# 3HIFEE @ Illinois

## August 11-12, 2017

## Final Program

# 3rd Huixian International Forum on Earthquake Engineering for Young Researchers

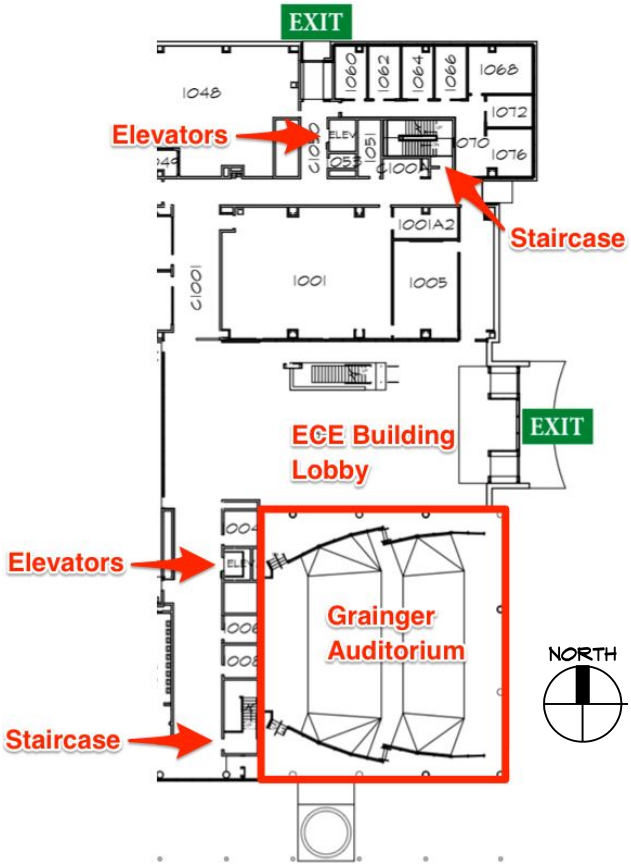
## University of Illinois at Urbana-Champaign

