



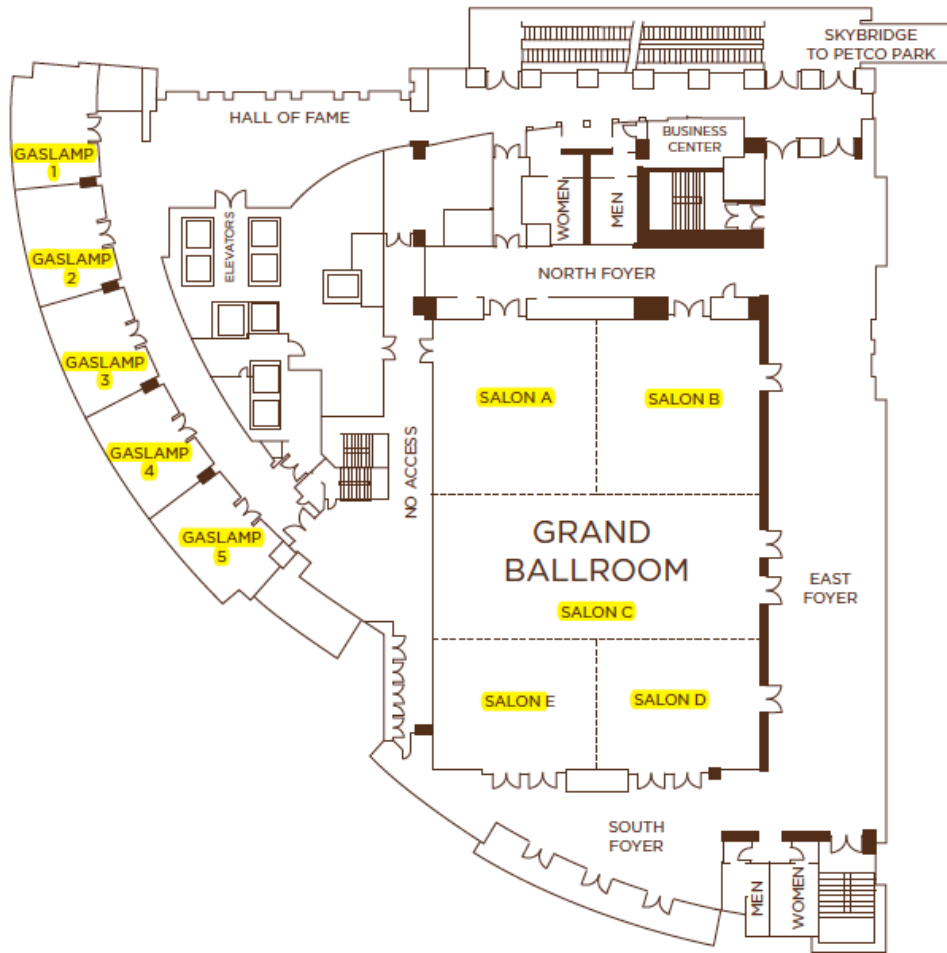
EMI 2017

Engineering Mechanics Institute Conference

June 4-7, 2017, San Diego



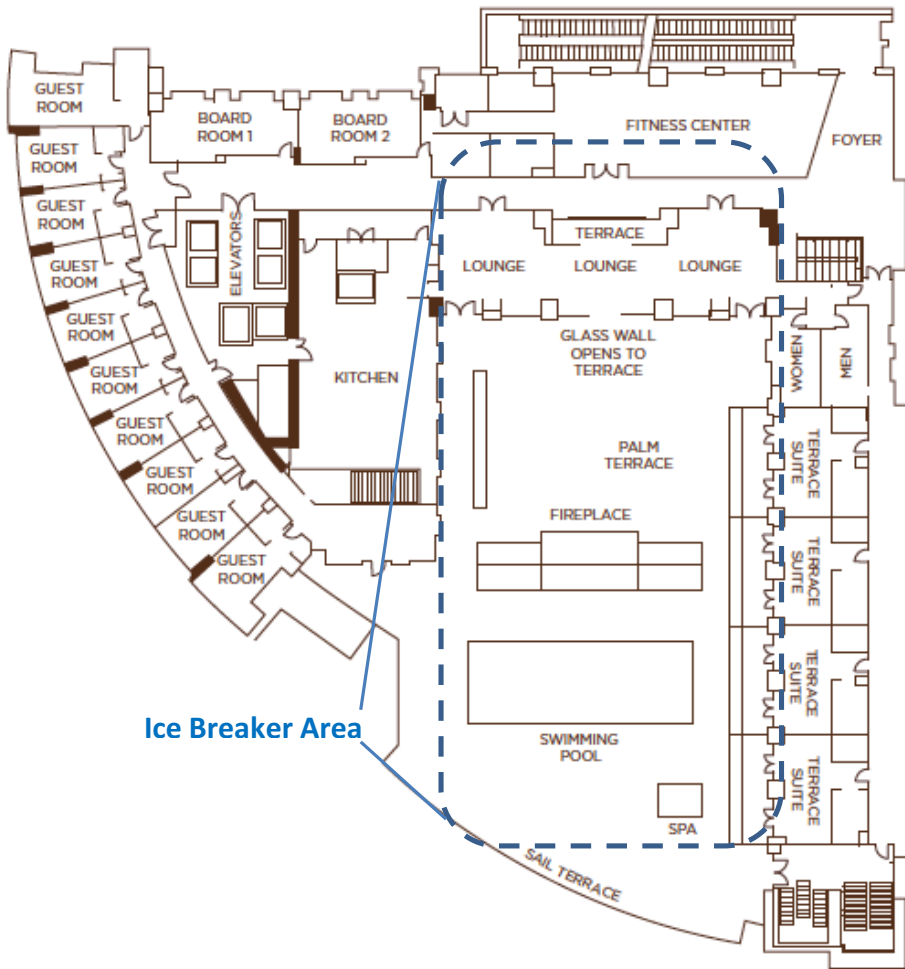
UC San Diego



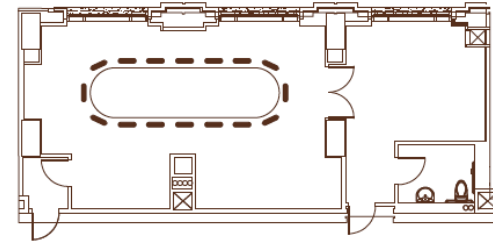
**Omni Hotel 4<sup>th</sup> Floor  
(Technical Sessions, Receptions, Banquet)**



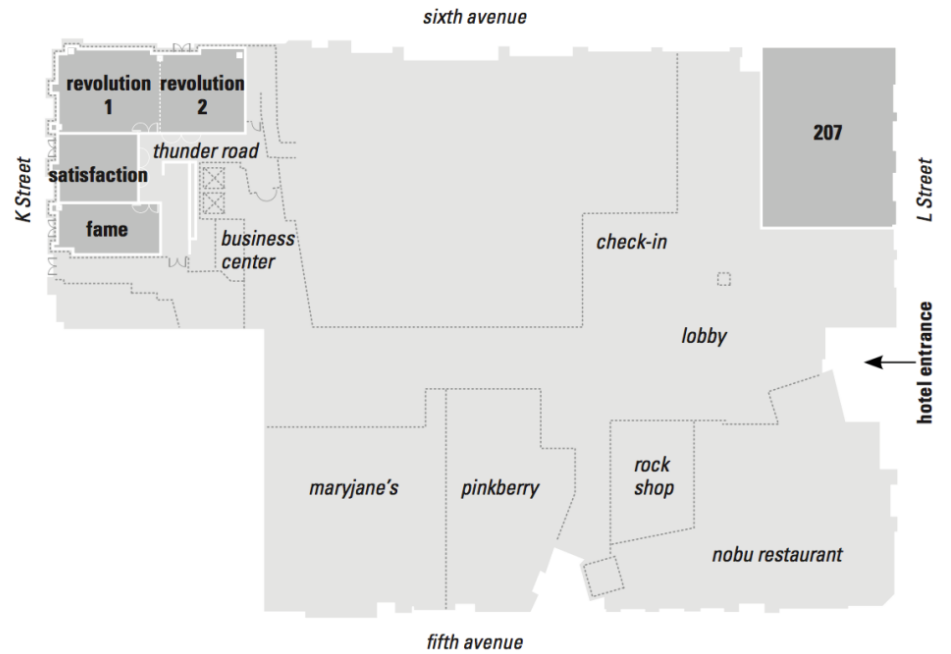
**Omni Hotel 5<sup>th</sup> Floor  
(Technical Sessions)**



**Omni Hotel 6<sup>th</sup> Floor  
(Ice Breaker)**



**Omni Hotel 19<sup>th</sup> Floor  
(Office)**



**Hard Rock Hotel 1st Floor  
(Technical Sessions)**

# Overall Conference Program

Saturday, June 3	Sunday, June 4	7:30 – 17:00 Registration (daily)	Monday, June 5	Tuesday, June 6	Wednesday, June 7	
9:00 – 16:00 <u>Short Course 1</u>	17:00 – 19:00 Registration	7:30 – 8:00	Continental Breakfast	Continental Breakfast	Continental Breakfast	
	8:00 – 16:00 EMI Board of Governors Meeting	8:00 – 8:15	Opening Remarks	Morning Plenary Lecture (Z. Bažant)	Morning Plenary Lecture (T.J.R. Hughes)	Morning Plenary Lecture (M. Baker)
		8:15 – 9:00	Coffee Break			
		9:00 – 9:30	Technical Sessions	Technical Sessions	Technical Sessions	
		9:30 – 11:30	Lunch Break*	Lunch Break*	Lunch Break*	
		11:30 – 13:00	Afternoon Plenary Lecture (W.K. Liu)	Afternoon Plenary Lecture (T.E. Tezduyar)	Afternoon Plenary Lecture (L. Graham- Brady)	
		13:00 – 13:45				Coffee Break
		12:00 – 18:00 EMI Technical Committee Meetings	13:45 – 14:15	Technical Sessions	Technical Sessions	Technical Sessions
			14:15 – 16:15	Short Coffee Break	Short Coffee Break	Short Coffee Break
	16:15 – 16:30		Technical Sessions	Technical Sessions	Technical Sessions	
16:30 – 18:30	18:00 – 20:00 Ice Breaker Reception	16:30 – 18:30	18:30 – 20:00 Welcome Reception with Student Poster Competition	19:00 - 19:30 Reception		
				19:30 – 22:00 Conference Banquet and Award Ceremony		

\* Many lunch options of your choice are available within walking distance from the conference site

\*\* Lab Tours: UCSD Structural Labs and Englekirk Structural Engineering Center Tours (all 60 slots for sign up are full)

# Minisymposium Schedule and Room Allocation

**M: Monday, T: Tuesday, W: Wednesday**

MS No.	MS Title	MS Organizers	Time	Meeting Room
1	Symposium in honor of Prof. Zdeněk Bažant on the occasion of his 80th birthday	Huajian Gao, Yonggang Huang	M1, M2, M3	Salon A
11	16th Symposium on Biological and Biologically Inspired Materials and Structures	Dinesh Katti, Christian Hellmich	T1, T2	Revolution 1 (Hard Rock Hotel)
12	Computational Biomechanics for Biological Tissues & Human Body Systems	Chung-Hao Lee, Ming-Chen Hsu, Yue Yu, Dominik Schillinger, Ankush Aggarwal	T3, W1, W2	Revolution 1 (Hard Rock Hotel)
13	Mechanics of Bioinspired Materials and Structures	Nima Rahbar, Qiming Wang, Wanliang Shan	W3	Revolution 2 (Hard Rock Hotel)
14	Mechanics of Soft Materials	Ali Ghahremaninezhad, Nima Rahbar, Qiming Wang,	W1, W2	Revolution 2 (Hard Rock Hotel)
21	Computational Methods and Applications for Solid and Structural Mechanics	Timothy Truster, Caglar Oskay, Guglielmo Scovazzi, Ertugrul Taciroglu, Haim Waisman	M1, M2, M3, T1, T2, W1, W2	Salon C
22	Computational Modeling in Civil Engineering	Ertugrul Taciroglu, Pedro Arduino, Andre Barbosa, Joel Conte, Chanseok Jeong, Payman Khalili-Tehrani, Farzin Zareian	M1, M2, M3, T1, T2	Salon D
23	Extreme Events Modeling	Jason Roth, J. S. Chen, Michael Hillman	M1, M2, M3	Gaslamp 2
24	Isogeometric Methods in Computational Mechanics	Artem Korobenko, Ming-Chen Hsu, Michael J. Borden, Thomas J.R. Hughes	T1, T2	Salon A
25	LES and DNS: Methods and Applications	Andres E. Tejada-Martinez, Yuri Bazilevs	T1, T2	Gaslamp 2
26	Recent Advances in Real-time Hybrid Simulation	Wei Song, Richard Christerson	T2, T3	Satisfaction (Hard Rock Hotel)
27	Third Symposium on Molecular Scale Modeling and Experimentation	Dinesh Katti, Sinan Keten, Nima Rahbar, Rouzbeh Shahsavari, Kalpana Katti, Steve Cranford	W3	Salon B
28	Topology Optimization; from Algorithmic Developments to Applications	Mazdak Tootkaboni, Alireza Asadpoure, Mehdi Jalalpour	W1, W2	Salon A
31	Cementitious Materials: Experiments and Modeling Across the Scales	Bernhard Pichler, Franz-Josef Ulm, Gilles Pijaudier-Cabot, Günther Meschke Ruhr, Christian Hellmich	T3, W1	Gaslamp 5

