

CBBG

Center for Bio-mediated & Bio-inspired Geotechnics

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As I See It: View from Director's Chair

More and Less than Halfway to Somewhere

The CBBG ERC is now two and a half years into the initial five-year funding increment from the NSF. While I am tempted to describe this as the half-way mark, it is both more and less than that. It is more than halfway to the point at which the decision on whether or not to extend our funding for a second five-year increment will be made, which is slated to occur by the end of the fourth year of CBBG operations. So, from the perspective of when this critical decision will be made, we are 62.5 % of the way towards that mark. However, it is also less than halfway to the end of NSF funding period in that, worst case, if NSF decides not to fund us for a second five-year increment, they will still fund us, or our graduate students, at least for a sixth year. And, being an optimist, I like to believe that we will be funded for a second five-year increment, which means we are only 25% of the way through the NSF funding period, at which point we will graduate from the Engineering Research Center program and be on our own. Hence, we are both more and less than halfway to somewhere.

(continued on page 2)

In Memoriam: Regina Sanborn 1952 - 2018



We are saddened to report that Regina Sanborn, Administrative Director of the CBBG, passed away sometime between June 10 and 11, 2018. Regina was Administrative Director for CBBG since its inception, guiding it through its start-up in 2015 and into its current operational phase. Regina worked at ASU since 1998. Prior to joining CBBG, she served as Administrative Director of the QESST (Quantum Energy and Sustainable Solar Technologies) ERC from 2013-2015. Her other ASU appointments included Assistant Director (2011-2013) and Program Manager (2007-2011) for the Center for Nanotechnology in Society and Director, Member Services (2006-2007), Director, Research and Partnerships (2004-2006), Director, Marketing and Membership (2000-2004), and Marketing Specialist (1998-2000) for the ASU Alumni Association. Through these positions, she touched the lives of many people in CBBG, at ASU, and beyond. Regina was instrumental in CBBG's success and in building the CBBG community. She never hesitated to go out of her way to help students and staff and will be remembered for her large heart as well as her commanding presence.

Important Dates

May 21, 2018 - July 27, 2018
ASU/GT/NMSU REU

May 29, 2018 - June 29, 2018
ASU/GT RET

May 29, 2018 - June 29, 2018
GT/NMSU YSP

June 4-29, 2018
NMSU SCCORE REU

June 10, 2018 - August 17, 2018
UCD REU

June 11, 2018 - July 13, 2018
UCD YSP

July 17-20, 2018
9th International Conference on Physical Modelling in Geotechnics (ICPMG 2018)
London

July 31, 2018
Year 3 Grant Year Ends

August 5, 2018
Last Day to Enter Information into ERC 360

September 10-12, 2018
ISSMGE TC105 International Symposium
Academy of Medicine
Georgia Institute of Technology
Atlanta, Georgia, USA

September 13, 2018
B2G - Atlanta 2018
Academy of Medicine
Georgia Institute of Technology
Atlanta, Georgia, USA

October 10, 2018
Annual Report Due to NSF

November 14-15, 2018
NSF Site Visit to CBBG
Tempe, Arizona

(continued from page 1)

The decision on whether to extend our funding for another five years will rest to a large extent on the results of the NSF site visit at the start of our fourth year (or end of our third year), i.e., at the NSF site visit this November, and on a proposal we submit for renewal of CBBG funding sometime during the fourth year. So, in fact, we are more than 62.5% of the way through the period on which we will be judged and have on the order of 12 months left to demonstrate that NSF funding for CBBG merits being extended for an additional 5 years. With that in mind, it is a good time to take stock on where we stand now and what we still need to accomplish by the time we are evaluated for continued funding.

When CBBG was funded, we had an overarching goal of establishing biogeotechnical engineering as a sub-discipline within the geotechnical field. Included in this goal was the development of commercially viable and sustainable biogeotechnologies and a recognition within academia and industry of biogeotechnics as a distinct field of study. We also had goals of establishing the CBBG as a focal point within the new field of biogeotechnics and creating an innovation ecology in partnership with industry that would allow CBBG to continue to thrive beyond the 10-year funding window available from the NSF. Two and a half years into this effort, we can point to substantial success on all fronts. Regarding the establishment of biogeotechnics as a recognized sub-discipline with CBBG as a focal point, we can point to the upcoming CBBG-sponsored B2G (Bio-inspired and Bio-mediated Geotechnics) Symposium at Georgia Tech on 12-13 September 2018 that attracted 40 abstracts from biogeotechnical investigators around the world. CBBG Co-Principal Investigator, Jason DeJong, has been contacted by a major journal publisher about starting a new scholarly journal dedicated to the emerging field of biogeotechnics, and CBBG investigators are taking the lead in organizing the 1st International Workshop on Bio-Inspired Geotechnics in 19-22 May 2019. The awarding of a \$2.5 million EU grant to Professor Lyesse Laloui of Ecole Polytechnique Fédérale de Lausanne (EPFL), a CBBG collaborator, for Bio-mediated Geo-material Strengthening for Engineering Applications (BIOGEOS) by the European Research Council is additional evidence of the recognition of biogeotechnics as an emerging and important field of study.

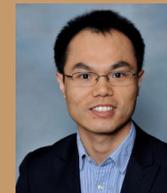
CBBG is also beginning to push its biogeotechnologies into the field. The U.S. Bureau of Reclamation recently approved funding for an ASU field study of the use of Enzyme Induced Carbonate Precipitation (EICP) for fugitive dust control and stabilization of low volume roads, and CBBG will be involved with its newest Industry Partner, Groundwater Technology of the Netherlands, in implementation and evaluation of carbonate precipitation for ground improvement at two field sites in Canada over the next six months. At a redevelopment

site along the Toronto waterfront, Professor Leon van Paassen was originally engaged by Groundwater Technology for a bench scale study in preparation for field trials using microbially induced carbonate precipitation through hydrolysis of urea (i.e., MICP) to stabilize a slope in running sands. The challenges were whether ureolytic bacteria could be enriched and active in hydrocarbon contaminated soils and whether the process could then stabilize the fine sands, which had a high silt content. Based on success of the bench scale tests, the owner, Waterfront Toronto, decided to proceed with a field trial. The project team then convinced the owner to construct a second test section using microbial denitrification (i.e., MIDP) to precipitate carbonate for slope stabilization. Both field demonstrations are now underway. Working with Groundwater Technology, CBBG is also conducting preliminary studies for a second MIDP field test section, this time for mitigating the potential for earthquake induced liquefaction beneath levees along the shoreline in Richmond, British Columbia. UC Davis, under the leadership of Professor Jason DeJong, is moving towards field scale testing on the use of industrial grade reagents for MICP in a large tank test on the UC Davis campus, and is continuing field-scaled testing on the liquefaction resistance of soil improved by MICP using the UC Davis geotechnical centrifuge. Planning is also underway for several additional field and field-scale projects on EICP, including work at NMSU on using EICP for slopes stabilization, a second ASU test site on fugitive dust control, and on testing at the ASU Polytechnic test bed site using the rainfall simulator to study infiltration in and erosion resistance of EICP treated soil and using the test pit to evaluate the performance of Biocemented soil columns.