## August 11-12, 2017

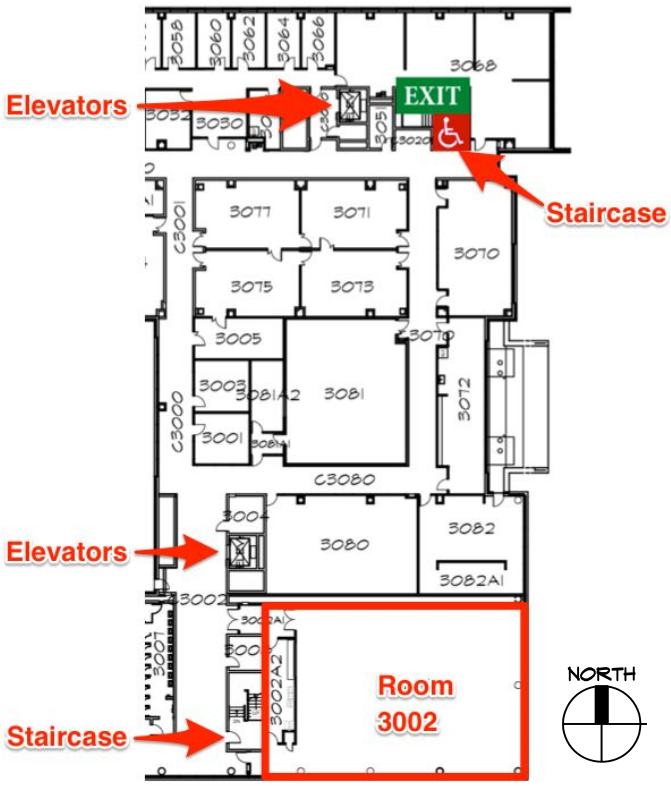
# Conference Program

# VENUE MAPS

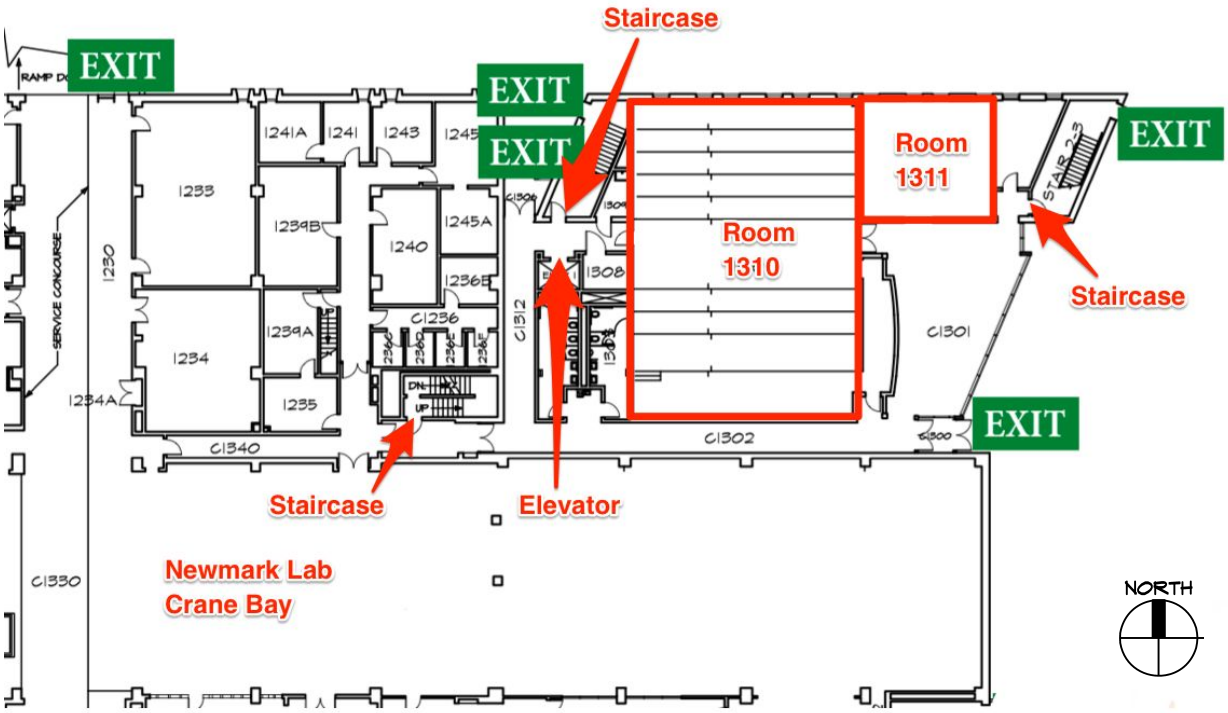
*ECE Building, First Floor*



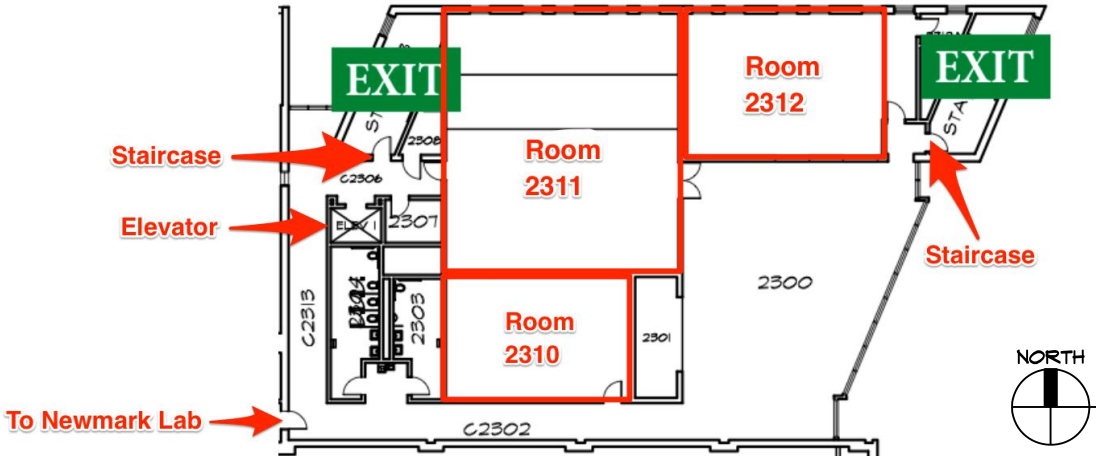

*ECE Building, Third Floor*



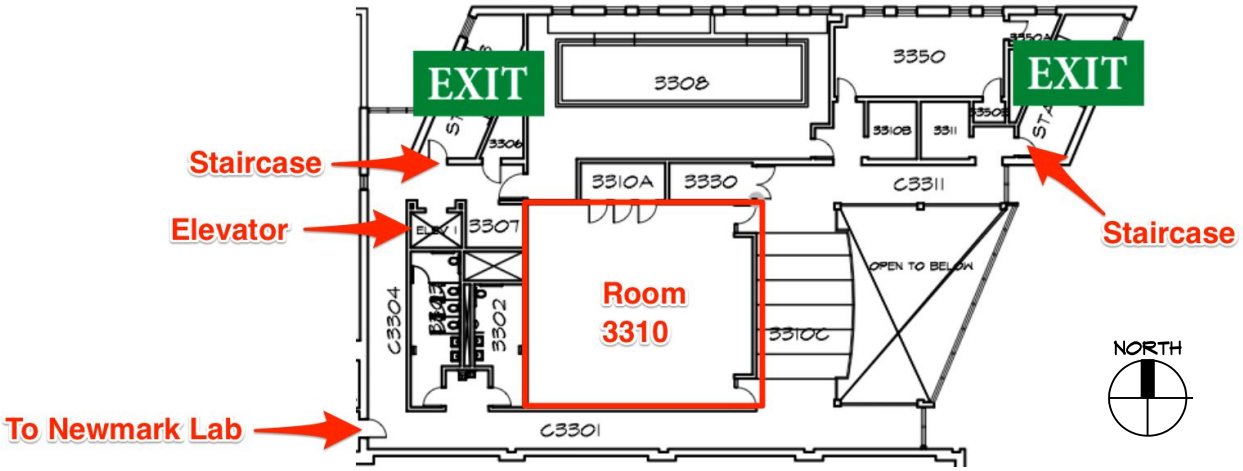
*Newmark Lab and Yeh Student Center, First Floor*



*Yeh Student Center, Second Floor*




*Yeh Student Center, Third Floor*



# SCHEDULE AT A GLANCE

**FRIDAY, AUGUST 11, 2017**

| | |
|---|---|
| 08:00 - 08:45 | Registration – *ECE Building Lobby* |
| 08:45 - 09:15 | Opening Ceremony – *ECE Building Grainger Auditorium* |
| 09:15 - 10:00 | Plenary Session 1 – *ECE Grainger Auditorium*<br>Speaker: Youssef Hashash |
| 10:00 - 10:30 | Break w/ coffee and snacks – ECE Building Lobby |
| 10:30 - 11:15 | Plenary Session 2 – *ECE Grainger Auditorium*<br>Speaker: Toru Takeuchi |
| 11:15 - 12:00 | Plenary Session 3 – *ECE Grainger Auditorium*<br>Speaker: Satish Nagarajaiah |
| 12:00 - 12:15 | Group Photo – *ECE Building Lobby* |
| 12:15 - 13:45 | Luncheon – *ECE Building Room 3002*<br>Speaker: Baitao Sun |
| 13:45 - 14:00 | Break / Walk to Newmark |
| 14:00 - 15:40 | Parallel Session 1 – *Yeh Student Center* |
| 15:40 - 16:10 | Break w/ coffee and snacks – *Newmark Lab Crane Bay* |
| 16:10 - 17:50 | Parallel Session 2 – *Yeh Student Center* |
| 18:30 - 21:00 | Welcome Reception – *Newmark Lab Crane Bay* |

**SATURDAY, AUGUST 12, 2017**

| | |
|---|---|
| 08:30 - 10:10 | Parallel Session 3 – *Yeh Student Center* |
| 10:10 - 10:40 | Break w/ coffee and snacks – *Newmark Lab Crane Bay* |
| 10:40 - 12:20 | Parallel Session 4 – *Yeh Student Center* |
| 12:20 - 13:30 | Standing Lunch Buffet – *Newmark Lab Crane Bay* |
| 13:30 - 15:10 | Parallel Session 5 – *Yeh Center* |
| 15:10 - 15:45 | Walk to ECE Building/Break w/ coffee and snacks |
| 15:45 - 16:30 | Plenary Session 4 – *ECE Building Grainger Auditorium*<br>Speaker: Paulo Lourenço |
| 16:30 - 17:15 | Plenary Session 5 – *ECE Building Grainger Auditorium*<br>Speaker: Hui Li |
| 17:15 - 18:00 | Plenary Session 6 – *ECE Building Grainger Auditorium*<br>Speaker: Guo-Qiang Li |
| 18:30 - 21:00 | Closing Banquet – *Alice Campbell Alumni Center*<br>Speaker: John Rogers |

# WELCOME FROM THE CONFERENCE CHAIRS

Dear Conference Delegates:

Welcome to the University of Illinois! We are very pleased that you are joining us here in Urbana-Champaign for this exciting event - The Huixian International Forum on Earthquake Engineering for Young Researchers. Proposed jointly by the Huixian Earthquake Engineering Foundation and the US-China Earthquake Engineering Foundation, the forum aims at commemorating the pioneers in earthquake engineering and providing young researchers a platform for communication, knowledge sharing, and research collaboration. The first forum was held at the Institute of Engineering Mechanics, CEA, Harbin, China (2014), and the second forum was held at the Beijing University of Technology, Beijing, China (2016).

By the force of your participation, we have an excellent program that covers a wide range of earthquake engineering topics covering materials, design, experimentation, simulation, sensing and health monitoring. The conference includes 120 technical presentations with 150 delegates representing 12 countries. We are anticipating a vibrant two days of interaction as we hear about cutting-edge research, catch up with old friends and make new connections. We trust that you will enjoy your time here on the U of I campus and in Urbana-Champaign!

Best regards,

Billie F. Spencer, Jr.
Larry A. Fahnestock
Tao Wang

# CONFERENCE LOGISTICS

**Registration.** All on-site registrations will take place in the lobby of the ECE Building. Also, a Welcome Package will be given to all Registered Delegates.

**Conference Venue.** The plenary sessions will be held at the ECE Building, located at 306 N. Wright Street in Urbana, Illinois, on the campus of the University of Illinois at Urbana-Champaign. Meanwhile, all parallel sessions will be held at the Newmark Civil Engineering Laboratory (NCEL) in the M.T. Geoffrey Yeh Student Center within the Civil and Environmental Engineering Department at the University of Illinois at Urbana-Champaign. The Newmark Civil Engineering Lab is located on the north edge of campus.

**Lunch.** On Friday, the Luncheon will be served in Room 3002 of the ECE Building. Meanwhile, the theme for Saturday's standing lunch will be "The Best Texas BBQ in Illinois" and will be served in the Crane Bay of the Newmark Structural Engineering Building.

