< SUMMIT >

FALL 2017

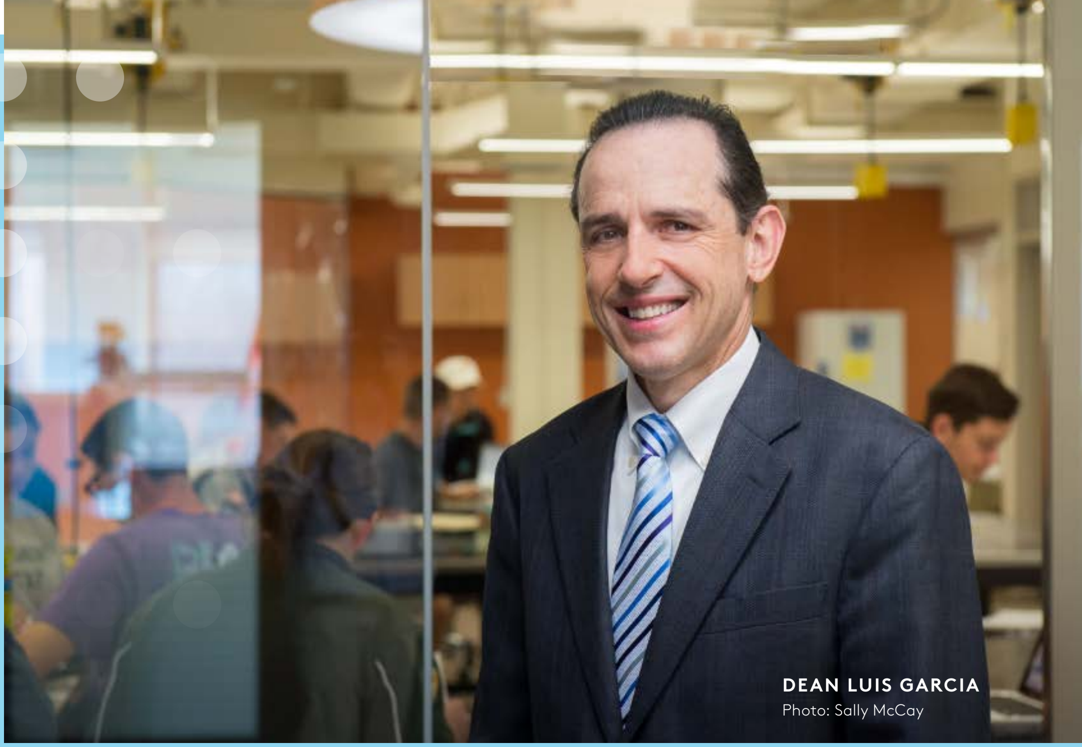
COLLEGE OF ENGINEERING AND MATHEMATICAL SCIENCES

SOLVING FOR: THE BIGGER PICTURE

How CEMS faculty are improving natural and built infrastructure

The University of Vermont

THE DEANS VIEW



DEAN LUIS GARCIA
Photo: Sally McCay

Dear Alumni and Friends of CEMS,

This issue focuses on infrastructure and related research by some of our outstanding faculty members. This is a very timely topic because of the critical need that we have in this country and the world for improved and resilient infrastructure (as has become acutely evident by the damage from the recent natural disasters).

We also highlight the fantastic transformation to the facilities of the college that have been accomplished during the past four years. This critical upgrade of the infrastructure of the college will be complete with the opening of the Innovation building during the summer of 2019. Summer renovations in Votey Hall feature modernization and expansion of all teaching labs, as well as the creation of new labs and design studios to better support the college effort to enable our students to imagine, design and build their future.

The college continues to see growth in our student population (34% over the last four years) while increasing the quality of our student body. This fall we welcomed the most diverse and qualified freshman class ever with the highest SAT scores, while still increasing selectivity by 9% and growing female representation in our incoming class over 81% these last four years.

Our total graduate population has steadily increased over the past few years and we currently have three proposals for graduate programs being reviewed (Ph.D. in Complex Systems and Data Science, M.S. in Biomedical Engineering, and M.S. in Engineering Management) with the expectation that they will be approved for launch in the fall of 2018. These new degrees will help increase the growth of our graduate student population.

In order to meet the needs of our growing student body we have received approval to conduct 14 faculty searches this academic year, in addition to conducting searches for a few support staff. This is an unprecedented number of searches for CEMS and reflects the strong and sustained growth of the college.

Also in this issue of SUMMIT, you will get glimpses of faculty research, student-led senior Capstone projects, service activities by student clubs, service-learning projects and work of our alumni.

I continue to take the opportunity to visit with alumni, parents and friends, and I am very grateful for the generosity and support that you provide to the college. It is a great pleasure to be able to highlight the impact this is having by allowing us to continue the vital mission of educating the next generation of engineers and scientists. We are transforming the learning environment for all students, and this would not be possible without the generous support from our alumni and friends who to date have helped us raise $10.2M of the $26M private funding goal for the STEM Complex project with a little less than two years to go until its completion.

The University of Vermont

CEMS Career Readiness Coordinator Lauren Petrie and Elizabeth Richards Pg 6

Photo: Andy Duback

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I hope you enjoy reading about our many accomplishments. Please make sure to keep us apprised of your news, and check our website and social media feeds for more frequent updates.

Sincerely,
Luis Garcia, Ph.D.
DEAN AND BARRETT FOUNDATION PROFESSOR
COLLEGE OF ENGINEERING AND MATHEMATICAL SCIENCES


Photo: GradImages

Families and Friends gathered at Burlington's Flynn Theatre to celebrate the graduation of 238 CEMS students on May 21, 2017

NEWS

OUR GOAL: Raise $26 million to complete the STEM Complex project to benefit students, faculty and the larger UVM community.

THE IMPACT: Transform UVM's main campus to better connect the many disciplines at the heart of STEM teaching, learning and research.

STEM Complex Discovery Building
Photo: Sally McCay

DESIGNING & BUILDING A BETTER FUTURE

The UVM campus is transforming before our eyes. Fall courses are happening in the new Discovery Building, faculty and graduate students are actively engaged in groundbreaking research in its new research labs. Votey and Perkins halls opened this fall with 22,915 square feet of newly renovated lab and classroom space. The Cook Physical Science Building and Angell Hall have been demolished to make room for construction for the Innovation Building.

The university's largest-ever construction project, the 266,000 square foot STEM Complex consists of three buildings: **Discovery Building,** a new state-of-the-art research and laboratory building to replace Cook, **Innovation Building** a new flexible and tech-equipped classroom and office building, and an extensively renovated **Votey Hall.** Once completed, the $104 million STEM Complex will provide UVM with the infrastructure required to continue teaching and innovating in the STEM disciplines of science, technology, engineering and mathematics.

The STEM Complex is an interdisciplinary hub for advanced research and scholarship as we address the world's most challenging issues. It will also serve as a portal open to students from all disciplines, reflecting UVM's broad commitment to preparing students for the country's fastest-growing careers and industries.

BARRETT BRIDGE

In August, the new Barrett Bridge between Votey and Discovery opened. It's named for Richard Barrett '66, who studied mechanical engineering and also founded the Barrett Scholarship to inspire CEMS students to follow their research passions.

Barrett Bridge
Photo: Sally McCay

moveMountains
The Campaign for The University of Vermont

Move Mountains: The Campaign for The University of Vermont presents CEMS with an opportunity to excel. Campaign support will help us continue to attract the very best students and faculty, while at the same time providing them with the tools and technology they need to move mountains.

JOIN US.

movemountains.uvm.edu
411 Main Street Burlington, VT 05401
888-458-8691 (toll free)

CEMS WELCOMES NEW FACULTY AND STAFF

DAVID DARAIS

Assistant Professor
Computer Science

Joining UVM in January 2018, Darais comes from the University of Maryland, where he has been conducting post-doctoral research in highly reliable software through advances in program analyzers, computer checkable proofs of software correctness and their combination. Originally from Salt Lake City, he completed his B.S. in computer science at the University of Utah, his M.S. in computer science at Harvard University and his Ph.D. in computer science at the University of Maryland.

JAMES EDDY

Lecturer
Computer Science

A part-time lecturer at UVM for several years, Eddy now becomes full-time at CEMS, leaving his post as chief technology officer at a local company. He received his B.A. in physics and applied mathematics from UVM in 2004 before earning a certificate in applied cybersecurity from MIT and an M.S. in information systems from Northwestern University. Eddy's interests include cybersecurity and cryptography, as well as embedded systems programming and computer organization/architecture.

NICCOLO FIORENTINO

Assistant Professor
Mechanical Engineering

Fiorentino's expertise is in solid mechanics with a focus on musculoskeletal biomechanics, orthopaedics and imaging. He earned his Ph.D. in mechanical engineering from the University of Virginia, after which he completed postdoctoral training in the Orthopaedic Research Laboratory at the University of Utah. His long-term research goals are to improve the overall health and well-being of those who have suffered an orthopaedic injury and to reduce the burden from all disabling musculoskeletal conditions.

LAURENT HÉBERT-DUFRESNE

Assistant Professor
Computer Science

Hébert-Dufresne joins UVM CEMS in January 2018. He is a James S. McDonnell Fellow at the Santa Fe Institute, specializing in the research of network theory and nonlinear dynamics. He received his B.Sc., M.Sc. and Ph.D. in physics from the Université Laval in Québec, has authored dozens of papers and lists biking, hiking, snowshoeing, music, cooking, Scotch, coffee and French pastries among his interests.

RYAN MCGINNIS

Assistant Professor
Electrical and Biomedical Engineering

McGinnis earned his B.S. in mechanical engineering, graduating *summa cum laude* with honors, from Lafayette College in Pennsylvania, before completing his Ph.D. at the University of Michigan and undertaking postdoctoral training at the same institution's School of Kinesiology. Since August 2016, he has been a lecturer at UVM, teaching such courses as System Dynamics and Wearable Sensing in Biomechanics. He has also worked as an algorithms engineer and consultant for MC10, Inc. Additionally, he's consulted for several start-ups and larger companies.

MELISSA RUBINCHUK

Departmental Administrator

Rubinchuk joined the Department of Mathematics and Statistics this summer. She has a B.S. in Marine Biology from the University of Rhode Island and early in her career she led research/science based dives while teaching undergraduate field labs at the Bermuda Institute of Ocean Sciences (BIOS). After Moving to Vermont seven years ago, she began a residential and commercial property management business here in Burlington. She brings business, customer service, education, and entrepreneurial experience to her new position running the day-to-day operations of the department's front office.