The growth of the CBBG Industrial Partner program and direct involvement of industry partners in CBBG research provide additional metrics of success in meeting our goals. The Industry Partner Program has grown to 18 firms from the initial 11 that signed on, several of these partners have contributed directly to CBBG research through cash contributions and services in kind, and we are negotiating with several of our partners for additional support. Projects receiving direct support include development of a reactive geocomposite mat for treating surface and ground water laden with phosphorous and nitrates, the aforementioned Bureau of Reclamation project on fugitive dust control, and a project on groundwater detoxification through combined bioremediation and zero-valent iron reduction. In addition to these projects that already have industry support, we are currently negotiating with industry partners on direct support and/or collaboration on our EICP and MICP projects, on remediation of seepage from mine tailings impoundments, and on using electro-kinetics to facilitate bioremediation and biocementation.

While we have made substantial progress towards our goals, there is still work to do to secure extension of NSF support for another five years, and provide a foundation upon which CBBG will continue to thrive after the end of the 10-year NSF-supported period. We must continue to push our technologies out into the field and then on to commercialization. We must also expand our portfolio of biogeotechnologies, taking advantage of the myriad of potentially beneficial processes developed in nature over the last 3.8 billion years. And we must continue to expand the support from our Industry partners by developing technologies that they perceive as beneficial and by recruiting new, active members into our Industry Partner program. Considering the great group of senior investigators, students, staff, and industry partners we have engaged in the CBBG to date, I am confident we can accomplish these objectives and we will look back at this point as being "less than halfway" in CBBG's existence.

Tao to Join ASU, SSEBE, CBBG in August



Dr. Junliang (Julian) Tao has agreed to join the ASU faculty as a Civil Engineering Associate Professor in August 2018. Julian is currently working

in the Department of Civil Engineering at the University of Akron and holds a Ph.D degree from Case Western Reserve University. His research explores innovative solutions to address emerging geotechnical challenges from a nature-inspired perspective. Treating soils as living systems, the backbone of his research lies in advancing knowledge of the fundamental behaviors of soil affected by living organisms (e.g., burrowing animals, bacteria and plants) involving multi-physics processes at multiple scales. The new knowledge is then applied to develop next-generation geotechnics. Specific research topics include: bio-inspired smart sensors, bio-inspired smart construction technologies and bio-inspired sustainable countermeasures to nature hazards. He has authored more than 50 journal and conference publications. Dr. Tao is a recipient of a NSF CAREER Award in 2017 and the Young Engineer of the Year Award from ASCE Akron-Canton section in 2017. He also serves on the editorial board of ASTM Journal of Testing and Evaluation, reviews papers for more than 20 journals, and serves on committees for the ASCE, TRB, SPIE and IEEE. Julian looks forward to collaborating with other CBBG investigators on his research focus.

Research Highlights

Nelson Teaching New Graduate Course



Professor Doug Nelson (Microbiology, UC Davis) is currently teaching a participatory, literature-based seminar on: "Microbiology of MICP and Related Microbial Processes". Participants include 5 CBBG graduate students (4 Engineering, including one from University of Washington; 1 Microbiology), 3 additional Microbiology graduate students, and 2 Microbiology undergraduates.

Georgia Tech Hosted Mid-Year Meeting Lab Tours



From left to right: Ahmad Mostafa, Vinay Krishnan, Karie Yamamoto, Nariman Mahabadi, Hamed Khodadadi, and Mahdi Roozbahani

At the end of the CBBG mid-year meeting in Atlanta, ASU graduate students and post-docs visited the geotechnical engineering laboratories at Georgia Institute of Technology. Mahdi Roozbahani from Georgia Tech was leading the lab tour for guests from ASU.

Biology Professor Giancarlo Lopez-Martinez Joins CBBG-NMSU Project



Dr. Giancarlo Lopez-Martinez is an assistant professor in the Department of Biology and leads the Comparative Stress Physiology Laboratory at New Mexico State University (NMSU). Dr. Lopez-Martinez collaborates with Dr. Douglas Cortes and his NMSU research team to develop a bio-inspired solution to optimize the efficiency of geothermal heat exchange systems.

Marquez Enjoys Her Work on CBBG Project



Priscyla Marquez studies the affinity of two selenium oxyanions (selenate and selenite) for the iron-modified surface of zeolites. With her graduate mentor, Neda Halalsheh, she runs batch equilibrium experiments and column flow through experiments with different selenium concentrations, pH, and ionic strength. The

overall goal of this CBBG project is to develop a microbially enhanced iron-modified permeable reactive barrier to remove harmful elements, such as selenium and arsenic, from contaminated groundwater. Priscyla is a junior in the Civil Engineering Department at New Mexico State University. She plans to continue her research through the next year.

Geotechnical Engineer Talks to NMSU Class and ASCE Student Chapter



Derrick Dasenbrock (MnDOT) (center) with NMSU students after his class on deep foundations.

The ASCE Geo-Institute and the Minnesota Department of Transportation (MnDOT) sponsored Derrick Dasenbrock, P.E., F.ASCE to visit the NMSU Department of Civil Engineering on April 18-19. Mr. Dasenbrock is the Geomechanics/LRFD Engineer of MnDOT Office of Materials and Road Research and the 2020 Geo-Congress Chair. Mr. Dasenbrock was the Guest Lecturer of the NMSU Student Chapter of the American Society of Civil Engineers (ASCE) and gave a class on Deep Foundations for Transportation Structures. Through these presentations, CBBG-NMSU students had the opportunity to learn about state-of-the-art instrumentation and monitoring, design, construction, testing and current standards and codes for deep foundations.

