CBBG

Center for Bio-mediated & Bio-inspired Geotechnics

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As I See It: View from Director's Chair

WE HAVE SOME WORK TO DO!

The CBBG Leadership Team recently completed responses to the report prepared by the NSF Site Visit Team (SVT) following the annual meeting in October 2016. While the overall review of our first year of Center operations was very positive, we clearly have some work to do to meet NSF expectations for a fully functioning Engineering Research Center (ERC). In their SWOT (Strength Weaknesses Opportunities and Threats) analysis, the SVT identified a number of weaknesses and threats that need to be addressed as CBBG moves forward. However, we should not regard the weaknesses and threats identified by the SVT as indication of unsatisfactory performance, merely as a recognition that we cannot satisfy all of NSF's expectations for an ERC in the first year of operations.

Foremost among SVT comments was the need to improve communications among CBBG stakeholders. The new BioGeotechNotes email that arrives in your in-box every Monday morning from me is the first step in improving our communications program. This email will be the main vehicle we use to communicate with you, and will include a schedule of webinars, meetings, and other activities of interest to CBBG members, updated weekly. To avoid inundating you with emails, this will be the sole means of communications from headquarters on many issues, so we encourage you to review the entire email when it arrives on Monday and make note of events of interest in your calendar. The SVT also noted that we needed to enhance communications to facilitate knowledge-sharing among CBBG investigators. The weekly webinar series we have initiated is one means of accomplishing this goal. Look for other measures such as Thrust and Working Group teleconferences, student exchanges, and inter-University teaming arrangements on projects and technical papers during Year 2. In the coming months, we will be actively soliciting ideas from you (our CBBG members) on other ways we can enhance communication among faculty, staff, students, and industrial partners.

Another persistent theme in the SVT comments was the need to formalize our processes for evaluation of ongoing projects and proposals. We will be developing formal rubrics for this evaluation process with clear and concise evaluation criteria that senior investigators can use to guide the direction of ongoing projects and the development of proposals for new projects. The SVT also took note of the fact that we have yet to develop a formal Innovation and Entrepreneurship educational program for our students, and a formal program for International Collaboration. Developing both of these programs is high on our list for Year 2 initiatives. The Intellectual Property training webinar in November 2016 was a first step in developing the Innovation and Entrepreneurship program, and we are working on a Memorandum of Understanding to formalize and facilitate student and information exchanges with International partners.

The SVT did make note of several of the significant accomplishments of the CBBG in Year 1. Among the accomplishments noted by the SVT were: identification of new research areas not previously explored by the geotechnical community; significant international recognition of CBBG as a leader in the emerging field of biogeotechnology; a promising start on industry and governmental agency participation in the Center; participation levels for women in Center leadership and research activities well above the national average; and engagement of a large and diverse group of partners for pre-college education activities. I note that not just the SVT, but all participants in the annual meeting we impressed by the quality and enthusiasm of our student researchers.

The Leadership Team and the IDEA (Innovation Diversity Education Activities) Working Group have already begun working on addressing the weaknesses and threats identified by the SVT. We will be reaching out to other CBBG members, including faculty, staff, students, industry partners, and our science advisory board members, in the next few months to help us address these issues. We look forward to your cooperation as we strive not just to meet, but to exceed NSF expectations and make the CBBG all that it can be!

Important Dates

February 25, 2017
ASU Night of the Open Door

April 5-7, 2017
CBBG Mid-Year Meeting
University of California, Davis

June 2017 - July 2017
Summer Programs at CBBG Partner Universities
REU/RET/Young Scholars

August 7, 2017
ERC 360 Closes for Grant Year 2

September 2017
CBBG Year 2 Annual Report Due to NSF

October 2017
Year 2 NSF Site Visit to CBBG

Research Highlights

Helping to Fortify Defenses Against Earth-Shaking Problem

In 2011, a powerful earthquake that hit Christchurch, New Zealand, the country's second-largest city, resulted in massive damage, especially for a quake that registered a relatively modest 6.3 on the Richter scale. Many buildings collapsed, road surfaces cracked, bridges buckled, water and sand that burst up from the ground caused substantial flooding. Nearly 200 people died as a result. More than 100,000 modern, single-family homes were damaged and as many as 15,000 had to be abandoned and demolished. The government later estimated that the cost to completely rebuild after the earthquake could rise to about $40 billion. Some economists estimate it will take more than 50 years for full economic recovery.

The prime culprit responsible for the severe impact of the earthquake was a process called liquefaction. It occurs when loose, water-saturated soil at or near the ground surface loses it strength when the ground experiences strong shaking. Liquefaction and its destructive potential is a fairly widespread threat. "There is literally trillions of dollars' worth of infrastructure around the world on ground that is at risk of liquefaction," says Edward Kavazanjian. The U.S. Geological Survey estimates that 40 percent of the United States is subject to ground motions severe enough to cause liquefaction sufficient to damage infrastructure.

The Christchurch quake was one of several big natural disasters that prompted the Earthquake Engineering Research Institute (EERI), an international technical and professional society, to call for an extensive study of methods to better determine soil liquefaction risks and deal with its consequences. The EERI committee that recommended the study also recommended it be conducted by the National Academies for Science, Engineering, and Medicine, given the importance of its goal.

The National Academies' Committee on Geological and Geotechnical Engineering was tasked with raising the money for the study and commissioning an ad hoc committee to conduct the study and write the report. Kavazanjian was the committee's chair at the time and worked with National Academy staff to raise the approximately $1 million necessary for the study from a variety of stakeholders.

Once funds were raised, nominations were solicited for study committee members through a variety of channels, including the National Academies and the study's sponsors. A select group of 11 engineers and scientists covering the spectrum of disciplines considered necessary for the study was selected from the nominations. Kavazanjian's term as chair of the National Academy's engineering committee ended by the time the funding was secured, but he then was asked to chair the ad hoc committee that conducted the study and wrote the report.