32	Modeling time-dependent behavior and deterioration of concrete	Roman Wendner, Mohammed Alnaggar, Giovanni Di Luzio, Gianluca Cusatis	M1, M2	Gaslamp 5
33	The mechanical failure of hard/soft materials: from yogurt to cement	Roland Pellenq, Katerina Ioannidou, Thibaut Divoux	W2	Gaslamp 5
41	Advances in Computational Failure of Composites	Jose L. Curiel, Tinh Q. Bui, Romesh C. Batra, Sohichi Hirose	W1	Salon B
42	Advances in Experimental, Theoretical and Computational Fracture Mechanics	Christian G. Hoover, Ali Ghahremaninejad, Ange-Therese Akono, Christian Linder, Haim Waisman	M1, M2, M3	Gaslamp 4
43	Damage modelling of engineering structures: from localized cracking to structural collapse	Jie Li, Xiaodan Ren, Jianying Wu	T1, T2, T3	Gaslamp 4
44	Modeling and Characterization of Quasibrittle Fracture	Jia-Liang Le, Marco Salviato	T1, T2	Gaslamp 5
45	Multiscale Behavior of Damage and Failure Mechanics	Lizhi Sun, J. Woody Ju, George Z. Voyiadjis, Glaucio H. Paulino	T3, W1	Balboa 2 (T3), Salon B (W1)
46	Simulation-based Natural Disaster Prediction and Mitigation	Sheng-Wei Chi, J. S. Chen, Pai-Chen Guan, Dongdong Wang	W1, W2	Salon D
51	Biomedical Fluid Mechanics and Fluid Structure Interaction	Tayfun Tezduyar, Kenji Takizawa, Yuri Bazilevs	M1, M2, M3	Salon E
52	Flows With Moving Boundaries and Interfaces	Tayfun Tezduyar, Yuri Bazilevs, Kenji Takizawa	T3, W1	Gaslamp 1 (T3), Salon E (W1)
53	Fluid-Structure Interaction	Tayfun Tezduyar, Kenji Takizawa, Yuri Bazilevs	T1, T2	Salon E
54	Flow Induced Motions	Ning Zhang	W1	Satisfaction (Hard Rock Hotel)
61	Computational Geomechanics	Waiching Sun, Ronaldo Borja, Richard Regueiro, Jose Andrade, Majid Manzari, Qiushi Chen, Xiaoyu Song, Joshua A. White	M1, M2, M3, T1	Salon B
62	Genome of Stone-based Civil Infrastructure Materials	Yong-Rak Kim, Linbing Wang, Hao Wang, Shane Underwood,	T3	Revolution 2 (Hard Rock Hotel)
63	Recent Advances in Constitutive Modeling for Geotechnical Engineering	Samuel Yniesta, Katerina Ziotopoulou	W1	Fame (Hard Rock Hotel)
71	Degradation and healing in particulate systems	Ranganathan Parthasarathy, Mahdia Hattab, Ali Daouadji	W1	Gaslamp 1
72	Recent Trends in Granular Materials Across the Scales	Matthew R. Kuhn, Shunying Ji Dalian, Anil Misra, Tang-Tat Ng, Payam Poorsolhjoui, Junliang Tao, Wei Zhou	M1, M2, M3, T1, T2	Gaslamp 1

81	Advances and Applications of Elasticity within Applied Mechanics	Euclides de Mesquita Neto, John C. Brigham, Sonia Mogilevskaya, Ney Dumont	T2, T3	Balboa 1
82	Multifunctional Materials	Donghyeon Ryu, Kenneth J. Loh	M1, M2, M3	Balboa 1
91	Advanced Analysis for Earthquake Engineering	Steven McCabe, Ting Lin, Kevin Wong,	W1, W2	Balboa 1
92	Analytical and experimental investigation of the resiliency of the critical infrastructures under multiple hazards	Asad Esmaeily, Suren Chen, Bernhard Pichler	W1, W2	Balboa 2
93	Control of Structures for Multiple Hazards	Aly Mousaad Aly	M3	Fame (Hard Rock Hotel)
94	Fire Safety Engineering and Mechanics	Richard Kwok Kit Yuen, Siu Ming Lo	M1, M2	Balboa 2
95	Recent Advances in Uplifting Structures and Rocking Isolation	Nicos Makris	W3	Balboa 2
96	Seismic Protective Devices for Structures and Nonstructural Components	Dimitrios Konstantinidis, Masaru Kikuchi	T1, T2	Balboa 2
98	Wind Engineering in Natural Hazards	Aly Mousaad Aly, Elena Dragomirescu	W3	Fame (Hard Rock Hotel)
101	Coupled Environmental-Mechanical Response of Civil Infrastructures and Materials	Masoud K. Darabi, Silvia Caro, Yong-Rak Kim	T3, W1	Gaslamp 2
102	Multiphysics and Multiscale Modeling of Engineering Materials	Chung R. Song, Yong-Rak Kim, Huiming Yin	T3, W1	Gaslamp 3
103	Multi-scale modeling of microstructure and property evolution	Pritam Chakraborty, Michael Tonks, Wen Jiang, Benjamin Spencer	M1, M2, M3	Gaslamp 3
104	Multiscale Mechanics and Physics of Shale	Amin Mehrabian, Younane Abousleiman	W2	Gaslamp 3
105	The Link Between Composition, Structure, and Physical Properties of Materials	Mohammad Javad Abdolhosseini Qomi, Matthieu Vandamme, Enrico Masoero, Konrad Krakowiak	W1, W2, W3	Gaslamp 4
106	Hierarchical and Multiscale Methods for Simulation Based Design of Materials	Arif Masud, Somnath Ghosh	T1, T2	Gaslamp 3
111	Nano- and micro-scale evolution of infrastructure materials under load, humidity, or radiation	Christian G. Hoover, Mathieu Bauchy, Enrico Masoero	T3	Fame (Hard Rock Hotel)
112	Nano- and Microstructured Materials	Marcus P Rutner, Michael J Demkowicz	W3	Salon C
121	Advances in efficient computational methods for probabilistic analysis and design	Hadi Meidani, Vahid Keshavarzzadeh, Arash Noshadravan	M1, M2	Satisfaction (Hard Rock Hotel)
122	Numerical Methods for Engineering Stochastic Dynamical Systems	Ioannis Kougioumtzoglou, Mircea Grigoriu, Athanasios Pantelous, Antonina Pirrotta	M1, M2, M3	Revolution 2 (Hard Rock Hotel)

123	Probabilistic mechanics in damage, fracture, and failure	Lori Graham-Brady, Jia-Liang Le	T2, T3	Revolution 2 (Hard Rock Hotel)
124	Random Functions in Engineering Mechanics and Civil Engineering	Paolo Bocchini, Michael D. Shields, Manuel J. Miranda	T1	Satisfaction (Hard Rock Hotel)
125	Stochastic computational treatment of multiphysics and multiscale problems	Loujaine Mehrez, Roger Ghanem	M3	Satisfaction (Hard Rock Hotel)
131	Advances in system safety and reliability for risk assessment and management of energy infrastructure developments	Arash Noshadravan, Zenon Medina-Cetina	W2	Balboa 4
132	Safety Assessment of Aging Infrastructure: From Data to Decision	Suparno Mukhopadhyay, Simos Gerasimidis, Raimondo Betti	W3	Salon A
141	Fatigue damage monitoring, diagnosis and prognosis	Eric M. Hernandez, Yongming Liu	W2	Salon E
142	Human Performance Sensing and Condition Monitoring	Kenneth Loh, Michael Todd	T1	Balboa 1
143	Infrastructure system integrity through damage precursor sensing	Marcus P Rutner, Ed M Habtour, Branko Glisic	W2, W3	Balboa 3
144	Inverse problems for tomographic imaging and remote sensing applications in engineering	Fabio Semperlotti, Tyler Tallman	W3	Salon E
145	Structural Identification and Damage Detection	Eleni Chatzi, Costas Papadimitriou	M1, M2, M3, T1	Balboa 3
146	Vibration measurement, modal analysis and model updating of structures	Heung Fai Lam, Jiahua Yang, Siu-Kui Au	W1, W2	Balboa 4
147	Vision-based Studies in Structural Health Monitoring	Mohammad Jahanshahi, Shirley Dyke	T2, T3, W1	Balboa 3
152	Robustness of Infrastructures (Progressive Collapse)	Simos Gerasimidis, George Deodatis	T2, T3	Balboa 4
153	Stability and failure of structures and materials	Jifeng Xu, Ahmer Wadee, Yang Xiang	M1, M2, M3, T1	Balboa 4
161	Advances in Model Development and Data Analytics for Quantitative Engineering Sustainability	Arghavan Louhghalam, Franz-Josef Ulm, Roger Ghanem, Marta Gonzalez	M3	Revolution 1 (Hard Rock Hotel)
163	Introduction to EMI Objective Resilience Manual of Practice	Mohammed Ettouney	M1, M2	Revolution 1 (Hard Rock Hotel)
164	Structural modeling and identification for performance and resilience assessment of civil structures	Hamed Ebrahimian, Babak Moaveni, Joel P. Conte	M1, M2	Fame (Hard Rock Hotel)
165	Sustainable and Resilient Structural Engineering, Mechanics, and Materials (SR-SEMM)	Fariborz M. Tehrani, Arezoo Sadrinezhad, Maryam Nazari	T1, T2	Fame (Hard Rock Hotel)



# PLENARY LECTURES

Monday, June 5 Grand Ballroom		
8:15 - 9:00	Zdeněk Bažant	Probabilistic Mechanics of Quasibrittle Structures: Strength, Lifetime and Scaling
13:00 - 13:45	Wing Kam Liu	Self-Consistent Clustering Analysis for Fast Microstructure-Based Modeling of Elastoplastic Strain Softening Materials
Tuesday, June 6 Grand Ballroom		
8:15 - 9:00	Thomas J.R. Hughes	Isogeometric Analysis: Past, Present, Future
13:00 - 13:45	Tayfun E. Tezduyar	Space-Time Computational Analysis: It Adds Another Dimension
Wednesday, June 7 Grand Ballroom		
8:15 - 9:00	Mary Baker	Hybrid Time- and Frequency-Domain Methods for Simulation of Dynamic Environments with the Goal of Understanding the Statistics and Uncertainty of the Result
13:00 - 13:45	Lori Graham-Brady	Uncertainty in the Context of Materials by Design: Key Roles for Stochastic Mechanics

# EMI 2017

## 2017 ENGINEERING MECHANICS INSTITUTE (EMI) CONFERENCE San Diego, California, USA June 4-7, 2017

ORGANIZED BY

UNIVERSITY OF CALIFORNIA  
SAN DIEGO (UCSD)

### CONFERENCE CO-CHAIRS

Yuri Bazilevs, UCSD                      J. S. Chen, UCSD

### LOCAL ORGANIZING COMMITTEE

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Gilbert Hegemier, UCSD  
Alicia Kim, UCSD  
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Frank Beckwith, Structural Engineering  
Natalie Favorite, Structural Engineering  
Tsung-Hui Huang, Structural Engineering  
Dominique Nguyen, Office of Engineering Computing  
Lisa Russon, Jacobs School of Engineering

### ON-SITE COORDINATOR

Ruth Hengst, US Association for Computational Mechanics

### EMI STAFF

Amar Chaker, ASCE/EMI  
Verna Jameson, ASCE/EMI

### INTERNATIONAL SCIENTIFIC COMMITTEE

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Roberto Ballarini	Ning Lu
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Noel Challamel	Arif Masud
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Roger Ghanem	Andrew Smyth
Somnath Ghosh	Lizhi Sun
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Muhammad Hajj	Vikas Tomar
Christian Hellmich	George Voyiadjis
Mike Hillman	Haim Waisman
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### 2017 EMI BOARD OF GOVERNORS

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## WELCOME FROM THE EMI 2017 CO-CHAIRS



Yuri Bazilevs



J. S. Chen

Welcome to the 2017 Engineering Mechanics Institute (EMI 2017) conference, the annual national conference of the Institute, held at Omni San Diego and Hard Rock Hotels in San Diego, CA, on June 4-7, 2017. This meeting presents a change from the university-campus format of the EMI conferences, which is reflective of the growth of engineering mechanics research and activities, as well as the Institute membership. This year at EMI 2017 we also celebrate the 10<sup>th</sup> anniversary of the Institute, which makes this meeting even more special.