SAFWAN WSHAH

Assistant Professor
Computer Science

Wshah joins UVM CEMS from PARC (Palo Alto Research Center), a Xerox company, where he worked as a research scientist in the fields of machine learning/deep learning, computer vision, and image/video processing. Dr. Wshah holds a Ph.D. in computer science and engineering from SUNY-Buffalo. He received fourteen issued U.S. patents and has authored 18 conference and journal publications. He is currently investigating machine learning algorithms to be applied in transportation and healthcare fields.

Faculty Photos: Sally McCay | David Darais Photo: Olivia Darais


Photo: Sally McCay

UVM NAMES GEORGE PINDER UNIVERSITY DISTINGUISHED PROFESSOR

During the 216th Commencement Ceremonies, May 20 and 21, 2017, at UVM, President Thomas Sullivan and Provost and Senior Vice President and Professor of Engineering David Rosowsky named George Pinder as the newest University Distinguished Professor.

"Professor Pinder, you are an internationally recognized pioneer in the creation and use of computer models for solution of groundwater contamination problems," said Rosowsky in his remarks. "Working at the nexus of groundwater hydrology and numerical mathematics, you were the first to recognize the power of this interdisciplinary approach to addressing the critical environmental issue of rehabilitating contaminated aquifers. Always at the forefront of pioneering efforts in groundwater modeling since your days as a graduate student; today you are universally recognized as one of the preeminent scholars of that discipline."

A citizen of both the U.S. and Canada, Pinder studied at the University of Illinois and the University of Ontario. After working as a research hydrologist, he was a professor and chair at Princeton University and served as the CEMS Dean at UVM from 1989 to 1996; he has mentored hundreds of students and authored or co-authored more than 250 papers and 16 book chapters. Pinder was the founding editor of *Advances in Water Resources and Numerical Methods for Partial Differential Equations* and has received numerous prestigious recognitions including the Lifetime Achievement Award from the Environmental and Water Resources in 2016. He is the only UVM faculty member to have been inducted into the National Academy of Engineering.

CEMS BY THE NUMBERS

31.3
THE AVERAGE CLASS SIZE IN 2017

22,915
SQUARE FEET OF TEACHING AND RESEARCH SPACE RENOVATED IN PERKINS AND VOTEY HALLS

101%
OF THE $11 MILLION FUNDRAISING CAPITAL CAMPAIGN GOAL RAISED FOR SCHOLARSHIPS, PROFESSORSHIPS AND PROGRAMMATIC SUPPORT

39.2%
OF THE $26 MILLION PRIVATE FUNDING GOAL RAISED FOR THE STEM COMPLEX

81.2%
INCREASE IN THE NUMBER OF FEMALE FTFY STUDENTS FROM FALL 2013 TO FALL 2017

CEMS STUDENTS SHARE INTERNSHIP EXPERIENCES

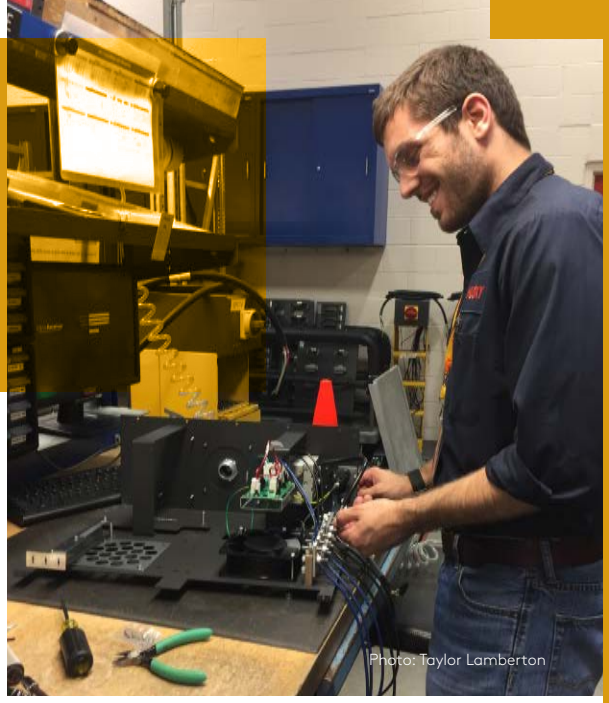


Photo: Taylor Lamberton

This past summer, **Rebecca McManus '18** interned at Carnegie Mellon University building robots and working on autonomous drone designs. An electrical engineering student, she was selected from more 800 applicants to be part of a 35-student team participating in Carnegie Mellon's Robotics Institute Summer Scholars program.

Kevin Teets '18, meanwhile, received training for both Hospital Equipment Maintenance System (HEMS) Enterprise and Alaris equipment during his seven-month biomedical engineering aide internship with the Technical Services Partnership (TSP) division at UVM Medical Center. Kevin also learned about small infusion pumps, thermometers and patient-owned devices needing inspection upon hospital admittance. Disassembling equipment that was being retired from service allowed him to see the technology inside the biomedical equipment; he also assembled new equipment with accompanying performance inspections before adding them to the inventory. "I merely scratched the surface of the field," says Kevin, "but gained technical skills and an appreciation for the hard work that goes on behind the scenes at hospitals."

Sam Shuster '16 has been earning his accelerated masters at UVM and working with E.A.S.Y. LLC on the manufacturing and design of tactile graphic printers that are accessible drawing tools for people who are visually impaired. "I chose to do an accelerated master's at UVM primarily because Dr. Rosen (co-founder) of E.A.S.Y. LLC encouraged me to apply to work with him," says Sam. "My project is really exciting, and it's the kind of work that hasn't really been done before. I get to help work on pretty much all aspects of the mechanical and electrical systems of the printer, and that is experience that is hard to come by immediately after college."

Taylor Lamberton '18 spent his summer working as an assembly technician at Husky Injection Molding Systems in Milton. His primary area was in the Altanium Controllers Department, which builds and tests temperature controllers. "Each controller is custom made, and I could spend as little as one or two hours or three to four days building one," says Taylor. "The hardest controller I've built is the model they call the UltraSync, which can control the temperature of the mold and the movements of the mold as well by connecting to a servomotor. Because of this, there are a lot of wiring and electrical components." Taylor was also able to work with some of Husky's design engineers, learning about processes for designing cables, controllers, and hot runners. Taylor notes that he received valuable career advice from mechanical engineers at Husky.

149 TO 219

INCREASE IN GRADUATE STUDENT ENROLLMENT FROM FALL 2013 TO FALL 2017

> 79% -70%

PERCENTAGE BY WHICH CEMS INCOMING FRESHMAN CLASS SELECTIVITY HAS INCREASED FROM FALL 2013 TO FALL 2017

274 TO 347

INCREASE IN FIRST TIME FIRST YEAR (FTFY) STUDENT ENROLLMENT FROM FALL 2013 TO FALL 2017

American Society of Civil Engineers Honors UVM with Awards

At the New England Regional ASCE Steel Bridge Competition, hosted by the University of Connecticut on April 8, UVM placed second in construction speed, second in stiffness and second in efficiency. By landing in third overall, UVM qualified to go to the 2017 National Student Steel Bridge Competition, hosted by Oregon State University in Corvallis.

Photo: UVM American Society of Civil Engineers (ASCE).

AWARDS

ACM Award
Lily Nguyen

AIAA Award
Greg Castaldi

ASCE Award
Zachary Miles & Ryan Graves

ASME Award
Noah Mostow

Atwater-Kent EE Senior Award
Blake Hewgill & Nicholas Medor

BME Sophomore Award
Lara Weed

Brett Vincent Gorky - Dean's Recognition Award
Noah Mostow

CE Junior Award
Timothy Yandow

CE Student Engineer of the Year Nominee
Elizabeth Richards

CEMS First Year Student of Color Award
Eli Bacher-Chong

CEMS Sophomore Student of Color Award
Luis M. Garcia

CEMS Junior Student of Color Award
Felix Madero

CEMS Senior Student of Color Award
Isiah Simon

CEMS Non-Traditional Student of Color Award
Abdoulaye Ira

CS Graduate Award
Sepehr Amir-Mohammadian

CS Sophomore Award
Josiah Witt

CS Junior Award
Brian Columbini

CS Senior Award
Owen Marshall

Douglas P. Fay Award
Aaron James & Samuel Marano

Edmund F. Little Senior Award
Tyler Kane & Lukas Adamowicz

Edward H. Phelps Senior Prize
Kaelyn Burbey

EE Junior Award
Adam Potasiewicz

EE Student Engineer of the Year Nominee
Blake Hewgill

EE Sophomore Award
Connie Ou

EENV Junior Award
Christopher Diehl

EMGT Senior Award
Jackson Dayton

Engineers Without Borders Award
Samuel Marano

IEEE Award
Tariye Peter

John F. Kenney Graduate Award
Andrew Reagan

June Veinott Award
Gretta Groves, Sarah Nelson, Eve-Audrey Picard, Alicia Tanneberger, Haley Rose Warren

Lecture Instruction
Abigail Ross

MATH Sophomore Award
Laura Jennings

MATH Junior Award
Tyson Pond

MATH Senior Award
Nicholas Adler

ME Graduate Teaching & Outreach Award
Ahmad El Achwah

ME Graduate Research Award
Farzad Farajidizaji

ME Student Engineer of the Year Nominee
Madeline Pomicter

ME Sophomore Award
Becca Osborn

ME Undergraduate Research Award
Ashley Chase

ME Undergraduate Service Award
Jake Fragnoli

Nam Sang Kil Scholarship - Statistics Undergrad Achievement Award
Niesa Ryder

Nam Sang Kil Scholarship in Mathematics
Ryan Gallagher & Rachel Bayersdorfer

Nam Sang Kil Scholarship in Statistics
Rachel Schmidt

Reginald Milbank CE Sophomore Award
Dunia Karzai

Reginald Milbank EENV Sophomore Award
Sienna Roberge

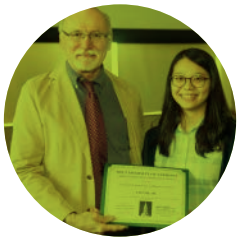
Sean O'Flaherty Fahey Commemorative Junior Award
Madeline Pomicter

Society of Women Engineers Award
Cassandra Albrecht

STAT Graduate Award
Gareth Cleveland

Student Engineer of the Year
Cassandra Albrecht

Tau Beta Pi/John O. Outwater Prize
Elizabeth Richards



Professor Kurt Oughston and Connie Ou

Professor Yves Dubief and Madeline Pomicter

CEMS Career Readiness Coordinator Lauren Petrie and Elizabeth Richards

Photos: Andy Duback

COLLEGE OF ENGINEERING AND MATHEMATICAL SCIENCES

STUDENT NEWS

UPCOMING EVENTS

AIKEN K-12 MAKER FAIRE AND ENGINEERING CHALLENGE
Saturday, December 2, 2017
10am – 2pm
UVM Davis Center

FIRST ROBOTICS CHAMPIONSHIP
Saturday, February 24, 2018
Essex High School, Essex Junction, Vermont

University of Vermont Alternative Energy Racing Organization (UVM AERO) placed third in the Electric Category at Formula Hybrid competition last spring at the New Hampshire Motor Speedway in Loudon, NH.