Words On Water #35: Dr. Bruce Rittmann on Microbial Communities



Dr. Bruce Rittmann is the director of the Swette Center for Environmental Biotechnology at the Bidesign Institute at Arizona State University. He was named the 2018 Stockholm Water Prize Laureate for revolutionizing water and wastewater treatment. In this episode, Bruce discusses how his first job at a wastewater plant shaped his career, the cutting-edge use of

microbial communities to convert pollutants into resources, and how mathematical modeling can improve the treatment process.
Link to Podcast: <https://wordsonwaterwef.com/2018/05/28/words-on-water-dr-bruce-rittman-on-microbial-communities/>

ASU to Study Water Savings at City of Phoenix Parks Thanks to Innovative Conservation Program Award



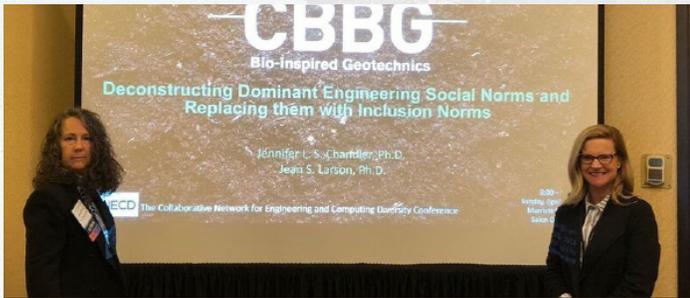
ASU Researchers will be looking at using composted "green waste" materials to replace traditional fertilizer for maintaining grass in public parks in Phoenix. An initial study indicates the compost could boost the water-retaining capacity of soils. If it works, the change could help conserve water, reduce parks maintenance costs and become an operational model program for other cities. Enrique Vivoni, a professor in the

Fulton Schools and the School of Earth and Space Exploration, is leading the research team. Vivoni is a hydrologist whose work focuses on interactions between climate, ecosystems and landscapes.

Link to article: <https://www.cap-az.com/public/blog/804-asu-to-study-water-savings-at-city-of-phoenix-parks-thanks-to-innovative-conservation-program-award>

Out & About

CBBG Team Facilitates Workshop at Inaugural Conference



Dr. Jennifer Chandler (left) and Dr. Jean Larson (right)

Drs. Jennifer Chandler and Jean Larson facilitated a workshop at the 1st Annual Collaborative Network for Engineering and Computing Diversity (CoNECD) Conference, which was held in Arlington, Virginia April 29–May 2, 2018. The inaugural conference was jointly sponsored by NAMEPA (National Association of Multicultural Engineering Program Advocates), Women in Engineering Pro-Active Network (WEPAN), the American Society for Engineering Education's (ASEE) Minorities in Engineering Division (MIND), and ASEE Women in Engineering Division (WIED). The conference provided a forum for exploring current research and practices to enhance diversity and inclusion of all underrepresented populations in the engineering and computing professions, including gender identity and expression, race and ethnicity, disability, veterans, LGBTQ+, 1st generation and socio-economic status.

The workshop they conducted was titled, "Deconstructing Dominant Social Norms and Replacing Them with Inclusion Norms," using the Colluding, Colliding, and Contending with Dominant Social Norms Model (Chandler, 2017). Participants used the model and practiced identifying dominant social norms operating in their STEM environments. After identifying dominant social norms, participants identified the ways in which they interact with those norms. Finally, participants began identifying ways for deploying this new tool in their STEM organizations to further their Diversity and Inclusion goals.

Chandler, J. L. S. (2017). Examining Interactions with Dominant Social Norms. In **Teaching Resources and Innovations Library for Sociology**. Washington, DC: American Sociological Association.

CBBG Graduate Students Present at Conference

Srivatsan Mohana Rangan and Megan Altizer, CBBG Graduate Students, presented at the **Eleventh International Conference on Remediation of Chlorinated and Recalcitrant Compounds**

The Influence of Electrokinetic Bioremediation on Subsurface Microbial Communities in Perchloroethylene Contaminated Soil. M.L. Altizer, A.G. Delgado, R. Krajmalnik-Brown, C. Torres, J. Wang, and E. Cox. Megan Leigh Altizer (Enoveo USA/USA)

Trade-Offs in Utilizing Zero-Valent Iron for Synergistic Biotic and Abiotic Reduction of Trichloroethene and Perchlorate. S. Mohana Rangan, A. Mouti, A.G. Delgado, R. Krajmalnik-Brown, G.V. Lowry, L. LaPat-Polasko, and H. Brenton. Srivatsan Mohana Rangan (Arizona State University/USA).

Krajmalnik-Brown's Lab Filmed for Korean PBS



Korean PBS filmed in Dr. Rosa Krajmalnik-Brown's lab.

Link to story: <http://sceb.co/2017/12/06/rosa-krajmalnik-brown-and-daewook-kang-host-korean-pbs-eps-to-share-fecal-microbiota-transplant-study-results/>

UCD Team Visits University of Washington



(photo on left) Minyong Lee (left) and Mike Gomez (right)

(photo on right) left to right: Maya El Kortbawi, Minyong Lee, Francisco Humire, Katerina Ziotopoulou, Pedro Arduino

Professor Katerina Ziotopoulou and Maya El Kortbawi (CBBG UC Davis), together with Francisco Humire (PhD Student UC Davis) visited Professor Michael Gomez and his student, Minyong Lee, at the University of Washington where they spent two days discussing cyclic direct simple shear testing of MICP treated sands as well as constitutive modeling of MICP treated sands. Professor Arduino joined parts of the day and of course showed the team around the beautiful (and sunny) UW campus.

Cortes Presents Bio-Inspired Research



Dr. Douglas Cortes presents about his bio-inspired geo-probe.

Dr. Douglas Cortes of New Mexico State University presented at the 2018 New Mexico TransCon Conference, held at the Las Cruces Convention Center in April. His talk focused on the near surface geotechnical exploration applications of the bio-inspired geo-probe that his research team is developing at NMSU. Cortes' geo-probe is inspired by the physiology of worms and root plants. The NM TransCon conference was

attended by over 400 engineers and contractors of the region and is the first joint conference of ASCE, NM Department of Transportation, NMSU, the American Council of Engineering Companies (ACEC) of New Mexico, the Associated Contractors of New Mexico (ACNM), and the Asphalt Pavement Association of New Mexico (APANM).

Honors & Awards

Kavazanjian Honored as ASCE Distinguished Member



Edward Kavazanjian, Jr., Ph.D., P.E., D.GE, Dist.M.ASCE, NAE, a Regents' Professor and the Ira A. Fulton Professor of Geotechnical Engineering in the School of Sustainable Engineering and the Built Environment at Arizona State University, has been honored by ASCE with inclusion in its 2018 class of Distinguished Members for his leadership in the geotechnical field and contributions to the design of waste containment systems and geotechnical earthquake engineering.

Distinguished Member status is reserved for the most eminent of civil engineers in the Society. A mere 229 of ASCE's more than 150,000 current members can call themselves Distinguished Members.

Kavazanjian is an eminent leader in geotechnical engineering, a visionary thinker, and a powerful doer in engineering practice and academic research. He literally "wrote the book" on the properties of municipal waste materials and their behavior in earthquakes, coauthoring the EPA's guidance document for seismic design of solid waste landfills and serving as lead author or coauthor on numerous technical papers on the subject. He also coauthored the FHWA guidance document on LRFD seismic analysis and design for geotechnical features of transportation facilities.