The congress features an extensive four-day technical program that includes 6 plenary lectures, 68 Minisymposia, 6 student paper competitions, a student poster competition, 3 short courses on important and emerging topics in engineering mechanics, and tours of the UCSD Structural Labs and Englekirk Structural Engineering Center. Plenary lectures given by the six renowned engineers and scientists feature several important and new areas in engineering mechanics. The minisymposia presentations are likewise given by researchers of international prestige, which further contributes to the exceptional quality of the EMI 2017 technical program. We encourage young researchers to attend a meeting with the NSF Program Directors, which is also scheduled as part of the EMI 2017 technical program.

The EMI 2017 social program features a poolside icebreaker reception, a welcome reception accompanied by a student poster competition, and a conference banquet, all to take place at the Omni Hotel. The Institute and Society awards, and student-competition and poster-session prizes, will be presented at the conference banquet. Although the conference technical program is quite busy, be sure to take time to enjoy San Diego and its surroundings. This part of Southern California is one of the most desirable locations in North America in terms of its geography, climate, and the natural beauty and cultural diversity it offers.

Many contributed to the success of EMI 2017. We thank the EMI 2017 scientific and local organizing committees, and the EMI Board of Governors and staff, for providing valuable advice for congress organization. We thank the minisymposia organizers for attracting high-quality speakers and assembling a diverse set of technical sessions. We thank the UCSD staff and graduate students for their tremendous conference-organization support. We thank the sponsors of EMI 2017 – UCSD Jacobs School of Engineering, UCSD Center for Extreme Events Research (CEER), UCSD Department of Structural Engineering, Birkhauser, and Livermore Software Technology Corporation (LSTC) – for their generous support. We thank all the speakers, and student-paper and student-poster competition participants for their technical contributions.

Yuri Bazilevs and Jiun-Shyan (J.S.) Chen  
EMI 2017 Co-Chairs  
Department of Structural Engineering  
Center for Extreme Events Research (CEER)  
University of California, San Diego

## WELCOME FROM THE EMI PRESIDENT



J. S. Chen  
University of California, San Diego



ENGINEERING  
MECHANICS  
INSTITUTE

Dear Participants of EMI 2017:

As I complete my second year of service as President of EMI, I express my sincere thanks to the dedication and hard work of the Board of Governors, the EMI staff, the technical committees and our members from around the globe.

On behalf of EMI, I thank my UCSD colleague Professor Yuri Bazilevs and staff members for co-hosting this year's EMI Annual Conference which is reaching new heights, with more than 700 registrations. The ever-increasing attendance at the EMI events reflects EMI's growing reputation of being the premier venue for mechanics.

In this EMI Conference, we are also celebrating the Institute's 10th anniversary. EMI has experienced a healthy increase in its membership from 1,850 in 2007 to 2,350 in 2017. The attendance at its annual conference has grown from the low 300 in 2007 to over 700 in 2017. EMI's service to its membership also includes the publication of the well-regarded ASCE Journal of Engineering Mechanics and ASCE Journal of Nanomechanics and Micromechanics.

I invite you to get more involved with our Institute. EMI will grow only through your participation. Opportunities for engagement include the delivery of webinars, publication in ASCE Journal of Engineering Mechanics, ASCE Journal of Nanomechanics and Micromechanics, and Lecture Notes in Mechanics series, active participation on technical committees, organization of conference sessions, and engagement in the EMI-industry collaboration.

I wish you an enjoyable and productive conference.

Yours truly,

Jiun-Shyan (J.S.) Chen, Ph.D., F.EMI, M.ASCE

# Information about the Conference

## Registration Desk

Registration desk is located in the 4th Floor Foyer of the Omni Hotel. Registration hours are:

Sunday: 17:00 - 19:00

Monday: 7:30 - 17:00

Tuesday: 7:30 - 17:00

Wednesday: 7:30 - 17:00

## Registration Fees

Regular Participants (EMI/ASCE Members)  
\$695 (early), \$735 (regular), \$795 (on-site)

Regular Participants (Non-EMI/ASCE Members)  
\$745 (early), \$785 (regular), \$845 (on-site)

Students  
\$375 (early), \$395 (regular), \$455 (on-site)

Regular registration Includes Ice Breaker Reception, Welcome Reception with Student Poster Competition session, breakfast, coffee breaks, Banquet, access to conference presentations, and conference materials.

Student Registration does not include Banquet. Banquet tickets are available and can be purchased at the registration desk.

## Program Format

The technical program consists of 6 Plenary Lectures, and 68 Minisymposia, with approximately 700 Presentations in 144 Technical Sessions.

Each day, the program starts with a morning Plenary Lecture, followed by morning Technical Sessions, afternoon Plenary Lecture, and early and late afternoon Technical Sessions in 18 parallel sessions.

## Breakfast

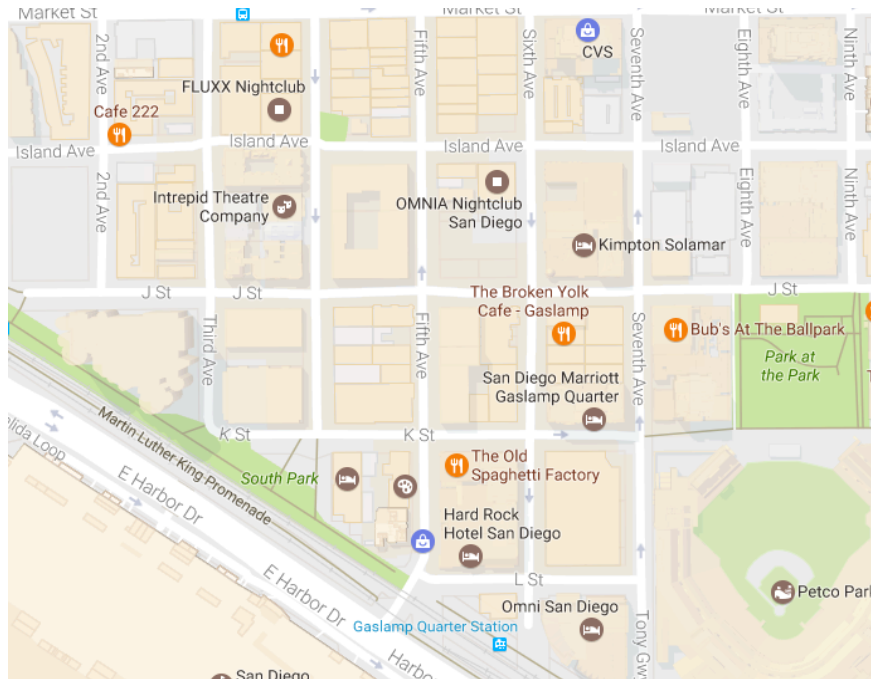
Continental breakfast will be served in the 4th Floor Foyer of Omni Hotel on Monday 7:30-8:00, Tuesday and Wednesday 7:30-8:15.

## Refreshment Breaks

Refreshment breaks will be served in the mornings and afternoons of Monday to Wednesday in the 4th Floor Foyer of Omni Hotel and in the hallway of Revolution Rooms in the 1st Floor of Hard Rock Hotel. The timings are indicated in the Technical Program.

## Options for Lunch

In addition to the restaurants in the Omni and Hard Rock Hotels, many restaurants are located nearby Gaslamp Quarter. Additional restaurants with many food types are located within the Gaslamp area (about 5-min walk); See maps below and the list of restaurants at the end of this booklet (P. 91).



## Places to See

Balboa Park  
Gaslamp Quarter  
USS Midway Museum  
San Diego Zoo  
Padres at Petco Park  
Aerospace Museum

Coronado Island  
Sea World  
Birch Aquarium

## Social Events

### Ice Breaker Reception

Sunday, June 4, 18:00 – 20:00  
Omni Hotel 6th Floor Poolside

### Welcome Reception

Monday, June 5, 18:30 – 20:00  
Omni Hotel 4th Floor Foyer

### Banquet and Award Ceremony

Tuesday, June 6  
19:00 – 19:30, Reception  
19:30 – 22:00, Banquet and Award Ceremony  
Omni Hotel 4th Floor Foyer and Grand Ballroom

## Special Events

### Meeting with NSF Program Managers (P. 49)

Tuesday, June 6, 14:15 – 16:15  
Omni Hotel 4th Floor Salon B

### Student Poster and Paper Competitions (P. 13)

Monday, June 5, 18:30 – 20:00  
Omni Hotel 4th Floor Foyer

### Short Courses (P. 13)

Saturday (June 3), Sunday (June 4), 9:00 - 17:00  
Omni Hotel 4th Floor Balboa 1/2/3

# STUDENT COMPETITIONS

## POSTER COMPETITION

### **EMI Computational Mechanics Committee Student Poster Competition**

Sponsored by: EMI Computational Mechanics Committee  
Chair: Ertugrul Taciroglu  
Monday, June 5, 18:30 – 20:00, Omni Hotel 4th Floor Foyer

## PAPER COMPETITION

### **Granular Materials Technical Committee Student Paper Competition**

Sponsored by: Granular Materials Technical Committee  
Chairs: Anthony Rosato, Mathew Kuhn  
Monday, June 5, 11:30 – 13:00, Omni Hotel Gaslamp 4

### **EMI Structural Health Monitoring and Control Committee Student Competition**

Sponsored by: EMI Structural Health Monitoring and Control Committee  
Chair: Lauren Linderman  
Monday, June 5, 11:30 – 13:00, Omni Hotel Gaslamp 5

### **EMI Modeling Inelasticity & Multiscale Behavior (MIMB) Committee Student Competition**

Sponsored by: EMI Modeling Inelasticity & Multiscale Behavior (MIMB) Committee  
Chair: Caglar Oskay  
Monday, June 5, 11:30 – 13:00, Omni Hotel Gaslamp 2

### **EMI Objective Resilience Committee Student Competition (ORC-SC) 2017**

Sponsored by: EMI Objective Resilience Committee (ORC)  
Chair: Mohammed Ettouney  
Monday, June 5, 11:30 – 13:00, Hard Rock Hotel Revolution 1

### **EMI Probabilistic Methods Committee Student Paper Competition**

Sponsored by: EMI Probabilistic Methods Committee  
Chair: Alex Taflanidis  
Monday, June 5, 11:30 – 13:00, Omni Hotel Balboa 2

### **Dynamics Committee Student Paper Competition**

Sponsored by: EMI Dynamics Committee  
Chairs: Judge Panel, Siu Kui Au  
Monday, June 5, 18:30 – 20:00, Omni Hotel Skybox

## SHORT COURSES

### **Computational Fluid-Structure Interaction**

Saturday, June 3, 9:00 – 16:00

Sunday, June 4, 9:00 – 16:00

Omni Hotel 4th Floor Balboa 1

Instructors:

Yuri Bazilevs, UC San Diego  
Kenji Takizawa, Waseda University  
Tayfun Tezduyar, Rice University

### **Resilience-Based design of structures and infrastructures during emergencies**

Sunday, June 4, 9:00 – 16:00

Omni Hotel 4th Floor Balboa 2

Instructors:

Gian Paolo Cimellaro, Politecnico di Torino  
Steve Mahin, University of California, Berkeley

### **Bayesian Model Updating and Uncertainty Quantification: Theory, Computational Tools, and Applications**

Sunday, June 4, 9:00 – 16:00

Omni Hotel 4th Floor Balboa 3

Instructors:

Babak Moaveni, Tufts University  
Costas Papadimitriou, University of Thessaly, Greece

# EMI COMMITTEE MEETINGS (OMNI HOTEL)

DAY	COMMITTEE	CHAIR	TIME	ROOM	
Sunday, June 4	EMI Board of Governors	J. S.Chen	7:30 - 17:00	Salon E	
	Granular	Ali Daouadji	15:00 - 17:00	Salon C	
	Experimental Analysis & Instrumentation	Asad Esmaeily	14:00 - 16:00	Salon A	
	Objective Resilience	Mohammed Ettouney	14:00 - 17:00	Skybox	
	Journal of Nanomechanics & Micromechanics	Christian Hellmich	14:00 - 16:00	Gaslamp 2	
	Properties of Materials	Kalpana Katti	13:00 - 16:00	Salon D	
	Mechanics of Pavements	Yong-Rak Kim	16:30 - 18:00	Salon B	
	Modeling Inelasticity Multiscale Behavior	Caglar Oskay	14:00 - 16:00	Salon B	
	Nanomechanics and Micromechanics	Lizhi Sun	16:00 - 18:00	Salon D	
	Computational Mechanics	Ertugrul Taciroglu	16:00 - 18:00	Salon A	
	Stability	Jifeng Xu	16:00 - 18:00	Gaslamp 2	
	Monday, June 5	Dynamics	Siu Kui Au	11:45 - 12:45	Gaslamp 1
Journal of Engineering Mechanics		Roberto Ballarini	11:30 -13:00	Gaslamp 3	
Fluid Dynamics		Panayiotis Diplas	16:30 - 18:30	Balboa 2	
Biomechanics		Christian Hellmich	11:30 - 13:00	Balboa 1	
Tuesday, June 6	Elasticity	John Brigham	11:30 - 13:00	Balboa 1	
	Probabilistic Methods	Erik Johnson	11:30 - 13:00	Gaslamp 2	
	Structural Health Monitoring & Control	Babak Moaveni	11:30 - 13:00	Gaslamp 5	
	Poromechanics	Matthieu Vandamme	11:30 - 13:00	Gaslamp 1	

# THE ENGINEERING MECHANICS INSTITUTE

## WINNERS OF THE 2017 AWARDS

The Executive Committee of the ASCE Board of Direction approved the list of winners of several prestigious 2017 Society awards administered by the Engineering Mechanics Institute. The awards will be presented on June 6, 2017 at the banquet and awards presentation ceremony of the EMI 2017 Conference.