**Breaks.** Coffee breaks will be served in the lobby of the ECE building and Crane Bay of the Newmark Structural Engineering Laboratory.

**Internet Access.** We provide free public WiFi for guests. Follow these simple steps to get online:

1. Select IllinoisNet_Guest as the network to connect to.
2. Open a web browser (e.g. Chrome, Firefox, Safari, Internet Explorer), and go to http://illinois.edu
3. At the bottom of the page, click on "Register a guest account"
4. Provide relevant information (name, phone number, email address).
5. Click Register.

Your username and password will pop up on the screen and will be emailed to you. Your access expires after 24 hours. Be sure to follow these steps every day you want to get online.

**Emergencies.** To report any police, fire or medical emergency, call 911. In the event of a fire, please pull the manual fire alarm BEFORE calling 911. Evacuate the building immediately. Campus emergencies may be reported to Campus Police by activating any (Blue Light) phone located throughout campus. In case of severe weather, if you are outside, proceed to the nearest protective building.

# LUNCHEON SPEAKER

## Nepal earthquake and its implications in engineering

*Baitao Sun, Institute of Engineering Mechanics, China Earthquake Administration*

Friday, August 11, 2017
12:45 – 13:30
ECE Building Room 3002

**Abstract**

This presentation will explore several aspects of the 2015 Mw 7.5 Nepal earthquake. First, the seismic characteristics, such as the epicenter and crust movement, will be presented. Then, the severe consequences that the Nepal earthquake brought to many communities and some of the reasons for the heavy damage in different building types will be discussed. Finally, some guidelines are proposed by Government Agencies to manage seismic risk will be examined.

**Biographical Sketch**

Baitao Sun is the Director and Professor of the Institute of Engineering Mechanics, China Earthquake Administration. Prof. Sun has conducted research mainly in the fields of earthquake resistance of structures and seismic retrofit, seismic performance assessment of buildings, earthquake disaster risk evaluation among many other contributions. To date, he has completed more than 20 national and provincial scientific research projects. He has authored/edited more than 150 scientific papers, 4 books and 11 national codes. His work has been recognized by 6 provincial or ministry level science and technology awards. Prof. Sun is also Director of International Association for Earthquake Engineering, the President of Asian-Pacific Network of Centers for Earthquake Engineering (ANCER), and a member of the United Nations Disaster Assessment and Coordination.

# BANQUET SPEAKER

**Micro/nanomechanics for soft, body-integrated electronics**
*John Rogers, Northwestern University*
Saturday, August 12, 2017
19:15 – 20:00
Alice Campbell Alumni Center

**Abstract**
Biology is soft and curvilinear; semiconductor devices are not. Electronic and optoelectronic systems that eliminate this profound mismatch in properties create opportunities for devices that can intimately integrate with the body, for diagnostic, therapeutic or surgical function with important, unique capabilities in biomedical research and clinical healthcare. Over the last decade, a convergence of new concepts in mechanical engineering, materials science, electrical engineering and advanced manufacturing has led to the emergence of diverse, novel classes of 'biocompatible' electronic platforms. This talk describes the key ideas, with examples in wireless, skin-like electronic 'tattoos' for continuous monitoring of physiological health.

**Biographical Sketch**
Professor John A. Rogers obtained BA and BS degrees in chemistry and in physics from the University of Texas, Austin, in 1989. From MIT, he received SM degrees in physics and in chemistry in 1992 and the PhD degree in physical chemistry in 1995. From 1995 to 1997, Rogers was a Junior Fellow in the Harvard University Society of Fellows. He joined Bell Laboratories as a Member of Technical Staff in the Condensed Matter Physics Research Department in 1997, and served as Director of this department from the end of 2000 to 2002. He then spent thirteen years on the faculty at University of Illinois, most recently as the Swanlund Chair Professor and Director of the Seitz Materials Research Laboratory. In 2016, he joined Northwestern University as the Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering and Medicine, with affiliate appointments in Mechanical Engineering, Electrical and Computer Engineering and Chemistry, where he is also Director of the newly endowed Center for Bio-Integrated Electronics. He has published nearly 600 papers and is co-inventor on more than 100 patents. His research has been recognized by many awards including a MacArthur Fellowship (2009), the Lemelson-MIT Prize (2011), and the Smithsonian Award for American Ingenuity in the Physical Sciences (2013). He is a member of the National Academy of Engineering, the National Academy of Sciences, the National Academy of Inventors and the American Academy of Arts and Sciences.

# PLENARY LECTURE 1

**Seismic response of underground structures near tall buildings**

*Youssef Hashash, University of Illinois at Urbana-Champaign*

Friday, August 11, 2017
09:15 – 10:00
ECE Building Grainger Auditorium

**Abstract**

Underground structures are an essential part of civil infrastructure and play an ever-increasing role in a rapidly urbanizing world. Underground structures perform better than above ground structures during earthquakes when transient motion is considered. Nevertheless, underground structures can be vulnerable to damage due to ground shaking. This lecture will describe emerging challenges and opportunities in the seismic evaluation of underground structures including focusing on the interaction with adjacent tall buildings in urban areas. For these complex structures the use of pseudo-static approaches is no longer applicable as these approaches cannot account of significant inertial contributions of structural elements. The lecture will present experimental and numerical models developed to evaluate the impact of mid-rise and high-rise buildings on underground structures. Centrifuge experiments were conducted with simplified representation of the subject buildings. The underground structures were extensively instrumented to measure the displacements and the loads experienced by these structures. Numerical models were developed that can reproduce experimental measurements. The lecture describes advances in nonlinear dynamic soil-structure interaction whereby the soil and the structure are equally represented in the numerical model. These dynamic analyses can represent soil and structure details that have an important impact on the system response and cannot be captured in simplified analyses. The use of modern analysis software makes accessible analyses that can take advantage of modern computer hardware and parallelization. It is possible to run multiple ground motions and rapidly process analysis results within a short timeframe. The combined experimental and numerical studies clearly demonstrate that for underground structures next to tall buildings, portion of the building inertial load in the form of base shear is transmitted to the underground structure. The impact of buildings on seismic loads on underground structures must therefore be taken into account in design.

**Biographical Sketch**

Youssef Hashash, Ph.D., P.E is the William J. and Elaine F. Hall professor of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign. He is the vice president of the GeoInstitute of ASCE. He received his undergraduate and graduate degrees from MIT after which he worked in Dallas, Texas and San Francisco, California on a number of underground construction projects in the U.S. and Canada. Youssef joined the faculty of the Department of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign in 1998. He taught courses in Geotechnical Engineering, Numerical Modeling in Geomechanics, Geotechnical Earthquake Engineering, Tunneling in Soil and Rock, and Excavation Support Systems. His research focus includes deep excavations in urban areas, earthquake engineering, continuum and discrete element modeling and soil-structure interaction. He also works on geotechnical engineering applications of visualization, augmented reality, imaging and drone technologies. He has published over 200 articles and is co-inventor on four patents. His research group developed the software program DEEPSOIL that is used worldwide for evaluation of soil response to earthquake shaking.

# PLENARY LECTURE 2

## Recent seismic design with energy-control concepts in Japan

*Toru Takeuchi, Tokyo Institute of Technology*

Friday, August 11, 2017
10:30 – 11:15
ECE Building Grainger Auditorium

**Abstract**

To keep the resilience of the major cities after large earthquake, damage controlled design using various energy-dissipation devices or seismic isolation techniques for buildings and city facilities are obtaining the popularity in high seismic zones as in Japan. The energy-dissipation concept is concentrating the input seismic energy into limited part of structural members with high-ductility members and keeping the main structure undamaged by dissipating the energy by these replaceable members. BRBs (Buckling-Restrained Braces) can be used as one of representative such members. In the presentation, the detailed applications of this concept into various structural systems including new constructions and retrofits of existing buildings are introduced and discussed.

