NHERI Natural Hazards Engineering Research Infrastructure

QUARTERLY NEWSLETTER
NEWS FROM THE NHERI COMMUNITY
FEBRUARY 2020

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COMING EVENTS

February 25-28
Geo-Congress 2020
Minneapolis, MN

February 27
Performance-based Wind and EQ Design Frameworks for Tall Wood-Concrete Hybrid Buildings
NHERI-Lehigh Seminar Series
Online Webinar

March 4 - March 6
2020 National Earthquake Conference and 72nd EERI Annual Meeting
San Diego, California

March 19-20
ICWE 2020: 14. International Conference on Wind Engineering
Prague, Czechia

April 22-24
2020 NZSEE Annual Technical Conference
Wellington, New Zealand

May 18-29
Disaster Ethics Conference 2020
Copenhagen, Denmark

FOLLOW US AND JOIN THE NATURAL HAZARDS ENGINEERING COMMUNITY!

DESIGN SAFE RADIO

Novel simulation technique to assess wind-load on tall buildings

A NHERI Lehigh study demonstrates the viability of RTHS for testing wind response in tall buildings and the value of outrigger damping systems for mitigating wind damage as well as earthquake damage.

In a recent NSF-funded study performed at the NHERI Lehigh Experimental Facility, a Lehigh University team led by principal investigator James Ricles demonstrated two key findings: One is that outrigger damping systems are useful for mitigating damage from natural hazards to tall buildings. The other is the fundamental conclusion that the real-time hybrid simulation (RTHS) methodology is viable for simulating and assessing tall buildings for response to natural hazards such as wind and earthquakes.

The Lehigh team includes Richard Sause, Chinmoy Kolay (now at the Indian Institute of Technology, Kanpur), Safwan Al-Subaihawi, Thomas Marullo, Liang Cao and Spencer Quiel.

To date, limited studies have experimentally investigated the damped outrigger system response to wind or earthquake loads on tall buildings. It is impractical or impossible to test such a large structural system in a boundary layer wind tunnel or in an existing wind simulation facility due to model size limitations.

Similarly, it is impractical to test these systems for seismic excitations even in large shaking table facilities. The RTHS experimental method not only eliminates such limitations of physical testing and computational simulations — but it also integrates their benefits.

With real-time hybrid simulation, the definition of the system can be expanded beyond the size of typical laboratory physical models. The response of the system to a dynamic load is simulated by solving the equations of motion in real time, which enables physical testing of rate-dependent devices present in the system.

NOVEL METHODOLOGY

Until this study, the RTHS technique has primarily been applied to simulate seismic effects in structures. This novel work at Lehigh successfully extends its application to wind response simulation of a 40-story tall building outfitted with nonlinear fluid viscous dampers.

Investigator James Ricles demonstrated two key findings: One is that outrigger damping systems are useful for mitigating damage from natural hazards to tall buildings.

The other is the fundamental conclusion that the real-time hybrid simulation (RTHS) methodology is viable for simulating and assessing tall buildings for response to natural hazards such as wind and earthquakes.

Courtesy: Amal Elawady, Arindam Chowdhury, Peter Erwin, FIU.

Aerodynamic wind testing at the NHERI FIU WOW to obtain wind pressure time histories distributed on the building.

An RTHS enables a given system component, one for which an accurate numerical model is unavailable, to be modelled physically in the laboratory. The rest of the system is then modelled numerically. The physically and numerically modelled parts are termed as the experimental and analytical substructures, respectively.

For this study, 3D nonlinear building models were created in which the building frame is modelled numerically and the dampers are modelled physically. The team performed a series of 3D large-scale RTHS for both seismic and wind loadings.

EXPERIMENTAL HIGHLIGHTS

For the tall building, the wind excitation force was determined based on wind tunnel tests conducted on high-rise buildings by Tokyo Polytechnic University.

To this end, a basic wind speed of 110 mph with a mean recurrence interval (MRI) of 700 years was considered. The earthquake loading was based on scaling natural earthquake accelerograms to the Maximum Considered Earthquake (MCE) 2,475-year return period hazard level.

To conduct RTHS in a damped outrigger system configuration, vertically oriented nonlinear fluid viscous dampers were added between the ends of the outriggers and the perimeter columns at the 20th and 30th stories and at the roof level of the prototype building — an office-building prototype developed for use by the Pacific Earthquake Engineering Research Center (PEER) Tall Building Initiative.

KEY FINDINGS

In the direction of the outriggers, the damped outriggers reduce the RMS roof accelerations by 43% under the 110 mph wind loading.

For seismic events, the peak story drift is reduced by 25% under the MCE hazard level compared to a structure without the dampers. The dampers in the outriggers are not as effective in reducing response in the orthogonal direction to the plane of the outriggers. Dampers would need to be placed in the core of the building in this orthogonal direction since outriggers do not exist in this direction of the structure.

IMPACT ON THE FIELD OF NATURAL HAZARDS ENGINEERING

After multiple simulations conducted at the NSF-supported NHERI Lehigh Experimental Facility, the researchers concluded that RTHS is highly useful and a viable means in assessing the performance of the damped outrigger system under wind and earthquake loads. Further, the RTHS data shows that the damped outrigger system has great potential in mitigating wind hazards — as well as seismic hazards — in tall buildings.