Now, five years after fund raising began and three years after initiation of the study, the "State of the Art and Practice in the Assessment of Earthquake-Induced Soil Liquefaction" has been released.

The Center for Bio-mediated and Bio-inspired Geotechnics is developing new technologies and methods to help mitigate damage caused by soil liquefaction and similar problems.

Ed Kavazanjian and his students in lab.
Photographer: Jessica Hochreiter/ASU

"We have conducted a comprehensive study that tells you the best practices that the experts know of to assess what is likely to happen if liquefaction occurs and to guide decisions on what to do in the way of prevention, mitigation and remediation," Kavazanjian says. Now he will be among the contingent of study committee representatives to lead presentations and workshops to introduce the report to major stakeholders around the country.

The events include an open session at the February meeting of the Committee on Geological and Geotechnical Engineering in Irvine, California, and a breakout session in early March at the Earthquake Engineering Research Institute annual meeting in Portland, Oregon, and later in March at a featured session at the 2017 annual Geo-Congress of the Geo-Institute of the American Society of Civil Engineers at the international Geotechnical Frontiers Conference in Orlando, Florida.

The importance of the study's conclusions to industry and government agencies is reflected by the list of sponsors that funded the project. Those are the Nuclear Regulatory Commission, the U.S. Bureau of Reclamation, the Ports of Long Beach and Los Angeles, the American Society of Civil Engineers, and the Federal Highway Administration. "There was substantial contribution from groups that had never before helped to fund a national study like this," Kavazanjian says. "That's because this is something with a potentially big impact on major business and economic interests, as well as public safety."

(continued on page 3)

Soil liquefaction resulting from earthquakes can dramatically increase the severity of damage done by major seismic events. Ed Kavazanjian was part of a team that worked with the National Academies of Science, Engineering, and Medicine to produce guidelines to cope with the threat of liquefaction. Photograph courtesy of the National Geophysical Data Center.

Photos and article courtesy of ASU Full Circle.

(continued from page 2)

For example, coastal Southern California, which includes the two major ports in Los Angeles and Long Beach, as well as other critical infrastructure — not to mention the region's broad swaths of high-priced real estate — is among places most at risk of liquefaction.

Kavazanjian says completing the report has been a challenge because the authors ultimately had to accommodate the viewpoints of differing schools of thought on the optimal methods to address assessment of the potential for liquefaction and the consequences of its occurrence. He believes the study will nevertheless be well received by stakeholders despite the inevitable debates over some of its content. "The 11-person study committee had to reach consensus on its recommendations, which were then subject to a high-level of peer review in accordance with National Academies policy," he says. Still, one conclusion of the report is that there is much more to learn about coping with liquefaction.

To answer all the questions on the subject, Kavaznajian says, "We need much more field data on how liquefaction interacts with structures. We need liquefaction observatories to study at-risk sites. We basically need to instrument some sites and then wait for an earthquake to happen at one of those locations. It could take 20 to 30 year to get all the data we need."

While the report addresses the consequences of liquefaction, it stopped short of addressing how to mitigate those consequences. Some of the answers on how to do that will likely come from Kavazanjian's work at the Center for Bio-mediated and Bio-inspired Geotechnics,. "Right now there are no cost-effective ways to remediate potentially liquefiable soil under and adjacent to existing buildings and infrastructure. That's a big national and international problem," he says. "It's one of the big things we want to make possible with the technologies we are developing at CBBG."

National Academies Study on Liquefaction Released

A long-awaited report from the National Academies of Sciences, Engineering, and Medicine of "State of the Art and Practice in the Assessment of Earthquake-Induced Soil Liquefaction and its Consequences" was released to the public on December 23, 2016. The report provides eleven recommendations on how to improve the state of the art and practice for assessing the threat this natural hazard poses to trillions of dollars of civil infrastructure worldwide. CBBG has several research projects aimed at mitigation of this hazard using bio-mediated and bio-inspired processes.

The eleven-person study committee that authored the report was chaired by CBBG Director Ed Kavazanjian and included CBBG Science Advisory Board member Jim Mitchell. Issuance of the report in the culmination of three years of work that included a symposium at ASU, three other public meetings at which input from the geotechnical engineering community was solicited, and several webinars through which the committee received input from subject matter experts.

The report can be downloaded for free from the National Academies website at: https://www.nap.edu/catalog/23474/state-of-the-art-and-practice-in-the-assessment-of-earthquake-induced-soil-liquefaction-and-its-consequences

Inside and Out, ASU Engineer Studies Role Microbes Play in Health

Dr. Rosa Krajmalnik-Brown in her lab.
(Photo and article courtesy of ASU Full Circle)

We humans can't function without the help of trillions of helpful bacteria that form communities in our guts and other parts of our bodies, also known as microbiomes. There's still a lot we don't know about how these ecosystems of microflora affect our health, and how it interacts with outside substances.

CBBG Thrust Leader, Professor Rosa Krajmalnik-Brown has been selected to help the National Academies of Sciences, Engineering and Medicine to explore the topic.

Krajmalnik-Brown is serving on the National Academies' Committee for Advancing Understanding of the Implications of Environmental-Chemical Interactions with the Human Microbiomes. This ad hoc committee is tasked with developing a research strategy to better understand the interactions between chemicals found in our environment and intestinal, skin and lung microbiomes, as well as to determine their health effects.
First, the committee will assess the state of scientific work regarding the health implications of the human microbiota's chemical metabolism and the effect of chemical exposure on microbiota diversity and function. Then, it will look at what we know about how these effects differ based on individual differences or age. Finally, the committee will develop a research strategy to identify what studies we need to improve our understanding of how different microbiome communities can affect chemical exposure, how chemical exposure effects microbiome functions and the ramifications for human health risks. As part of this effort, it will also determine methodological or technological barriers to advancing the field. Additionally, the committee will look for opportunities for collaboration and what research investments will provide the most information for improving our understanding of the microbiome's health effects.