A State of Vermont House Resolution has honored CEMS Civil Engineering students Jacob Sprague, Rachel Lombard, Louisa Deering, Jack Barfuss, and advisor John Lens for their outstanding participation in the U.S. Department of Energy's 2017 Race to Zero Student Design Competition.

Undergraduate researcher and Barrett Scholar Ena Ibrisimovic '20 worked this summer with Professor Frederic Sansoz, studying the growth of silver nanowires, which are very small (nano-sized) wires made of silver. The wires "come with some amazing properties like high conductivity and flexibility," she says. "My research is focusing on better controlling their growth so that smooth, unbranched wires can be made, as that is the ideal form/shape for their applications in electronics. Specifically, they can be applied to already existing technologies, such as solar panel electrodes, to make them more energy efficient."

Last spring more than 75 computer science students had the opportunity to work with the Raspberry Pi, a credit-card sized Linux based computer in the course CS 121 Computer Organization. Team "Eye's on the Pi's" was made up of Aaron Wise, Noah Mintz Roberts and Kevin Masse. Their project, intended to assist the visually impaired, incorporates sensors and dynamic haptic feedback that allow the user to navigate complex environmental obstacles. In their final report the team said, "We're really excited with how it's turned out so far; this class has been an incredibly unique opportunity to get creative and make a project." The course was taught by Professor Jim Eddy.

Engineering students and recent graduates Emmie Bolt, Greg Castaldi, Sami Connolly, Duncan Hacker, Cam Ruffle-Deignan, Moritz Thali, Matthew Walton, and Jacob Wainer and their faculty advisor Professor Darren Hitt won second place in the American Institute of Aeronautics and Astronautics (AIAA) Foundation Undergraduate Life Sciences Team Design Competition for their project "Design of a Manned Base on Phobos."

UNDERGRADUATE RESEARCH
Ena Ibrisimovic studies the growth of silver nanowires in Professor Frederic Sansoz's new lab in the Discovery Building.
Photo: David Seaver

FORMULA HYBRID
AERO at the 2017 Formula Hybrid Competition at the New Hampshire Motor Speedway in Loudon, NH.
Photo courtesy of Fomula Hybrid Competition.

FACULTY & STUDENTS
Professor Jim Eddy and students Aaron Wise, Noah Mintz Roberts and Kevin Masse.

EXPANDING INNOVATION

MassMutual Funds Pilot Program with $500,000

Professors James Bangrow, Chris Danforth and Peter Dodds of UVM's Complex Systems Center.
Photo: David Seaver

In August, Massachusetts Mutual Life Insurance Company (MassMutual) announced that it's providing UVM's Complex Systems Center with $500,000 to fund an innovative pilot program that helps to expand the applications of computational, social and data science.

The partnership with UVM focuses on three specific initiatives:

Funding for a newly created MassMutual Ph.D. Fellowship. This four-year fellowship will provide funding for a Ph.D. student working in data science and complex systems at UVM. The MassMutual fellow will explore research at the intersection of human health and well-being, data science, and complex systems.

Supporting faculty collaboration. Through a named research fund, MassMutual will support exploratory questions related to wellness, human behavior and networks with a team of interdisciplinary faculty in UVM's Vermont Complex Systems Center.

Hiring a visual data artist-in-residence. Visual data is an essential tool that communicates complex information clearly, creatively and effectively. The MassMutual Visual Data Artist-in-Residence will partner with Complex Systems Center students and faculty and with MassMutual's data science team to create visualizations that allow people to easily understand and interact with complex data.

"We are excited to be working with the Vermont Complex Systems Center, and the world class research talent it brings to our strategic initiative of blending and applying academic and industrial capabilities to many fundamental issues," said Sears Merritt, MassMutual's head of data science. "Our partnership with UVM aims to enable the development of novel quantitative methods, as well as uncover new insights related to changes and patterns in human behavior and the determinants of social well-being."

The data science initiative with MassMutual represents the largest single corporate collaboration with the Vermont Complex Systems Center since its inception in 2009.

"All of us at the Vermont Complex System Center are very excited about our new and growing connection with MassMutual," said Professor Peter Dodds. "In this increasingly data-rich age, our students are becoming ever more valuable for companies like MassMutual, and we're also seeing a vast landscape of basic science possibilities."
— with reporting from MassMutual and UVM

RESEARCH AWARDS

Faculty from across the College are engaged in leading-edge research sponsored by the National Science Foundation, NASA, and other funding agencies.

LEARN MORE
For more awards visit
UVM.EDU/~CEMS/

PRINCIPAL INVESTIGATOR	SPONSOR	PROJECT TITLE	AWARD
Mandar Dewoolkar Darren Hitt	NSF	Collab Rsrch: Novel Measurement of Shear Strength Evolution in Liquefied Soil and Calibration of a Fluid-based Model for Flow Liquefaction	$ 377,339
Jonathan Dowds Jim Sullivan	VAoT/USDOT RITA	Snow and Ice Control Performance Measurement: Comparing "Grip", Traffic Speed Distributions and Safety Outcomes during Winter Storms	$ 132,943
Douglas Fletcher	NASA	Energy Accommodation from Surface Catalyzed Reactions in Air Plasmas	$ 74,000
Ehsan Ghazanfari	VAoT/USDOT RITA	Implementation of Intelligent Compaction for Pavement Construction in Vermont	$ 126,554
Paul Hines Mads Almassalkhi	VELCO	Stochastic Receding Horizon Optimal Power Flow Given High-resolution Weather Forecast Data	$ 108,291
Paul Hines Maggie Eppstein	NSF	CRISP Type 2: Collaborative Research: The Risks and Benefits of Interdependence in Critical Infrastructure Systems	$ 979,522
Darren Hitt	NASA	Main Space Grant Year 3	$ 570,000
Darren Hitt	NASA	Vermont Phase V NASA EPSCoR RID Project	$ 125,000
Patrick Lee	Guangdong Jinming Machinery Co.	A Comprehensive Investigation of Polymer Foaming Behavior in Blown Film Foaming Process, Phase 2	$ 81,000
Julia Perdrial Donna Rizzo	NSF	Collab Rsrch: Combining Complex Systems Tools, Process-based Modeling and Experiments to Bridge Scales in Low Temperature Geochemistry	$ 300,204
Douglas Porter Darren Hitt	National Park Service	Conduct Historic Preservation Field School to Assess and Stabilize the Lost Horse Mill, Joshua Tree National Park	$ 195,330
Donna Rizzo Douglas Porter, Mandar Dewooklar, Dryver Huston, Asim Zia	NSF	S&CC: Smart Connections for Conserving and Catalyzing Community Cultural Resources	$ 99,993
Christian Skalka	NSF	SaTC: CORE: Small: Collaborative Research: A New Approach to Federated Network Security	$ 196,872
Tian Xia Dryver Huston	White River Technologies	Acoustically/Vibrationally Enhanced High Frequency Electromagnetic Detector for Buried Landmines Phase II	$ 369,920

FACULTY NEWS

JIANKE YANG
Photo: Sally McCay

CATHERINE BLISS
Photo: Keri Toksu

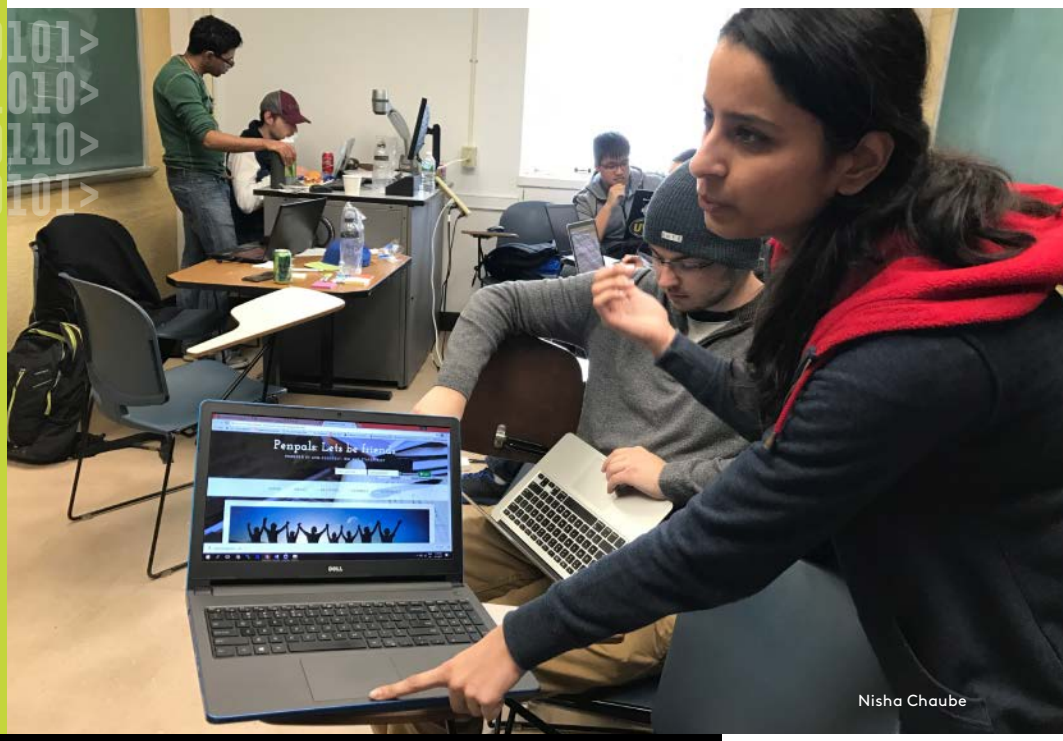
• **Jianke Yang** has been named a University Scholar for 2017-2018. He joined UVM in 1994, rose to the rank of full Professor in 2005, and is a professor of applied mathematics in the Department of Mathematics and Statistics. He received his B.S. from Tsinghua University and Ph.D. from MIT. Yang has been editor-in-chief for the premier applied mathematics journal, *Studies in Applied Mathematics,* since 2014. He received the inaugural College of Engineering and Mathematical Sciences Faculty Award for Excellence in Research at UVM in 2014. He also sits on the organizing board for two premier conferences, CLEO in the field of nonlinear optics and IMACS in the field of nonlinear waves in general. His research in applied and physical mathematics has been supported by continuous extramural funding for the past 20 years. His work developing advanced mathematical techniques to solve important physical problems combines theoretical approaches with applied solutions. He has authored two research monographs and 130 articles and book chapters.