**Biographical Sketch**

Born in 1960, he graduated from Tokyo Tech in 1984, worked for Nippon Steel Corporation for 19 years as a structural engineer & researcher including several year experiences in Ove Arup & Partners London. After starting research and education in Tokyo Tech from 2003, he has been working on steel structure, seismic design including various energy-dissipation members including BRBs, spatial design including latticed shells and cable structures. Awarded as Japan structural design award 2005, IASS Tsuboi award 2005, Good design award Japan 2005,2012,2013, AIJ research theses award in 2011.

# PLENARY LECTURE 3

## Advanced seismic protection systems: state of the art and practice

*Satish Nagarajaiah, Rice University*

Friday, August 12, 2017
11:15 – 12:00
ECE Building Grainger Auditorium

**Abstract**

This keynote focuses on the state of art and practice of seismic protection of structures around the world. The talk will include details of recent developments and applications of seismic isolation, supplemental damping systems, adaptive passive stiffness systems, buckling restrained braces and uplift systems, and tuned mass dampers. Base isolation is widely accepted technology, which has protected critical structures around the world in several recent near fault earthquakes. We present new nonlinear dynamic analysis techniques developed to analyze large base isolated structures. We present successes of seismic isolated structures in recent earthquakes in detail--made possible by system identification and structural monitoring systems in place to monitor their performance in large earthquakes. Advantages of allowing uplift in fixed base and sliding isolated structures is presented. Wide spread application of fluid dampers is large structures and their performance recent earthquakes is presented. Recent developments and applications of large scale tuned mass dampers for earthquake (/wind) protection is presented. Recent advances in development of passive adaptive stiffness systems for seismic protection is presented. We present various stages of development of the concept of adaptive passive negative stiffness device (NSD) achieved through the introduction of supplemental negative and positive tangential stiffness, and the design procedure for implementing it in various structures for seismic response control of buildings and bridges. Detailed analytical and shake table test results of NSD in different structures are presented to show the effectiveness of the new and innovative concept of adaptive negative-positive tangential stiffness, which provides significant earthquake protection, while keeping the primary system essentially elastic or mildly inelastic in strong earthquakes, thus preventing damage experienced.

**Biographical Sketch**

Satish Nagarajaiah is a Professor of Civil and Environmental Engineering with joint appointment in Mechanical Engineering and Material Science and Nano Engineering departments, at Rice University, Houston. He obtained his Ph.D. from University at Buffalo, where he was a post-doctoral researcher before he started his academic career. His expertise is in nonlinear structural dynamics, advanced protective systems, structural control, structural system identification, structural monitoring, advanced noncontact strain sensing, and applied nanotechnology for sensing. He has published extensively and presented several keynote lectures at international conferences. For full details visit his web site satishnagarajaiah.rice.edu. Dr. Nagarajaiah currently serves as the managing editor of the journal of structural engineering [ASCE], editor of the structural control and health monitoring international journal [Wiley] and editor-in-chief (North America) of the structural monitoring and maintenance international journal [Techno-press]. He is an elected inaugural fellow of Structural Engineering Institute (SEI) of ASCE since 2012. He was awarded the NSF CAREER award in 1998 for his work on adaptive stiffness systems and ASCE Moisseiff Award in 2015 for research on Adaptive Stiffness Structures and ASCE Raymond Reese Research Award in 2017 for research on sparse system identification. Currently, he serves on the board of governors of ASCE SEI and the Technical Activities Division Executive Committee. He has founded and chaired numerous committees in SEI, EMI, and IASCM on Structural Control and Monitoring.

# PLENARY LECTURE 4

## Historic and modern masonry structures: recent shaking table testing and tools for advanced simulation

*Paulo Lourenço, University of Minho*

Saturday, August 12, 2017
15:45 – 16:30
ECE Building Grainger Auditorium

**Abstract**

Modern societies understand built cultural heritage as a landmark of culture and diversity. Only during the last decades the idea that ancient buildings could be conserved and reused became appealing. Large investments have been concentrated in this field, leading to impressive developments in the areas of inspection, non-destructive testing, monitoring and structural analysis of historical constructions. Still, this heritage is at risk, due to intrinsic seismic vulnerability. A recent international benchmark test on shaking table testing prediction is shown and conclusions are made on earthquake engineering simulation tools. For modern structural masonry, the use of unreinforced, confined and reinforced masonry is briefly addressed, discussing the influence of seismic hazard and presenting different solutions adopted in developed countries. Recent research is presented, with conclusions on the performance of masonry systems for lateral loading. Shaking table tests addressing the performance of masonry infills are also shown. Finally, a short review on modeling possibilities of masonry structures subjected to earthquakes is given and research needs are briefly discussed.

**Biographical Sketch**

Paulo B. Lourenço, Full Professor, Department of Civil Engineering, University of Minho, Guimarães, Portugal. Head of the Structural Group and Co-Head of the Institute in Sustainability and Innovation in Structural Engineering. Editor of the International Journal of Architectural Heritage: Conservation, Analysis and Restoration. Coordinator of the International Erasmus Mundus Master in Structural Analysis of Monuments and Historical Constructions. Leader of the Project Team responsible for the revision of the Eurocode 6 (Part 1). Main research interests are NDT, advanced experimental and numerical techniques, innovative strengthening techniques, product development for the industry and earthquake engineering of modern and historical masonry. Supervisor of more than 40 completed PhD theses and coordinator of several research projects. He is author of more than 1000 technical and scientific publications in the fields of masonry, timber and concrete structures, with an h-index of 36 (Scopus). Specialist in structural repair, conservation and strengthening, with works in more than 100 monuments worldwide. Specialist in forensic engineering and modern masonry design.

# PLENARY LECTURE 5

## Multiple-hazard Effects and Control Techniques of Bridges

*Hui Li, Harbin Institute of Technology*

Saturday, August 12, 2017
16:30 – 17:15
ECE Building Grainger Auditorium

**Abstract**

As an important component of transportation system, bridge is vulnerable to multiple-hazard actions, such as earthquake, tsunami, wind, wave, etc, in the long-term operation period. Comparing to that under single extreme natural hazard action, the response of the bridges are more complicated due to the couple effects and disaster chain transmission when subjected to multiple-hazard actions. This paper presents a comprehensive investigation on this topic conducted by the research group of the authors. Firstly, the multiple-hazards effects of highway bridge structures concerned about the earthquake hazard is presented, including the contact element model and pounding analysis of bridge under earthquake excitation, the fast numerical simulation of tsunami propagation and the tsunami-induced wave force, the seismic-performance of coastal bridges incorporated with corrosion damage. Then, the wind effects, wind-rain-induced vibration and monitoring technique of the water rivulets of the stay cables, the multi-mode vortex-induced vibration of cables, the vortex-induced vibration of twin-box girders, the hydrodynamic wave action of bridge superstructure under hurricane-induced waves are introduced. Finally, the multiple-hazard control techniques of bridges are presented, including the control devices with shape memory alloy materials, the magnetorheological dampers with self-sensing and self-energy-harvest functions and the passive negative stiffness damper.