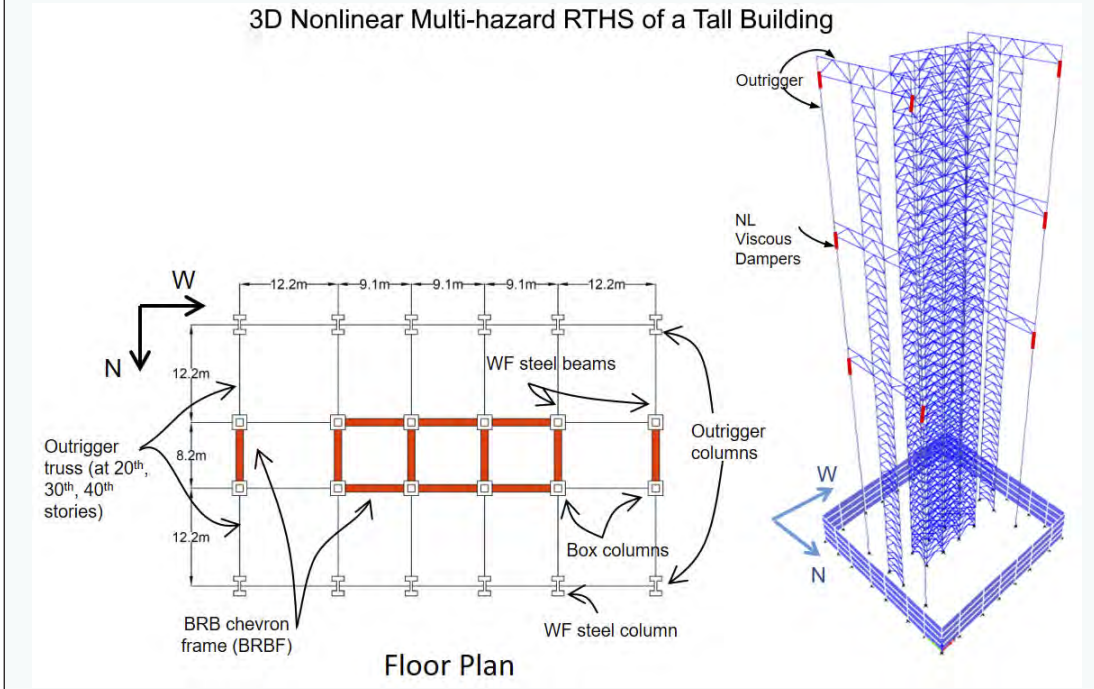
COLLABORATIONS, NEXT STEPS

The NHERI Lehigh Experimental Facility is conducting a follow-on study with researchers at the NHERI Wall of Wind Experimental Facility, located at Florida International University (FIU). Structures will be located in the Wall of Wind wind tunnel, and wind loading used in real time to perform RTHS to study the response of building systems to wind hazards.

Collaborators at FIU include Arindam Chowdhury, Amal Elawady and Peter Irwin. This collaborative effort will foster building capacity in RTHS related to wind engineering, produce algorithms and tools for research, and generate publications in conferences and journals. The outcomes will be documented on DesignSafe via links posted on the Multihazard Engineering Collaboratory on Hybrid Simulation (MECHS) to keep the research community abreast of new capabilities in RTHS.

ABOUT THE PROJECT

Natural Hazards Engineering Research Infrastructure: Experimental Facility with Large-Scale, Multi-directional, Hybrid Simulation Testing Capabilities. NSF award #CMMI 1520765. James Ricles (principal investigator), Richard Sause (co-principal investigator). Jan 2016-Dec 2020. Any opinions, findings, and conclusions expressed in this article are those of the researchers and do not necessarily reflect the views of the sponsor.