• **Catherine Bliss** has received the Kroepsch-Maurice Excellence in Teaching Award

CEMS PROMOTES PROFESSORS

• **Josh Bongard**, **Mandar Dewoolkar** and **Tian Xia** have been promoted to full professors. **Eric Hernandez** has been promoted to associate professor, and **Jim Bagrow** and **Eshan Ghazanfari** were reappointed to assistant professor.

DEPARTMENT OF COMPUTER SCIENCE HOSTS THIRD ANNUAL CODEFEST

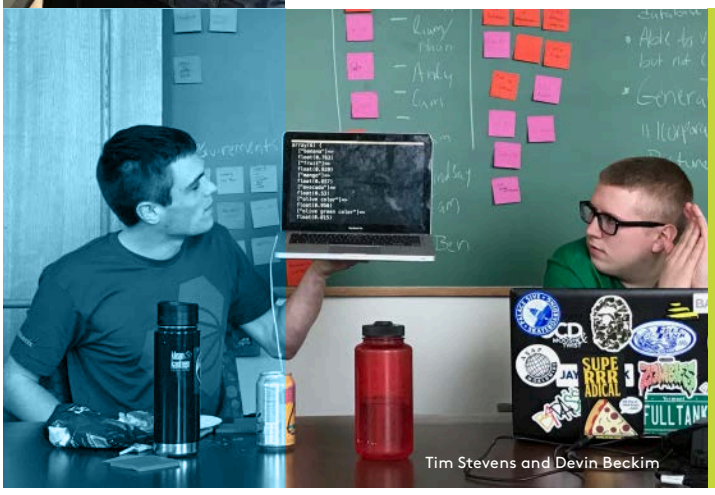


Nisha Chaube

< / AGILE CODEFEST >


Corey Dew and McKenna Todd

The Department of Computer Science, in conjunction with the State Street Corporation and IBM, hosted the third annual Agile Codefest on March 31 and April 1. State Street and IBM sent teams of professional software engineers to help student teams learn and leverage Agile software development lifecycle principles, and provided food and prize money. IBM was new to the CodeFest this year and provided students with free access to its Bluemix cloud computing platform. All projects were required to be built on the Bluemix platform and take advantage of some services and APIs that Bluemix provides, including Watson Language Translation, Speech to Text, Alchemy News, Natural Language Processing Services, and Live Weather information. Students were encouraged to attend Bluemix information webinars in advance of the Codefest, and three Bluemix experts were on-site throughout the CodeFest to help teams trouble-shoot problems.



Tim Stevens and Devin Beckim

There were 70 students participating, and they were organized into eight teams of five to 10 students. Each team developed its own project vision for an app that should benefit student life on campus. Projects went through four Agile iterations, with final presentations at the end of the day. Nineteen judges, including UVM faculty and staff and software engineers and other professionals from State Street and IBM evaluated Teamwork, Technical, Innovation, and Impact.

1ST PLACE ($1500): CAMPUS MAP
Brandon Goodwin, David Duong, Eric DeWind, Meghan King, Monique Demers

2ND PLACE ($700): NOTAKER
Aaron Longchamp, Alex Beard, Anel Korajkic, Christopher Pecor, Cuong Lai, Emma Tait, Thang Nguyen, Xuanyi Zhu

3RD PLACE ($300): CATAMOUNT MARKETPLACE
Andrew Hollar, Benjamin Citrin, Cam Weston, Devin Beckim, Ishan Verma, Ivan Spizizen, Liam O'Toole, Lindsay Ross, Tim Stevens, Timothy Guyon

Photos courtesy of the Department of Computer Science.

IN MEMORIAM: KEN GROSS, PROFESSOR EMERITUS OF MATHEMATICS

BY JEFF BUZAS
PROFESSOR AND CHAIR
DEPARTMENT OF MATHEMATICS AND STATISTICS

Ken's long and highly successful career in academia spanned 50 years. Prior to coming to UVM, he had faculty appointments at Tulane University, Dartmouth College, University of North Carolina and University of Wyoming. He was recruited to UVM in 1987 to chair the Department of Mathematics and Statistics. Ken always excelled at development, and during his time as department chair he led the creation of a mathematics Ph.D. program and jointly created the applied mathematics program with Professor Bill Lakin, whom he hired to lead the program. In 1989, he also co-founded the Vermont State Mathematics Coalition, an organization that is still active in administering the Governor's Institute in Mathematical Sciences, among other important functions. In 1993, Ken co-founded the Vermont High School Summer Mathematics Institute with Tony Trono, which evolved into the Governor's Institute in Mathematical Sciences in 2005.

In 1999, Ken founded the Vermont Mathematics Initiative (VMI) to improve mathematics and statistics education in K-12 (initially pre-K to grade 8). The VMI has been an immense success and is known as a model program nationally. Over 500 teachers have obtained masters degrees in mathematics through the VMI since its inception. "You can't teach what you don't know, and your students won't love the subject unless you love the subject," he told The Washington Post.

Ken had an impressive research record, having published 40 papers and edited three books. His research was continuously supported by NSF grants from 1968 through 2003; thereafter, his work in education was supported by grants from NSF, the U.S. Department of Education, and the Vermont Department of Education.

Ken received many prestigious awards throughout his career, spanning teaching, scholarship and service, to mention but a few. In 1981, Ken received the prestigious Chauvenet Prize from the Mathematics Association of America. He also received three significant UVM awards. He was honored as a University Scholar in 1995, received the George V. Kidder Outstanding Faculty Award in 1998, and was named Williams Professor of Mathematics in 2012. In 2007, he received The Deborah and Franklin Tepper Haimo Award for Distinguished University Teaching. He was an inaugural Fellow of the American Mathematical Society in 2012 and received The Reverend Stanley J. Bezuska Lifetime Service Award for Mathematics Teaching and Learning in 2013.

KEN'S LONG AND HIGHLY SUCCESSFUL CAREER in academia spanned 50 years and during this time he and his work impacted countless individuals. A celebration of Ken's life took place on Sunday, October 15, 2017 at the UVM Alumni House

Ken's dedication and passion for mathematics and the Department of Mathematics and Statistics was infectious. While he will be sorely missed, may the words of his first graduate student, Yang Hua, be a comfort:

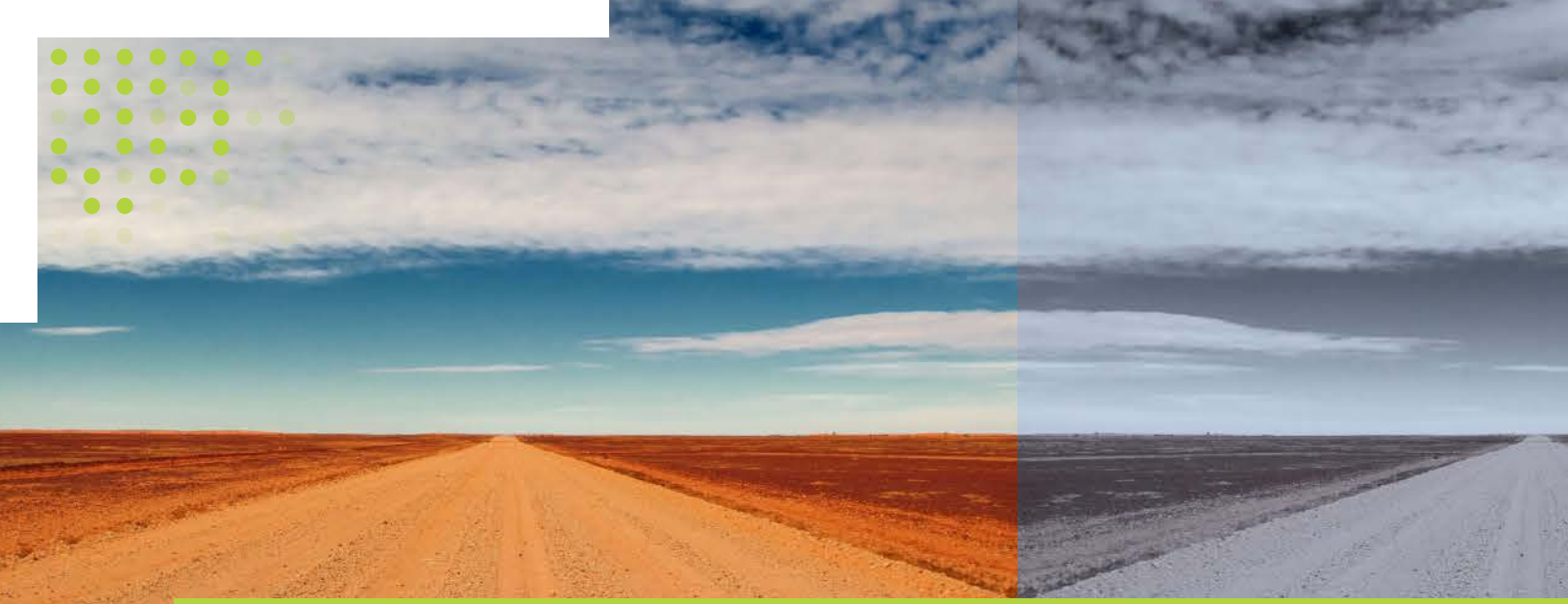
To live well is Ken's best wish and love to us.
Wipe out tears and live well as usual.
Let him stay in our hearts.

Our heartfelt condolences go out to his family.

Photo: David Seaver

VERMONT MATHEMATICS INITIATIVE

Dedicated K-12 math teachers gathered this past summer for the Vermont Mathematics Initiative (VMI) in pursuit of master's degrees in teaching, curriculum and instruction.



< /ELEVATING HUMANKIND >

RESEARCHERS DISCOVER AN EARLY-WARNING SYSTEM FOR DEPRESSION IN SOCIAL MEDIA

When you're feeling blue, your photos turn bluer, too. And more gray and dark as well, with fewer faces shown. In other words, just like people can signal their sadness by body language and behavior—think deep sighs and slumped shoulders—depression reveals itself in social media images.

BY JOSHUA E. BROWN

That's the conclusion of new research showing that computers, applying machine learning, can successfully detect depressed people from clues in their Instagram photos. The computer's detection rate of 70 percent is more reliable than the 42 percent success rate of general-practice doctors diagnosing depression in-person.