**Biographical Sketch**

H.Li. received her Ph.D. in theoretical and applied mechanics from the Harbin Institute of Technology (HIT) in 1994. She then worked at Institute of Engineering Mechanism as a postdoc fellow for two years. She works at HIT as an associate professor (1996) and professor (1998). Now she is Changjiang Scholarship professor at HIT. Her research has been primarily in the areas of structural health monitoring, structural control, artificial intelligence applications, nanomaterials, wind engineering and earthquake engineering. Dr. Li has directed more than $5M in funded research and published more than 300 technical papers/reports, including three books. Dr. Li is the current president of International Association for Structural Control and Health Monitoring, the Board member of International Society of Structural Health Monitoring for Intelligent Infrastructure, the associate editors of Structural Health Monitoring, Civil Structural Health Monitoring, Vibration and Control, and the president of Structural Control and Health Monitoring for Structures in China. She has received numerous awards, including the Structural Health Monitoring Person of the Year Award, Ho Liang Ho Li Awards, the National Awards for Science and Technology, etc.

# PLENARY LECTURE 6

## Enhancing aseismic performance of buildings with bifunctional metal components

*Guo-Qiang Li, Tongji University*

Saturday, August 12, 2017
17:15 - 18:00
ECE Building Grainger Auditorium

**Abstract**

The performance of buildings in seismic zones is usually more complicated than that in non-seismic zones. The buildings are not only required to be damage-limited for fully operational after frequent earthquakes, but also collapse-prevented under rare earthquake events for life safety. So the buildings in seismic zone require the structure to bear proper stiffness and load-bearing capacity to limit the damage from frequent earthquakes, and possess proper ductility and energy-dissipating capacity to prevent collapse due to rare earthquakes as well. A bifunctional component is defined as a combination of structural member and energy-dissipating damper. It not only provides structural stiffness and strength for the buildings against damage from frequent earthquakes, but also contributes additional damping to dissipate energy input to the buildings to reduce the structural seismic response to a considerable extent for the purpose of collapse-prevention. Four types of bifunctional components, including buckling-restrained steel brace (BRB), buckling-restrained steel plate shear wall (BRSW), steel link beam and steel energy-dissipating column, are introduced to be employed to enhance the performance of buildings in seismic zones. Function requirements of bifunctional components used for resisting seismic effects on buildings are discussed. Examples of using various bifunctional metal components for aseismic performance of buildings are presented. The effectiveness of bifunctional components enhancing the performance of buildings subjected to earthquakes is illustrated.

**Biographical Sketch**

Guo-Qiang Li is currently a professor of structural engineering at the College of Civil Engineering in Tongji University, the director of Research Centro of Education Ministry of China for Steel Construction and the director of National Research Center of China for Pre-fabrication Construction. He is also a vice-chairman of Chinese Society of Steel Construction and a vice-chairman of Chinese Association of Construction Standardization. In addition, he is the director of the steering committee of Higher-Education on Civil Engineering of China. He is also a fellow of Institution of Structural Engineers in UK, an Honorary Fellow of Hong Kong Institute of Steel Construction. Professor Li's research has been mainly in the area of hazard mitigation including earthquake-resistance, fire-resistance and blast-resistance for steel structures. He has been the principal investigator for more than 30 research projects funded respectively by Chinese Science and Technology Ministry, Construction Ministry, Education Ministry, Natural Science Foundation and Shanghai Science and Technology Committee. He has published 13 technical books and more than 600 journal papers in Chinese and English relevant to his research topics.

# PARALLEL SESSIONS
# FRIDAY, AUGUST 11, 2017

| Parallel Session | Time | Rooms | | | | |
|---|---|---|---|---|---|---|
| | | **Yeh 1310** | **Yeh 2310** | **Yeh 2311** | **Yeh 2312** | **Yeh 3310** |
| PS1 | 14:00 – 15:40 | **MS11** Seismic Behavior of Building Systems and Components | **MS90** Seismic Analysis and Assessment | **MS71** Supplemental Energy Dissipation and Structural Control | **MS150** Experimental Behavior | **MS171** Ground Motions and Site Response |
| PS2 | 16:10 – 17:50 | **MS12** Seismic Behavior of Building Systems and Components | **MS100** Risk Analysis and Loss Assessment | **MS72** Supplemental Energy Dissipation and Structural Control | **MS160** Simulation and Testing Methods | **MS172** Ground Motions and Site Response |

# PARALLEL SESSIONS
# SATURDAY, AUGUST 12, 2017

| Parallel Session | Time | Rooms | | | | |
|---|---|---|---|---|---|---|
| | | **Yeh 1310** | **Yeh 1311** | **Yeh 2311** | **Yeh 2312** | **Yeh 3310** |
| PS3 | 08:30 – 10:10 | **MS13** Seismic Behavior of Building Systems and Components | **MS30** Seismic Response of Bridges | **MS73** Supplemental Energy Dissipation and Structural Control | **MS141** Seismic Response Assessment through Hybrid Simulation | **MS121** Sensing and Condition Assessment |
| PS4 | 10:40 – 12:20 | **MS14** Seismic Behavior of Building Systems and Components | **MS130** Innovations in Displacement Measurement | **MS74** Supplemental Energy Dissipation and Structural Control | **MS142** Seismic Response Assessment through Hybrid Simulation | **MS122** Sensing and Condition Assessment |
| PS5 | 13:30 – 15:10 | **MS15** Seismic Behavior of Building Systems and Components | | **MS60** Base Isolation | **MS180** Foundations | **MS123** Sensing and Condition Assessment |

# ORAL PRESENTATIONS

| **MS11. Seismic behavior of building systems and components** | Chairs: |
|---|---|
| PS1 Friday, August 11, 14:00 – 15:40 | Xun Guo |
| Room: Yeh 1310 | Yuko Shimada |

**237. Lightweight rapidly constructible and reconfigurable modular steel floor diaphragm: cyclic performance**
E. Boadi-Danquah, D. MacLachlan, Matthew Fadden
14:00 – 14:20

**243. Protection of inter-story isolated structures through rate-independent linear damping**
Ashkan Keivan, R. Zhang, Brian M. Phillips, K. Ikago
14:20 – 14:40

**253. Preliminary parametric study of plastic deformation capacity in composite beams**
Yuko Shimada, Satoshi Yamada
14:40 – 15:00

**255. Modeling of fully-grouted masonry shear walls with unbonded post-tensioning under reverse-cyclic loading**
Dimitrios Kalliontzis, Arturo E. Schultz
15:00 – 15:20

**260. Effect of the column base flexibility on the hysteretic response of wide flange steel columns**
Hiroyuki Inamasu, Dimitrios G. Lignos, Amit M. Kanvinde
15:20 – 15:40

| **MS12. Seismic behavior of building systems and components** | Chairs: |
|---|---|
| PS2 Friday, August 11, 16:10 – 17:50 | Maria Koliou |
| Room Yeh 1310 | Zhe Qu |

**115. From performance-based engineering to community resilience: buildings under extreme ground shaking**
Maria Koliou, John van de Lindt
16:10 – 16:30

**180. Topology optimization of buildings subjected to stochastic dynamic ground motions**
Fernando Gomez, Billie F. Spencer, Jr.
16:30 – 16:50

**206. Stiffness demands for pin-supported walls in reinforced concrete moment frames**
Zhe Qu, T. Gong, T. Wang
16:50 – 17:10

**216. Seismic behavior of perforated-steel plate reinforced concrete composite shear wall**
Zhongyi Zhou, Wanlin Cao
17:10 – 17:30

**257. Research on seismic behavior of concrete filled bilateral steel plates composite shear walls with damping interlayer: finite element simulation**
Limeng Zhu, Chunwei Zhang, D. An
17:30 – 17:50

| **MS13. Seismic behavior of building systems and components** | | Chairs: |
|---|---|---|
| PS3 | Saturday, August 12, 08:30 – 10:10<br>Room: Yeh 1310 | Chenxi Mao<br>Takanori Ishida |