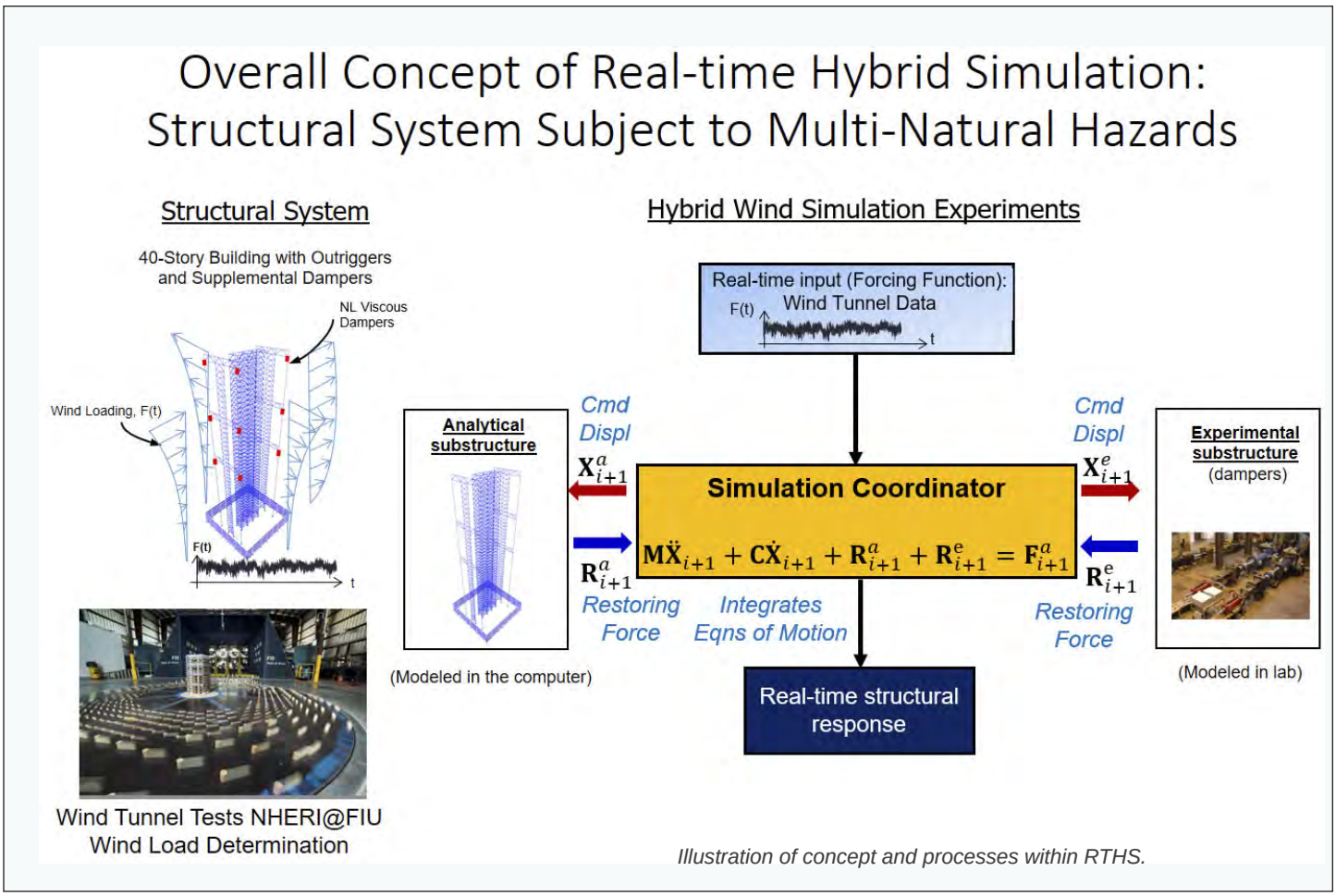
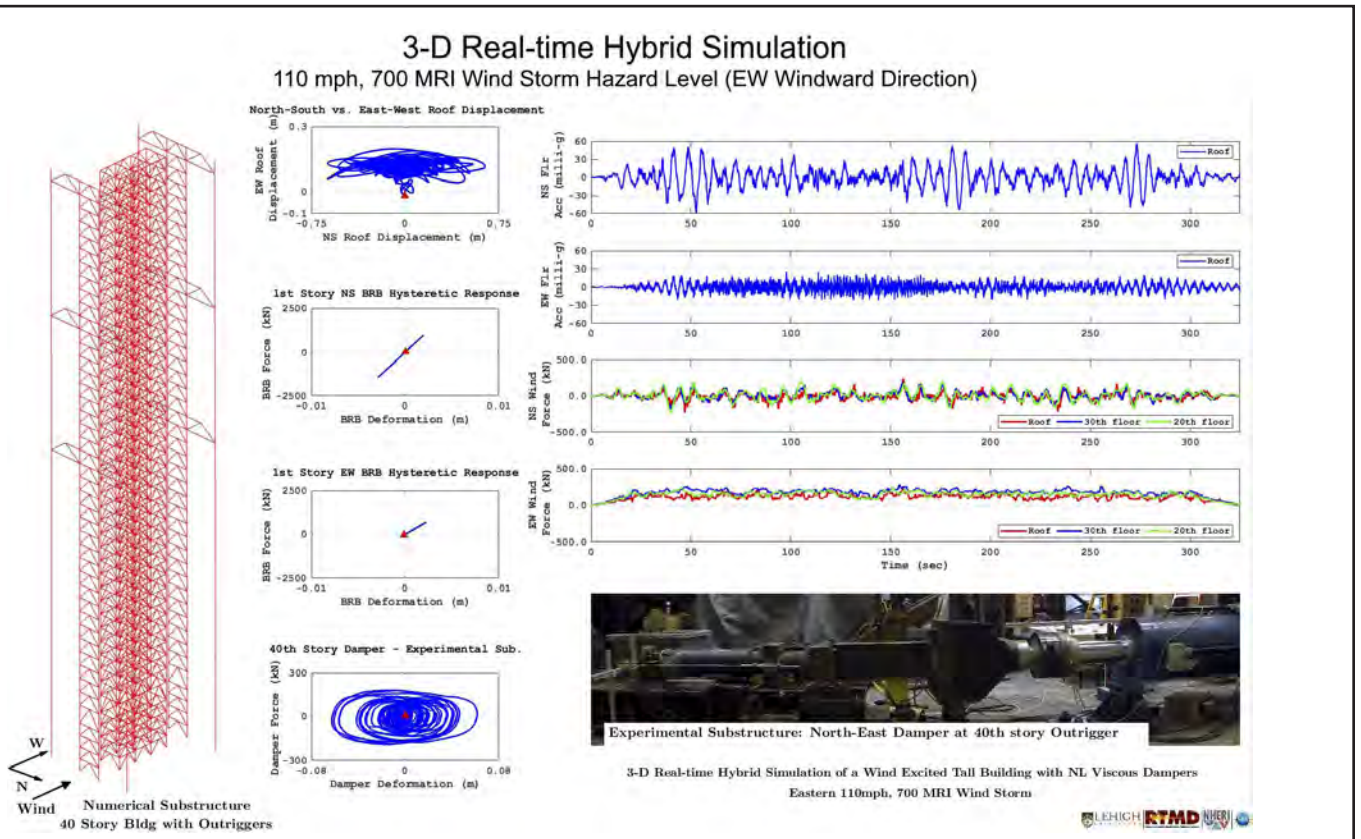
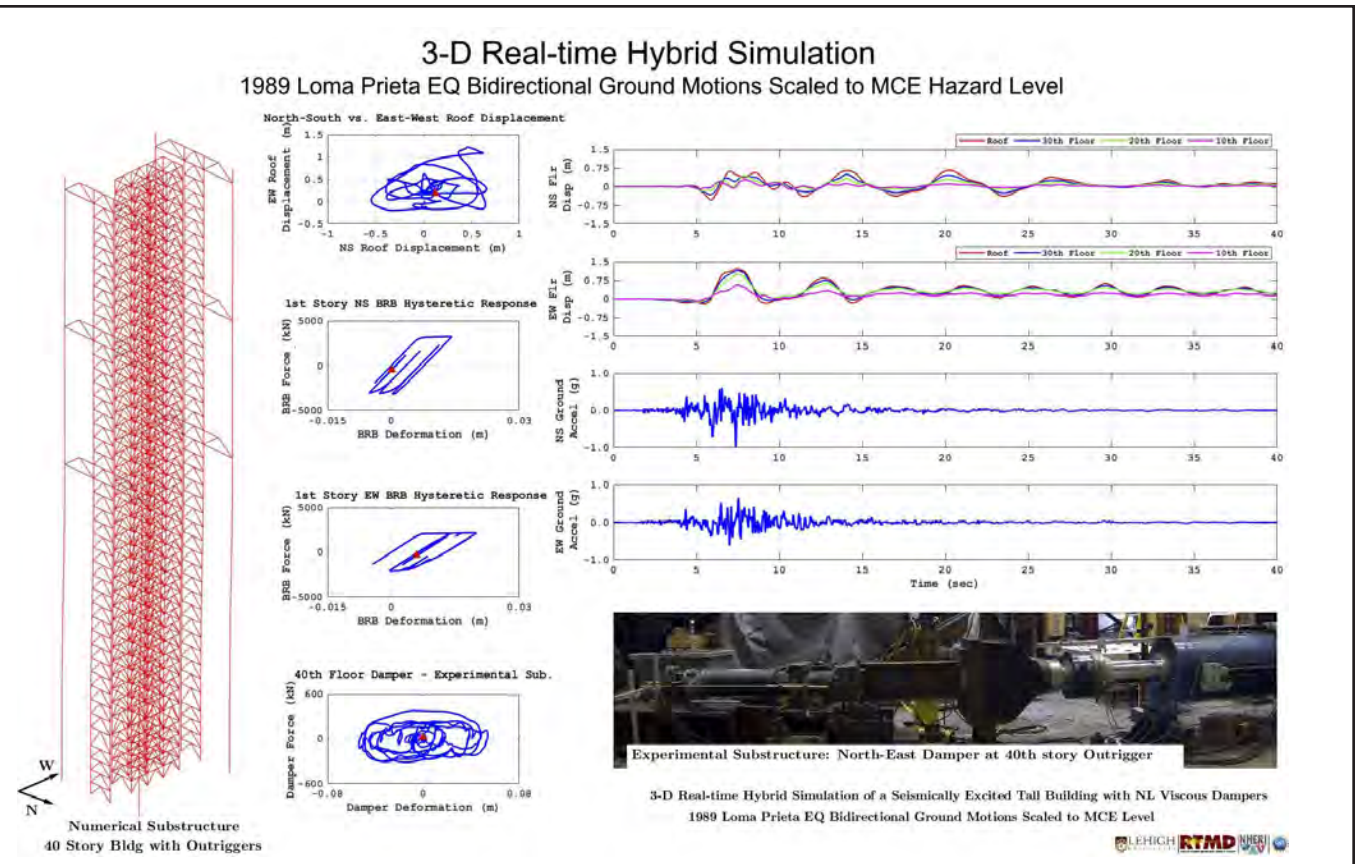