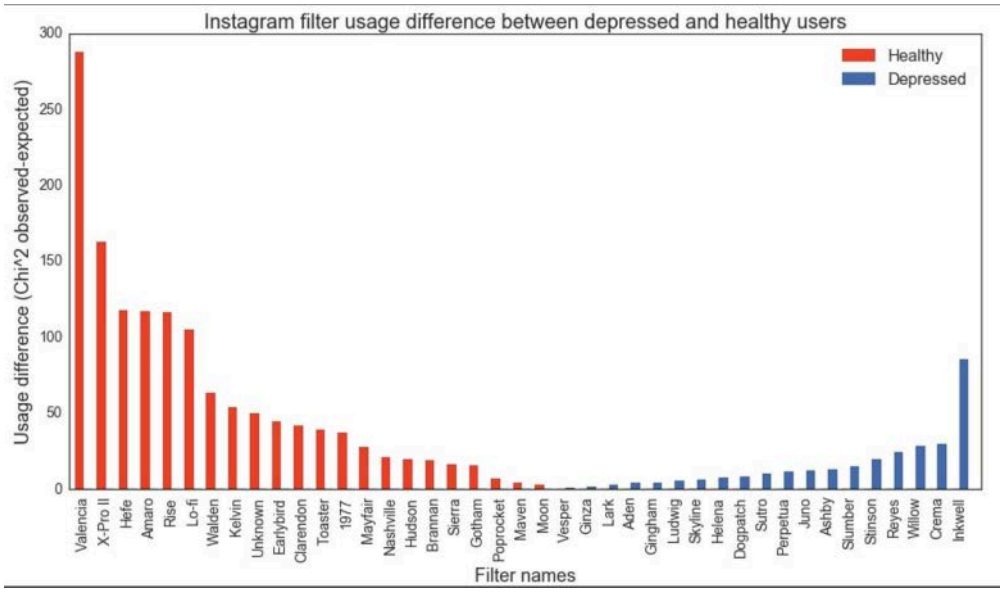
"This points toward a new method for early screening of depression and other emerging mental illnesses," says Chris Danforth, a professor at the University of Vermont who co-led the new study with Andrew Reece of Harvard University. "This algorithm can sometimes detect depression before a clinical diagnosis is made."

The team's results were published August 8 in a leading data-science journal *EPJ Data Science*—and have been followed by media stories in outlets around the world including *The New York Times, USA Today, Quartz,* and hundreds of others.

EMOTIONAL FILTERS

The scientists asked volunteers, recruited from Amazon's Mechanical Turk, to share their Instagram feed as well as their mental health history. From 166 people, they collected 43,950 photos. The study was designed so that about half of the participants reported having been clinically depressed in the last three years.

Then they analyzed these photos, using insights from well-established psychology research, about people's preferences for brightness, color, and shading. "Pixel analysis of the photos in our dataset revealed that depressed individuals in our sample tended to post photos that were, on average, bluer, darker, and grayer than those posted by healthy individuals," Danforth and Reece write in a blog post to accompany their new study. They also found that healthy individuals chose Instagram filters, like Valencia, that gave their photos a warmer brighter tone. Among depressed people the most popular filter was Inkwell, making the photo black-and-white.



WHAT FILTER DO YOU CHOOSE?
New research shows that Instagram photos posted by depressed individuals had values shifted towards those in the right photograph—darker, grayer and bluer—compared with brighter photos posted by healthy individuals. Photo: EPJ Data Science

"In other words, people suffering from depression were more likely to favor a filter that literally drained all the color out the images they wanted to share," the scientists write.

Faces in photos also turned out to provide signals about depression. The researchers found that depressed people were more likely than healthy people to post a photo with people's faces—but these photos had fewer faces on average than the healthy people's Instagram feeds. "Fewer faces may be an oblique indicator that depressed users interact in smaller settings," Danforth and Reece note, which corresponds to other research linking depression to reduced social interaction—or it could be that depressed people take many self-portraits.

"This 'sad-selfie' hypothesis remains untested," they write.

ALGORITHMIC AID

As part of the new study, Danforth and Reece had volunteers attempt to distinguish between Instagram posts made by depressed people versus healthy people. They could, but not as effectively as the statistical computer model—and the human ratings had little or no correlation with the features of the photos detected by the computer. "Obviously you know your friends better than a computer," says Chris Danforth, a professor in UVM's Department of Mathematics and Statistics and co-director of the university's Computational Story Lab, "but you might not, as a person casually flipping through Instagram, be as good at detecting depression as you think."

Consider that more than half of a general practitioners' depression diagnoses are false—a very expensive health care problem—while the computational algorithm did far better. The new study also shows that the computer model was able to detect signs of depression before a person's date of diagnosis. "This could help you get to a doctor sooner," Danforth says. "Or, imagine that you can go to doctor and push a button to let an algorithm read your social media history as part of the exam."

As the world of machine learning and artificial intelligence expands into many areas of life, there are deep ethical questions and privacy concerns. "We have a lot of thinking to do about the morality of machines," Danforth says. "So much is encoded in our digital footprint. Clever artificial intelligence will be able to find signals, especially for something like mental illness." He thinks that this type of application may hold great promise for helping people early in the onset of mental illness, avoid false diagnoses, and offer a new lower-cost screening for mental health services, especially for those who might not otherwise have access to a trained expert, like a psychiatrist.

"This study is not yet a diagnostic test, not by a long shot," says Danforth, "but it is a proof of concept of a new way to help people."

WHAT LIES

SOLVING FOR THE BIGGER PICTURE

New research project uses a "smart cities" approach to managing and using local underground utility infrastructure

BY SARAH TUFF DUNN

On a recent Wednesday afternoon, CEMS Professor Dryver Huston offers a tour of his laboratory on the UVM campus where he is producing sophisticated sensor systems for the cities of Burlington, Winooski and beyond. A valuable project that Huston has undertaken with Professor Tian Xia and other UVM researchers is to help planners manage and use urban underground utility infrastructure as part of the nonprofit US Ignite Global Cities Team Challenge. Its a "smart cities" approach that uses remote sensing and information technology to detect and monitor water pipes, gas lines and much more by leveraging the extensive research experience of the CEMS community.

The EAGER project, as it is known, is a new strategy for mapping places once invisible to city planners, and one designed to prevent failures and disruptions after emergencies and disasters, saving money and allowing urban areas to operate more efficiently. Having started in September 2016, this innovative project will continue until next August.

"We're exploring microwave sensing technology to image the underground utility and structural conditions," explains Xia. "The microwave signal can penetrate through barriers." For example, a cell phone signal can penetrate

GROUND RADAR
Professors Dryver Huston and Tian Xia test their mobile ground penetrating radar system on the UVM campus with graduate students Yu Zhang and Dan Orfeo
Photo: David Seaver

BENEATH?

A SELECTION OF SCHOLARLY PUBLICATIONS BY HUSTON AND XIA

Ahmed A, Zhang Y, Burns D, Huston D, Xia T. (2016) "Design of UWB Antenna for Air-Coupled Impulse Ground-Penetrating Radar." IEEE Geoscience and Remote Sensing Letters, Vol. 13, Issue 1, pp 92 – 96, DOI: 10.1109/LGRS.2015.2498404

Barrios C, Motai Y, Huston D. (2015) "Trajectory Estimations using Smartphones." IEEE Transactions on Industrial Informatics, IEEE Transactions on Industrial Electronics, 62 , 12, 7901-7910, DOI:10.1109/TIE.2015.2478415

Venkatachalam AS, Xu X, Huston D, Xia T. (2013) "Development of a New High Speed Dual-Channel Impulse Ground Penetrating Radar." IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing Vol. 7, No. 3, 753-760 DOI:10.1109/JSTARS.2013.2280995

Huston D, Xia T, Burns D, Orfeo D, Zhang Y, Ou C. (2017) "Mapping, Assessing and Monitoring Urban Underground Infrastructure." Proceedings of the 11th International Workshop on Structural Health Monitoring 2017, Stanford, CA

Huston D, Xia T, Zhang Y, Fan T, Orfeo D, Razinger J. (2017) "Urban Underground Infrastructure Mapping and Assessment." SPIE 10168, Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems 2017, 101680M, doi:10.1117/12.2263530

Zhang Y, Huston D, Xia T. (2017) "Rough Ground Surface Clutter Removal in Air-Coupled Ground Penetrating Radar Data using Low-Rank and Sparse Representation." SPIE Smart Structures and NDE Conference as Paper No. 10169-3, Portland, OR, doi:10.1117/12.2261355

Zhang Y, Orfeo D, Burns D, Miller J, Huston D, Xia T. (2017) "Buried Nonmetallic Object Detection using Bistatic Ground Penetrating Radar with Variable Antenna Elevation Angle and Height." SPIE 10169, Nondestructive Characterization and Monitoring of Advanced Materials, Aerospace, and Civil Infrastructure 2017, 1016908, doi:10.1117/12.2260055

through the wall, so cell phones can be used in a building. In Ground Penetrating Radar (GPR) sensing, they control the microwave signal's radiation toward the ground and penetrate through the ground surface. "The reflection signal from the underground utility can be received by a highly sensitive antenna and the electronic circuit," he says. "By analyzing the reflection signal with sophisticated signal processing methods, we produce an underground image."

Back in the Votey lab, Huston points out some of the machines they've built to find pipes in utility systems; one of the radar rigs has a brand-new gimbal mount for a smartphone while the other resembles a giant boom box on wheels. Nearby, "a graduate student Robert Farrellis collects data," looking like a large kid in a large sandbox as he has intentionally hidden pipes in a rectangular container of sand.

"This is pretty exciting," says Huston as he looks at a computer screen that to the untrained eye seems to be a picture of grey. Not that many people would find such a blurry image exciting, but not that many people are like Huston and his team, able to see the blips that represent buried pipes. It's a significant moment of progress for the EAGER project, which dates back to 1994, when Huston was working with the Vermont Agency of Transportation to use GPR on detecting early corrosion in bridge decks. But it wasn't until about two years ago that he and the team realized that the timing was right to use similar techniques for cities' underground infrastructure. As Burlington is one of US Ignite's "Smart Gigabit Communities" (and the only one in New England), it was well positioned to complement its high-speed telecommunications network with the ability to sense and collect data on underground infrastructure in a state-of-the-art way. (Indeed, Huston explains that a parallel project, which started in January 2017 in partnership with the city of Chattanooga, Tennessee, and continues for three years, brings the two together.)

The biggest hurdles for Huston, Xia and the handful of graduate students involved in the EAGER project range from the funny (having to answer questions from curious onlookers as they push what seems to be an oversized metal detector through the streets) to the formidable. "The subsurface utility infrastructure is very complicated," says Xia. "The citywide survey scope is huge. How to leverage survey efficiency and accuracy is challenging."

Continued on page 24

REAL-WORLD SOLUTIONS FOR CARS AND COMMUNITIES

HOW UVM UNDERSTANDS INFRASTRUCTURE RESILIENCY

BY SARAH TUFF DUNN

Beep! Honk! To most people sitting in a gridlock, those sounds are irritating. But to Civil Engineering Professor Lisa Aultman-Hall, they're the legacy of many decades of infrastructure and systems engineering.