**MAURICE A. BIOT MEDAL:** Prof. Ning Lu, Ph.D. F.EMI, F. ASCE (Colorado School of Mines) *“for his outstanding contributions to fundamental understanding of the mechanics of unsaturated porous materials.”*



**GEORGE W. HOUSNER MEDAL:** Prof. James L. Beck, Ph.D., F.EMI, M.ASCE (Caltech) *“for his exceptional and influential scholarship in structural monitoring and control research, and for his leadership in tackling uncertainty and model complexity through probabilistic approaches with emphasis on Bayesian methods.”*



**ROBERT H. SCANLAN MEDAL:** Prof. Giovanni Solari, Ph.D., P.E., F.EMI, M.ASCE (University of Genova) *“for his outstanding contributions to wind engineering and their applications in structural mechanics.”*



**MASANOBU SHINOZUKA MEDAL:** Prof. Ahsan Kareem, Ph.D., F.EMI, NAE, Dist.M.ASCE (The University of Notre Dame) *“for his contributions to the modeling of stochastic wind, waves, and earthquake loads, and their effects on buildings, bridges, and offshore structures.”*





**THEODORE VON KÁRMÁN MEDAL: Prof. Huajian Gao, Ph.D., M.EMI** (Brown University) *“for his ground-breaking research on the mechanical behaviors of engineering and biological systems across multiple length scales, with particular emphasis on deformation and failure mechanisms in thin films and hierarchically structured materials.”*



**WALTER L. HUBER CIVIL ENGINEERING RESEARCH PRIZE: Prof. James K. Guest, Ph.D., A.M.ASCE** (The Johns Hopkins University) *“for research at the forefront of topology optimization, focusing on the rigorous integration of mechanics, optimization, manufacturing and uncertainty quantification.”* (To be presented at the 2017 ASCE Annual Convention to be held on October 8-11, 2017 in New Orleans, Louisiana).

The Engineering Mechanics Institute is also pleased to announce the 2017 winner of its award:



**EMI LEONARDO DA VINCI AWARD: Prof. Jia-Liang Le, Ph.D., M.ASCE** (University of Minnesota) *“for important contributions to probabilistic mechanics of quasi-brittle structures, scaling of their failure and consequent reliability-based structural design.”*

Also accepting their awards this year are the following **2016** Award Winners



**ROBERT H. SCANLAN MEDAL: Yukio Tamura, D.Eng., F.EMI, M.ASCE** (Tokyo Polytechnic University) *“for fundamental contributions to mathematical modeling, quantification, and analysis of wind effects on buildings and structures”.*



**THEODORE VON KARMAN MEDAL: Ares J. Rosakis, Ph.D., A.M.ASCE** (California Institute of Technology) *“for discovering several fundamental physical phenomena in dynamic fracture of heterogeneous materials and interfaces at various length and time scales.”*

**Monday, June 5**  
**8:15 – 9:00**

**Plenary Lecture 1**  
**Room: Grand Ballroom**

Zdeněk Bažant

Northwestern University

Probabilistic Mechanics of Quasibrittle Structures: Strength, Lifetime and  
Scaling

Chair: Yonggang Huang



**Zdeněk Bažant**  
Mechanical Engineering and  
Material Science and  
Engineering  
Northwestern University

## **Probabilistic Mechanics of Quasibrittle Structures: Strength, Lifetime and Scaling**

### **Abstract:**

The size effect on structural strength and its statistical distribution is a complex problem for quasibrittle materials because their failure behavior transits from quasi-plastic at small sizes to brittle at large sizes. These are heterogeneous materials with brittle constituents in which the size of inhomogeneity, or representative volume element (RVE), is not negligible compared to the structure size. Aside from concrete, the archetypical example, they include fiber composites, coarse-grained ceramics, rocks, sea ice, snow slabs, wood, bone, foam, stiff soil, dry snow, masonry, carton, etc., and on the micro- or nano-scale, all brittle materials become quasibrittle. Since the break probability is known exactly only for interatomic bonds (being equal to frequency), Kramers' rule of transition rate theory is applied to nano-crack jumps. Based on proving the rules of multiscale transition of tail probabilities of break to material scale, the probability distribution of strength of one macro-scale representative volume element (RVE) is shown to have a Weibullian tail, calibrated to reach to probability 0.001, the rest being Gaussian. On the structure scale, only Type 1 failure is considered, i.e., the structure fails as soon as the first RVE fails. Hence the weakest-link model applies on the structure scale. But, crucially, the number of links is finite, because of non-negligible RVE. For increasing structure size, the Weibullian portion gradually spreads into the Gaussian core. Only in the infinite size

limit the distribution becomes purely Weibull, but, importantly, with a zero threshold. Based on an atomistic derivation of the power law for subcritical macro-crack growth, a similar Gauss-Weibull transition is shown to apply to structure lifetime. The theory is then extended to the size dependence of Paris law and Basquin law for fatigue fracture, to statistics of fatigue lifetime, and to residual strength after a period of preload. The theory is shown to match the existing experimental results on the monotonic strength, residual strength after preload, static and fatigue crack growth rates, and static and fatigue lifetimes, including their distributions and size effects on the distributions. There are three essential consequences: 1) The safety factors must depend on structure size and shape; 2) To predict the pdf of strength, the size effect tests of mean strength suffice; 3) To predict the static and fatigue lifetimes, it suffices to add tests of initial subcritical crack growth rate. An interesting mathematical analogy predicting the lifetime of new nano-scale high-k dielectrics is also pointed out. Finally, an extension to failures after large stable crack growth is outlined and various practical implications are discussed.

### **Selected References:**

- [1] Z. P. Bažant and J.-L. Le (2017) Probabilistic Mechanics of Quasibrittle Structures: Strength, Lifetime and Size Effect, Cambridge U P
- [2] Bažant, Z.P. (2004). "Scaling theory for quasibrittle structural failure." Proc., Nat. Acad. of Sciences 101 (37), 14000—14007.
- [3] Bažant, Z.P., and Pang, S.-D. (2006). "Mechanics based statistics of failure risk of quasibrittle structures and size effect on safety factors." Proc. of the National Academy of Sciences 103(25), 9434-9439.
- [4] Bažant, Z.P., Le, J.-L., and Bazant, M.Z. (2008). "Scaling of strength and lifetime distributions based on atomistic fracture mechanics." Proc. of the Nat. Academy of Sciences, 106 (28), 11484- 11489.
- [5] Le, J.-L., Bažant, Z.P., and Bazant, M.Z. (2011). "Unified Nano-Mechanics Based Probabilistic Theory of Quasibrittle and Brittle Structures. I. Strength, static crack growth, lifetime and scaling." J. of the Mechanics and Physics of Solids 59, 1291—1321.
- [6] Le, Jia-Liang, and Bažant, Z.P. (2014). "Finite weakest-link model of lifetime distribution of quasibrittle structures under fatigue loading." Mathematics and Mechanics of Solids 19(1), 56—70.

## Monday, June 5, 9:30 – 11:30, Session M1

Room	MS Number	Minisymposia Session Title
Salon A	MS1	Symposium in honor of Prof. Zdeněk P. Bažant on the occasion of his 80th birthday
Salon B	MS61	Computational Geomechanics
Salon C	MS21	Computational Methods and Applications for Solid and Structural Mechanics
Salon D	MS22	Computational Modeling in Civil Engineering
Salon E	MS51	Biomedical Fluid Mechanics and Fluid-Structure Interaction
Gaslamp 1	MS72	Recent Trends in Granular Materials Across the Scales
Gaslamp 2	MS23	Extreme Event Modeling
Gaslamp 3	MS103	Multi-scale modeling of microstructure and property evolution
Gaslamp 4	MS42	Advances in Experimental, Theoretical and Computational Fracture Mechanics
Gaslamp 5	MS32	Modeling time-dependent behavior and deterioration of concrete
Balboa 1	MS82	Multifunctional Materials
Balboa 2	MS94	Fire Safety Engineering and Mechanics
Balboa 3	MS145	Structural Identification and Damage Detection
Balboa 4	MS153	Stability and failure of structures and materials
Revolution 1 (Hard Rock Hotel)	MS163	Introduction to EMI Objective Resilience Manual of Practice
Revolution 2 (Hard Rock Hotel)	MS122	Numerical Methods for Engineering Stochastic Dynamical Systems
Satisfaction (Hard Rock Hotel)	MS121	Advances in efficient computational methods for probabilistic analysis and design
Fame (Hard Rock Hotel)	MS164	Structural modeling and identification for performance and resilience assessment of civil structures

# Monday, June 5

9:30 - 9:50	9:50 – 10:10	10:10 – 10:30	10:30 – 10:50	10:50 – 11:10	11:10 – 11:30	11:30 – 11:50
<b>Room: Salon A MS 1</b> Symposium in honor of Prof. Zdeněk P. Bažant on the occasion of his 80th birthday <b>First Chair: Herbert Mang Second Chair: Kaspar J Willam</b>						
On a kinematics-based hypothesis for a breakdown of the strain energy.  Herbert Mang*	A Three Invariant Formulation for Steel Behavior: Experimental Observations and Constitutive Models.  Kaspar J Willam*, Francesco Di Simoi, Reza Mousavi, Giovanna Xotta	Le Chatelier's Conjecture - OR- Measurement of Colloidal Stresses.  Franz-Josef Ulm*, Roland Pellenq, Muhannad Abuhaikal	Structural Testing at the Micro and Nano Scales.  Roberto Ballarini*	Ultrasonic Nondestructive Evaluation of Alkali-Silica Reaction Damage in Concrete Prism Samples.  Jianmin Qu*, Taeho Ju, Jan Achenbach, Laurence Jacobs, Maria Guimaraes	Multiscale Mechanics and Modeling of Concrete Damage Processes.  J. S. Chen*, Michael Hillman	Time-Scaling in Atomistics and the Rate-Dependent Mechanical Behavior of Nanostructures,  Pradeep Sharma*
9:30 - 9:50	9:50 – 10:10	10:10 – 10:30	10:30 – 10:50	10:50 – 11:10	11:10 – 11:30	11:30 – 11:50
<b>Room: Salon B MS 61</b> Computational Geomechanics <b>First Chair: WaiChing Sun Second Chair: Shahrzad Roshankhah</b>						
A critical assessment on phase field and eigen-erosion modeling of fractures in anisotropic fluid-infiltrating porous medias.  WaiChing Sun*, Kun Wang, Jinhyun Choo, SeonHong Na	Laboratory Hydraulic Fracture in Shale.  Shahrzad Roshankhah*, Jose E. Andrade, Vito Rubino, Gioacchino Viggiani, Edward C. G. Ando, Tengattini Alessandro, Ares Rosakis	Modeling hydraulic fracturing with a pressure dependent cap model and peridynamics.  John T. Foster*, Jason York	Numerical modeling of subsidence induced by hydrocarbon production in southern Louisiana.  Yaneng Zhou*, George Z. Voyiadjis	Dynamic fracture simulation of inhomogeneous rock.  Bahador Bahmani*, Philip L. Clarke, Reza Abedi, Bahador Bahmani	Investigation of shear bands and the microscopic origin of macroscopic strength in granular materials.  Reid Kawamoto*, Jose Andrade	
<b>Room: Salon C MS 21</b> Computational Methods and Applications for Solid and Structural Mechanics <b>First Chair: Timothy Truster Second Chair: Caglar Oskay</b>						
<b>[Keynote]</b> Computational Framework Involving Spatial and Temporal Multi-Scaling for Coupled Transient Electromagnetics-Mechanical Phenomena.  Somnath Ghosh*, Shu Guo, Reza Yaghmaie		Incremental-secant mean-field-homogenization method for elasto-visco-plastic materials systems.  Ling Wu*, Benoît Bidaine, Laurent Adam, Maxime Melchior, Issam Doghri	Adaptive multiscale homogenization of discrete models to continuum with application to concrete.  Roozbeh Rezakhani*, Gianluca Cusatis	Multi-scale computational framework for Modeling of Open-cell Foams.  Ruishen Lou*, Xiaowo Wang, Hui Liu, Arun Prakash	An Automated Framework for the Computational Modeling of Materials with Complex Microstructures.  Soheil Soghrati*, Anand Nagarajan, Bowen Liang, Fei Xiao, Hossein Ahmadian	
<b>Room: Salon D MS 22</b> Computational Modeling in Civil Engineering <b>First Chair: Chanseok Jeong Second Chair: Ertugrul Taciroglu</b>						
Soil-Structure Interaction Modeling of Building Structures: Substructure analyses vs. finite element simulations using mechanics-based nonlinear models.  Danilo Kusanovic*, Hamed Ebrahimiyan, Domniki Asimaki	Stiffness-Matrix Coupling Method For Surface Foundations Interacting With Pile Groups  Josue Labaki*, Euclides Mesquita	Validation of a Multi-Axial Inelastic Soil Model for Wave Propagation Analyses Using Centrifuge Experiments.  Wenyang Zhang*, Wenyang Zhang, Elnaz Esmailzadeh Seylabi, Ertugrul Taciroglu	A Mathematical Approach for Modeling Pile-Soil-Pile Interaction for Laterally Loaded Pile Groups in a Linear Elastic Medium.  Volkan İşbuğa*	A Fiber-Based Model for Soil-Abutment Interaction for Skew Bridges.  Arastoo Dasmeh*, Ertugrul Taciroglu		