Illustration of concept and processes within RTHS.



Response of building to wind loading from 3D RTHS involving 110 mph, 700 MRI wind storm. Click to VIEW VIDEO. *Click to see video response in* COMPRESSED TIME.



Response of building to seismic loading from 3D RTHS involving Maximum Considered Earthquake (MCE) hazard. Click to VIEW VIDEO.

Thomas M. Marullo, NHERI Lehigh IT Systems Manager and research scientist, in the Multi-directional Experimental Laboratory.

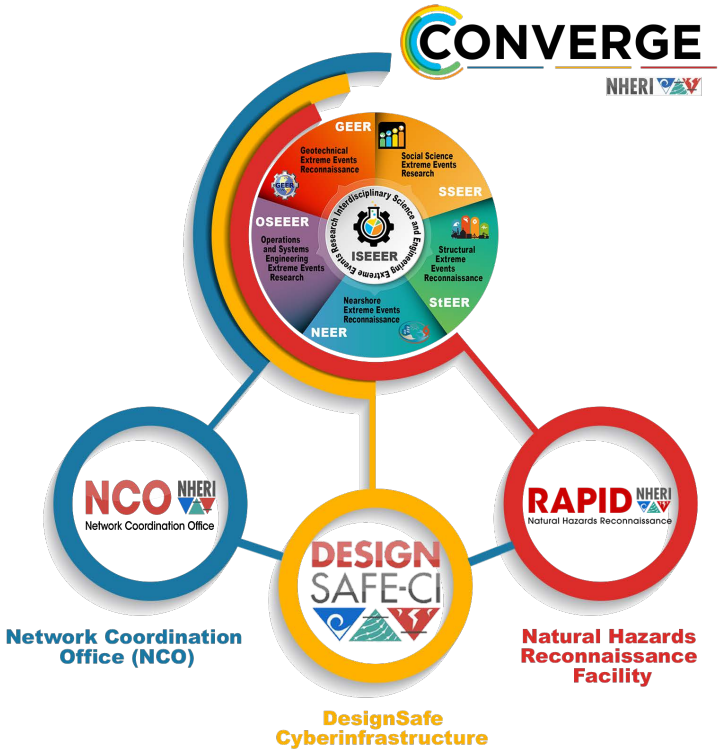
CONVERGE training modules bring social science insights to natural hazards engineering research

U of Colorado Boulder facility uses convergence science approach for advancing natural hazards research

Since its inception in August 2018, the NHERI-CONVERGE facility has made significant advancements in identifying, coordinating, and training social science and engineering researchers and interdisciplinary teams. The National Science Foundation-funded CONVERGE facility is based at the Natural Hazards Center at the University of Colorado Boulder.