He is the director of the Engineering Research Center for Bio-Mediated and Bio-Inspired Geotechnics (CBBG), which is opening new understandings and applications in biogeotechnical engineering. As principal investigator, Kavazanjian's role in securing funding for this project was crucial to the Center's startup, designed in part to ensure the national intellectual health of the geotechnical profession through the engagement of younger members. His willingness to devote his time and effort to this cause demonstrates his clear understanding of the importance of developing the next generation of geotechnical leaders.

CBBG is funded by the National Science Foundation, and is taking the lead internationally in establishing a field which links traditional geotechnics with biology as a means to improve the mechanical properties of soils. Kavazanjian joined the ASU faculty in 2004 after 20 years as a practicing geotechnical engineer, including 10 years with Geosyntec Consultants. Among his many awards are ASCE's Ralph B. Peck Award, Karl Terzaghi Award, and Thomas A. Middlebrooks Award (co-recipient). In 2013, he was elected to the National Academy of Engineering.

Kavazanjian served on the Board of Governors of the ASCE Geo-Institute from 2004 to 2011, and was president 2009-10. He is a past chair of the G-I Technical Coordination Council and of the Geotechnical Group of ASCE's Los Angeles Section. He is also a past chairperson of the National Academies of Science and Engineering Committee on Geological and Geotechnical Engineering and served on the Board of Earth Sciences and Resources of the National Research Council.

Additionally, he has served on the Transportation Research Board committees on Design of Foundations for Bridges and Other Structures and Seismic Design of Bridges, and as the first chair of the joint subcommittee of these two committees on Geo-Seismic Concerns.

Kavazanjian is a registered professional engineer in Arizona, California, and Washington and a Diplomate of the Academy of Geo-Professionals.

The Distinguished Member Induction Ceremony will take place during ASCE's Annual Conference October 12-15, 2018 in Denver, Colorado.

Mahabadi Receives Fellowship for NSF-USUCGER Early Career Workshop in May 2018



Nariman Mahabadi, CBBG Post-Doctoral Scholar, has received a fellowship from USUCGER to participate in a Career Workshop. The United States Universities Council for Geotechnical Education and Research (USUCGER), with financial support from the National Science Foundation (NSF), will hold its 2nd Early Career Workshop (the Workshop) at Case Western Reserve University (Case) from May 20-22, 2018.

The goal of the Workshop is to mentor early career academic professionals (junior faculty, postdocs, and senior graduate students), and to promote peer-to-peer interactions. In addition to mentoring from successful senior professionals, the Workshop will enable early career professionals to share personal experiences (both successful and unsuccessful) in starting an academic career. The targeted outcome is to help young geotechnical scholars launch their academic career productively, avoid common pitfalls, and be successful in their academic journey.

The Workshop will focus on establishing a successful sponsored research program and will address the ongoing evolution of the sponsored research landscape. The past few years have witnessed major shifts in geotechnical-related research programs at NSF, consistent with the national trend towards a focus on the Grand Challenges identified by the National Academy of Engineering.

Esquivel-Elizondo Graduates with Doctorate/Secures Post-Doc Position



Sofia Esquivel-Elizondo graduated with her doctorate degree, and is now a post-doctoral scholar at the Max Planck Institute in Germany

Krajmalnik-Brown to Serve on NAE Committee



Dr. Rosa Krajmalnik-Brown was invited to serve on the National Academies of Sciences, Engineering, and Medicine; Division on Earth and Life Studies; Board on Environmental Studies and Toxicology; Board on Life Sciences; Committee on Advancing Understanding of the Implications of Environmental-Chemical Interactions with the Human Microbiome.



This group recently released the following publication: National Academies of Sciences, Engineering, and Medicine. 2018. Environmental Chemicals, the Human Microbiome, and Health Risk: A Research Strategy. Washington, DC: The National Academies Press. <https://doi.org/10.17226/24960>.

This PDF is available at <http://nap.edu/24960>.

Ziotopoulou Receives Greek International Women Award in Science



Congratulations to Dr. Katerina Ziotopoulou, CBBG Senior Investigator at the University of California, for receiving the Greek International Women Award in Science. The first Greek International Women's Award ceremony (GIWA) took place on Saturday, December 9, 2017, at the British Museum of London. The new institution recognizes and rewards Greek women all over the world who excel in their fields. Please congratulate Katerina on her achievement!

Reynolds Wins Best Poster at ASM Conference



Mark Reynolds from Cadillo-Quiroz lab received an award of \$115.00 for his graduate poster presentation. Best poster presentation at the American Society of Microbiology (ASM), Arizona/Southern Nevada Branch Meeting.

Greer Receives Full Scholarship to AAAS CASE Workshop in Washington, DC



Jordan Greer, CBBG graduate student at the University of California, Davis, was awarded a full scholarship by UCD to the AAAS CASE Workshop in Washington, DC on March 18-21, 2018.

Hall Receives Full Scholarship to AAAS CASE Workshop in Washington, DC



Caitlyn Hall, CBBG graduate student and SLC President, was awarded a full scholarship by the American Geophysical Union (AGU) to attend the AAAS CASE Workshop in Washington, DC. Caitlyn will be attending Congressional meetings, blogging on her experience, and using social media to share information about the workshop.

Krajmalnik-Brown Promoted to ASU Professor



Effective August 16, 2018: Rosy Krajmalnik-Brown has been promoted to Full Professor. Dr. Krajmalnik-Brown is an associate professor in Civil and Environmental Engineering and is part of the Center for Environmental Biotechnology in the Biodesign Institute. She worked for a year at IBTech, an environmental engineering consulting firm, and in 1997 she was awarded a Fulbright

scholarship, which she used to obtain her master's degree at Georgia Tech. She completed her Ph.D. in Environmental Engineering at Georgia Tech in August of 2005. She is author of a patent, several peer-reviewed publications, and has presented numerous talks and posters at national and international conferences.

van Paassen and Hall Approved to Participate in NSF I-Corps Cohort



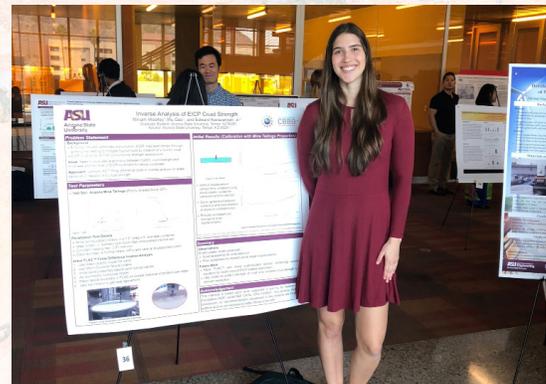
Dr. Leon van Paassen, CBBG Senior Investigator, and Caitlyn Hall, CBBG Graduate Student and SLC President, have been invited by the National Science Foundation (NSF) to participate in the upcoming I-Corps cohort that will take place in person and online from April 30 through June 12, 2018 in Indianapolis, Indiana.