**114. Effect of modeling resolution on the seismic resilience of a steel hospital building**
E. Hassan, Hussam N. Mahmoud
08:30 – 08:50

**157. Seismic fragility and functional failure probability of a typical mobile communication station in china**
Chenxi Mao, S. Y. Li, L. Q. Zhang
08:50 – 09:10

**208. Overview of AISC's seismic standards development and research for steel structures**
Leigh Arber
09:10 – 09:30

**263. Energy dissipation behavior of RC Frame with dry stack infilled panel**
Kun Lin, Hongjun Liu, W. Hou, Chunli Wei
09:30 – 09:50

**294. Retrofit and health monitoring effectiveness verification on a real building with vibration control damper damaged during 2011 Great Earthquake**
Songtao Xue
09:50 – 10:10

| **MS14. Seismic behavior of building systems and components** | Chairs: |
|---|---|
| PS4 Saturday, August 12, 10:40 – 12:20 | Shuli Fan |
| Room: Yeh 1310 | Lan Kang |

**161. The effects of shear wall configuration on seismic performance of high-rise reinforced concrete buildings**
Hezhalutfalla Sadraddin, Xiaoyun Shao, Yufeng Hu
10:40 – 11:00

**209. Numerical analysis on seismic behavior of roof joint**
Yao Cui, Xiaoyu Gao, Mengyue Li, Satoshi Yamada
11:00 – 11:20

**211. Evaluation of Ds value of steel moment resisting frames with exposed column bases**
Takanori Ishida, Satoshi Yamada
11:20 – 11:40

**212. Experimental investigation on seismic behavior of beam-to-column joints with external-diaphragm considering the slab effect**
Lingling Wang, Ben Mou, Chunwei Zhang,Y.H. Gu
11:40 – 12:00

**217. Hysteretic behaviour modeling of beam-column connections made of bolted angles**
Thierry Beland, Robert Tremblay, Larry A. Fahnestock, Eric M. Hines, C.R. Bradley, Joshua G Sizemore, A. Davaran
12:00 – 12:20

| **MS15. Seismic behavior of building systems and components** | Chairs: |
|---|---|
| PS5 Saturday, August 12, 13:30 – 15:10 | Zheng He |
| Room: Yeh 1310 | Zhongyi Zhou |

**125. Study on the seismic performance of the rural buildings in Jiujiang, Jiangxi province, China**
Qiang Zhou, Feng Shao, Quanhuan Min, Baitao Sun
13:30 – 13:50

**132. Effect analysis of link beam stiffness variation on failure path and collapse margin of super-tall frame-core tube structure**
Zheng He
13:50 – 14:10

**182. Optimization of a novel damped outrigger system subject to stochastic excitation**
Chuangjie Fang
14:10 – 14:30

**226. Strength and ductility predictions of stiffened box sectional columns made of high strength steel**
Lan Kang
14:30 – 14:50

**165. The use of movable bracing elements as 'temporary danger-time retrofit' for upgrading the seismic performance of existing buildings**
S. Benyamin Adibzadeh, Mahmood Hosseini
14:50 – 15:10

| **MS30. Seismic response of bridges** | | Chairs: |
|---|---|---|
| PS3 | Saturday, August 12, 08:30 – 10:10<br>Room: Yeh 1311 | Petros Sideris<br>Derek Kozak |

**130. Seismic response of continuous girder bridge under spatially varying earthquake wave excitation**
Shuli Fan, Xuyang Zhao, Yi Shi, Jianyun Chen
08:30 – 08:50

**160. Pounding effect analysis of isolated continuous girder bridge considering seismic characteristics**
Hao Wang
08:50 – 09:10

**163. Novel seismically resilient bridge systems for accelerated construction and rapid post-earthquake retrofit**
Petros Sideris, M.T. Nikoukalam, Mohammad Salehi, Abbie B. Liel
09:10 – 09:30

**219. Seismic behavior of single-span integral abutment bridges**
Derek L. Kozak, James M. LaFave, Larry A. Fahnestock
09:30 – 09:50

**248. Investigation on seismic behavior of bridge exterior shear keys**
Yulong Zhou, Xiuli Du, Q. Han
09:50 – 10:10

| **MS60. Base isolation** | Chairs: |
|---|---|
| PS5 Saturday, August 12, 13:30 – 15:10<br>Room: Yeh 2311 | Yao Cui<br>Ben Mou |

**124. Numerical simulation of frictional heating effects of sliding friction bearings for isolated bridges**
Jianian Wen, Qiang Han
13:30 – 13:50

**168. Analytical study of a quasi-zero-stiffness vertical isolation system**
Peng Chen, Gilberto Mosqueda, Ying Zhou
13:50 – 14:10

**200. Performance test and analysis of sliding hydromagnetic bearing**
Yongbo Peng, Luchuan Ding, Junyang Shi, Jianbing Chen
14:10 – 14:30

**236. Effect of vertical ground acceleration on isolated structures**
F.A. Ahmad, Jenna Wong
14:30 – 14:50

**166. Experimental investigation of adaptive base isolation system employing magnetorheological elastomer**
Yancheng Li, Xiaoyu Gu, Yang Yu, Jianchun Li
14:50 – 15:10

| **MS71. Supplemental energy dissipation and structural control** | Chairs: |
|---|---|
| PS1 Friday, August 11, 14:00 – 15:40<br>Room: Yeh 2311 | Chia-Ming Chang<br>Yan Yu |

**190. Design of linear passive control systems for buildings using dynamic output feedback control method**
Chia-Ming Chang, S. Shia, C.Y. Yang
14:00 – 14:20

**205. Experimental study of a wireless structural vibration control system based on fuzzy PID algorithm**
Yan Yu, Changping Yang, Luyu Li, Xiaozhi Leng, Zhiqiang Liu, Ping Xu
14:20 – 14:40

**265. Investigation of vehicle shock absorbers for seismic protection of structures**
Christopher Zaverdas, M.D. Symans
14:40 – 15:00

**298. A robust controller based on regional pole-assignment method for flexible buildings considering parametric uncertainties**
Chaojun Chen, Zuohua Li, Jun Teng and Kun Lin
15:00 – 15:20

**301. Study of model reference adaptive control of shaking table system**
Y.C. Tsai, P. Pan
15:20 – 15:40

| **MS72. Supplemental energy dissipation and structural control** | Chairs: |
|---|---|
| PS2 Friday, August 11, 16:10 – 17:50<br>Room 2311 | Nicholas Wierschem Shujun Hu |

**126. Numerical investigation of new shear links with slotted bolted connections for eccentrically braced frames**
Shujun Hu, Guquan Song, Zhibin Lin
16:10 – 16:30

**149. Performance evaluation of a variable friction cladding system for seismic hazard mitigation**
Y. Gong, Liang Cao, Simon Laflamme, Spencer Quiel, James Ricles, Douglas Taylor
16:30 – 16:50

**196. Seismic performance evaluation of inerter-based tuned mass dampers**
Abdollah Javidialesaadi, Nicholas E. Wierschem
16:50 – 17:10

**213. Damage-control seismic structural system constructed of high-strength steel and fuses**
Xuchuan Lin
17:10 – 17:30

| **MS73. Supplemental energy dissipation and structural control** | Chairs: |
|---|---|
| PS3 Saturday, August 12, 08:30 – 10:10<br>Room: Yeh 2311 | Dongyu Zhang Longhe Xu |

**139. Vibration control of a constructing bridge tower with magnetorheological elastomer variable stiffness tuned mass dampers**
Qi Wang, Xufeng Dong, Luyu Li, Jinping Ou
08:30 – 08:50