Growing Convergence Research (GCR) is one of NSF's 10 Big Ideas. Lori Peek, principal investigator of CONVERGE, explains that "convergence science starts with a complex problem — like rising disaster losses — that requires interdisciplinary collaboration to solve." She adds: "Convergence science focuses on applications and solutions, which makes crossing disciplinary and organizational boundaries so necessary."

By providing free, online resources based on social science research, the CONVERGE team enables individuals from differing disciplines to work together as they design ways to protect the built environment — and the people living within it — against earthquakes, tsunamis, windstorms flooding and other natural hazards.



EDUCATIONAL MODULE CONCEPT

On the education front, the CONVERGE team is developing a series of training modules. The 30- to 60-minute online courses are intended for the broad natural hazards research community, which includes social scientists, reconnaissance engineers, urban planners, public health and medicine researchers, first responders, and others involved in natural hazards or disaster research. Each standalone module concludes with a 10-question quiz required to receive a certificate of completion.

Lori Peek, PhD, Director, Natural Hazards Center, University of Colorado Boulder

Rachel Adams, PhD, postdoctoral research associate

Candace Evans, MA, doctoral student and graduate research assistant

"Our modules are designed to help train early-career researchers from various disciplines and others new to the natural hazards and disaster field," Peek says. "Those who complete the modules receive a certificate for each one, which will eventually build toward a credentialing system." She notes this is similar to earning certification for conducting human subjects research. "Our goal is to ensure a minimum competence in the field, which remains highly event-driven, and to democratize access to research information."

Peek and her team encourage educators to adopt the modules in their classrooms. Currently, two training modules are available that focus on social vulnerability and disaster mental health. Upcoming training modules will emphasize cultural competence in hazards and disaster research, institutional review board procedures for hazards and disaster researchers and conducting emotionally challenging research.

THE CONVERGE TEAM

Lori Peek, PhD, sociology professor and director of the Natural Hazards Center at UCB, leads the CONVERGE initiative. Working with Peek on the CONVERGE modules is postdoctoral research associate Rachel Adams. Adams earned her PhD in community health sciences from the UCLA Fielding School of Public Health, and she has a Master of Public Health degree in epidemiology and biostatistics from the University of Southern California.

Adams led the design and development of the Social Vulnerability and Disasters module. "We've received a lot of positive feedback and enthusiasm surrounding the first module and the other upcoming modules," she says. "A number of engineering students have expressed their desire to apply their newfound knowledge about the social aspects of disaster vulnerability to inform their future research endeavors."

Candace Evans, a graduate research assistant at the Natural Hazards Center and part of CONVERGE, helped Adams and Peek create the first two modules. Evans is a second-year PhD student at UCB in the department of sociology.

The Social Vulnerability and Disasters module focuses on potentially vulnerable populations such as the elderly, children, and low-income persons.

In addition to the current core team, a variety of other researchers associated with the CONVERGE facility have contributed in numerous ways. For instance, a former CONVERGE postdoc, Haorui Wu, led the development of two other modules before he accepted his first faculty position. Graduate students affiliated with the Natural Hazards Center have also contributed to the review and testing of several other forthcoming modules.

MODULES GROUNDED IN SOCIAL SCIENCE RESEARCH

Similar to a college-level seminar, the CONVERGE modules provide a review of the academic literature. In the Social Vulnerability and Disasters module, participants learn common research approaches, how to understand and incorporate secondary sources, and apply ethical considerations. Also, the team develops case studies for real-world understanding of the module topic.

"For each module, our team works for months developing and testing," Adams says. "With our first module, we piloted it with 23 undergraduates taking part in the NSF-funded NHERI Research Experience for Undergraduates program. They enjoyed learning about vulnerable populations, and they gave us excellent practical feedback."

The Disaster Mental Health module makes evidence-based connections between damage to the built environment, slow recovery processes, and mental health outcomes.

All of the students and the staff affiliated with CONVERGE thoroughly test and review the modules, Peek emphasizes. "Reviewing and synthesizing the literature takes time," Peek says. "We've learned, too, that using case studies and other interactive lessons in the module can really help the lessons to stick."

Social Vulnerability and Disasters module. For this module, participants learn to understand and recognize vulnerable groups, understand ways to study social vulnerability, understand the ethics of such research, and learn how vulnerability research can improve natural hazards research as a whole — and improve outcomes for citizens and improve resiliency in communities.

Disaster Mental Health module. This module teaches participants about common mental health outcomes associated with disasters, with a particular emphasis on risk factors over time that render certain populations vulnerable to poor disaster mental health outcomes. Examples of methods used to study mental health during a disaster and evidence-informed policy and practice are highlighted throughout.

Key partnerships. The UCB team prepares each course with academic rigor typical of the social sciences. For the Social Vulnerability and Disasters and Disaster Mental Health modules, the team worked closely with subject matter experts at the Centers for Disease Control and Prevention's Center for Preparedness and Response. Such collaborations ensure the modules are empirically thorough and relevant to a wide audience of researchers and practitioners.

Both modules are informed by decades of research indicating that certain groups in society are more vulnerable to the impacts of natural disasters. The Social Vulnerability module incorporates CDC data and practical solutions for reducing exposure in target populations, as well as links to additional resources for students seeking to research the topic further.