The National Science Foundation (NSF) I-Corps program prepares scientists and engineers to extend their focus beyond the university laboratory, and accelerates the economic and societal benefits of NSF-funded, basic-research projects that are ready to move toward commercialization.

Through I-Corps, NSF grantees learn to identify valuable product opportunities that can emerge from academic research, and gain skills in entrepreneurship through training in customer discovery and guidance from established entrepreneurs.

I-Corps Teams participate in the seven-week I-Corps curriculum. Each I-Corps Team learns what it will take to achieve a commercial impact with their innovation. The I-Corps curriculum enables Teams to systematically identify and address knowledge gaps in order to understand the most appropriate path forward for their technology concept. I-Corps Team awards support the team's participation in the curriculum and their discovery work.

Woolley Wins First Place in SSEBE Poster Symposium



Miriam Woolley, CBBG Graduate Student, won first place in the recent poster symposium held by the ASU School of Sustainable Engineering and the Built Environment (SSEBE).

The poster was entitled, "Inverse Analysis of EICP Crust Strength." Authors were Miriam Woolley, Wu Gao, CBBG Visiting Scholar, and Dr. Edward Kavazanjian, Jr., CBBG Center Director.

Rittmann Wins 2018 Stockholm Water Prize



Professor Bruce Rittmann, CBBG Senior Investigator, was named the 2018 Stockholm Water Prize Laureate for revolutionizing water and wastewater treatment. This award is given annually by the Stockholm International Water Institute (SIWI) to promote excellent water achievements and inspire future water-wise action.

By revolutionizing microbiological-based technologies in water and wastewater treatment, Rittmann demonstrated the possibilities of removing harmful contaminants from water, cutting wastewater treatment costs, reducing energy consumption, and even recovering chemicals and nutrients for recycling. This pioneering research and innovations have led to a new generation of energy-efficient water treatment processes that can effectively extract nutrients and other chemicals — both valuable and harmful — from wastewater.

The Stockholm Water Prize is an annual global award founded in 1991. It is appointed by SIWI and the Royal Swedish Academy of Sciences, and awarded by SIWI, to an individual, organization or institution for outstanding water-related achievements.

In its citation, the Stockholm Water Prize nominating committee recognized Rittmann for “pioneering and leading the development of environmental biotechnology-based processes for water and wastewater treatment. This has revolutionized treatment of water for safe drinking, and refined purification of polluted water for release or reuse — all while minimizing the energy footprint!”

Escoto Recipient of Prestigious NSF Graduate Research Fellowship



Eric Escoto, a CBBG graduate student at ASU, is the recipient of a prestigious NSF Graduate Research Fellowship. Escoto is working on the development of the rainfall simulator at the Polytechnic site, and is a PhD student in the ASU School of Earth and Space Sciences.

The program recruits high-potential, early-career scientists and engineers, and supports their graduate research training in science, technology, engineering and mathematics (STEM) fields. The new awardees were selected from more than 12,000 applicants, and come from all 50 U.S. states, as well as the District of Columbia and U.S. territories.

The group of 2,000 awardees is diverse, including 1,156 women, 461 individuals from underrepresented minority groups, 75 persons with disabilities, 27 veterans and 780 who have not yet enrolled in graduate school. These awardees did their undergraduate studies at more than 443 institutions, ranging from small undergraduate, minority-serving, tribal and community colleges, to large state or private universities and Ivy League institutions.

NSF Awards REU Site to University of California, Davis



The National Science Foundation (NSF) has awarded an REU Site: Bio-mediated and Bio-inspired Geotechnics (BBG REU) to the University of California, Davis (UCD). The Principal Investigator is Dr. Colleen E. Bronner of UCD. Other organizations involved include Arizona State University (ASU), Georgia Institute of Technology (GT), New Mexico State University (NMSU), and the Center for Bio-mediated and Bio-inspired Geotechnics (CBBG).

This three-year grant will permit these organizations to host sixteen undergraduates each summer for ten weeks. This program will complement the Center for Bio-mediated & Bio-inspired Geotechnics (CBBG). Its primary objectives are to: 1) recruit and prepare students from diverse pathways to increase URG representation in geotechnical engineering; 2) increase awareness of graduate school and career opportunities in engineering; 3) develop students technical and professional skills; 4) emphasize the need to consider sustainable solutions to future engineers and scientists; 5) expose participants to bio-mediated and bio-inspired geotechnologies; 6) advance CBBG research from fundamental research stages to implementation in practice; and 7) create inclusive learning and research environments.

Activities will include a local institution and cross-institution orientation, a one-week CBBG immersion experience for professional development training and activities, weekly webinars/trainings, networking sessions, poster presentations, and social events.

Congratulations to Colleen and her team for this outstanding achievement!

CBBG Receives REU Supplemental Funds to Support Native American Students at NMSU



CBBG at NMSU will sponsor two Community College students for summer research experiences in the NMSU College of Engineering. Each of these students will have a CBBG faculty mentor and a graduate student mentor while working on a research project at NMSU. The mentors will help introduce the students to the practices of hands-on laboratory work, to increase their awareness of academic research, and to help them learn about the emerging field of biogeotechnics. The CBBG faculty at NMSU have an excellent track record mentoring undergraduate students from minority groups, and will be good role models to the Native American CBBG summer students.

The Community College students will have the opportunity to present their research at a regional poster session, the Undergraduate Pipeline Network at the University of New Mexico (UNM, Albuquerque). They will also have the opportunity, along with other undergraduate researchers participating in summer Research Experiences for Undergraduates (REU) at CBBG to present their research through webinars delivered to all four CBBG partner universities. The students will also have the opportunity to participate in the annual CBBG meeting at Arizona State University in order to have a more complete picture of the research conducted by the Center. This supplemental project is part of a Tribal Initiative for CBBG, which will engage Native American students in Center activities.

Irra, Former CBBG REU, Wins Jack Kent Cooke Foundation's Undergraduate Transfer Scholarship



Gabiella Irra, one of our CBBG inaugural class of REUs, is one of 7 recipients of the Jack Kent Cooke Foundation's Undergraduate Transfer Scholarship. This highly competitive national scholarship will provide Gabriela with up to \$40,000 annually for a maximum of three years to complete her bachelor's degree.

In addition to the monetary award, Cooke Transfer Scholars will receive comprehensive educational advising from foundation staff to guide them through the processes of transitioning to a four-year school and preparing for their careers. The foundation will additionally provide opportunities for internships, study abroad, and graduate school funding, as well as connection to a thriving network of 2,300 fellow Cooke Scholars and alumni.

This year, nearly 2,500 students applied for the Cooke Undergraduate Transfer Scholarship. The foundation evaluated each submission based on academic ability, persistence, leadership, and service to others. The recipients selected have a median adjusted gross income of \$5,000 and an average GPA of 3.92. Biological sciences, engineering, and computer/informational sciences are the most popular fields of study among the cohort.