**242. Passive self-centering hysteretic damping brace based on the elastic buckling mode jump mechanism of a capped column**
Jingzhe Wu, Brian Phillips
08:50 – 09:10

**244. Numerical analysis of tuned liquid dampers**
Kamalendu Ghosh
09:10 – 09:30

**258. Cyclic behaviors of pre-pressed spring self-centering energy dissipation braces**
Longhe Xu, Xiaowei Fan, Zhongxian Li
09:30 – 09:50

| **MS74. Supplemental energy dissipation and structural control** | | Chairs: |
|---|---|---|
| PS4 | Saturday, August 12, 10:40 – 12:20<br>Room: Yeh 2311 | Oren Lavan<br>Brian Phillips |

**199. Multi-objective optimal design of tuned-mass-dampers in tall buildings**
Oren Lavan
10:40 – 11:00

**299. Partially buckling restrained braces**
Ricardo Herrera
11:00 – 11:20

**303. Adjustable template stiffness device with application for seismic protection of base isolated building structures**
Zhilu Lai, Tong Sun, Satish Nagarajaiah, Hong-Nan Li
11:20 – 11:40

**246. Investigation on seismic performance of bridge with new-type self-centering friction damper**
Jianping Han, Y. Liu
11:40 – 12:00

**137. Optimum design of viscous dampers for dissipation structure using multi-objective genetic algorithm**
Xin Chen
12:00 – 12:20

| **MS90. Seismic analysis and assessment** | | Chairs: |
|---|---|---|
| PS1 | Friday, August 11, 14:00 – 15:40<br>Room: Yeh 2310 | Hongjun Liu<br>Zhang Yu |

**103. Synthesis method of single reference transmissibility function**
Zhang Yu
14:00 – 14:20

**172. Cyclic behavior of mortarless brick joints with different interlocking shapes**
Hongjun Liu, K. Lin, D.X. Peng
14:20 – 14:40

**215. A practical numerical substructure method for earthquake analysis of structures including geometric nonlinearity**
Baoyin Sun
14:40 – 15:00

**164. Simulation of occupant evacuation based on refined CA model considering the gather attraction**
Shuang Li, Mengmeng Gao, Quankui Yu, Changhai Zha
15:00 – 15:20

**167. Quick estimation of the first passage probability of the bridge with Lyapunov equation and large mass method considering traveling wave effect**
Luyu Li, Han Qin, Billie F. Spencer, Jr., Y. Yu
15:20 – 15:40

| **MS100. Risk analysis and loss assessment** | | Chairs: |
|---|---|---|
| PS2 | Friday, August 11, 16:10 – 17:50<br>Room: Yeh 2310 | Hussam Mahmoud<br>Sangwook Park |

**133. A new direction in post-earthquake fire risk evaluation**
Pegah Farshadmanesh, Jamshid Mohammadi
16:10 – 16:30

**148. Seismic fragility of optimally controlled structural systems in presence of signal loss over wireless sensor networks**
Thao H. T. Truong, Peter Seiler, Lauren E. Linderman
16:30 – 16:50

**155. Performance-based framework of steel structures under cascading earthquake and fire hazards**
Hussam Mahmoud, M. Memari
16:50 – 17:10

**191. Framework for fragility assessment of damaged reinforced-concrete frame buildings subjected to artificial earthquakes**
Sang Wook Park, B.K. Oh, H.S. Park
17:10 – 17:30

**252. Review on the development of earthquake insurance in China**
Bingbing Jing, X. Li, S. Chen
17:30 – 17:50

| **MS121. Sensing and condition assessment** | | Chairs: |
|---|---|---|
| PS3 | Saturday, August 12, 08:30 – 10:10<br>Room: Yeh 3310 | Linsheng Huo<br>Shuang Hou |

**113. SA-based damage monitoring of RC frame shaking table test and finite element model updating**
Shuang Hou
08:30 – 08:50

**187. Earthquake monitoring of civil infrastructure using wireless smart sensors**
Yuguang Fu, Li Zhu, Jong Woong Park, Billie F. Spencer, Jr.
08:50 – 09:10

**247. Performance evaluation of unmanned aerial vehicle for bridge inspection and application in 2016 Kumamoto earthquake**
Ji Dang, K. Endo, S. Matsunaga, A. Kasai
09:10 – 09:30

**259. Fast recognition of earthquake damaged structures based on image processing**
Linsheng Huo
09:30 – 09:50

**272. Automated vision-based bridge component extraction using multiscale convolutional neural networks**
Yasutaka Narazaki, Vedhus Hoskere, Tu A. Hoang, Billie F. Spencer Jr.
09:50 – 10:10

| **MS122. Sensing and condition assessment** | Chairs: |
|---|---|
| PS4 Saturday, August 12, 10:40 – 12:20<br>Room: Yeh 3310 | Jian Li<br>Feifei Sun |

**122. Enhancing the accuracy of near-real-time seismic loss estimation using post-earthquake aerial images**
Xinzheng Lu, Xiang Zeng, Zhen Xu, Yuan Tian
10:40 – 11:00

**204. Monitoring the entire collapse of a three-floor frame model under earthquake based on stereovision**
Baohua Shan, Wenting Yuan, Hai Wang, Zhanxuan Zuo, Shuang Li
11:00 – 11:20

**227. Vision-based structural inspection using deep multi-scale convolutional neural networks**
Vedhus Hoskere, Yasutaka Narazaki, Tu A. Hoang, Billie F. Spencer, Jr.
11:20 – 11:40

**233. Bayesian model updating of a cable-stayed bridge using long-term monitoring data**
Parisa Asadollahi, Yong Huang, Jian Li
11:40 – 12:00

**256. Acoustic emission signal characteristics of steel plate shear walls under cyclic loading**
Feifei Sun, Ben Xiao
12:00 – 12:20

| **MS123. Sensing and condition assessment** | Chairs: |
|---|---|
| PS5 Saturday, August 12, 13:30 – 15:10<br>Room: Yeh 3310 | Dongsheng Li<br>Suchao Li |

**251. Effects of soil rigidities on vibration-based damage localization in multi-story buildings**
Jun-Yang Shi, Y.Y. Wu
13:30 – 13:50

**268. Ultrasonic guided wave damage imaging method based on the beamforming sensor network technique for plate-like structure**
Dongsheng Li
13:50 – 14:10

**271. Displacement based RC frame structure seismic damage assessment in post-earthquake field**
Haoyu Zhang
14:10 – 14:30

**162. Pounding analysis of highway bridges based on spatial distribution of stress wave**
Suchao Li, Anxin Guo, Xiangdong Zhan, Hui Li
14:30 – 14:50

| **MS130. Innovations in displacement measurement** | Chairs: |
|---|---|
| PS4 Saturday, August 12, 10:40 – 12:20<br>Room: Yeh 1311 | Fernando Moreu<br>Ali Ozdagli |

**102. Measuring lateral displacements of railroad bridges susceptible to asymmetric loading**
Ali Ozdagli, B. Liu, Fernando Moreu
10:40 – 11:00

**106. Observation and monitoring of total reference-free displacements**
Fernando Moreu, Bideng Liu, Ali I. Ozdagli
11:00 – 11:20

**107. Measurement of direct reference-free dynamic displacements of railroad bridges under train-crossing and ground motion excitations**
Bideng Liu, Ali I. Ozdagli, Fernando Moreu
11:20 – 11:40

**104. Vision-based displacement test method for high-rise building shaking table test**
Su Chen, Lei Fu
11:40 – 12:00

| **MS141. Seismic response assessment through hybrid simulation** | Chairs: |
|---|---|
| PS3 Saturday, August 12, 08:30 – 10:10<br>Room: Yeh 2312 | Huimeng Zhou<br>Xiaoyun Shao |