"I've been obsessed with transportation my whole life," says Aultman-Hall. "My dad worked in the railroad industry, and I remember sitting in traffic congestion as a small child in Toronto and being intrigued — where is the bottleneck?"

Decades later, she and other Civil and Environmental Engineering (CEE) faculty are answering more complex questions, and much more, about congestion, resiliency, the environment and social equity and mobility as they apply their research skills toward real-world solutions for cars and communities. As *Scientific American Mind* reports, demand for urban transportation is expected to more than double by 2050, bringing true the 1925 prediction of Swiss architect Le Corbusier who wrote in *The City of To-morrow and Its Planning,* "The motor-car...has completely overturned all our old ideas of town planning." This concept has also influenced ideals for rural places like Vermont, says Aultman-Hall.

After receiving her Ph.D. in civil engineering from McMaster University in Hamilton, Ontario Aultman-Hall taught at the University of Kentucky and the University of Connecticut before coming to UVM in 2006. Since 1995, she's worked on more than $20 million in grants, some her own research projects and many were large programs intended to attract diverse disciplines to the study of transportation systems. A director of the Connecticut Transportation Institute and founding director of the UVM Transportation Research Center, she brings a unique interdisciplinary approach to problem-solving.

"The advantage of being in Vermont is having the Vermont perspective to not be obsessed with urban congestion as the critical issue," says Aultman-Hall, who has written 60 refereed journal papers and 85 technical reports in addition to participating in 116 presentations, invited seminars and conference papers. "I've come from an environmental motivation — seeing how we change our designs and systems operations to lower our impact on the environment."

She's also concerned about social equity. "People have such unequal access to mobility," says Aultman-Hall. Working with both graduate and undergraduate students and collaborating widely across the UVM campus, she has focused not only on transportation system design but also innovative data collection including online and in-vehicle travel surveys. In 2014, Dr. Aultman-Hall was named UVM Graduate Student Senate Outstanding Faculty Advisor.

"I would not know how to look at a bridge in Vermont and say, 'Yes, I am sure that is resilient to a 100-year storm,'" says Aultman-Hall. "But my CEE colleagues do. I can look at the location and say, 'Is that serving critical travel demand and connections based on the travel demand data we collect.'"

LISA AULTMAN-HALL
Photo: Nich Hall

HAVE WE FINALLY REACHED THE AGE OF THE ELECTRIC CAR?
Listen to this interview with Lisa Aultman-Hall

GO.UVM.EDU/ECAR

VERMONT'S TRANSPORTATION RESEARCH CENTER

In fall 2015, Vermont's Transportation Research Center (TRC) joined CEMS after 9-years as a Matrix Center in the Office of the Vice-President for Research. The move was motivated by UVM's new budget model which is college-based and recognizes the leadership and innovation of the CEMS faculty who worked to establish the TRC.

The TRC is an interdisciplinary hub for research, workforce development, and outreach on sustainable transportation system solutions. The TRC faculty and professional staff focus on transportation planning as it relates to resilience, energy, and equity.

SINCE ITS FOUNDING IN 2006, THE TRC HAS:

- Attracted millions of dollars of funding to UVM in new external grants;
- Hosted over 10,500 people at its events;
- Included over 400 students on research projects;
- Established the Transportation Air Quality Lab (TAQLab);
- Launched a significant transportation workforce development initiative.

"You need to have different people looking at different parts of a complex system," she says. "In interdisciplinary work, the language is so hard, but through meetings and brainstorming, you come to realize you are thinking the same thing, just using different words."

Travel demand patterns tell an analyst which links in the network are most critical for connectivity and thus require upgrades or adaptations to correct for vulnerabilities. Aultman-Hall relies on her faculty colleagues Eric Hernandez, Arne Bomblies and Mandar Dewoolkar to round out the systems approach to the problem. "This is not the way scientific discovery used to work," says Dewoolkar.

"It's very exciting to see how a particular decision in engineering or social realms cascades through the system and ultimately affects how to change legislation."

A specialist in geotechnical engineering, Dewoolkar is able to collaborate with Aultman-Hall on infrastructure vulnerability; Bomblies brings in his expertise in hydrology and adaptation to climate change; and Hernandez, meanwhile, has expertise in structural dynamics, uncertainty quantification and inverse problems in structural engineering, which creates a dynamic team able to expand with other disciplines in order to ensure our transportation system functions well at critical times such as those during extreme weather.

"The most exciting aspect of my current work is long-distance intercity travel," says Aultman-Hall. "It's really fascinating to me that in our transportation system analysis, we've kept air and highway transportation in completely separate realms. For climate-change resiliency, we have to consider them integrated."

Ultimately, the study of built infrastructure at UVM comes down to seeing the forest for the trees. The roads and the vehicles are about the people inside them – delivering accessibility and mobility to individuals. "Cars can be a wonderful thing, but we don't use them in an optimal way," says Aultman-Hall. "So when we focus on infrastructure we must focus on the travel behavior on that system — where people are coming from, where they are going to, and why."

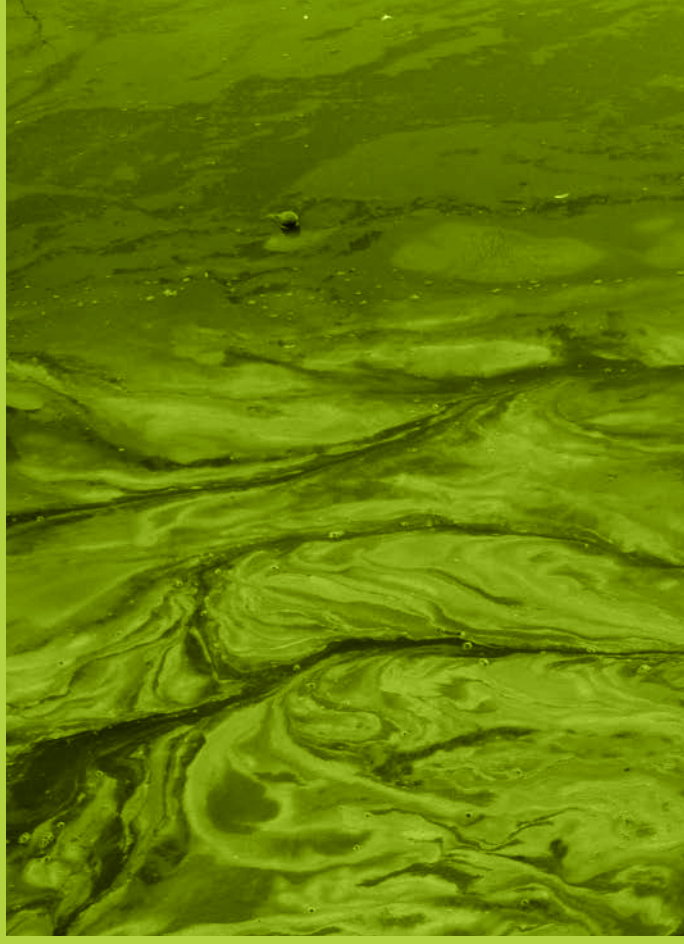
A SELECTION OF SCHOLARLY PUBLICATIONS BY LISA AULTMAN-HALL

Dowds, Jonathan, Karen Sentoff, James L. Sullivan and Lisa Aultman-Hall. Assessing the Impact of Network Resolution and Origin-Destination Aggregation on the Stability of Transportation Network Criticality Rankings. Forthcoming Transportation Research Record 2653. DOI 10.3141/2653-11

Aultman-Hall, Lisa, Chester Harvey, James Sullivan and Jeffrey LaMondia. (2016) The Impact of Long-Distance Tour Generation and Travel Attributes on Data Collection in the United States. TRANSPORTATION, Volume 43 Number 6, November. DOI 10.1007/s11116-016-9754-y

Harvey, Chester, Lisa Aultman-Hall, Austin Troy and Stephanie Hurley. (2016) Streetscape Skeleton Measurement and Classification. Environment and Planning B: Planning and Design. doi: 10.1177/0265813515624688

A PASSION FOR COLLECTING AND UNDERSTANDING NATURAL DATA



Merging Machine-Learning Tools to Better Understand and Manage Natural Resources

BY SARAH TUFF DUNN

When Donna Rizzo walks across campus, she's looking at the trees and the people — and not a smartphone, because she doesn't own one. This year, she'll have plenty of leaf peeping, and watching the snow gather on branches, as she crosses between Votey Hall and the Gund Institute for Environment, where she is serving as acting director for nine months while Taylor Ricketts is on sabbatical.

The post highlights the cross-collaboration that has become a hallmark of Rizzo's research, and of CEMS faculty members as they work together to tackle such problems as lake pollution, bridge vulnerability, sustainable materials, and human disease.

"She uses computational tools to look at problems where she can use real-world data, using models that are data-driven," explains Mandar Dewoolkar, chair, Department of Civil and Environmental Engineering, of Rizzo's robust approaches. "You don't take a model first and fit your data into that; you look at data to come up with a model of the system."

Rizzo grew up on Long Island Sound, immediately drawn to the issue of clean water, which became even more of a passion after a stint teaching English in Turkey, where she watched women carrying water and began querying its' contamination. On the road toward becoming the first Ph.D. student to graduate from UVM's Civil and Environmental Engineering Program in 1994, she also studied studio art in Europe, but found that she was most drawn to natural systems and visualizing data that she could measure and monitor.

"I became fascinated by environmental sensors, and collecting enormous amounts of data in real time," says Rizzo, who places a high value on the interdisciplinary design that underlies the datasets she and her teammates collect. "People do not value environmental data in the same manner that say credit card or oil companies do. Environmental data are viewed as a cost of regulation. As a result, the tools needed to analyze these data lag behind other sectors. The environmental industry has not come to grips with this fact."

By inventing new computational tools that can gauge what's happening in the environment, Rizzo is able to connect her two lifelong loves, and is able to apply skills learned to a multitude of areas. "The beautiful thing

"I became fascinated by environmental sensors, and collecting enormous amounts of data in real time."

DONNA RIZZO
Photo: Andy Duback

is that every single time I get on one of these projects, it's a really sharp learning curve for me to get up to speed on the vocabulary, but I love learning about these new systems. What your brain does when you start to classify and cluster can be applied to almost every single application that's out there."