John Successfully Defends Master's Thesis



Sheldon John successfully defended his Master's thesis titled, "Utilitarian Subterranean Bio-Inspired Geo-Probe," in April 2018, under the mentorship of Dr. Douglas Cortes. During his graduate studies at New Mexico State University, Sheldon was very active in CBBG research, outreach and leadership activities. Sheldon was a dedicated mentor and role model to four CBBG undergraduate research students and served in the CBBG Student Leadership Council as the NMSU graduate member in 2015-2016. Sheldon received his B.S. in Civil Engineering also from NMSU. Congratulations, Sheldon!

Three CBBG-NMSU Faculty Recognized during Engineers' Week



(From left) NMSU Department Head of Civil Engineering David Jauregui with Paola, Douglas and Brad at the NMSU College of Engineering Awards Ceremony.

The New Mexico State University College of Engineering presented awards to three civil engineering faculty. Dr. Douglas Cortes received the Foreman Faculty Excellence Award and Dr. Paola Bandini received the Synergy Faculty Leadership Award. Dr. Brad Weldon received the Harold Foreman Endowed Professorship for Excellence in Civil Engineering. The awards banquet was held on February 23, 2018 at the NMSU Golf Course Clubhouse.

Borah Wins ASU Teaching Excellence Award

Devajani Borah, CBBG graduate student at ASU, has been awarded the Teaching Excellence Award by the Graduate Professional Students Association (GPSA) for her performance as the Teaching Assistant for CEE 351-Geotechnical Engineering.

The GPSA Teaching Excellence Award recognizes graduate and professional students that exemplify excellence in education and classroom instruction across all disciplines. Winners of the Teaching Excellence Award receive a \$500 prize, in addition to cross-campus recognition and are honored at the Annual Awards Ceremony in the spring.

van Paassen Invited to be Keynote Speaker at Upcoming International Conference in Korea



Dr. Leon van Paassen, CBBG Senior Investigator, has been invited to be a Keynote Speaker at the 2018 International Conference on Geomechanics and Engineering (ICGE18), which will be held as a participating conference of ACEM18 (2018 World Congress on Civil, Environmental, and Materials Research)/Structures18 and the 3rd Symposium on "Innovative Soil Treatment and Geotechnical Approaches" to be held concurrently on August 27-August 29, 2018. van Paassen will present on "A multiscale approach towards improved design and better understanding of bio-based ground improvement methods."

NMSU Graduate Student Receives Scholarship



Diego Garcia Vera (right) received the scholarship check from Jessica Sena of APANM.

Diego Garcia-Vera received a \$1,000 scholarship from the Asphalt Pavement Association of New Mexico (APANM). The scholarship was presented during the Awards Luncheon of the 2018 New Mexico TransCon Conference on April 19, 2018. Diego is a Master's student in geotechnical engineering at NMSU. Diego studies the strength properties of natural fiber-reinforced soil and is the mentor of two undergraduate

researchers in his CBBG project Bio-inspired Resilient Earthen Construction. After defending his Master's thesis this fall, Diego will continue to the PhD program under the advising of Dr. Paola Bandini.

NMSU Students Present CBBG Research, Win 'Audience's Vote' Award



(From left) NMSU Department Head of Civil Engineering David Jauregui with Paola, Douglas and Brad at the NMSU College of Engineering Awards Ceremony.

Graduate students Jason Alcantar and Saman Mostafazadeh-Fard presented research posters at the Student Research Poster Session of the 2018 NM TransCon Conference on April 20. Jason's presentation was about his research work as part of the project Bio-inspired Unsaturated Soil Improvement and Foundations. Saman's poster described the production and laboratory testing of a liquid organic anti-icer/deicer and won the "Audience's Vote" award (and a \$200 check!). The session showcased 15 student research posters.

Education & Outreach

CBBG Partnering with Phoenix College on Research Project

The CBBG is assisting Phoenix College, a CBBG Founding Educational Partner, in the chemical analyses of soils for a project aimed at understanding hillslope transport of heavy metals deposited by recreational target shooting in the Tonto National Forest. Phoenix College Geosciences faculty Dr. Abeer Hamdan and her student Raja "RJ" Mabry are conducting the research project. RJ Mabry is a sophomore at Phoenix College and currently serving in the US military while working on an undergraduate research project with Dr. Hamdan. She will be participating in the 2018 CBBG Research Experience for Undergraduates (REU) Program at Arizona State University (ASU) this summer. As an REU, she will be working with Dr. Anca Delgado on bioremediation of chlorinated solvents via microbial metabolic chain elongation. RJ plans to attend to ASU in the fall of 2018 to pursue a degree in chemistry.

NMSU CBBG Education and Engineering Team Implements Outreach Module

CBBG faculty, students and staff of the NMSU College of Engineering and NMSU College of Education are collaborating to implement the CBBG Adobe Bricks module in 10 schools of two districts this spring. The 6th grade students are engaged for 2 hours each week in this after-school program. CBBG students work with a class, talk with the students, and help them design and test the adobe walls. The 6th graders are preparing for a competition at each school to determine which adobe wall stands the longest as it endures the "shaker table." The "shaker tables" were designed by the CBBG graduate students and staff, and were constructed by the College of Education students. The soil was donated by farms nearby and the fun has already begun in the classes!

As this pilot project progresses, we will adjust the curriculum based on the teachers' feedback and the impact of each lesson in the classroom. We will have a master curriculum at the end of May and we will implement this module on a larger scale in the fall of 2018. All results will be shared with our CBBG partners.