# Monday, June 5

9:30 - 9:50	9:50 – 10:10	10:10 – 10:30	10:30 – 10:50	10:50 – 11:10	11:10 – 11:30
<b>Room: Salon E</b>		<b>MS 51</b>		<b>Biomedical Fluid Mechanics and Fluid Structure Interaction</b>	
		<b>First Chair: Tayfun Tezduyar</b>		<b>Second Chair: Hiroshi Suito</b>	
<b>[Keynote]</b> Multiscale Simulation of Platelets Adhesion Process as an Initial Stage of Thrombosis.  Shu Takagi*, Kazuya Shimizu, Satoshi Ii, Kazuyasu Sugiyama	<b>[Keynote]</b> Aorta Modeling with the Element-Based Zero-Stress State and Isogeometric Discretizations.  Kenji Takizawa*, Tayfun E. Tezduyar, Takafumi Sasaki	Divergence-conforming immersogeometric analysis of heart valve fluid–structure interaction.  David Kamensky*, Ming-Chen Hsu, John A. Evans, Yuri Bazilevs, Michael S. Sacks, Thomas J. R. Hughes	Heart Valve Flow Analysis with the Integrated Space-Time VMS, Slip Interface, and Topology Change Methods and Isogeometric Discretization.  Takuya Terahara*, Kenji Takizawa, Tayfun E. Tezduyar, Takafumi Sasaki	Patient-Specific Aorta Flow Analysis with the Space–Time VMS Method and Isogeometric Discretization.  Hiroaki Uchikawa*, Kenji Takizawa, Tayfun E. Tezduyar	Necessity of patient-specific viscosity models for hemodynamics simulations of intracranial aneurysms.  Takashi Suzuki*, Hiroyuki Takao, Tomoaki Suzuki, Toshihiro Ishibashi, Yuichi Murayama, Hideki Yamamoto, Makoto Yamamoto
<b>Room: Gaslamp 1</b>		<b>MS 72</b>		<b>Recent Trends in Granular Materials Across the Scales</b>	
		<b>First Chair: Anil Misra</b>		<b>Second Chair: Payam Poorsolhjoui</b>	
Micro-macro behavior of reinforced sand.  Shintaro Miyamoto*, Yoshihisa Miyata, Hideto Nonoyama	Incremental deformation in granular materials: elastic, plastic, and coupled.  Matthew R. Kuhn*, Ali Daouadji	Influence of interstitial fluid rheology on the compaction of granular slurries.  Teng Man*, Jia-Liang Le, Mihai Marasteanu, Kimberly Hill	Packing of micro-particles with arbitrary adhesion, friction and long-range repulsion.  Wenwei Liu*, Shuiqing Li	DEM simulations of direct shear behavior of coarse crushed stones with complex grain shape under different densities.  Xu Zhang*, Wanming Zhai, Can Shi	
<b>Room: Gaslamp 2</b>		<b>MS 23</b>		<b>Extreme Events Modeling</b>	
		<b>First Chair: Jason Roth</b>		<b>Second Chair: Frank Beckwith</b>	
<b>[Keynote]</b> Stable and Robust Meshfree Integration for Extreme Event Simulations.  Michael Hillman*, J.S. Chen	A Sliding/Contact Algorithm for the Combined Particle-Element Method.  Charles Gerlach*, Gordon Johnson	A Riemann-SNNI Galerkin meshfree method for solid and fluid dynamics.  Guohua Zhou*, J.S. Chen, Michael Hillman	Early prediction of slope failure patterns from kinematical data: from laboratory to field.  Antoinette Tordesillas*, Zhongzheng Zhou, David Easey, Robin Batterham		
<b>Room: Gaslamp 3</b>		<b>MS 103</b>		<b>Multi-scale modeling of microstructure and property evolution</b>	
		<b>First Chair: Pritam Chakraborty</b>		<b>Second Chair: Wen Jiang</b>	
<b>[Keynote]</b> Phase Field Crystal Method: Three-Dimensional Grain Growth and the Role of Dislocations.  Peter Voorhees*, Akinori Yamanaka, Kevin McReynolds	Damage initiation in high energy density materials.  Marisol Koslowski*, Nicolo Grilli	Microstructure Sensitive Phase Field Fracture Model with Anisotropic Elastic Properties.  Michael Tonks*. Shuaifang Zhang, Srujan Rokkan	Predicting self-organization of nanostructure morphologies in physical vapor deposited phase-separating binary alloys.  Kumar Ankit*, Benjamin Derby, Michael J. Demkowicz, Amit Misra	Modeling Anisotropic Interfaces: A Derivation From Phase-Field Crystal.  Nana Ofori-Opoku*	

# Monday, June 5

9:30 - 9:50	9:50 – 10:10	10:10 – 10:30	10:30 – 10:50	10:50 – 11:10	11:10 – 11:30
<b>Room: Gaslamp 4</b>		<b>MS 42</b>		<b>Advances in Experimental, Theoretical and Computational Fracture Mechanics</b>	
		<b>First Chair: Christian Hoover</b>		<b>Second Chair: Ange Akono</b>	
Crack propagation modelling with minimal remeshing using the weak form quadrature element method.  Minmao Liao*, Xin Deng	A Crack-Tip Element For Dynamic Fracture Simulation Based On Non-Nodal Enrichment Parameters.  Iman Asareh*, Young-Cheol Yoon	A Complex Valued Finite Element Method to Compute the Energy Release Rate in Thermoelastic Problems.  Arturo Montoya*, Daniel Ramirez Tamayo, Harry Millwater	Nonlocal Damage Analysis Using GraFEA (Graph-based Finite Element Analysis).  Parisa Khodabakhshi*, J. N. Reddy, Arun Srinivasa	Modeling of Thermo-Mechanical Contact Problems in Fractured Domain with eXtended Finite Element Method.  Bahador Bahmani*, Amir Reza Khoei	
<b>Room: Gaslamp 5</b>		<b>MS 32</b>		<b>Modeling time-dependent behavior and deterioration of concrete</b>	
		<b>First Chair: Mohammed Alnagger</b>		<b>Second Chair: Gianluca Cusatis</b>	
Determination of fracture energy based on experimental testing with digital image correlation measurement and sequential linear analysis.  Jan Vorel*, Lisa-Marie Czernuschka, Marco Marcon, Roman Wendner	Influence of aggregates on concrete failure of anchors loaded in tension and shear.  Kresimir Nincevic*, Kresimir Nincevic, Marco Marcon, Roman Wendner	Creep and relaxation Poisson's ratio. From the foundations of linear viscoelasticity to applications.  Charpin Laurent*, Sanahuja Julien	Errors in the Theory of Viscoelasticity Concrete in the International Standards for Concrete and Reinforced Concrete.  Tatyana Ter-Emmanuilyan*, Rudolf Sanjarovskiy, Maksim Manchenko	Effect of radial stress component of stress-slipage law on bonded anchor pull-out tests.  Marco Marcon*, Krešimir Ninčević, Jan Vorel, Roman Wendner	Time-dependent bearing capacity of reinforced concrete beams.  Xiangling Gao*
<b>Room: Balboa 1</b>		<b>MS 82</b>		<b>Multifunctional Materials</b>	
		<b>First Chair: Kenneth J. Loh</b>		<b>Second Chair: Evgueni T. Filipov</b>	
<b>[Keynote]</b> Naturally Dried Graphene Aerogel metamaterials with Superelasticity and Positive/Zero/Negative Poisson's Ratio  Hui Li*, Xiang Xu, Qiangqiang Zhang, Yikang Yu, Kaichun Yang	Mechanical response of graphene based nano-composites at high strain rate Utilizing Artificial Neural Networks.  Alharith Manasrah*, Xiaobing Li, Khalil Qatu, Ahmed Al-Ostaz, Hunain Alkhateb, Damian Stoddard	Paper-based graphene strain sensors for structural health monitoring.  Long Wang*, Kenneth J Loh, Wei-Hung Chiang	Origami tubes coupled into reconfigurable structures and metamaterials.  Evgueni T. Filipov*, Tomohiro Tachi, Glaucio H. Paulino	Additively Manufactured, Adaptive Stiffness Materials.  Julie Jackson*	
<b>Room: Balboa 2</b>		<b>MS 94</b>		<b>Fire Safety Engineering and Mechanics</b>	
		<b>First Chair: Wan Ki CHOW</b>		<b>Second Chair: Anthony Chun Yin YUEN</b>	
<b>[Keynote]</b> Integrating Optimization, Resilience And Robustness: The Case Of Structural Fire Safety.  Jose Luis Torero*	Effects of rotational and axial restraints on bending fire resistance of reinforced concrete beams.  Yong Wang*, Sherwan Albrifkani	Influence of non-uniform elevated temperature on structural behavior of gypsum-sheathed cold-formed steel beam channel members.  Elias Yusuf Ali*, Yared Shifferaw, Kermelos Woldeyes	Numerical Simulation of the Driving Mechanism of Fire Whirls Using Large Eddy Simulation.  Richard Kwok Kit Yuen*, Anthony Chun Yin Yuen, Guan Heng Yeoh	Influence of smoke curtain height on fire smoke spreading features in an underground subway concourse.  Jianyu Wang*, Jian Ma, Junmin Chen, SM Lo	