Krajmalnik-Brown has been researching the human microbiome for nearly 10 years, focusing on two important aspects: its role in obesity and autism. She received a National Institutes of Health grant to discern the role of the gut microbiome to the success or failure of bariatric surgery, and has recently received a second NIH grant to quantify the effect of the microbiome on energy extraction.

For the last few years, she has studied the gut-brain connection and how it differs between children diagnosed with autism and those not. Recent research suggests our gut microbiomes affect brain communication and neurological health. A high number of children with autism have gastrointestinal disorders compared to those without autism. Krajmalnik-Brown says this implies a link between autism and gut microbe abnormalities.

After comparing the gut microbiomes of children with autism and children without, Krajmalnik-Brown and her research team found that children with autism had less diverse gut microbiomes, changes which correlated with symptoms of autism spectrum disorder. These abnormalities can cause digestive issues and discomfort that are believed to exacerbate behavioral problems associated with autism spectrum disorder and can diminish quality of life.

Her microbiome research also extends beyond human health to environmental health through a process called bioremediation, or using microbes to clean up contaminants.

The Krajmalnik-Brown Laboratory uses strong microbiological skills, genomic techniques, and environmental engineering to carry out research in biodegradation of water containments such as nitrate, perchlorate and chlorinated organics, biotechnology for renewable bioenergy production and microbial ecology in the human gut and its relationship with human diseases.

CBBG Visiting Scholar

Miriam de Luca joined the ASU CBBG team in December 2016. Miriam is a visiting scholar from the Polythecnic University of Turin (Politecnico di Torino), where she is pursuing a Master's degree. Under the supervision of Dr. Claudia Zapata from Arizona State University and Professor Ezio Santagata from the Department of Environmental, Territorial and Infrastructure Engineering at the Polythecnic, she is studying and pilot testing the precipitation of silica processes from rice husk ash and its applicability to mitigation of expansive potential and soil improvement in general. We welcome Miriam, and wish her a productive visit to Arizona!

CBBG Researcher Studies Root Growth

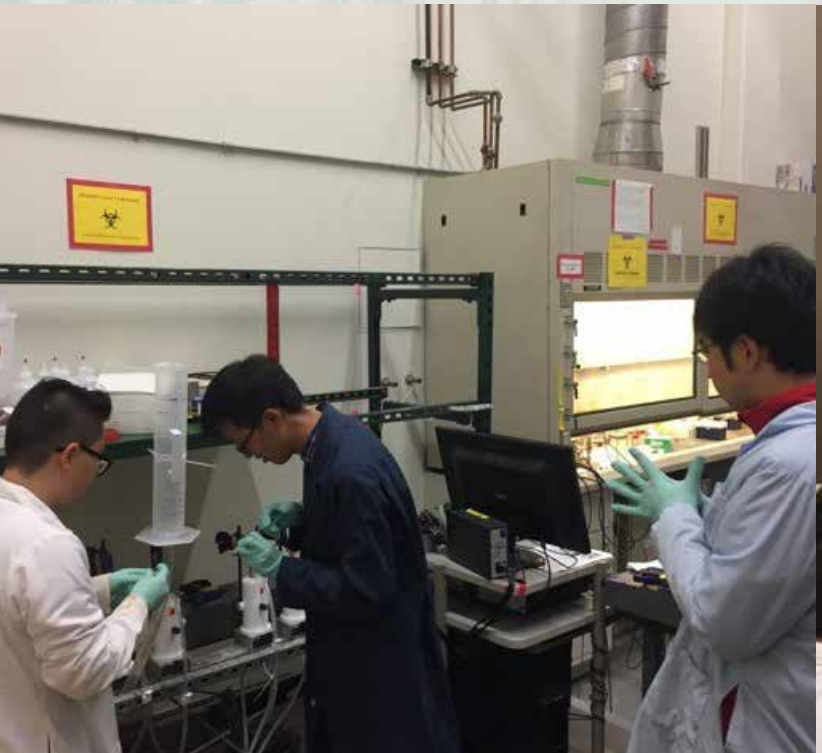
CBBG Ph.D. researcher Wencheng Jin is in communication with Dr. Javaux at the Université Catholique de Louvain to account for obstacles in the programs developed at UCL to model Root System Architecture. Dr. Scott Retterer and his group at Oak Ridge National Laboratory are currently improving the experimental set up to assess root-inspired deployment of water lines on Georgia Tech campus.

Simplified campus maps were 3D printed and wheat root growth on agar is monitored by time-lapse photography. Root growth will be simulated with the Root System Architecture program improved by Wencheng Jin after calibration, to assess the performance of bio-inspired design.

Sabbaticals at University of California, Davis

Ruixing Wang, a professor from China, and Kazuyuki Hayashi, a professor from Japan, are both on sabbatical at UCD. Professor Wang is working on the newly funded research project on biofilm formation while Professor Hayashi is working on the ongoing MICP work. CBBG welcomes these international collaborations.

International visitors in UCD Lab.



CBBG Student Participates in LAUNCH Entrepreneurship and Commercialization Program

NMSU graduate student Saman Mostafazadeh-Fard presents his research poster at the CBBG midyear meeting

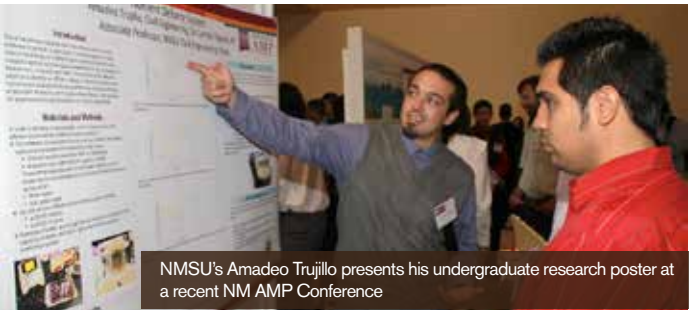
Graduate student Saman Mostafazadeh-Fard participates in the Arrowhead Center's LAUNCH program at New Mexico State University (NMSU) this spring. LAUNCH is designed to evaluate and select potential technologies proposed by entrepreneur students for financial support to grow their ideas and businesses and eventually, introduce their products and technologies to the market.