College and Career Fair at Estrella Vista STEM Academy

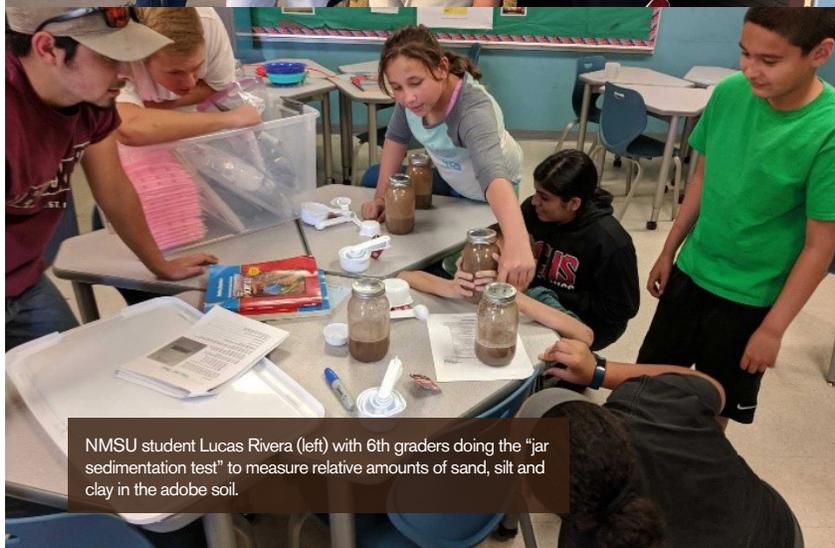
Education Coordinator, Dr. Jean Larson, Education Director, Dr. Willi Savenye and doctoral student, Mr. Hani Selmi S. Alharbi shared about Biogeotechnics careers, CBBG opportunities, and college study possibilities at the College and Career Fair at Estrella Vista STEM Academy (EVSA), one of the Center's partner schools, on April 19. Hani demonstrated for these 3rd through 8th grade students his research on improving expansive soils, and joined Jean and Willi in discussing with students opportunities for research and work in biogeotechnics and engineering at CBBG. Jean then made 2 presentations to almost 100 middle-school students introducing them to the field of biogeotechnical engineering. The three were welcomed by Principal Richard Ramos, also met with the new RET teacher from EVSA for this coming year, Ms. Jessica Gensel, and discussed briefly with last year's four RET teachers from EVSA, Dr. Susan Rumann, Mr. Stephen Batchelder, Mr. Anthony Haduch and Ms. Michelle Gerrick their follow-up work this year.



Phoenix College student Raja "RJ" Mabry collecting soil samples for chemical analysis.



NMSU graduate student Peter Zelkowski (farthest to the right) and engineering student Gabriella Sing (farthest to the left) with kids participating in this CBBG outreach activity.



NMSU student Lucas Rivera (left) with 6th graders doing the "jar sedimentation test" to measure relative amounts of sand, silt and clay in the adobe soil.



Dr. Jean Larson and Mr. Hani Selmi Alharbi at College and Career Fair at Estrella Vista STEM Academy

Drew 7th-Graders Design, 3-D Print, Test Bio-Inspired Foundations at Georgia Tech

More than 100 seventh-graders from Atlanta's Drew Charter School spent the day at Georgia Tech, March 8-9, 2018, working with graduate students in the School of Civil and Environmental Engineering who have spent the semester teaching them about geotechnical engineering and helping them with a bio-inspired design challenge.

The testing was the capstone: For some teams, it took more than 10 pounds of force to pull their design — a miniature of a plant-root-inspired deep-pile foundation — from the bucket. For others, it was less than a pound.

A group of master's and Ph.D. students have spent upwards of 250 hours this past semester delivering the problem-based learning module to the Drew students and planning the finale on campus. The outreach was funded by the Center for Bio-Mediated and Bio-Inspired Geotechnics, a National Science Foundation Engineering Research Center, co-led by Higginbotham Professor David Frost. Master's student Ariel Siegel led the modules, which were designed to align with the state of Georgia's educational standards.

CBBG Supports Phoenix Indian Center

Dr. Nasser Hamdan, his wife Dr. Abeer Hamdan and representatives from CBBG Industry Partner Freeport McMoRan attended the Phoenix Indian Center's 35th Annual Silver & Turquoise Ball signature fundraiser event held at the gorgeous Scottsdale Resort in McCormick Ranch. Guests enjoyed a delicious three-course dinner reflecting the unique tastes of American Indian cuisine prepared by American Indian Chef Felicia Cocotzin Ruiz. Guests were treated to live entertainment that featured traditional and modern cultural entertainment. Indeed, a main highlight of the evening was the American Indian dancers adorned in brightly colored and intricate American Indian garb. These performers skillfully displayed their traditional dance on separate stages and simultaneously as to immerse the audience in the evening's cultural experience. However, the most impressive aspect of the Silver & Turquoise Ball was the Phoenix Indian Center youth who attended this event. These young people appeared to be high school age students and served as hosts and greeters throughout the evening. These elegantly dressed and professional individuals exhibited exceptional enthusiasm and sincerity that added to the wonderful experience. These youth are incredible indicators of the work that the Phoenix Indian Center undertakes in its mission to serve the American Indian community.



Post-doctoral fellow, Jong Muk Won, sets up testing on the deep-pile foundation models designed by seventh-graders at Drew Charter School. In the foreground are several of the teams' designs.



Students participated in two other engineering challenges during their day at Georgia Tech. Here, a group of students tries to build the longest bridge using only pennies.



Their other engineering challenge was to build a tower using only drinking straws that was strong enough to hold a golf ball for at least five seconds. Left: Students build a spot to hold their golf ball atop their tower. Right: Students smile after their tower remained standing for more than five seconds.



CBBG Volunteers at STEM - Red Mountain Ranch Science Night

CBBG undergrad, Rachael Adam (2016 YS, ASU Undergrad, VIP), and Devon Von Lichtenstein (ASU Undergrad, VIP, VRS - Veterans Research Supplement) volunteered at the STEM - Red Mountain Ranch Science Night on April 19, 2018.

Diversity & Inclusion

AccessERC Funding for Students with Disabilities

The AccessERC project is accepting seed grant applications to provide funding for a student with a disability to work at your ERC. The student can engage in general ERC research, or they can work to promote the inclusion of people with disabilities at your ERC (e.g., plan a student panel, evaluate labs & facilities, share best practices, create case examples).

Please contact Scott Bellman if you know of a student and you are interested in this funding.

Scott Bellman
DO-IT Program Manager
CSNE Diversity Manager
www.uw.edu/doit
206-685-6222

Fain Presents Diversity and Inclusion Webinar



Lisa Z. Fain
Center for
Mentoring Excellence

On April 20, 2018, Lisa Fain, CEO for the Center for Mentoring Excellence presented a webinar to CBBG participants on Communication Across Difference: Win/Win Strategies for Bridging the Divide." She explained that culture competency is how we can leverage diversity and inclusion. She presented a model of cultural competency that includes the elements of understanding self, understanding others, and understanding

context. She presented strategies for deepening cultural understanding. She emphasized the importance of connecting across both commonality and difference. The participants thought about where we, as individuals and as an organization, are positioned on the Intercultural Development Continuum. The participants learned how to create deeper understanding, establish trust and improve communication across differences.