# Monday, June 5

9:30 - 9:50	9:50 – 10:10	10:10 – 10:30	10:30 – 10:50	10:50 – 11:10	11:10 – 11:30
<b>Room: Balboa 3</b>		<b>MS 145</b>		<b>Structural Identification and Damage Detection</b>	
		<b>First Chair: Manolis Chatzis</b>		<b>Second Chair: Eleni Chatzi</b>	
<b>[Keynote]</b> Online Estimation and Model Assessment of Dynamic Systems using Nonlinear Filters.  Andrew Smyth*	Generalized Minimum Variance Unbiased Joint Input-State Estimation.  Wei Song*	Fatigue prediction on wind turbine support structures using a substructure approach and output-only measurement.  Konstantinos Tatsis*, Eleni Chatzi	A Genetic Algorithm - Ensemble Kalman Filter framework for optimal sensors placement in buildings.  George Saad*, Dana Nasr	A discontinuous treatment for identifying damage using Kalman Filters.  Manolis Chatzis*, Eleni Chatzi	
<b>Room: Balboa 4</b>		<b>MS 153</b>		<b>Stability and failure of structures and materials</b>	
		<b>First Chair: Jifeng Xu</b>		<b>Second Chair: Simos Gerasimidis</b>	
<b>[Keynote]</b> Enhanced Geometrically Non-Linear Generalized Beam Theory (GBT) Formulation: Derivation, Numerical Implementation and Application.  Dinar Camotim*, André Dias Martins, Rodrigo Gonçalves, Pedro Borges Dinis	Non-local formulation for fiber beam-column element to mitigate mesh dependency.  Subodh Kolwankar*	Optimization-based stability analysis of slender elastic structures with unilateral constraints.  Anna Liakou*, Emmanuel Detournay	Collapse analysis of thin cylindrical shell structures: extending single perturbation load approach via surrogate modeling.  Shafee Farzanian*, Mazdak Tootkaboni	Stability of Liquid Storage Tanks Subjected to Different Earthquakes.  Sukhvarsh Jerath*, Wiriychai Roopkumdee	
<b>Room: Revolution 1</b> (Hard Rock Hotel)		<b>MS 163</b>		<b>Introduction to EMI Objective Resilience Manual of Practice</b>	
		<b>First Chair: Mohammed Ettouney</b>		<b>Second Chair: Simos Gerasimidis</b>	
On the Definition of Resilience  Simos Gerasimidis*, Mohammed Ettouney	Metrics for Community Resilience using PEOPLES framework.  Gian Paolo Cimellaro*, Omar	Imprecise Credal Network Learning of Disaster Losses from Remote Sensing Data.  ZhiQiang Chen*, Varun Chavakula	Enhancing Structural Visual Inspection Using HoloLens.  Brian Bleck*, Shreya Vemuganti, David Mascarenas, Chuck Farrar, Andrea Polli, Fernando Moreu		
<b>Room: Revolution 2</b> (Hard Rock Hotel)		<b>MS 122</b>		<b>Numerical Methods for Engineering Stochastic Dynamical Systems</b>	
		<b>First Chair: Ioannis Kougioumtzoglou</b>		<b>Second Chair: Antonina Pirrotta</b>	
Assessing the accuracy of the Wiener Path Integral technique for a class of stochastic differential equations.  Antonios T. Meimaris*, Ioannis A. Kougioumtzoglou, Athanasios A. Pantelous	Stochastic averaging of a Duffing oscillator with fractional derivative terms based on the Hilbert transform.  Ketson Roberto Maximiano *, Ioannis A. Kougioumtzoglou, Pol D. Spanos, André T. Beck	Model order reduction of non-homogeneous discrete systems using fractional calculus.  John Hollkamp*, Fabio Semperlotti, Mihir Sen	Efficient Uncertainty Quantification for Locally Nonlinear Dynamical Systems.  Subhayan De*, Erik A. Johnson, Steven F. Wojtkiewicz	A Frequency Domain Methodology For Determining The Stochastic Response Statistics Of Systems With Singular Matrices.  Vasileios Fragkoulis*, Ioannis Kougioumtzoglou, Athanasios Pantelous, Antonina Pirrotta	



# Monday, June 5

9:30 - 9:50	9:50 - 10:10	10:10 - 10:30	10:30 - 10:50	10:50 - 11:10	11:10 - 11:30
<b>Room: Satisfaction (Hard Rock Hotel) MS 121</b>					
<b>Advances in efficient computational methods for probabilistic analysis and design</b> <b>First Chair: Hadi Meidani Second Chair: Arash Noshadran</b>					
<p><b>[Keynote]</b> Multi-objective optimization under uncertainty through metamodeling in augmented input space.</p> <p>Alexandros Taflanidis*, Jize Zhang</p>	<p>Exploiting Locality of Attachments of Vibrational Energy Harvesters in Computational Analysis, Design and Optimization under Uncertainty.</p> <p>Lissette Fernandez*, Steven Wojtkiewicz, James Gibert, Erik Johnson</p>	<p>Efficient sparse recovery techniques for building better predictive surrogates in under-sampled conditions.</p> <p>Hadi Meidani*, Negin Alemazkoo</p>	<p>Pipeline corrosion mitigation via maintenance optimization under uncertainty.</p> <p>Mihir Mishra*, Vahid Keshavarzadeh, Arash Noshadran</p>	<p>Uncertainty quantification of fragility functions with limited data.</p> <p>Francisco Peña*, Ilias Bilionis, Shirley Dyke</p>	
<b>Room: Fame (Hard Rock Hotel) MS 164</b>					
<b>Structural modeling and identification for performance and resilience assessment of civil structures</b> <b>First Chair: Hamed Ebrahimian Second Chair: Babak Moaveni</b>					
<p>Performance-Based Risk Assessment of Structures Subjected to Multi-Hazard Case of Tsunamis Following Earthquakes.</p> <p>Navid Attary*, Navid Attary, John W. van de Lindt, Andre R. Barbosa, Daniel T. Cox, Vipin U. Unnikrishnan</p>	<p>Effect Of Modeling Resolution On The Seismic Fragilities And Resiliency Of A Steel Hospital Building.</p> <p>Hussam Mahmoud*, Emad Hassan</p>	<p>Community Resilience Assessment for Fire Following Earthquake Using a Probabilistic Framework.</p> <p>Negar Elhami-Khorasani*, Max Coar, Amir Sarreshtehdari, Maria Garlock</p>	<p>Calibration and Updating of State-Dependent Deterioration Models based on Field Data.</p> <p>Leandro Iannaccone*, Paolo Gardoni</p>	<p>Multi-index evaluation method of seismic damage-based resilience of single-layer lattice shell structures.</p> <p>Zheng He*, Tingting Liu</p>	<p>Uncertainty Analysis on Updated Finite Element Model of a Pedestrian Bridge.</p> <p>Shanglian Zhou*, Shanglian Zhou, Wei Song</p>

**Monday, June 5**

**13:00 – 13:45**

**Plenary Lecture 2**

**Room: Grand Ballroom**

Wing Kam Liu

Northwestern University

Self-consistent clustering analysis for fast microstructure-based modeling  
of elastoplastic strain softening materials

Chair: J. S. Chen



**Wing Kam Liu**  
Mechanical Engineering and  
Material Science and  
Engineering  
Northwestern University

## **Self-consistent Clustering Analysis for Fast Microstructure-based Modeling of Elastoplastic Strain Softening Materials**

### **Abstract:**

The advent of advanced processing and manufacturing techniques provides unparalleled freedom to design new material classes with complex microstructures across scales from nanometers to meters. In this lecture a new data-driven computational framework for the analysis and design of these complex material systems will be presented. A mechanistic concurrent multiscale method called self-consistent clustering analysis (SCA) is developed for general inelastic heterogeneous material systems. The efficiency of SCA is achieved via data compression algorithms which group local microstructures into clusters during the off-line training stage, thereby reducing required computational expense. Its accuracy is guaranteed by introducing a self-consistent method for solving the Lippmann-Schwinger integral equation in the on-line predicting stage. The integration of microstructure reconstruction and subsequent high-fidelity multiscale predictions of the materials behavior leads to the generation of vast amounts of reliable data. This structure-property feedback loop enables the design of new material systems with new capabilities. In mathematical physics, the “structure” and “property” can be interpreted as the nonlocal

interaction of the microstructure clusters and the virtual work at the corresponding material point, respectively. Based on the computational design of experiments, data mining techniques offer the ability to discover the influence of the microstructure on the macroscopic materials behavior. The proposed framework will be illustrated for advanced composites and the integrated design of various advanced material systems.

### References

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## Monday, June 5, 14:15 – 16:15, Session M2

Room	MS Number	Minisymposia Session Title
Salon A	MS1	Symposium in honor of Prof. Zdeněk P. Bažant on the occasion of his 80th birthday (by invitation only)
Salon B	MS61	Computational Geomechanics
Salon C	MS21	Computational Methods and Applications for Solid and Structural Mechanics
Salon D	MS22	Computational Modeling in Civil Engineering
Salon E	MS51	Biomedical Fluid Mechanics and Fluid-Structure Interaction
Gaslamp 1	MS72	Recent Trends in Granular Materials Across the Scales
Gaslamp 2	MS23	Extreme Event Modeling
Gaslamp 3	MS103	Multi-scale modeling of microstructure and property evolution
Gaslamp 4	MS42	Advances in Experimental, Theoretical and Computational Fracture Mechanics
Gaslamp 5	MS32	Modeling time-dependent behavior and deterioration of concrete
Balboa 1	MS82	Multifunctional Materials
Balboa 2	MS94	Fire Safety Engineering and Mechanics
Balboa 3	MS145	Structural Identification and Damage Detection
Balboa 4	MS153	Stability and failure of structures and materials
Revolution 1 (Hard Rock Hotel)	MS163	Introduction to EMI Objective Resilience Manual of Practice
Revolution 2 (Hard Rock Hotel)	MS122	Numerical Methods for Engineering Stochastic Dynamical Systems
Satisfaction (Hard Rock Hotel)	MS121	Advances in efficient computational methods for probabilistic analysis and design
Fame (Hard Rock Hotel)	MS164	Structural modeling and identification for performance and resilience assessment of civil structures

# Monday, June 5

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Salon A</b> <b>MS 1</b> <b>Symposium in honor of Prof. Zdeněk P. Bažant on the occasion of his 80th birthday</b> <b>First Chair: Ares J. Rosakis</b> <b>Second Chair: Huajian Gao</b>					
Using Laboratory Earthquake Ruptures to reveal the structure of Dynamic Friction.  Ares J. Rosakis*, Nadia Lapusta, Vito Rubino	History-independent cyclic response of fatigued nanotwinned metals governed by correlated necklace dislocations.  Huajian Gao*, Haofei Zhou, Qingsong Pan, Lei Lu	Mechanically-driven, deterministic 3D assembly.  Yonggang Huang*	Failure of defect induced thick wavy carbon fiber composites due to kinking and/or splitting: Experimental and numerical study.  Anthony M. Waas*, Paul Davidson	Current and Future Challenges in Probabilistic Mechanics.  George Deodatis*	On second order tensorial damage framework.  Rodrigue Desmorat*
<b>Room: Salon B</b> <b>MS 61</b> <b>Computational Geomechanics</b> <b>First Chair: Jason Marshall</b> <b>Second Chair: Sheng Zeng</b>					
Level Set Discrete Element Method Computational Laboratory.  Jason Marshall*, Jose Andrade	DEM simulation and characterization of the shear strength of isotropic and cross-isotropic sands.  Sheng Zeng*, Xilin Lu, Yiyue Ma, Yilin Liu	A Combined Finite-Discrete Element Method for Rock Fragmentation in Radial Jet Drilling.  Andreas Kampitsis*, Jiansheng Xiang, John-Paul Latham	Multi-scale microstructure characterization of shale through statistical combination of imaging across scales.  Shabnam J. Semnani*, Ronaldo I. Borja	Statistical analysis of shape characteristics of rock fragments produced by FDEM-simulated single grain crushing.  Gang Ma*, Richard A. Regueiro	
<b>Room: Salon C</b> <b>MS 21</b> <b>Computational Methods and Applications for Solid and Structural Mechanics</b> <b>First Chair: Caglar Oskay</b> <b>Second Chair: Haim Waisman</b>					
Mesh-size independent multiscale damage modeling of fiber-reinforced composites subjected to multi-axial loading.  Rudraprasad Bhattacharyya*, Caglar Oskay	Thermo-chemical modeling of a new manufacturing process for composite materials based on frontal polymerization.  Elyas Goli*, Philippe H Geubelle, Ian Robertson, Jeffrey S. Moore	Thermoelectroelastic Analysis Of Simply Supported Piezoelectric Laminate In Cylindrical Bending.  Yogesh M. Desai*, Sameer S. Sawarkar, Dr. Sandeep Pendhari	Application of Time-Temperature Superposition Principle with a Modified Arrhenius Equation for the Relaxation Analysis of Metal Seals.  Linan Qiao*, Sven Nagelschmidt, Uwe Herbrich, Dietmar Wolff, Uwe Zencker, Holger Völzke	Variational h-adaption for coupled thermo-mechanical problems.  Rohit Pethe*, Thomas Heuzé, Laurent Stainier	A rate-dependent interfacial damage model: Constitutive equation and fracture simulation.  Reza Abedi*, Robert Haber
<b>Room: Salon D</b> <b>MS 22</b> <b>Computational Modeling in Civil Engineering</b> <b>First Chair: Ertugrul Taciroglu</b> <b>Second Chair: Chanseok Jeong</b>					
Identification of an incident seismic motion signal into a truncated heterogeneous semi-infinite solid in the time domain.  Chanseok Jeong*, Elnaz Esmaeilzadeh Seylabi	Parameter estimation in layered media using dispersion-constrained full-waveform inversion.  Hamidreza Mashayekh*, Loukas F. Kallivokas, John L. Tassoulas	The combined effects of topography and model dimensionality on the amplification of seismic waves.  Babak Poursartip*, Loukas F. Kallivokas	A computational framework to model flow in porous media with multiple pore-networks.  Seyedeh Hanie Seyed Jooda*, Kalyana Babu Nakshatralla, Roberto Ballarini	A Micromechanical Model of Flow in Unsaturated Soil using a Coupled DEM-LBM.  Jonathan F. Fili*, M. Asce Farshid Vahedifard, Bohumir Jelinek, John F. Peters	