During the selective process of the LAUNCH competition, in the first round, applicants introduce their product and plans for commercializing. The second round is PITCH day, in which the LAUNCH judges select applicants based on their presentation of their product, potential market and commercialization strategies. Saman has been selected to continue to the third round, and is preparing for the interview to finalize the details of the seed funding he will receive from LAUNCH.

The student entrepreneurs work closely with an entrepreneur mentor and faculty mentor to assess and validate the technology, explore customer development, and identify investment opportunities to enter the market within 6 months. NMSU's Arrowhead Center helps entrepreneur students commercialize their technologies and assists small businesses owned by students at all stages start and grow rapidly.

Drs. Zohrab Samani and Paola Bandini are Saman's LAUNCH team faculty mentors. Saman also has applied to NSF's I-CorpsTM Program. His CBBG research studies the application of an organic fertilizer produced from green leaf plant waste to restore degraded soils. http://arrowheadcenter.nmsu.edu/launch/

CBBG Students Graduate and Continue into Graduate School and Industry



NMSU's Amadeo Trujillo presents his undergraduate research poster at a recent NM AMP Conference

Four CBBG undergraduate research assistants graduated with B.S. in civil engineering degrees at New Mexico State University (NMSU) in Fall 2016. Jason Alcantar, Eduardo Davila and Amadeo Trujillo continued to the Master's program at NMSU, and are now graduate assistants in CBBG research projects. Victor Lara joined a civil engineering design firm in Houston, Texas, and plans to pursue graduate school in the near future.

Greer Pursues Master's Degree at UCD

Jordan Greer is a new graduate student at UC Davis pursuing a master's degree in Geotechnical Engineering. She is working on a new project on biofilm formation, and is fascinated by the strength and behavior of the ground. With a background in sustainability, focusing on renewable energy, she looks forward to the opportunity for influencing the field with creativity and innovation.

New Graduate Student at UCD

Annie Kirkwood is a new graduate student at UC Davis as of January 2017 working on a new project evaluating K-12 civil engineering outreach.

NMSU Partners in New Regional University Transportation Center

Dr. Craig Newtson leads new Regional University Transportation Center at NMSU

NMSU's Civil Engineering Department is member of a new university consortium to establish a regional transportation research center with funding from the U.S. Department of Transportation's University Transportation Center (UTC) program. The Transportation Consortium of South-Central States, or Tran-SET, is led by Louisiana State University.

Tran-SET has been awarded a five-year grant and nearly $2.5 million for this fiscal year. Professor Craig Newtson is the NMSU principal investigator (PI), and Dr. Paola Bandini is the NMSU co-PI of this grant. The emphasis for Tran-SET is to improve transportation infrastructure through innovative materials and technology. The priorities of the center are to fund and conduct research that focuses on extending the life of transportation infrastructure, preserving the environment and preserving the existing transportation system. Drs. Newtson and Bandini collaborate on a CBBG research project on root-inspired foundations.

NMSU Recognizes Paola Bandini with Research Discovery Award

Dr. Paola Bandini, second from right, NMSU Associate Professor of Civil Engineering, receives a Research Discovery Award from Regent Debra Hicks as President Garrey Carruthers (left), College of Engineering's Dean Lakshmi Reddi (right) and the New Mexico Secretary of Higher Education Barbara Damron applaud at the Pan American Center. (Photo by Andres Leighton)

Dr. Paola Bandini was recognized by New Mexico State University (NMSU) with the Research Discovery Award. Bandini was presented with this award by the NMSU President and the College of Engineering Dean during the NMSU vs. UNM men's basketball home game on December 10, 2016. President Carruthers highlighted Bandini's accomplishments and her leadership in CBBG and S-STEM programs. The NMSU Aggies won 84-71 this Rio Grande Rivalry game! Congratulations Dr. Bandini!

Honors & Awards

Inventions that Clean Up Water Earn Rittmann NAI Fellowship

Photo and article courtesy of ASU Full Circle

What makes a successful invention? There are many criteria, but often our most widely used inventions solve multiple problems. WD-40 and duct tape both boast hundreds of uses or more, and likely we all have both at hand.

Another example involves making natural processes do a variety of work for us, such as using bacteria to clean up contaminants in wastewater. But, Professor Bruce Rittmann took his discovery of this process a step further, and figured out how to create fuel and other valuable substances in the process.

This innovative and practical approach to the world's waste problem helped earn Rittmann the honor of being named a National Academy of Inventors Fellow. NAI Fellowship is the highest professional distinction awarded to academic inventors. To be selected, nominees must hold U.S. patents that make a tangible impact on "quality of life, economic development and welfare of society."

This is a unique and prestigious honor, showing how Rittmann's ideas and inventions have gained traction beyond his lab at ASU's Ira A. Fulton Schools of Engineering. "Professors typically get honors that relate to their publications and students. Getting patents and moving technologies to commercialization are signs that one's ideas are getting beyond the ivory tower of academia," Rittmann says. "Inventing helps me be part of a new and important culture."

Rittmann is the third Fulton Schools faculty member to be named an NAI Fellow.. Rittmann is an international leader in utilizing bacteria and microbes to solve problems involving water, waste and energy. He holds 15 patents related to his work. He says his greatest patenting achievements involve the Membrane Biofilm Reactor, a commercialized technology used for water decontamination.

About half of Rittmann's inventions involve the MBfR, which uses bacteria to reduce oxidized contaminants — for example, nitrate from agricultural fertilizer and sewage, perchlorate from jet fuel, selenate from coal, chromate from metals industries, and chlorinated solvents from the semiconductor industry — to harmless substances.

In this process, bacteria are given hydrogen gas diffused through hollow-fiber membranes to biofilms that grow attached to the outside of the fiber walls. "It is a very simple and robust system, and it works for all oxidized contaminants," Rittmann says. "It is used to treat contaminated groundwater, wastewater and surface water, and this makes the water safe for human, agricultural or environmental use."