**146. OpenSees software architecture for substructure-based seismic simulation of partially-nonlinear structures**
Jian Wang, M. Fang, Hui Li
08:30 – 08:50

**221. Effects of time delays and filtered feedback in hybrid simulation with shake table**
Humberto Caudana Quintana, M. Vega, Gilberto Mosqueda
08:50 – 09:10

**238. Robust control for multi-axial real-time hybrid simulation testing including specimen interaction and multi-actuator dynamic effects**
Gaston Fermandois-Cornejo, Billie F. Spencer, Jr.
09:10 – 09:30

**261. Implementing online updating to complex hysteresis models in real-time hybrid simulation using constrained unscented Kalman filter**
Bilal Ahmed Mohammed, Xiaoyun Shao
09:30 – 09:50

**302. Stability of an explicit time integration algorithms for nonlinear pseudo dynamic test**
Tao Wang, H.M. Zhou, X.P. Zhang
09:50 – 10:10

| **MS142. Seismic response assessment through hybrid simulation** | Chairs: |
|---|---|
| PS4 Saturday, August 12, 10:40 – 12:20<br>Room: Yeh 2312 | Cheng Chen<br>Maria Cortez-Delgado |

**183. Distributed real-time hybrid simulation at LESS**
Mohamed Ahmed, Xiaoyun Shao
10:40 – 11:00

**214. Equivalent force control combined with adaptive polynomial-based forward prediction for real-time hybrid simulation**
Huimeng Zhou, David J. Wagg
11:00 – 11:20

**225. Demand analysis for adaptive actuator delay compensation in real-time hybrid simulation: a SDOF study**
Cheng Chen, F. Sanchez, Y. Xu, J. Liang
11:20 – 11:40

**234. Development of the UPRM hybrid simulation facilities: substructuring techniques coupled numerical simulations**
Maria D. Cortes-Delgado
11:40 – 12:00

| **MS150. Experimental behavior** | | Chairs: |
|---|---|---|
| PS1 | Friday, August 11, 14:00 – 15:40<br>Room: Yeh 2312 | Junxian Zhao<br>Gao Ma |

**131. Experimental investigation on seismic behavior of beam-to-column joints with external-diaphragm considering the slab effect**
Lingling Wang, Ben Mou, Chunwei Zhang, Y.H. Gu
14:00 – 14:20

**140. Seismic responses of steel frame structures with self-centering energy dissipation braces based on SMA cable**
Huihui Dong, Xiuli Du, Q. Han
14:20 – 14:40

**143. Experimental study on the mechanical behavior of damaged concrete cylinders wrapped with basalt fiber-reinforced polymers**
Gao Ma, L. Qi, Hui Li
14:40 – 15:00

**185. Subassemblage tests of novel sliding corner gusset connections for improved seismic performance of buckling-restrained braced frames**
Junxian Zhao, R.B. Chen, W. Han
15:00 – 15:20

**262. Research on seismic performance of civil structures using recycled materials**
Inas Al Jumaili, Xiaoyun Shao
15:20 – 15:40

| **MS160. Simulation and testing methods** | | Chairs: |
|---|---|---|
| PS2 | Friday, August 11, 16:10 – 17:50<br>Room: Yeh 2312 | Gang Li<br>Ahmed Elkady |

**147. Development of bidirectional cyclic lateral loading protocols for experimental testing of steel wide-flange columns**
Ahmed Elkady, Dimitrios G. Lignos
16:10 – 16:30

**150. A simplified method for seismic response estimation of low-ductility concentrically braced frames**
Gang Li, Zhiqian Dong
16:30 – 16:50

**153. Numerical analysis of fixed bottom offshore wind turbine under combined seismic, wind and wave loads**
Wenhua Wang, Xin Li
16:50 – 17:10

**159. A solution for preventing trains from toppling during earthquake inside subway tunnels**
Mahmood Hosseini, Banafshehalsadat Hashemi, Zahra Safi
17:10 – 17:30

**186. Model updating of plane frame structures based on a novel reduced model**
Dongyu Zhang, Tingqiao Wang, Hui Li
17:30 – 17:50

| **MS171. Ground motions and site response** | | Chairs: |
|---|---|---|
| PS1 | Friday, August 11, 14:00 – 15:40<br>Room: Yeh 3310 | Weiping Wen<br>Su Chen |

**181. Vertical-horizontal seismic response of earth-covered partially-embedded structures**
Prativa Sharma, ZhiQiang Chen, Ganesh Thiagarajan, John J. Daly, Harold O. Sprague
14:00 – 14:20

**189. Defining a parameter for long-period ground motions**
Shunming Gong, Ying Zhou, T.Y. Ping
14:20 – 14:40

**220. Stochastic model for the simulation of synthetic main shock-aftershock ground motion sequences**
Sheng Hu, Paolo Gardoni, Longjun Xu
14:40 – 15:00

**264. Slab deep dehydration in Northeast China: the dynamic source of the intraplate volcanos and deep earthquakes?**
Hanrui Ma, Qingfu Yang, Jian Sheng
15:00 – 15:20

**141. Estimation of source spectra, quality factors, and site responses in the Longmen Shan region using a virtual reference site**
Lei Fu, S. Chen
15:20 – 15:40

| **MS172. Ground motions and site response** | Chairs: |
|---|---|
| PS2 Friday, August 11, 16:10 – 17:50 | Changhai Zhai |
| Room: Yeh 3310 | Hanrui Ma |

**202. Influences of different aspects of aftershock ground motion on the nonlinear responses of SDOF system**
Weiping Wen, C. Zhai, D. Ji, Shuang Li
16:10 – 16:30

**203. Most unfavorable ground motions for nuclear power plant structures**
Changhai Zhai, C.H. Li
16:30 – 16:50

**218. Ground motion simulation in an urban environment considering site-city interaction: a case study of Kowloon station, Hong Kong**
Bence Kato, G. Wang
16:50 – 17:10

**250. Long period ground motion from the April 15, 2016 Kumamoto Mw7.0 earthquake in Japan**
Junju Xie
17:10 – 17:30

**249. Suggested normalized spectral accelerations on bedrock for seismic margin assessments of nuclear power plants in China**
Yushi Wang, X.J. Li, R.Q. Lan, L.B. Zhang
17:30 – 17:50

| **MS180. Foundations** | Chairs: |
|---|---|
| PS5 Saturday, August 12, 13:30 – 15:10 | Jun-Yang Shi |
| Room: Yeh 2312 | Peixin Shi |

**121. Calculation efficiency and application of the integrated numerical model of soil-foundation-pier with infinite element boundary**
Yan-li Shen, Zhu-qing Wang, Shao-kang Gu
13:30 – 13:50

**267. Seismic response of high-fill slope by combining 1g and Ng shaking table tests**
Di Meng, Kai Liu, Yanguo Zhou, Zhi-Hua Wang, Jian He, Ji-Rong Shen, Li-Ming Han, Guang-De Wang, Zheng-Fei Zhou
13:50 – 14:10

**279. A fully fluid-solid coupling dynamic model for analyzing seismic response of underground structures in saturated soils**
Liang Li, Peixin Shi
14:10 – 14:30

**297. Liquefaction resistance performance of rigid-drainage piles: field and modelling tests**
Yumin Chen
14:30 – 14:50

**207. Shaking-table test on seismic motion compressed characteristics in a liquefied soil**
Chengshun Xu, Pengfei Dou, Su Chen
14:50 – 15:10

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