# Monday, June 5

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Salon E</b>		<b>MS 51</b>		<b>Biomedical Fluid Mechanics and Fluid Structure Interaction</b>	
		<b>First Chair: Shu Takagi</b>		<b>Second Chair: Shaolie Hossain</b>	
<b>[Keynote]</b> FSI analysis for relation between blood flows and vessel geometries.	Blood Flow Measurement and Modeling for Predictive Medicine of Cardiovascular Diseases.	Near-future changes in the diagnosis and treatment of cerebrovascular disorder with hydrodynamics.	High-order geometric modeling and simulation of the fluid-structure interaction in end-to-side anastomoses.	Simulation of Coil Embolization for varying Stiffness and Length: Basic Model Study.	Immersed FSI with Embedded Level Sets.
Hiroshi Suito*, Kenji Takizawa, Viet Q.H. Huynh, Takuya Ueda, Tayfun E. Tezduyar	Keiichi Itatani*	Hiroyuki Takao*, Takashi Suzuki, Soichiro Fujimura, Toshihiro Ishibashi, Makoto Yamamoto, Yuichi Murayama	Lars Radtke*, Axel Larena-Avellaneda, Eike Sebastian Debus, Alexander Düster	Soichiro Fujimura*, Takao Hiroyuki, Takashi Suzuki, Chihebeddine Dahmani, Toshihiro Ishibashi, Yuichi Murayama, Makoto Yamamoto	Soonpil Kang*, Arif Masud
<b>Room: Gaslamp 1</b>		<b>MS 72</b>		<b>Recent Trends in Granular Materials Across the Scales</b>	
		<b>First Chair: Tang-Tat Ng</b>		<b>Second Chair: Shunying Ji</b>	
The equivalent stress and strain expression of granular materials.	A Study on Vibration and Energy Dissipation Characteristics of Particle System Considering Plastic Contact.	Displacement and Rotational Wave Dispersion in Granular Solids.	Study of an athermal quasi static plastic deformation in a 2D granular material.	Effect of particle size distribution on the density state and compressibility of granular materials.	
Zhengguo Gao*, Xin Guo, Qin Yang	Jian Li*, Wei Gao, Yunuo Liu, Xuetao Li	Anil Misra*, Payam Poorsolhjoui	Jie Zhang*	Ching Shung Chang*, Mehrashk Meidani, Yibing Deng	
<b>Room: Gaslamp 2</b>		<b>MS 23</b>		<b>Extreme Events Modeling</b>	
		<b>First Chair: Michael Hillman</b>		<b>Second Chair: Guohua Zhou</b>	
A micro-mechanical modeling approach for dynamic fragmentation in brittle multi-phase materials.	Fragment impact modeling of concrete structures.	Modeling Impact And Blast Effects With The High-Rate Brittle Material Model.	On the modeling of Blast Evolution and Dust Production by Fragmenting Charges in closed Chambers.	Damage Evaluation of Aging Transportation Structures Subjected to Close-In Detonations.	The dynamic behaviour of Poly(methyl methacrylate) based tri-block copolymers subjected to ballistic impact and perforation : experimental investigations.
Lori Graham-Brady*, Dmitriy Kats, Nitin Daphalapurkar, David Cereceda	Frank Beckwith*, Michael Hillman, J. S. Chen	George Vankirk*, Andreas Frank, Jason Roth	Joseph D. Baum*, Orlando A. Soto, Fumiya Togashi, Michael E. Giltrud, Rainald Lohner, Robert Frank	Yongwook Kim *, Salvatore Florio, Qian Wang	Matadi Boumbimba*, Mbarek, Voyiadjis, Rusinek, Gerard
<b>Room: Gaslamp 3</b>		<b>MS 103</b>		<b>Multi-scale modeling of microstructure and property evolution</b>	
		<b>First Chair: Michael Tonks</b>		<b>Second Chair: Benjamin Spencer</b>	
Morphology Dependent Flow Stress In Nickel-Based Superalloys In The Multi-Scale Crystal Plasticity Framework.	Microscale modeling of creep deformation and rupture using cohesive zone-crystal plasticity finite element analysis.	Statistically equivalent representative volume elements and multiscale modeling of Ni-based superalloys.	Microstructure-based Modeling of Ferritic-Martensitic Steels Including Crystal Plasticity and Grain Boundary Effects.	Degradation of Structural Aluminum Alloys Subjected to Fire Using AA5083: Crystal Plasticity Finite Element Modeling.	Physics-based Creep Model of Ni-based Alloy Welds using Crystal Plasticity.
Shahriyar Keshavarz*, Zara Molaeinia, Somnath Ghosh, Andrew Reid, Steve Langer	Xiang Zhang*, Van Tung Phan, Caglar Oskay	Akbar Bagri*, George Weber, Somnath Ghosh	Omar Nassif*, Timothy Truster	Ran Ma*, Timothy Truster	Wen Jiang*, Pritam Chakraborty, Thomas M Lillo

# Monday, June 5

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Gaslamp 4</b>		<b>MS 42</b>		<b>Advances in Experimental, Theoretical and Computational Fracture Mechanics</b>	
		<b>First Chair: Ange Akono</b>		<b>Second Chair: Haim Waisman</b>	
Dynamic shear crack propagation along heterogeneous interfaces: a length scale effect.	A new hybrid numerical scheme for simulating fault ruptures with near-fault bulk inhomogeneities.	Implicit Peridynamic Thermo-Mechanical Formulations for Fracture Modeling.	Peridynamic model for damage and fracture in porous materials.	Numerical Analysis of Delamination Initiation and Propagation in the CFRP Laminates with Mechanical Couplings in the DCB Test Configuration.	An updated-Lagrangian nonlocal damage mechanics formulation for modeling ice sheet flow and fracture.
David S. Kammer*	Setare Hajarolasvadi*, Ahmed E. Elbanna	Hailong Chen*, Yile Hu, Benjamin Spencer	Sina Niazi*, Ziguang Chen, Florin Bobaru	Hubert Debski*, Sylwester Samborski	Stephen Jimenez*, Ravindra Duddu, Jeremy Bassis
<b>Room: Gaslamp 5</b>		<b>MS 32</b>		<b>Modeling time-dependent behavior and deterioration of concrete</b>	
		<b>First Chair: Roman Wan-Wendner</b>		<b>Second Chair: Mohammed Alnaggar</b>	
<b>[Keynote]</b> Modeling Time-Dependent behavior of Concrete Affected by Alkali Silica Reaction in Variable Environmental Conditions		Application of 1st Order kinetic Approach to Model Alkali-Silica Reaction in Dry Cask Storage Structures	Effect Of Alkali Silica Reaction On Aging Mortar Bars	Lattice modeling of early-age behavior of concrete bridge decks.	Full Coupling Between Diffusion and Mechanical Analysis in Concrete.
Mohammed Alnaggar*, Gianluca Cusatis, Giovanni Di Luzio		Masoud Dehghani Champiri*, Reza Mousavi, Kaspar J. Willam	Madura Pathirage*, Faysal Bousikhane, Kaijing Luo, Matthew D'Ambrosia, Mohammed Alnaggar, Gianluca Cusatis	John Bolander*, Yaming Pan, Armando Prado	Faysal Bousikhane*, Giovanni Di Luzio, Weixin Li, Gianluca Cusatis
<b>Room: Balboa 1</b>		<b>MS 82</b>		<b>Multifunctional Materials</b>	
		<b>First Chair: Donghyeon Ryu</b>		<b>Second Chair: Nathan Salowitz</b>	
Experimental validation of a percolation-based nanocomposite strain sensor numerical model.	Carbon nanotube reinforced composite as a temperature sensing and de-icing element.	Multifunctional Mechano-Optoelectronic Composites for Autonomous Structural Systems.	Characterizing the Stress-Strain Behavior of Graphene Nanocomposites Utilizing Artificial Neural Networks.	Multi-scale Modeling of Self-Sensing Strain-hardening Cementitious Materials.	Mechanics & Analysis of Self-Healing Materials.
Bo Mi Lee*, Kenneth J. Loh	Sung-Hwan Jang*, Yong-Lae Park	Donghyeon Ryu*, Elias Pulliam	Khalil Qatu*, Hatem Almasaeid, Alharith Manasrah, Xioabing Li, Grace Rushing, Yacoub Najjar, Ahmed Al-Ostaz	Mo Li*, Xiaopeng Li	Nathan Salowitz*
<b>Room: Balboa 2</b>		<b>MS 94</b>		<b>Fire Safety Engineering and Mechanics</b>	
		<b>First Chair: Yong Wang</b>		<b>Second Chair: Wei Yang</b>	
Fire Hazards of Green Buildings in the Asia-Oceania Regions.	Investigation of the Pyrolysis Kinetics and Burning Characteristics for Australia Standard Furniture Materials.	Flexural behaviour of RC members under elevated temperature.	Experimental and analytical studies for temperature distribution of reinforced concrete beams exposed to fire under different load level.	Simulation of Dynamic Passenger-carried Fire Load in Metro Station.	
Wan Ki Chow*	Eric Wai Ming Lee*, Anthony Chun Yin Yuen, Wei Yang, Guan Heng Yeoh, Morgan Cook, Richard Kwok Kit Yuen	Pengda Li*, Yu-fei Wu, Fang Yuan	Eunmi Ryu*, Heesun Kim, Yeongsu Shin	Siu Ming Lo*, Juan Chen, Jian Ma, Kwok Leung Tsui	

# Monday, June 5

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Balboa 3</b>		<b>MS 145</b>		<b>Structural Identification and Damage Detection</b>	
		<b>First Chair: Vasilis Dertimanis</b>		<b>Second Chair: Audrey Olivier</b>	
On the performance of on-line parameter estimation algorithms in systems which exhibit challenging identifiability properties.	Fatigue monitoring and remaining lifetime prognosis in steel structures using output-only vibration measurement.	Reduced-order sensitivity-based parameterization for model updating and damage localization.	Model Falsification in a Bayesian Framework.	Model updating using sum of squares optimization for non-convex problems.	
Audrey Olivier*, Andrew W. Smyth	Costas Papadimitriou*, Eleni Chatzi, Saeed Eftekhar Azam, Vasileios Nertimanis	Jinwoo Jang*, Andrew Smyth	Subhayan De*, Patrick T. Brewick, Erik A. Johnson, Steven F. Wojtkiewicz	Dan Li*, Dan Li, Xinjun Dong, Yang Wang	
<b>Room: Balboa 4</b>		<b>MS 153</b>		<b>Stability and failure of structures and materials</b>	
		<b>First Chair: Noël Challamel</b>		<b>Second Chair: Libin Zhao</b>	
<b>[Keynote]</b> Compression-shearing buckling and postbuckling behaviors of configured composite panels.	Optimum design of typical stiffened composite structures based on post-buckling analysis.	Postbuckling of elliptically delaminated composite plates: A semi-analytical modelling approach.	Size-Dependent Failure Behavior Of A Single-Layer Triaxially Braided Composite.	Shearing buckling and postbuckling behaviors of curved composite panel with multiple hat stringers and frames.	Analytical and Finite Element Buckling Solutions of Simply Supported Anisotropic Laminated Composite Columns under Axial Compression Compared with Experiments.
Jifeng Xu*, Tianliang Qin, Lei Peng, Caoning Su, Mufeng Duan, Lingwei Tang	Kangkang Wang*, Libin Zhao, Fan Ding, Tianliang Qin, Jianyu Zhang, Jifeng Xu	Anton Köllner*, Christina Völlmecke	Chao Zhang*, Yulong	Tianliang Qin*, Lei Peng, Bo Ma, Zizi Lu, Chaobo Xin, Jifeng Xu	Rund Al-Masri*, Hayder Rasheed
<b>Room: Revolution 1 (Hard Rock Hotel)</b>		<b>MS 163</b>		<b>Introduction to EMI Objective Resilience Manual of Practice</b>	
		<b>First Chair: Mohammed Ettouney</b>		<b>Second Chair: Simos Gerasimidis</b>	
Objective Resiliency Framework for Ensuring Railroad Network Safety and Efficiency.	Quantitative models for interdependent functionality and recovery of critical infrastructure systems.	Reliability and Resilience Assessment of Stochastic Networks.	OR MOP – Asset and System Modeling.	Probabilistic Resilience Framework for Blast Resistant Infrastructure.	Contribution of Structural Health Monitoring Towards the Resiliency of Highway Bridges.
Jerome Lynch*, Fernando Moreu, Mohammed Ettouney	Paolo Bocchini*, Wenjuan Sun	Xi Chen*, E. A. Elsayed	Chris Mullen*, Prabodh Dahal	Shady Salem*, Manuel Campidelli, Michael Tait, Wael El-Dakhkhni	Katherine A. Flanigan*
<b>Room: Revolution 2 (Hard Rock Hotel)</b>		<b>MS 122</b>		<b>Numerical Methods for Engineering Stochastic Dynamical Systems</b>	
		<b>First Chair: Antonina Pirrotta</b>		<b>Second Chair: Ioannis Kougoumtzoglou</b>	
Response statistics of nonlinear rotating shaft subject to biaxial random excitation.	A Wiener path integral technique for stochastic response determination of structural systems under non-white excitation processes.	Sparse Representations and Wiener Path Integral for Efficient Stochastic Response Determination of MDOF Systems.	An efficient probability density evolution analysis of concrete frame structure with non-independent parameters.	Probability of failure analysis using adaptive Kriging surrogates with Bayesian model selection.	An Approximate Stochastic Dynamics Approach For Inelastic Stochastic Design Spectrum-Based Analysis.
Arvid Naess*, Oleg Gaidai, Michael Dimentberg	Olga Brudastova*, Ioannis A. Kougoumtzoglou, Giovanni Malara, Apostolos Psaros	Apostolos Psaros*, Ioannis Kougoumtzoglou	Jianbing Chen*, Zhiqiang Wan, Jie Li	V. S. Sundar*, Michael D. Shields	Ioannis P. Mitseas*, Ioannis A. Kougoumtzoglou, Michael Beer