Rittmann is proud of this achievement because it has been moved to commercial scale, it can be used for large array of oxidized contaminants, and he's developing many new applications for it in his lab. He is particularly excited about his continuing work on using the MBfR to create valuable products out of water contaminants. "For example, selenate (a pollutant coming from all operations involving coal) can be reduced in the MBfR to elemental selenium, which is an important industrial feedstock," Rittmann says. "Another example is palladium, which is a precious metal used as a catalyst, such as in the catalytic converters in automobiles. Mining of palladium and industrial uses result in wastes laden with oxidized palladium, and the MBfR can reduce that palladium to elemental palladium nanoparticles that are useful as catalysts."

He also holds patents for the development of microbial electrochemical cells, in which organic waste in wastewater is processed by bacteria through electron transfer with a fuel cell to either decontaminate the water or produce electrical power, hydrogen gas or hydrogen peroxide, a process that depends on where the electrons are transferred. The patents Rittmann holds involve features that make the electrochemical cells more efficient. "Microbial electrochemical cells provide two social benefits: removing organic pollutants via the anode reaction and producing a valuable output via the cathode reaction," Rittmann says.

His innovations also extend to industrial wastewater through a patent on intimately coupled photobiocatalysis (ICPB), which solves the difficult problem of detoxifying wastewater that contains nonbiodegradable organic pollutants such as pesticides, pharmaceuticals and dyes. "Photocatalysis slightly transforms the chemicals so that they become biodegradable, and bacteria are present to biodegrade them immediately," Rittmann explains. "The clever thing about ICPB is that photocatalysis often is used to kill bacteria, but we protect our bacteria so that they can function alongside photocatalysis."

The new class of NAI Fellows will be inducted and presented with a special trophy, medal and rosette pin on April 6, 2017 as part of the Sixth Annual Conference of the National Academy of Inventors at the John F. Kennedy Presidential Library & Museum in Boston, Massachusetts.

Rittmann, a senior investigator in the CBBG ERC, is also a member of the U.S. National Academy of Engineering, a Distinguished Member of the American Society of Civil Engineers, and a Fellow of the American Association for the Advancement of Sciences, the International Water Association, and the Water Environment Federation.

Arson Wins d'Alembert Fellowship

Dr. Chloe Arson was awarded a d'Alembert Fellowship by the University of Paris-Saclay in France to study the "micro-macro modeling of teeth with cavities restored by resin-based techniques" at the Mechanics, Structures and Materials Laboratory at Ecole Centrale de Paris (ECP) with Dr. Elsa Vennat.

During Summer 2017 and Summer 2018, Dr. Arson will continue the work started with two ECP students who interned at Georgia Tech during the two past years. A paper has already been submitted for the 6th Biot Conference of Poromechanics to be held in Paris in July 2017, and a journal paper is in preparation.

Publications

CBBG REU and graduate students are co-authors of a paper that has been accepted for 19th International Conference on Soil Mechanics and Geotechnical Engineering, which will be held in Seoul, Korea in September, 2017.

Based on part of the research they conducted at Georgia Tech in Summer 2016 by CBBG undergraduate students Kendra Jackson, Lindsay Leonard, Karie Yamamoto and Mykala Jones and CBBG graduate researchers Mahdi Roozbahani and Alejandro Martinez (now a faculty member at UC Davis), they co-authored a paper titled "Biologically-inspired insights into soil arching and tunnel stability from the topology of ant nests" with Dr. David Frost that has been accepted for publication in the Proceedings of the quadrennial conference later this year.

Dalal, M., Larson, J. , Zapata, C., Savenye, W., Hamdan, N. , and Kavazanjian, E., Jr. (accepted). An Interdisciplinary Approach to Developing an Undergraduate Module on Biogeotechnical Engineering, Society for Information Technology and Teacher Education (SITE) 2017 Conference, Austin, Texas, March 5-9, 2017.

Kavazanjian, E., Jr., Almajed, A., and Hamdan, N. (2017). Bio-Inspired Soil Improvement using EICP Soil Columns and Soil Nails. Submitted for publication, Proceedings of Grouting 2017, ASCE, July 9-12, Honolulu, HI.

Khodadadi, H.T., Kavazanjian, E., Jr., van Paassen, L., and DeJong, J. (2017). Bio-grout Materials: A Review. Submitted for publication, Proceedings of Grouting 2017, ASCE, July 9-12, Honolulu, HI.

Savenye, W. (2016). The Academic Road: Thorns and Roses. In J. A. Donaldson (Ed.) Women's Voices in the Field of Educational Technology: Our Journeys, Switzerland: Springer International Publishing, pp. 121-130. DOI 10.1007/978-3-319-33452-3.

Savenye, W. (2017). Response by Wilhelmina C. Savenye to Learning From and With Media and Technology by Thomas C. Reeves. In A. A. Carr-Chellman & G. Rowland (Eds.) Issues in Technology, Learning, and Instructional Design: Classic and Contemporary Dialogues. New York: Routledge.