In addition to the CDC, Peek and her team have worked with other key partners through the CONVERGE Leadership Corps. For instance, the principal investigators for the NSF-supported Structural Engineering Extreme Events Reconnaissance, or StEER, network, have begun reviewing forthcoming modules to ensure their relevance to reconnaissance engineers.

"Receiving feedback from so many partners representing different disciplines has helped advance the modules and ensure they can reach a wider audience," Peek says. "We are serious about using convergence science to improve these modules."

NEXT STEPS

Over the next five years, CONVERGE will release additional training modules. The next three modules will focus on the following:

- Cultural Competence in Hazards and Disaster Research.
- Institutional Review Board (IRB) Procedures for Hazards and Disaster Researchers.
- Conducting Emotionally Challenging Research.

Once those modules are published, the CONVERGE team will delve into modules covering high-level topics such as:

- Broader Ethical Considerations for Hazards and Disaster Researchers.
- Social Science Methods and Approaches for Hazards and Disaster Research.
- Interdisciplinary Methods and Approaches for Hazards and Disaster Research.
- The Science of Team Science: Forming Interdisciplinary Teams for Hazards and Disaster Research.
- Publishing Disaster Data, Data Collection Protocols, and Research Instruments.
- Public Disaster Science: Best Practices for Sharing Hazards and Disaster Research.

CONVERGE IMPACT

As of December 2019, there have been over 1,500 views of the CONVERGE website's Training Module page and 225 visits to the Natural Hazards Center's article announcing the launch of the first module.

Nearly 700 people have registered for the training modules, with 164 receiving a certificate of completion for the Social Vulnerability and Disasters module and 52 receiving a certificate for Disaster Mental Health. About 70% of those completing the first module are students and faculty members, with the remaining 30% representing government, non-profit, and private sector organizations.

A RESOURCE FOR THE DISASTER WORKFORCE

A key aspect of Peek's vision is to train and mentor a diverse next-generation disaster workforce. "The rising disaster losses we currently face demand this kind of training and interdisciplinary integration," she says. "I think we have a fighting chance when, as researchers, we recognize our interconnection and value the knowledge that has been produced by this vibrant natural hazards research community."

NSF AWARD #1841338

CONVERGE: Coordinated Social Science, Engineering, and Interdisciplinary Extreme Events Research

NHERI RAPID assists with the DUNEX initiative

The NHERI RAPID facility team spent a week in October 2019 collecting coastal data as part of the large-scale DUNEX pilot experiment.

DUNEX, which stands for DUring Nearshore EXperiment, is a multi-agency collaborative field campaign to study nearshore coastal processes during coastal storms.

“The DUNEX pilot experiment provided a unique opportunity to apply and demonstrate a wide range of our instrumentation — including the bathymetric survey vessel, drones, multispectral cameras and LiDAR — in a real-world coastal storm setting,” said RAPID facility director Joseph Wartman.

Although the methodologies for collecting the coastal data were not unique, the NHERI RAPID facility enabled a comprehensive, portable array of equipment that is simple for researchers to use.

“We think that, especially in reconnaissance conditions, having fast access to data-collection tools is a high-value addition to the DUNEX work,” said Wartman. “Our tools are highly usable for hazards researchers across the board — at any location and with diverse sets of teams.”

In the October 2019 effort, the NSF-funded RAPID team shipped equipment to Duck, North Carolina, for the DUNEX pilot project — a smaller scale field campaign focused on collecting preliminary data in support of the major campaign in 2020. The team tested several new instruments the RAPID facility recently acquired, including a fixed-wing drone capable of flying long distances, a multispectral camera for discerning features and objects on the ground, and a laser scanner that can continuously measure ocean waves.

Driven by academic researchers, multiple governmental agencies and non-governmental organizations — the DUNEX field campaign aims to improve basic understanding, predictive capabilities, and observational technologies for extreme coastal storm impacts. The DUNEX campaign is not a single project; rather it is an effort to coordinate many projects and facilitate the addition of more projects through shared data, infrastructure and other field resources.

The field campaign involved about 40 to 50 natural hazards and coastal researchers and utilized much of the RAPID’s instrumentation portfolio—including drones, scanners, and its hydrographic survey vessel, among other tools.

Members of the DUNEX research team and RAPID staff en route to deploy the RAPID hydrographic survey vessel in the Currituck Sound off Duck, North Carolina. (Photo: A. Renaud)

Virginia Tech professor and RAPID coastal hazards specialist Jennifer Irish (left) and VT undergraduate student Megan Beever collect multispectral camera data from a drone platform work with RAPID Operations Engineer Andrew Lyda. (Photo: A. Renaud)

The DUNEX Leadership Team is eager to have the NHERI RAPID team take part in next year's effort.

"The RAPID field training and deployment effort was one of the highlights of this year's Pilot and exemplified the collaborative nature of DUNEX," the DUNEX team wrote in a letter to Wartman. "The RAPID team's knowledge and skills contributed to the success of DUNEX."

The full DUNEX experiment will begin in fall 2020 and extend into winter 2021, as desired by participating science teams. The northern Outer Banks, NC, extending from the Cape Hatteras National Seashore north to the Virginia border, was selected as the region of focus, due to the prevalence of coastal storms that impact the area annually.

DUNEX projects are funded by a number of groups, including the new U.S. Coastal Research Program, the U.S. Army Corps of Engineers, and the National Science Foundation.

RAPID Operations Manager Michael Grilliot and Operations Specialist Jacqueline Peltier laser scan waves off a pier in Duck, North Carolina. (Photo: RAPID Facility)

The RAPID hydrographic survey vessel. (Photo: A. Renaud)

Summer programs seek participants

The Education and Community Outreach (ECO) Committee has been hard at work preparing for the 2020 NHERI Summer Institute and the NHERI Research Experiences (REU) for Undergraduates Summer Program.