Take, for example, Rizzo's work with Vermont EPSCoR, during which she was able to examine data, using machine-learning tools, that others had collected for 30 years on Lake Champlain, and how phosphorous and nitrogen levels were impacting algae blooms. "The data naturally clustered into two groups (bloom/no bloom), which got us really excited," she says. "It kept telling us it had something to do with measurements collected at the Lake's soil-water interface". This combination of high-resolution sensor data and complex systems tools for visualizing and analyzing the data is a theme that continues to this day with Vermont EPSCoR lake research."

Rizzo has also researched the transmission of Chagas disease in Central America with Professor Lori Stevens and colleagues in Guatemala, and has collaborated with other CEMS researchers on using ground-penetrating radar to detect buried land mines and urban infrastructure. It's helped to cultivate a more open and engaging environment when it comes to talking about the environment. "I didn't speak through four years of college — that's the only thing I really regret," she says. "I tell my students that things would have been so much easier if only I'd had the guts to ask what I viewed at the time as dumb questions, so I try to emphasize in classes that there are no dumb questions."

"Donna gets engaged in many, many different things — everything from ultrasound images and how people speak when they are being interviewed in hospitals to thyroid cancer, algae blooms in lakes, and bridges — it's just astonishing," says Dewoolkar, who foresees the next five to six years of UVM activities focusing on rivers and Lake Champlain, understanding pollution, and finding ways to mitigate them. "She has the optimism and also manages to find the time, and in meetings, her eyes light up when she becomes excited about a topic. She is recognized as a campus leader by both faculty and administrators and is a great mentor to our students. As a recognition of her outstanding work, she holds the Dorothean Chair in Engineering and Science and is a George V. Kidder Outstanding Faculty awardee.

THE POWER OF STUDENT INNOVATION

Electrical Engineering and Mechanical Engineering Capstone projects connect seniors to surrounding communities in solving long-standing problems

BY SARAH TUFF DUNN

Winter's snow has long receded from Burlington on April 21; a scant few patches remain in the Green Mountains and mud season is in full swing. At Burton Snowboards, however, the team is as elated as you would find them on a powder day, when they might be playing sanctioned hooky to plunge through the white stuff.

"It's amazing," marvels engineer Dave Connery. "So quiet!" adds another engineer.

Their subject of awe and scrutiny? A machine nicknamed "Tipsy," designed not by their in-house wizards, but by a team of UVM students from the Electrical Engineering and Mechanical Engineering programs as their senior capstone project. Resembling a cross between a medieval catapult-launching machine, a Star Wars sidekick to C3PO and a one-legged boarder wearing a black boot, it clicks in a repetitive motion, as the team looks on proudly, and Burton's staff scrutinizes.

"Tipsy has been our baby for the past year," says Noah Mostow '17 to a visitor, later explaining how the collaboration came to be. "Burton needed a testing device for its' step-on binding system. The first half of our project was very design based, creating multiple prototype ideas every week." Another member of the team, Rob Sasena, came up with the original concept: a main tipping tower that recreates human-like motion of the boot, running off a single motor. "Tipsy," says Mostow, "was what we needed to show Burton we could build their new testing device."

And show Burton they did, impressing the global snowboarding giant enough to land Tipsy a coveted place in the Craig Kelly Prototype Facility, producing critical data for binding development and having undergone more than 70,000 cycles by early July. "This project we gave them had some trickiness to it, so the fact that they could build something that has become a very useful device for testing and evaluating is impressive," says Chris Doyle, who has worked in R & D for Burton for more than 20 years. "They had a lot of drive, were very dedicated and it was fun to watch them grow and learn as they were able to put their hands on the technologies at Burton."

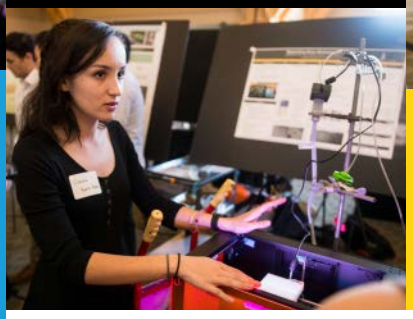
Doyle's comments speak to the unique collaboration between UVM and surrounding communities created by the senior engineering capstone projects. From working with Gordon Windows to develop a remote quick-release

ENGINEERING DESIGN NIGHT

Tariye Peters of Team 22 explains how a stationary motorcycle is used to control a model airplane or airplane simulator to Perekebina Yoroki and Benjamin Deming.

TIPSY
Professor Dustin Rand and Burton Snowboard engineers inspect "Tipsy," a testing device for Burton's step-on binding system. The device was designed by a team of UVM students from the Electrical Engineering and Mechanical Engineering programs as their senior Capstone project.
Photo: Peter Cirilli

BIO-PRINTING
Claudia Benito-Alston of Team 2 with Dr. Daniel Weiss labs explored methods for bio-printing breast tissue for post-mastectomy reconstructive surgery.



HAZARD MITIGATION
Andrew Carter of the Manchester Richville Road Flood Hazard Mitigation Design team. The team worked closely with the town of Manchester.

MOTORCYCLE SIMULATOR
Anna Svagzdys and Kevin Immerman, also of Team 22, designed a flying motorcycle simulator for their capstone project.

Photos: Andy Duback

cellular window shade to coming up with a Haiti water filtration design for the Vermont Haiti Project, these are not so much the end of a college career but the beginning of learning how to leverage local enthusiasm, innovation and relationships to make a better world.

Spring fever is at a peak on Friday, April 28, when the top floor of the Davis Center hosts the 2017 Engineering Design Night, an evening of poster presentations and engineering honors awards. Outside, it's 81 degrees, sending rivulets of perspiration down the shirts of Catamounts crossing Main Street. Inside the Davis Center, however, none of the 40 teams presenting their student project posters seems to be breaking a sweat. Not even Anna Svagzdys, who's straddling a flying motorcycle simulator, designed for Beta Technologies, that refuses to budge. "It's frustrating; everything worked this morning," says Svagzdys, who keeps her cool as she makes minor adjustments to the simulator. Soon enough it's working again.

If necessity is the mother of invention, then consider this assemblage the maternity ward. After months (not hours) of labor, the proud parents are the groups of four to five students pacing near their posters, ready to answer questions from the clients, community partners and other visitors strolling up and down the makeshift aisles. Sky-blue shirts, ties, sport coats, dresses and heels are in abundance; the attire is as smart as the crew. Andrew Carter '18 from Team 35 explains the graphics showing historic flooding and road damage to Richville Road in Manchester. "This is the hydraulics analysis of the largest culvert," he says.

Team 24, meanwhile, is showing off "Optimization of Surface Watercraft Construction Using Dampening Materials to Mitigate Forces and Vibration." In other words, the student-proposed project aims for a more stable surfboard; in other sporty realms, there is an Innovative Golf Shaft—Light Weight & Uniflex and an Improved Golf-Driver 2.0 – Aerodynamics for client BombTech, plus Suspension Telemetry for Mountain Bikes and, drawing oohs and ah's from many onlookers, an Adjustable Wall Mounted Bike Mount for Amtrak, for client VT Bike Solutions.

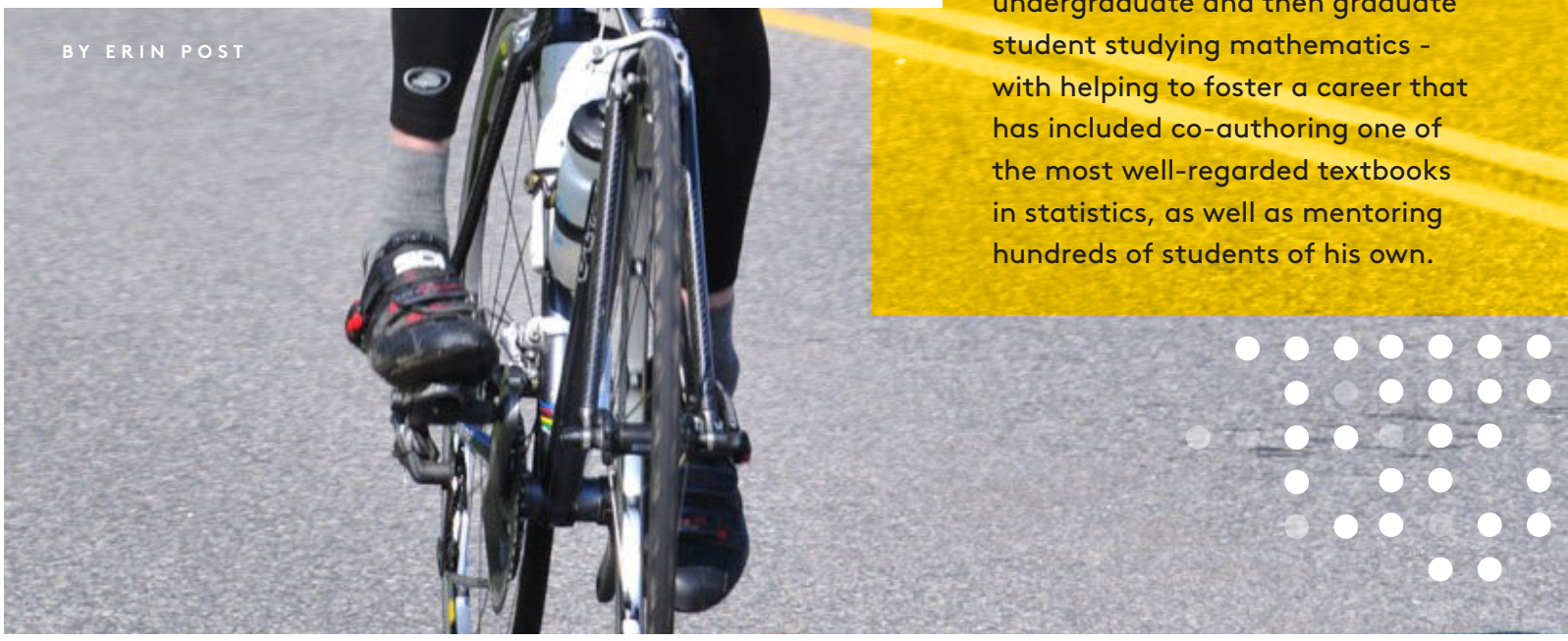
The Capstone projects solve problems, for sure, but also may save lives; projects such as the Smart Esophageal Balloon Dialator, Bio-Printing Breast Tissue for Post-Mastectomy Reconstructive Surgery and Altering Medical Device Surfaces to Impact Fluid Dynamics are good examples of this. Overseeing many of these endeavors is "Professor of the Practice" Dustin Rand, who serves as the faculty mentor for the Department of Mechanical Engineering and the Department of Electrical Engineering; "Professor of the Practice" John Lens holds the same role for the Department of Civil and Environmental Engineering, whose projects involve bridge rehabilitation, a U.S. Department of Energy Race to Zero Design Competition and the Georgia Public Library ADA Improvements Design, among others.