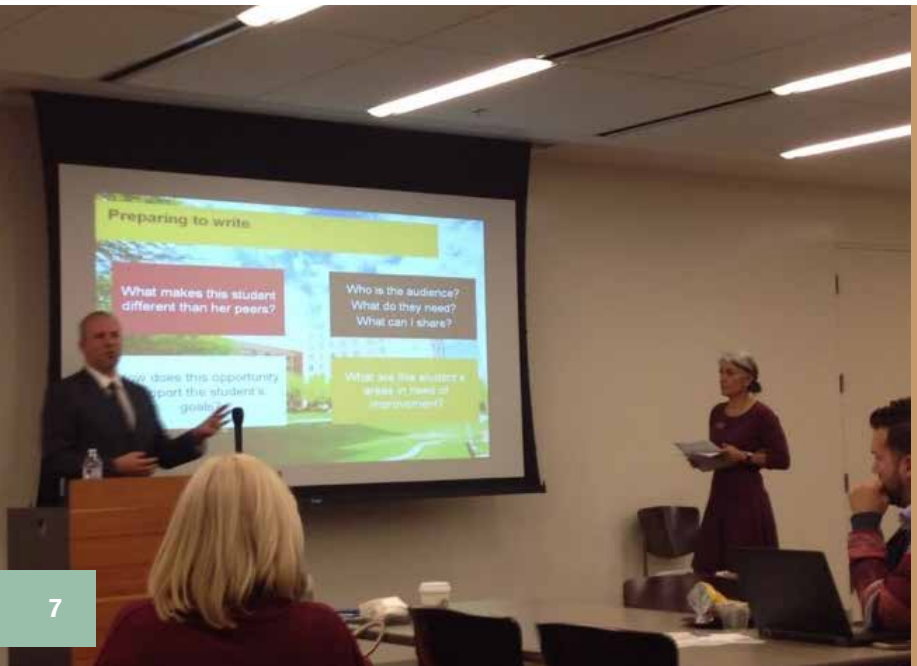
Yang, P., O'Donnell, S., Hamdan, N., Kavazanjian, E., and Neithalath, N. (2016). 3D DEM Simulations of Drained Triaxial Compression of Sand Strengthened using Microbially Induced Carbonate Precipitation. International Journal of Geomechanics, ASCE.

Fernando Patino

Jin., W., Xu, H. , Arson, C., Busetti, S. (2016). A Multi-Scale Computation Tool Coupling Mode II Fracture Propagation and Damage Zone Evolution, International Journal of Nu-merical and Analytical Methods in Geomechanics, DOI: 10.1002/nag.2553

Jin, W., C. Arson (2017). Discrete Wing Crack based Damage Model for Brittle Solids, International Journal of Solids and Structures (accepted).

The models described in these two papers (immediately above) are now being used by new CBBG PhD researcher student, Fernando Patino, to assess bio-inspired models of fracture pattern optimization for fluid-injection and withdrawal. Fernando is preparing a conference paper for the upcoming ARMA symposium in June 2017 on this topic.



Supporting Student Success and Documenting Mentoring Impact Workshop

CBBG education and diversity staff attended a workshop on "Best Practices for Mentoring and Supporting Student Success," offered online and in-person by ASU's Faculty Women's Association on January 19, 2017. Dr. Jacquelyn Scott and Dr. Kyle Mox of the Office of National Scholarship Advisement (onsa.asu.edu) presented techniques, along with many examples, for ways that faculty and graduate student instructors can mentor their students toward learning about and winning scholarships. Best practices included, ways to help students write their personal statements and provide recommenders with specific information about the scholarship criteria, their resume, deadlines and procedures needed to write highly effective letters of support. Other tips included contextualizing reasons students will be successful, providing examples of ways that students "stand out from the crowd" of other applicants, and ways to avoid gender bias in letters. The workshop will be available as a video later; contact Karen.Engler@asu.edu of FWA if you would like the link.

Out & About

Kristin Elwood, CBBG Graduate Student, Dr. Jean Larson, CBBG Education Coordinator, and Dr. Wilhelmina Savenye, CBBG Education Director, made a presentation entitled, "The Ultimate Higher Education Start-Up: Building Education, Outreach, and Diversity for an National Science Foundation Engineering Research Center at the Association for Educational Communications and Technology (AECT) Conference in Las Vegas, Nevada on October 18-21, 2016.

Dr. Ed Kavazanjian, CBBG Center Director, participated in the Transportation Research Board 96th Annual Meeting in Washington, DC, January 8-12, 2017, and presented at workshops and the plenary session.

Dr. Leon van Paassen, CBBG Senior Investigator, made a presentation on "Applications of Bio-mineralization in Geotechnical Engineering" to the Arizona Chapter of the Geo-Institute Event hosted by the American Society of Civil Engineers (ASCE) on January 26, 2017.

CBBG PhD researcher, Rodrigo Borela Valente attended the 1st Winter School on "Multi-Scale Approaches and Multi-Physics Couplings in Fluid and Solid Mechanics, which was held at Universite Grenoble Alpes in France from January 15 to 20, 2017. Rodrigo is working with CBBG Co-PI, Dr. David Frost on modelling root-inspired anchorage systems. Rodrigo joined Georgia Tech in August, 2016 after completing his MS degree at Purdue University. Rodrigo has also recently been appointed as a student member of the CBBG curriculum committee.

Two undergraduate research students joined Dr. Arson's group to work on bio-inspired design of infrastructure networks: Nicholas Djohan is working on, Bio-inspired models of fluid flow: Steiner tree algorithm and fractal leaf venation systems. Aditya Gupta is working on slime-mold inspired modelling of fracture patterns for optimal fluid flow. Both students are part of the Georgia Tech VIP program on Rock Damage Modeling and Energy Geostorage Simulation that Dr. Arson is leading in the Spring 2017 semester.

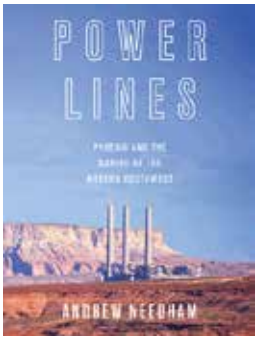
Stephen Romero participated in the launch on December 7, 2016, of a collaboration between UCD CBBG and the United States Forest Service (USFS) to identify research opportunities. This will likely lead to funding on rural roads, slope stability, and dam seepage. It is a great new opportunity.

Professor Jason DeJong, CBBG Thrust 1 Leader, participated in US-NZ NSF-funded workshop on earthquake engineering on November 3-4, 2016, at the University of California, Berkeley. The objective of meeting was to identify future research needs and opportunities. Several of the priorities align directly with CBBG's thrust areas.