The ECO Committee members reviewed pre- and post-assessment data from the 2019 events and strategically incorporated lessons learned into next year's programs. ECO representatives also reviewed the Summer Institute and REU online applications, and are currently reviewing schedules and curriculum.

These two educational initiatives bring together all NHERI facilities to connect undergraduates and early career scholars to the vast resources within this multi-hazard research network. The ECO Committee representatives collaborate to strategically bring the best outreach programs possible.

NHERI RESEARCH EXPERIENCES FOR UNDERGRADUATES

This summer from May 2020 through August 2020, we will host 2-3 undergraduate researchers at each of the ten NHERI sites.

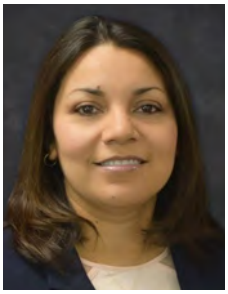
Students will participate in meaningful research projects alongside an experienced faculty mentor. NHERI REU students who complete the program will travel to the University of Washington to present their research projects and posters at the REU Research Symposium on August 3-4, 2020. They will tour the RAPID facility and learn more about reconnaissance efforts post-natural hazard events.

The NHERI REU application (https://www.designsafe.org/learning-center/reu/) is currently open to U.S. citizens and permanent residents who are enrolled in an undergraduate degree program. We encourage all students interested in mitigating the effects of natural hazards to apply!

The application deadline has been extended until February 12, 2020 at midnight. The most successful recruitment tool has been direct contact from faculty with potential student researchers. If you are a faculty member and know an undergraduate student that you believe will benefit from participating in this summer research experience, encourage her/him to apply to the program. Your recommendation will make a big difference!

NHERI SUMMER INSTITUTE

During the summer of 2020, we will also host 20 early career faculty and scholars at the fourth annual NHERI Summer Institute at the University of Texas at San Antonio, Downtown Campus.



Karina Vielma, EdD
NHERI Education and Community Outreach (ECO)
Research Fellow and Educational Specialist
University of Texas, San Antonio

The event brings together young scholars to learn more about the NHERI resources, network with others interested in future collaborations, and acquire information about the National Science Foundation (NSF) proposal development.

The event, which takes place June 29-July 1, will highlight successful CAREER and NSF awardees who will share their experiences of going through the proposal process that successfully resulted in obtaining funding for their research work.

Applications for the 2020 NHERI Summer Institute open in March. Applications for early career travel awards are open until March 30. Details here: https://www.designsafe-ci.org/learning-center/summer-institute/.

The Summer Institute is open to early career faculty, post-doctoral researchers, and rising doctoral scholars interested in learning more about collaborative opportunities within the NHERI network as well as acquiring knowledge about the NSF proposal process.

The NCO-ECO takes pride in the educational outreach programs that incorporate research and best practices to create a multi-hazards engineering and research platform for young, rising scholars. Join us this summer for another great program!

Grants awarded between Q2 and Q3 - April 1 through Sept 30, 2019

OREGON STATE UNIVERSITY

Understanding and Quantifying Structural Loading from Tsunami-Induced Debris Fields
Award Number:1933184; Principal Investigator: Michael Motley; Co-Principal Investigator: Gregory Miller, Marc Eberhard, Pedro Arduino; Organization: University of Washington; NSF Organization: CMMI Start Date:10/01/2019; Award Amount:$690,800.

Collaborative Research: Implementation Strategies and Performance of Unsaturated Bio-Cemented Dune Sand
Award Number: 1933355; Principal Investigator: T. Matthew Evans; Organization: Oregon State University; NSF Organization: CMMI Start Date:08/15/2019; Award Amount:$258,554.

Collaborative Research: Implementation Strategies and Performance of Unsaturated Bio-Cemented Dune Sand
Award Number: 1933350; Principal Investigator: Brina Montoya; Organization: North Carolina State University; NSF Organization: CMMI Start Date: 08/15/2019; Award Amount: $174,992.

NHERI DESIGNSAFE-CI

RAPID: Collaborative Research: Data Mining and Fusion Between Unmanned Aerial Systems and Social Media Technologies to Improve Emergency Operations
Award Number: 1945703; Principal Investigator: Anand Puppala; Organization: Texas A&M Engineering Experiment Station; NSF Organization:CNS Start Date:10/01/2019; Award Amount:$90,000.

EAGER: DREAM-B: Collaborative Research: Moldable and Wave Tunable Materials for Complex Freeform Structures
Award Number: 1912823; Principal Investigator: Anastasia Muliana; Co-Principal Investigator: Maria Koliou; Organization: Texas A&M Engineering Experiment Station; NSF Organization: CMMI Start Date:06/01/2019; Award Amount: $160,000.

EAGER: DREAM-B: Collaborative Research: Moldable and Wave Tunable Materials for Complex Freeform Structures
Award Number: 1913688; Principal Investigator: Negar Kalantar; Organization: California College of the Arts; NSF Organization: CMMI Start Date:06/01/2019; Award Amount:$69,999.

EAGER: DREAM-B: Collaborative Research: Moldable and Wave Tunable Materials for Complex Freeform Structures
Award Number: 1911678; Principal Investigator: Stefano Gonella; Organization: University of Minnesota-Twin Cities; NSF Organization: Start Date:06/01/2019; Award Amount: $70,000.

RAPID: Collaborative Research: Data Mining and Fusion Between Unmanned Aerial Systems and Social Media Technologies to Improve Emergency Operations
Award Number: 1945787; Principal Investigator: Navid Jafari; Co-Principal Investigator: Nina Lam; Organization: Louisiana State University; NSF Organization: CNS Start Date:10/01/2019; Award Amount:$90,000.00.