Continued on page 24

ALUMNI PROFILE
DAVID HOSMER

BY ERIN POST

Almost half a century later, David Hosmer, Ph.D., can recall with detail the kindness and dedication of his mentors at the University of Vermont. He credits these faculty members – whom he got to know during his six years as an undergraduate and then graduate student studying mathematics - with helping to foster a career that has included co-authoring one of the most well-regarded textbooks in statistics, as well as mentoring hundreds of students of his own.

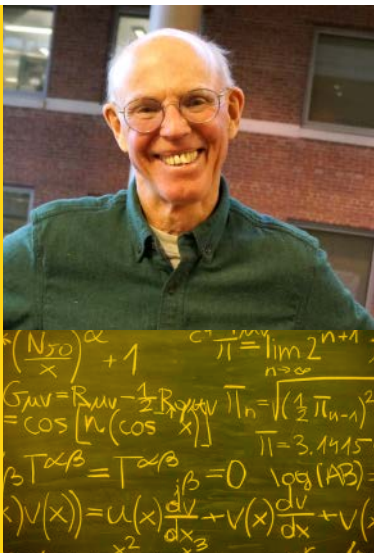


Hosmer arrived at UVM in the fall of 1962 from Syracuse, NY, eager to dive into his studies and the outdoor activities Vermont offered. After entertaining a major in botany, he soon realized that work in the lab wasn't for him, and shifted his focus to mathematics. It didn't take long for him to put his budding statistics knowledge to good use. The summer of his junior year, he joined a project led by legendary UVM Professor Hubert "Hub" Vogelmann, Ph.D., who was one of the first researchers to bring national attention to the effect of acid rain on the environment. Hosmer tabulated and summarized the data collected on weekly visits Tom Siccama, Voglemann's Ph.D. student, made to the top of Camel's Hump to gather data on spruce growth as part of that research.

After graduating with a bachelor's degree in mathematics in 1966, Hosmer began the master's program in mathematics. Statistics courses taught by Professors David Sylwester and David Hill combined his interests in mathematics as well as its applications to real data problems. Both were instrumental in encouraging him to pursue a Ph.D. at the University of Washington-Seattle.

Hosmer credits classes from another UVM great, Harry Lighthall, Ph.D., in teaching him how to "write math."

"It wasn't enough to scribble down numbers," he says. "He was very particular about the way it appeared. You had to have text about what you were doing."



LEFT
David Hosmer riding the Blue Ridge Parkway in May of 2016

Years later, that rigorous instruction proved key to his own writing career. At the University of Massachusetts Amherst, where he joined the faculty after receiving his Ph.D., he co-authored what is considered the seminal textbook on logistic regression, first published in 1989 and now in its third edition. With more than 50,000 Google scholar citations to date, it is the most cited reference in the field of statistics. At UMass Amherst, he served on countless thesis committees during his nearly 30 years on the faculty, and continues to stay in touch with many of his former students.

"I feel extremely fortunate to have gotten the foundation I did at UVM," he says. "Without that, the rest wouldn't have happened."

UVM also introduced Hosmer to his future wife. Although David met Trina in a class on topology during their first year in the master's program, it was the time they spent cross-country ski racing that brought them together. Trina got her start as a support person for the men's Nordic ski team—David was the captain—but once she tried the sport herself she was hooked. Her talent has taken her around the world: she was a member of the first U.S. international women's ski team, competing in two Nordic World Championships in 1970 and 1974, and representing the U.S. in the 1972 Winter Olympics in Sapporo, Japan. In 2015, she was inducted into the Vermont Ski and Snowboard Hall of Fame.

The Hosmers retired from UMass Amherst on the same day in 2002: she after nearly three decades as a statistical software consultant for the Office of Information Technology. In addition to the master's degree she earned from UVM, she holds a second master's in biostatistics from the University of Washington.

Several years after retiring, the Hosmers moved to Stowe. The pair continues to race at the master's level, and David teaches a course at UVM every other year on logistic regression and survival analysis, continuing the legacy of mentorship his UVM professors left to him.

"The faculty took an interest in me, and encouraged me," he says. "Mentoring by the faculty is a strength of the department and it always has been."

What Lies Beneath: Continued from page 15

The rewards, however, are receiving positive responses from local planners, knowing that some experimentation may pay off in exponential ways for cities.

"Our R & D efforts are inspired by the community partners based on their needs, their feedback and their encouragement," says Xia, who adds that next up is exploring new GPR application potential, such as antenna array design and artificial intelligence. "We will continue to engage in research that is meaningful to society."

"Managing, maintaining and growing underground infrastructure is an expensive and challenging problem for virtually all cities," says Huston. "As with most smart cities technologies, the research and development path of our techniques will hopefully lead to scalable and open-source solutions that are used by cities in the U.S. and worldwide. We are presently working with three cities in Vermont and Tennessee and are in active discussions with other cities in the Midwest and on the West Coast."

Student Innovation: Continued from page 21

What's easily perceptible about the event is the cool, collected energy that seems to have come from great minds thinking alike—and thinking differently. The graphics and the gimmicks give way to the students and their community partners telling the story, which has come to an end, but also a new beginning.

"Tonight is the final show for us," says Mastow, before leaving his post to accept the American Society of Mechanical Engineers (ASME) Award, given "for meritorious work" in the student ASME chapter; he fist-bumps teammate Pete Hoops as he steps aside. "Tipsy goes back to Burton, so it's a bit of a goodbye."

One week later student teams are presenting to faculty and partners for final grading. Summer's promise of jobs and other endeavors is palpable in Kalkin 003 and 004, which has seen a full day of Capstone Final Presentations for UVM's Civil and Environmental Engineering Department.

Carter '18 is here, as are others from the Manchester Richville Road Flood Hazard Mitigation Design team, which worked closely with the town of Manchester to bring the mother of invention to Mother Nature. "Vermonters have a long history of trying to get rivers to do what we what them to do," explains Manchester Town Manager John O'Keefe. "Rivers are not very good listeners, and during Irene, we found that water is such a powerful force that it does whatever it wants to do—floods, smashes trees."

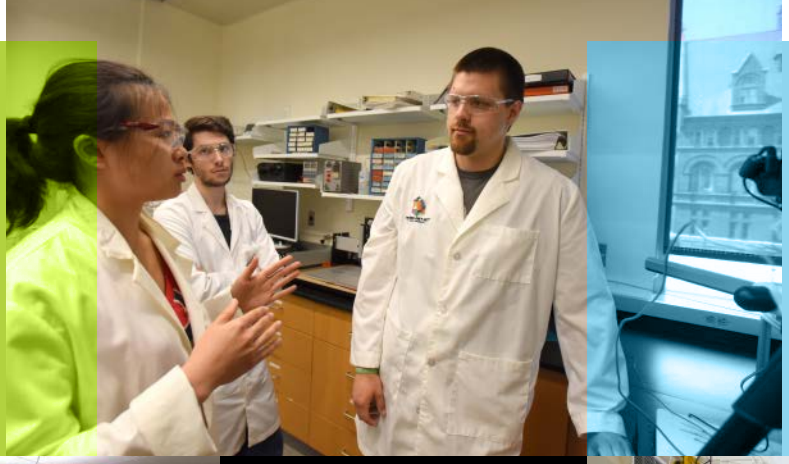
O'Keefe refers to the famous damage wrought by the remains of Hurricane Irene in the Green Mountain State in late August 2011. Six years later, southern Vermont is still seeking a way to let rivers run their course without ruining lives, and as Lens explains, Capstone was key. "The project was brought to us by Michael Batcher of the Bennington Regional Planning Commission," he says, "who connected the need to resolve a flooding problem with our students' Capstone opportunity."

Vermont Stream Alterations Engineer Joshua Carvajal worked closely with Team 35, meeting every few months to discuss the progress of tasks pertaining to recommendations on Richville Road. "After the initial meeting with the students, both Michael and I expected lots of follow-up questions and hand-holding to work through each of the tasks," he says. "But the students were very independent. It was very satisfying to watch the students learn about real-world issues and work toward providing potential solutions to problems."

The group dynamics were interesting, adds Carvajal, explaining that teammates Carter and Carli Shroyer, Yifan Li and Xuguang Shen shared responsibilities and played different roles. "Too many leaders on a project often complicates the end goal, so everything worked out fine," says Carvajal. "The days spent surveying Richville Road was the entertaining part, since people's personalities really come out during field work. They were long and often cold days but the group kept up their spirits with a bit of good-natured ribbing."

And that good nature, in the end, did help appease Mother Nature, or at least the officials doing their best to calm her down with rational designs. "Everybody here was really impressed with the focus of the students and the caliber and their engineering skills," says O'Keefe. "Any town thinking about doing a Capstone project with UVM I would definitely recommend."

Momentum is already underway for such projects. Burton's Doyle says with a laugh that as soon as Tipsy was under his wing, Professor Rand was in touch about Capstone ideas for 2017-2018. Doyle says, "I look forward to working with some rock stars again."



DISCOVERY BUILDING RESEARCH LABS
Ph.D. students Taylor Ducharme, Selina Yao and undergraduate David Bernier in Professor Patrick Lee's new lab in the Discovery Building of the STEM Complex.

VOTEY LOUNGE
Students are making good use of Votey's new student lounge.

SENIOR DESIGN COLLABORATION SPACE
A new senior design space provides project and collaborative space for senior capstone projects.

STUDENT CLUB SPACE
The student group Alternative Energy Racing Organization (AERO) breaks in the new CEMS Club Space during the first days of fall semester.

RENOVATION COMPLETED
President Sullivan joins Dean Garcia and Lab Manager Courntey Giles for a tour of Votey's new and renovated labs.

PROTOTYPE LABORATORY
The newly renovated machine shop includes two Kent 13 x 40 lathes, two Hurco CNC machining centers, two Kent knee millls (bridge port style) TIG and MIG welding, horizontal and vertical bansaw and a drill press.

VOTEY 2.0 UPGRADE AND DISCOVERY BUILDING LABS

Photos: Sally McCay & Jennifer Karson

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WE ARE ALL PART OF THE EQUATION

Alicia Tanneberger, Darija Dilba, and Sarah Hampson participate in a prosthetic hand competition as part of BME001: Introduction to Biomedical Engineering Design taught by Professor Ryan McGinnis. Using a prosthetic hand designed by their teams, competitors attempted to put on rubber gloves. Other events included painting the fingernail of a teammate, shooting a basketball into a hoop, and an egg and spoon race.
Photo: Blake Hewgill '17

FRONT COVER
Professors Dryver Huston and Tian Xia test their mobile ground penetrating radar system on the UVM campus with graduate students Yu Zhang and Dan Orfeo

Photo credit: David Seaver