On December 12-13, 2016, Professor Alejandro Martinez participated in the National Hazards Engineering Research Initiative (NHERI) training workshop at the University of California, San Diego for potential users of the large shake table. This is relevant to several projects in CBBG, especially those in the infrastructure construction and hazard mitigation.

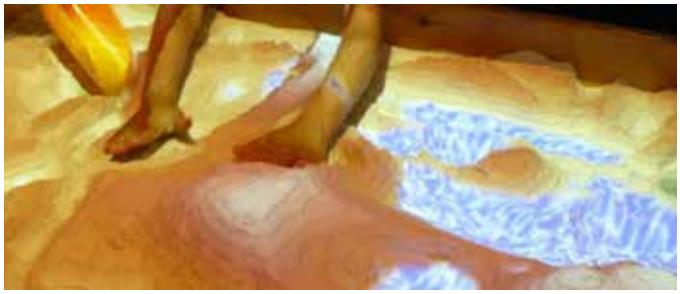
Education & Outreach

Power Lines



On November 16, 2016, Dr. Jean Larson and Dr. Nasser Hamdan visited Chandler-Gilbert Community College for a presentation and discussion with Dr. Andrew Needham, Associate Professor of History at New York University on his book Power Lines about the transformation of the Navajo Nation from an "open landscape of scattered sheepherders" to being surrounded by five coal-burning power plants and the location of two of the world's largest strip mines. Although the low-cost energy helped transform the desert southwest, particularly large metropolitan cities such as Phoenix, Dr. Needham notes that "almost half of Navajo households remained without electricity." The Navajo people initially hoped that energy development would improve their lands, however, misguided planning and unsustainable practices lead to environmentally damaging ash piles and air pollution. The issues that Dr. Needham discussed regarding the negative impacts of energy systems development on Navajo lands align well with CBBG's efforts to promote sustainable infrastructure development and to remediate past abuses. The Center aims to harness natural biological processes to mitigate risks and address challenges associated with urbanization, global climate change, and use of natural resources.

Augmented Reality GeoSandbox



CBBG staff attended the Geographic Information Systems (GIS) Day on November 18, 2016, in the Noble Science and Engineering Library on the ASU Tempe campus. Representatives from the new ASU Library Map and Geospatial Hub demonstrated how to configure and use the augmented reality GeoSandbox, a hands-on mapping and learning platform. This AR GeoSandbox is similar to the Shaping Watersheds Exhibit created at CBBG partner, University of California, Davis, and funded through the National Science Foundation.

UCD Hosts Middle School Students

Dr. Colleen Bronner

On December 12, 2016, Professor Colleen Bronner and students, Gabby Hernandez, Jordan Greer, and Alexandra San Pablo welcomed approximately 50 middle school students from AVID Middle School to the UC Davis Department of Civil Engineering. The students attended a UCD student panel consisting of CBBG students and a hands-on session evaluating their k'nex structures ability to withstand earthquakes using a shake table.

Field Trip Day

On November 21, 2016, students from Grayhawk Elementary School visited CBBG at ASU as part of a new engineering outreach event, "A Day in the Life of…Field Trip Days." Two groups of 25 4th-6th graders participated in an interactive biogeotechnics activity with CBBG researchers. Students were asked if they have ever been in an earthquake and to share what happened. Various Lego buildings were displayed around the room for small groups to examine and record their predictions for the most stable structure. All three buildings were put to the test in a simulated earthquake and participants were surprised by the results! CBBG faculty, staff, and graduate students discussed current research the Center is working on to find more sustainable solutions for some of the challenges that face biogeotechnical engineers.

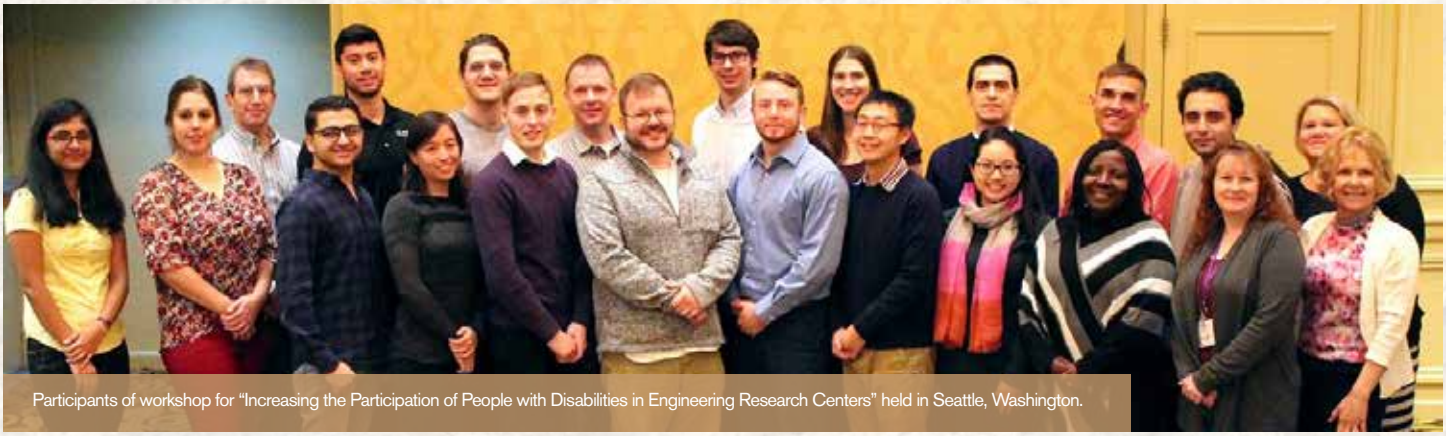
Ready for New Semester

NM Teachers gather at NMSU to learn about STEM afterschool programs

On January 14, 2017, over 300 teachers gathered at New Mexico State University to share best practices and review new curriculum for the upcoming semester of the STEM afterschool programs. After the initial gathering, the teachers divided into groups to share and learn. A new CBBG module was a component of the curriculum being shared with all of the teachers. NMSU is working with schools to schedule pilot programs to field test the CBBG lessons!