UNIVERSITY OF COLORADO BOULDER

CoPe EAGER: Nearshore Extreme Events Reconnaissance (NEER) Association
Award Number: 1939275; Principal Investigator: Britt Raubenheimer; Co-Principal Investigator: Steve Elgar; Organization: Woods Hole Oceanographic Institution; NSF Organization: ICER Start Date: 09/15/2019; Award Amount:$300,000.

UNIVERSITY OF FLORIDA

Collaborative Research: Wind Tunnel Modeling of Higher-Order Turbulence and its Effects on Structural Loads and Response
Award Number: 1930625; Principal Investigator: Kurtis Gurley; Organization: University of Florida; NSF Organization: CMMI Start Date: 09/01/2019; Award Amount: $430,771.

Collaborative Research: Wind Tunnel Modeling of Higher-Order Turbulence and its Effects on Structural Loads and Response
Award Number: 1930389; Principal Investigator: Michael Shields; Organization: Johns Hopkins University; NSF Organization: CMMI Start Date:09/01/2019; Award Amount:$318,766.

LEHIGH UNIVERSITY

Collaborative Research: Frame-Spine System with Force-Limiting Connections for Low-Damage Seismic Resilient Buildings
Award Number:1926326; Principal Investigator: Richard Sause; Co-Principal Investigator: James Ricles; Organization: Lehigh University; NSF Organization: CMMI Start Date:08/01/2019; Award Amount:$329,999.

Collaborative Research: Frame-Spine System with Force-Limiting Connections for Low-Damage Seismic Resilient Buildings
Award Number: 1928906; Principal Investigator: Larry Fahnestock; Organization: University of Illinois at Urbana-Champaign; NSF Organization: CMMI Start Date:08/01/2019; Award Amount:$740,001.

Collaborative Research: Frame-Spine System with Force-Limiting Connections for Low-Damage Seismic Resilient Buildings
Award Number: 1926365; Principal Investigator: Barbara Simpson; Organization: Oregon State University; NSF Organization: CMMI Start Date:08/01/2019; Award Amount:$254,000.

UNIVERSITY OF TEXAS AT AUSTIN

RAPID/Collaborative Research: Liquefaction Mitigation of Silts using MIDP and Field Testing with NHERI UTexas Large Mobile Shakers
Award Number: 1935774; Principal Investigator: Kenneth Stokoe; Organization: University of Texas at Austin; NSF Organization: CMMI Start Date:07/01/2019; Award Amount:$48,778.

RAPID/Collaborative Research: Liquefaction Mitigation of Silts using MIDP and Field Testing with NHERI UTexas Large Mobile Shakers
Award Number:1935670; Principal Investigator:Arash Khosravifar; Co-Principal Investigator: Diane Moug; Organization: Portland State University; NSF Organization: CMMI Start Date:07/01/2019; Award Amount:$150,211.

FLORIDA INTERNATIONAL UNIVERSITY

S&AS:INT:COLLAB: Aerodynamic Intelligent Morphing System (A-IMS) for Autonomous Smart Utility Truck Safety and Productivity in Severe Environments
Award Number: 1849264; Principal Investigator: Vladimir Vantsevich; Co-Principal Investigator: Nasim Uddin, Roy Koomullil; Organization: University of Alabama at Birmingham; NSF Organization: IIS Start Date: 05/01/2019; Award Amount: $651,260.

Collaborative Research: Rethinking the Role of Building Envelopes with Smart Morphing Facades
Award Number: 1826356; Principal Investigator: Alice Alipour; Co-Principal Investigator: Partha Sarkar, Behrouz Shafei; Organization: Iowa State University; NSF Organization: CMMI. Start Date: 01/01/2019; Award Amount:$399,998.

Understanding Particle Scale Motion Initiation Physics for Loose-laid Building Rooftop Aggregates in Severe Windstorms
Award Number:1760999; Principal Investigator: Nigel Kaye; Co-Principal Investigator:; Organization: Clemson University; NSF Organization: CMMI. Start Date:01/01/2019; Award Amount:$369,968.

Phase I I/UCRC at Florida International University: Center for Wind Hazard and Infrastructure Performance (WHIP)
Award Number: 1841503; Principal Investigator: Ioannis Zisis; Co-Principal Investigator: Arindam Chowdhury, Seung Jae Lee, Amal Elawady; Organization: Florida International University; NSF Organization: IIP Start Date:02/01/2019; Award Amount:$150,000.

UC DAVIS

In Situ Characterization and Dynamic Response of Well-Graded Coarse-Grained Soils
Award Number: 1916152; Principal Investigator:Jason DeJong; Co-Principal Investigator:Katerina Ziotopoulou, Alejandro Martinez; Organization:University of California-Davis;NSF Organization: CMMI Start Date:07/01/2019; Award Amount:$695,745.

RAPID, UNIVERSITY OF WASHINGTON

NSF Award 1826118: GEER - Earthquake to Anchorage, Alaska on April 25, 2019

NSF Award 1826118: GEER - Earthquake to Hokkaido, Japan on June 10, 2019

NSF Award 1826118: GEER - Earthquake to Ridgecrest, CA on July 04, 2019

NSF Award 1751216: UW - Seismic to Washington on August 29, 2019

NSF Award 1822307: LSU - Hurricane to Baton Rouge, LA on September 06, 2019

NSF Award 1841667: StEER - Hurricane to The Bahamas on September 16, 2019

NSF Award 1841667: StEER - Hurricane to The Bahamas on September 30, 2019

NSF Award 1917298: OSU CCE - Wildfire to California on September 26, 2019

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