors from other methods of community engagement, real application cases, and lessons learned for good practices of community development.

Konstantinos Konstantis, PhD Candidate, Department of History and Philosophy of Science (HPS) at the National and Kapodistrian University of Athens in Greece
Elizabeth & Emerson Pugh Young Scholar in Residence at the IEEE History Center in New Jersey, USA

AI ETHICS BY BIG TECH IS NOT ENOUGH: A PLEA FOR SCIENCE AND TECHNOLOGY STUDIES

November 7, 2022
In his talk, Mr. Konstantis made the case for integrating perspectives from Science and Technology Studies (STS) into artificial intelligence (AI) ethics. He provided a historical contextualization of AI and an overview of its ethical problems, followed by a discusison of how STS perspectives on Big Tech AI raise questions about how the field poses ethics. Finally, he shared his original research on Microsoft's AI ethics policies.

Mines HE Faculty and Students Led Several Sessions at the Joint 4S/ESOCITE Conference in Cholula, Mexico
At the Joint Society for Social Studies of Science (4S) and Asociación Latinoamericana de Estudios Sociales de la Ciencia y la Tecnología (ESOCITE) Conference on December 7-10 in Cholula, Mexico, a student and faculty team from the HE program shared their research in several panels and individual presentations.

- Beth Reddy organized a double panel "STS Structures & Agencies: Scholarship in Curricular Practice" that had a packed house and included two papers by Mines folks: one by Beth Reddy, Marie Kleine and Dean Nieusma on integrated engineering and one by Juan Lucena, Mateo Rojas, Jaime Styer, and Sofia Schlezak on professional formation (photo below).
- Juan Lucena, Mateo Rojas, Sofia Schlezak, Jamie Styer and Emma Chapman also presented their collaborative work titled "Epistemic Decolonization and Research Translation as Antidotes to the Neo-Colonial Pedagogies of Help."
- Casey Gibson and Mateo Rojas presented their thesis research on ASGM in Colombia in a double panel "Knowing the Underground."
- Jessica Smith co-organized an STS Underground meetup that was attended by about 40 scholars from around the world, ranging from grad students to senior faculty. The last time 4S/ESOCITE had a joint meeting in 2014, there were no virtually panels on mining, oil and gas, or energy, which prompted Roopali Phadke, Abby Kinchy and Jessica Smith to build

the STS Underground network. This year there were more sessions than people could attend at one time!

HE Discussed at Global Meeting of Engineering Educators
Professor Kevin Moore is pictured (third from right) with panelists he assembled to discuss the body of knowledge inherent in programs such as Humanitarian Engineering, at the 2022 World Engineering Education Forum and Global Engineering Dean's Council (WEEF/GEDC), in Capte Town, South Africa, Nov 28-Dec 1. More details about the conference can be found at https://weefgedc2022.org/. Panelists included well-known names in engineering education and humanitarian engineering, such as Bill Oakes of Purdue and Pali Singh of Villanova. During the 90 minute session, panelists consider three key questions related to doing "engineering for good:" what are the essential topics engineers should be taught to be successful in this space, what are the best ways to teach these topics (e.g., in the classroom, in the real-world, or both), and what are some exemplars of where this is done. Of course, Mines' Humanitarian Engineering was one of the exemplars noted by panelists!

To learn more about other Humanitarian Engineering media, news, and events, please visit our website!

HE IN THE NEWS

MINES NEWSROOM

HE was featured in a number of Mines Newsroom articles recently. Click on the selected articles below to learn more.

Mines hosts international exchange on sustainable artisanal and small-scale mining

New geoscience makerspace opens on campus

Mines professors contribute to roadmap for successful wind energy projects

Jon A. Leydens honored with ASEE Sterling Olmsted Award

GET INVOLVED

From corporate CEOs to the heads of NGOs, leaders committed to social, environmental, and economic stability worldwide demand a different kind of engineer for the 21st century. The Humanitarian Engineering Program is ready to meet this challenge with undergraduate focus areas in Engineering for Community Development and Leadership in Social Responsibility and a dynamic interdisciplinary Humanitarian Engineering and Science master's degree. We embrace engineering for good.

How will you meet this challenge? We invite you to collaborate on student design projects, share internships, give class lectures, share this newsletter with an interested potential student, learn more through the online graduate certificate, offer financial support and more. Please don't hesitate to reach out if you'd like to submit a piece to this newsletter or have other ways you'd like to get involved. In addition, you can stay in touch with Humanitarian Engineering at Mines using the links below.

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