Diversity & Inclusion

CBBG Students Participate in Access ERC Workshop



Participants of workshop for "Increasing the Participation of People with Disabilities in Engineering Research Centers" held in Seattle, Washington.

Four students from CBBG, Miriam Woolley from Arizona State, Karie Yamamoto from Georgia Tech, Saman Mostafazadeh Fard from New Mexico State, and Peter Zelkowski from New Mexico State were awarded travel grants from the AccessERC project at the University of Washington (http://www.washington.edu/doit/programs/accesserc). The travel grants allowed the students to students to participate in a three-day workshop at the University of Washington Seattle January 24-26, 2017, on engaging individuals with disabilities at Engineering Research Centers. It consisted of hands-on experiences, films and videos, and discussion with individuals with disabilities. This leadership workshop will help build skills in the area of diversity, inclusion, and engagement.

(left photo) Saman Mostafazadeh-Fard, NMSU CBBG student (front), working with access technologies used by people with disabilities at the workshop "Increasing the Participation of People with Disabilities in Engineering Research Centers"
(right photo) Saman Mostafazadeh-Fard, NMSU CBBG student (second from left), and other participants evaluating accessibility standards of a lab at the Department of Computer Science and Engineering of the University of Washington, Seattle

Resources for Improving Accessibility

Here are a couple of great resources that you can use to improve accessibility. Many of the ideas benefit everyone (in addition to individuals with disabilities):

Checklist for Making Computer Labs Accessible to Students with Disabilities: http://www.washington.edu/doit/checklist-making-computer-labs-accessible-students-disabilities

Checklist for Making Engineering Labs Accessible to Students with Disabilities: http://www.washington.edu/doit/checklist-making-engineering-labs-accessible-students-disabilities

There are many more resources at the AccessERC website!: http://www.washington.edu/doit/programs/accesserc

Industry & Innovation

"Intellectual Property" Webinar

CBBG students and faculty attended our first-ever Center-wide seminar/training on intellectual property. The seminar was given by Dr. Phil Dowd, the Director of Intellectual Assets at AzTE, ASU's technology transfer office, where he has been helping inventors protect and commercialize their ideas for the past ten years. Dr. Dowd joined AzTE with more than a decade of university and startup-based research and development experience, and is the inventor of four issued U.S. patents.

Protection of intellectual property (IP) is important to CBBG and our industry partners, as it provides protection for the products and processes. IP generated by CBBG may be licensable to companies who wish to employ it as developed or within their own processes. Dr. Dowd's presentation outlined basic definitions and concepts pertaining to IP, e.g., the different types of IP, and the steps required to protect them, as well as the importance of IP to universities.

The IP seminar was broadcasted to all four partner universities and served as an initial training/exposure to IP for many CBBG students/faculty. Additional IP training events are being planned, both Center-wide and institution specific, to strengthen student and faculty understanding of IP.

Dr. Dowd's presentation can be accessed at https://asureplay.idsflame.com/replay/showRecordingExternal.html?key=2sPr1pgG9Pl2Ysx. All CBBG participants who missed the seminar are encouraged to view it online.

"Evaluation of the Combined Use of BOF Slag and Sugarcane Bagasse for the Passive Remediation of Acid Mine Drainage" Webinar

CBBG hosted an industry seminar given by Dr. Dennis Grubb, Vice President for Research, Development and Technical Sales at Phoenix Services, LLC—a CBBG Industrial Partner.

The subject of Dr. Grubb's seminar was "Evaluation of the Combined Use of BOF Slag and Sugarcane Bagasse for the Passive Remediation of Acid Mine Drainage." CBBG students and faculty learned about Dr. Grubb's ongoing research on the passive remediation of acid mine drainage (AMD) using a biological material. This work was initiated in Peru (with the University of Colorado, Boulder) when sugarcane bagasse (shredded stalk after sugar removal), a locally abundant organic material, was found to be was capable of treating aggressive AMD without the need for other reagents or media.

Dr. Grubb is currently evaluating the use of two sustainable materials (basic oxygen furnace (BOF) steel slag and sugarcane bagasse) to passively remediate acid mine drainage (AMD) in parallel column studies with the goal of designing a scalable pilot system in 2017. Dr. Grubb believes that these two sustainable media have the potential to significantly reduce costs associated with AMD treatment either as a pre-treatment step or as a stand-alone method, depending on the flows to be treated.

Dr. Grubb has more than 25 years combined academic, research and engineering consulting experience in environmental remediation, beneficial use, stabilization/solidification, environmental forensics and litigation support.

Dr. Grubb's presentation can be accessed at https://asureplay.idsflame.com/replay/showRecordingExternal.html?key=lXfY2hVo6cXD65q.

Education Partners

Phoenix College

ASU is being assisted in its research on enzyme induced carbonate precipitation (EICP) by CBBG Education Partner Phoenix College. ASU researchers have been working with the Phoenix College Center for Microscopy on a variety of EICP-related research activities including Death Valley fieldwork (CBBG Fall 2016). The CBBG is grateful for the opportunity to work in the Phoenix College Center for Microscopy and for the technical guidance offered by the Dr. Eddie W. Ong., the Phoenix College full-time faculty member who helped establish the microscopy center. Dr. Ong describes the microscopy center as a research and outreach facility serving both their students and the greater educational community in Maricopa County. Dr. Ong also serves as the chemistry coordinator (Night Program) and Program Director for Engineering at Phoenix College and is no stranger to the ASU Community. He previously worked as a research scientist at ASU's Center for Solid State Science in the Interactive Nano Visualization for Science and Engineering (IN-VSEE) project and served as the Facility Manager for the center's "Scanning Probe Microscopy Facility." In addition to his work at Phoenix College and ASU, he has worked as a material scientist and chemist at Los Alamos National Laboratory and at Allied-Signal Corporation.

Partner Universities

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

Ira A. Fulton Schools of Engineering
Arizona State University