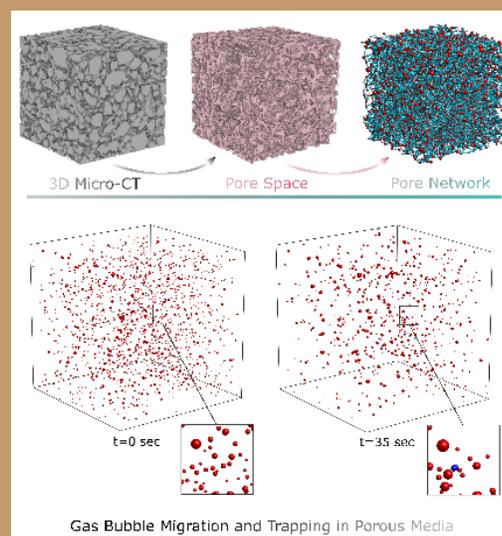
NMSU participants in Cultural Competency webinar

Publications

The team at the University of California, Davis recently published a paper in Environmental Science and Technology, entitled "[Diversity of Sporosarcina-like Bacterial Strains Obtained from Meter-Scale Augmented and Stimulated Biocementation Experiments](#)." Lindsay Kline and Sydney Morrill were, at the time, CBBG undergraduate researchers in microbiology. The findings suggest that the strain of *Sporosarcina pasteurii* frequently used in bioaugmented MICP competes poorly with native bacteria, and is overtaken by a surprisingly diverse set of closely related *Sporosarcina* species that are also abundant in biostimulated MICP treatments.

Graddy, C. M. R.; Gomez, M. G.; Kline, L. M.; Morrill, S. R.; DeJong, J. T.; Nelson, D. C., Diversity of Sporosarcina-like Bacterial Strains Obtained from Meter-Scale Augmented and Stimulated Biocementation Experiments. Environmental Science & Technology 2018, 52, (7), 3997-4005.

Nariman Mahabadi's paper with four other authors, regarding gas bubble transport in porous media (related to the MIDP project) has been selected as a featured article in Journal of Geophysical Research: Solid Earth.



Mahabadi, N., Zheng, X., Yun, T. S., van Paassen, L., & Jang, J. (2018). Gas bubble migration and trapping in porous media: Pore-scale simulation. Journal of Geophysical Research: Solid Earth, 123, 1060–1071. <https://doi.org/10.1002/2017JB015331>

Sofia Esquivel-Elizondo, Juan Maldonado, and Rosa Krajmalnik-Brown. 2018. Anaerobic carbon monoxide metabolism by *Pleomorphomonas carboxyditropha* sp. nov., a new mesophilic hydrogenogenic carboxydotroph. FEMS Microbiology Ecology, 94, 2018. doi: 10.1093/femsec/fiy056.

Tengfei Chen, Burcu M Yavuz, Anca G Delgado, Garrett Montoya, Delaney Van Winkle, Yi Zuo, Roopa Kamath, Paul Westerhoff, Rosa Krajmalnik-Brown, Bruce E Rittmann. 2018. Impacts of Moisture Content during Ozonation of Soils Containing Residual Petroleum. Journal of Hazardous Materials. 344: 1101–1108 <https://doi.org/10.1016/j.jhazmat.2017.11.060>

Esquivel-Elizondo, Sofia, Joseph Miceli III, Cesar I. Torres, and Krajmalnik-Brown, Rosa. 2018. Impact of carbon monoxide partial pressures on methanogenesis and medium chain fatty acids production during ethanol fermentation. Biotechnology and Bioengineering. 115:341–350 DOI: 10.1002/bit.26471.

Industry & Innovation

CBBG Industry Partners

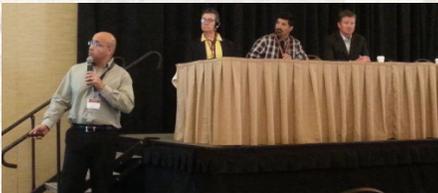
Celebrating Kavazanjian's Birthday



On Thursday, May 3rd, the Industry Advisory Board (IAB) met with the CBBG leadership to discuss the research portfolio. It also was Ed Kavazanjian's birthday. Claudia Zapata brought in a delicious chocolate cake to celebrate Ed's birthday with the CBBG team.

Hamdan Presents at TransCon

TransCon, Las Cruces, NM



Dr. Nasser Hamdan made a presentation at the 2018 NM Transportation Engineering Conference (TransCon) in Las Cruces, NM April 18-20 on "Biogeotechnical Strategies for the Mitigation of Fugitive

Dust." TransCon is a joint effort between New Mexico State University, NM Department of Transportation (NMDOT), ASCE NM Section, the City of Las Cruces, American Council of Engineering Companies (ACEC) NM and the Associated General Contractors (AGC) NM. The presentation discussed CBBG technologies for fugitive dust mitigation via enzyme induced carbonate precipitation (EICP) and restoration of native biocrust in desert soils (a project led by ASU's Professor Ferran Garcia-Pichel). The presentation was made during the NMDOT-Federal Highway Administration session titled "Dust Storm Mitigation."

CBBG Presents to DGA

DGA Joint Utility Technology Meeting, Gilbert, AZ

Dr. Nasser Hamdan and CBBG graduate student Vinay Lakshminarayanan made a lunchtime presentation at DiGioia Gray's (DGA) Joint Utility Technology Meeting in Gilbert, AZ. The purpose of this meeting was to provide an open forum on selected topics of interest to utilities and to disseminate technical ideas and information between various groups. Nasser and Vinay discussed the CBBG Industry Partners Program and presented CBBG technologies relevant to the major utility companies in Arizona. The event host DGA Associates attended this local meeting as well as representatives from Arizona Public Service, Tucson Electric Power and CBBG Industry Partner Salt River Project.

CBBG Participates in Inter-ERC Engineering and Sustainability Virtual Career Fair

The CBBG, QESST, and NEWT ERC's partnered to host an online recruiting event where students connected with employers in real-time – a valuable opportunity to talk to industry. All ERC students from all partner universities were encouraged to register for this event, which took place on Friday, February 9, 2018 from noon to 3 p.m. (Eastern).

This first career event saw 22 companies participate in the event, along with 560 total students, 33 from CBBG.



Partner Universities

UC DAVIS
UNIVERSITY OF CALIFORNIA

ASU ARIZONA STATE
UNIVERSITY

NM
STATE
UNIVERSITY

 **Georgia Institute
of Technology**



How does nature do it?

Nature has developed elegant, efficient and sustainable biologically-based solutions to many challenges that vex geotechnical infrastructure systems. Examples include ant excavation processes that are 1000 times more energy efficient than man-made tunneling machines, carbonate cemented sand that is exceptionally resistant to erosion and earthquakes, and self-sensing and self-healing tree root structures that are 10 times more efficient than any mechanical soil reinforcing/foundation system yet devised.

The NSF Engineering Center for Bio-mediated and Bio-inspired Geotechnics (CBBG) will focus on ecologically friendly, cost-effective solutions, inspired by nature, for development and rehabilitation of resilient and sustainable civil infrastructure systems. It will serve as a nexus for two transformative trends in engineering: biologically-based design and sustainability.



CBBG is a National Science Foundation (NSF) Engineering Research Center funded in 2015 under cooperative agreement EEC-1449501, and headquartered at Arizona State University.



biogeotechnics.org

ASU Ira A. Fulton Schools of
Engineering
Arizona State University