# Monday, June 5

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Satisfaction</b> (Hard Rock Hotel)					
<b>MS 121</b>		<b>Advances in efficient computational methods for probabilistic analysis and design</b> First Chair: Hadi Meidani    Second Chair: Arash Noshadran			
Bridge condition assessment based on live load effect monitoring under the Bayesian Framework.  Yang Yu*, C.S. Cai	Bayesian Model Updating Of Compressive Strength-Porosity Models For Cement Paste.  Yohanna Mejia Cruz*, Juan M. Caicedo, Fabio Matta				
<b>Room: Fame</b> (Hard Rock Hotel)					
<b>MS 164</b>		<b>Structural modeling and identification for performance and resilience assessment of civil structures</b> First Chair: Hamed Ebrahimian    Second Chair: Joel P. Conte			
<b>[Keynote]</b> Locating Performance Points In Capacity Spectrum Method Using Empirical Capacity Curve, Equivalent Viscous Damping And Nonlinear Displacement Estimates.  Ayhan Irfanoglu*, Pedram Hesam	Stochastic Simulation of Post-Earthquake Community-Level Recovery.  Henry V Burton*	Nonlinear modeling of a dynamically tested two-story RC structure.  Seyedsina Yousefianmoghad*, Andreas Stavridis, Babak Moaveni	Automated Processing of Laser Point Clouds towards Structural Modelling of Bridges.  Yujie Yan*, Jerome F. Hajjar		

## Monday, June 5, 16:30 – 18:30, Session M3

Room	MS Number	Minisymposia Session Title
Salon A	MS1	Symposium in honor of Prof. Zdeněk P. Bažant on the occasion of his 80th birthday (by invitation only)
Salon B	MS61	Computational Geomechanics
Salon C	MS21	Computational Methods and Applications for Solid and Structural Mechanics
Salon D	MS22	Computational Modeling in Civil Engineering
Salon E	MS51	Biomedical Fluid Mechanics and Fluid-Structure Interaction
Gaslamp 1	MS72	Recent Trends in Granular Materials Across the Scales
Gaslamp 2	MS23	Extreme Event Modeling
Gaslamp 3	MS103	Multi-scale modeling of microstructure and property evolution
Gaslamp 4	MS42	Advances in Experimental, Theoretical and Computational Fracture Mechanics
Balboa 1	MS82	Multifunctional Materials
Balboa 3	MS145	Structural Identification and Damage Detection
Balboa 4	MS153	Stability and failure of structures and materials
Revolution 1 (Hard Rock Hotel)	MS163	Introduction to EMI Objective Resilience Manual of Practice
Revolution 2 (Hard Rock Hotel)	MS122	Numerical Methods for Engineering Stochastic Dynamical Systems
Satisfaction (Hard Rock Hotel)	MS121	Advances in efficient computational methods for probabilistic analysis and design
Fame (Hard Rock Hotel)	MS93	Control of Structures for Multiple Hazards

# Monday, June 5

16:30 - 16:50	16:50 - 17:10	17:10 - 17:30	17:30 - 17:50	17:50 - 18:10	18:10 - 18:30
<b>Room: Salon A</b> <b>MS 1</b> <b>Symposium in honor of Prof. Zdeněk P. Bažant on the occasion of his 80th birthday</b> <b>First Chair: Jia-Liang Le</b> <b>Second Chair: Gilles Pijaudier-Cabot</b>					
Continuum Modeling of Probabilistic Failure of Polycrystalline Silicon MEMS Structures.  Jia-Liang Le*	Effects of surfaces on the mechanical properties of nanosized materials.  Gilles Pijaudier-Cabot*, Gyorgy Hantal, Guillaume Galliéro, Romain Vermorel	Discrete Modeling of Mesoscale Poromechanics: Formulation and Numerical Examples.  Gianluca Cusatis, Weixin Li*	Hyperelastic Modeling of Particle Reinforced Composites.  Zaoyang Guo*	A Probabilistic Model for Fracture and Scaling of Discontinuous Fiber Composites.  Marco Salviato*	A novel mixed-mode rate-dependent cohesive zone model using fractional viscoelastic theory.  Oliver Giraldo-Londono*, Glaucio H. Paulino, William G. Buttler
<b>Room: Salon B</b> <b>MS 61</b> <b>Computational Geomechanics</b> <b>First Chair: Konstantinos Karapiperis</b> <b>Second Chair: Majid T. Manzari</b>					
Reduced-gravity effects on the failure and flow of sand: DEM simulations vs experiments.  Konstantinos Karapiperis*, Jose E. Andrade	Modeling of Soil-Pile-Structure Interaction in Liquefiable Soils.  Majid T. Manzari*, Mohamed El Ghoraiby	Large deformation elastoplasticity with plastic volume change and Eshelby-Mandel stress in the intermediate configuration.  Kane Bennett*, Richard Regueiro, Ronaldo Borja	A Model for Athermal Strain Localization in Dry Sheared Fault Gouge.  Ahmed Elbanna*, Xiao Ma		
<b>Room: Salon C</b> <b>MS 21</b> <b>Computational Methods and Applications for Solid and Structural Mechanics</b> <b>First Chair: Soheil Soghrati</b> <b>Second Chair: Ertugrul Taciroglu</b>					
A GFEM for Three-Dimensional Crack Propagation in Fiber Reinforced Composites.  Phillipe Alves*, Carlos Armando Duarte	Modeling Multi-Stage Hydraulic Fracturing from a Borehole within a GFEM Framework.  Nathan Shauer*, Carlos Armando Duarte, Piyush Gupta, Alfredo Sanchez	Discontinuous Element Insertion Algorithm.  Timothy Truster*	A stabilized finite element approach for enforcing general cohesive laws.  Gourab Ghosh*, Chandrasekhar Annavarapu, Ravindra Duddu	The shifted Nitsche method: A new approach to embedded boundary conditions.  Nabil Atallah*, Alex Main, Guglielmo Scovazzi	The finite cell method and variational multiscale modeling for crack propagation in complex image-based geometries.  Lam H. Nguyen*, Joan E. Bechtold, Dominik Schillinger
<b>Room: Salon D</b> <b>MS 22</b> <b>Computational Modeling in Civil Engineering</b> <b>First Chair: Ioannis Koutromanos</b> <b>Second Chair: Bora Gencturk</b>					
Seismic Design of Ordinary Bridges for a Target Loss.  Farzin Zareian*, Behzad Zakeri	Simulation of Structural Softening and Collapse in Reinforced Concrete Structures Using a Finite-Strain Gradient-Inelastic Force-Based Element Formulation.  Petros Sideris*, Mohammad Salehi	Modeling and Simulation of Innovative Bridge Columns with High-Performance Materials Subjected to Seismic Loads.  Bora Gencturk*, Farshid Hosseini, Asfandyar Ahmed	Finite element modeling for the collapse assessment of reinforced masonry structures under seismic loading.  Andreas Koutras*, Benson Shing	Numerical Investigation of Rebar Buckling and Rupture in RC Columns Under Cyclic Loads.  Ioannis Koutromanos*, Sadik Can Girgin, Mohammadreza Moharrami	Simulating Bridge Deterioration: Models and Calibration.  Chris Kusiak*, Arun Prakash, Mark Bowman

# Monday, June 5

16:30 - 16:50	16:50 - 17:10	17:10 - 17:30	17:30 - 17:50	17:50 - 18:10	18:10 - 18:30
<b>Room: Salon E</b>		<b>MS 51</b>		<b>Biomedical Fluid Mechanics and Fluid Structure Interaction</b>	
		<b>First Chair: Hiroshi Suito</b>		<b>Second Chair: Keichi Itatani</b>	
Computational fluid dynamics study of cerebral vascular alterations and disease progression in subjects with Moyamoya disease.  Travis M. Sanders*, Shaolie S. Hossain, Zbigniew Staroloski, Dianna Milewicz, Ananth Annapragada	Volumetric truncated hierarchical splines over unstructured hexahedral meshes for isogeometric analysis applications.  Xiaodong Wei*, Yongjie Jessica Zhang	Estimating Thin-Walled Regions in Unruptured Cerebral Aneurysms by CFD.  Kazutoshi Tanaka*, H. Takao, T. Suzuki, S. Fujimura, T. Ishibashi, Y. Murayama, M. Yamamoto	Multivariate Analysis of Intracranial Aneurysms Analyzed by Computational Fluid Dynamics.  Y. Uchiyama*, H. Takao, T. Suzuki, S. Fujimura, T. Ishibashi, Y. Murayama, M. Yamamoto		
<b>Room: Gaslamp 1</b>		<b>MS 72</b>		<b>Recent Trends in Granular Materials Across the Scales</b>	
		<b>First Chair: Matthew R. Kuhn</b>		<b>Second Chair: Anil Misra</b>	
Delayed Breakage in Sand: A Model Based on Crack Growth Kinetics.  Giuseppe Buscarnera*, Yida Zhang	A coupled Smooth Particle Hydrodynamics and Discrete Element Method toward High-Shear Mixing Process in a Solid-Liquid Granular Flow.  Siyu Zhu*, Huiming Yin	Tuning mechanical response properties in a granular system by adding hard particle channels.  Wang Dengming*, Du Wei	A novel polyhedron based bonded model for fracture modelling of continuous media with discrete element method.  Yongjun Li*, Shunying Ji	Modeling Particle Compaction of Granular Media with Next Generation Finite Element Technology.  Wayne L. Mindle*, Anthony D. Rosato	Finding Inter-Granular Stiffness Coefficients for Granular Micromechanics Approach Using Nonlocal Contact Formulation.  Payam Poolsolhjouy*, Marcial Gonzalez
<b>Room: Gaslamp 2</b>		<b>MS 23</b>		<b>Extreme Events Modeling</b>	
		<b>First Chair: Jason Roth</b>		<b>Second Chair: George Vankirk</b>	
Meshfree reduced order modeling of fracture.  Qizhi He*, Camille Marodon, J. S. Chen	Geometrically Consistent Coupling of Beam and Continuum Elements to Model Structures Under Extreme Loads.  Kaijun Dong*, Hui Liu, Arun Prakash	Break-even analysis of protective measures against improvised explosive devices.  Manuel Campidelli*, Shady Salem, Wael W. El-Dakhkhni, Michael J. Tait, Waleed Mekky	Finite Element Analysis of Large Aboveground Steel Welded Storage Tanks Excited by Seismic Loads.  Sukru Guzey*, John M. Spritzer	Propagation of sediment pulses during major flood events: A numerical simulation approach.  Celso F. Castro-Bolinaga*, Panos Diplas, Robert J. Bodnar	
<b>Room: Gaslamp 3</b>		<b>MS 103</b>		<b>Multi-scale modeling of microstructure and property evolution</b>	
		<b>First Chair: Pritam Chakraborty</b>		<b>Second Chair: Wen Jiang</b>	
<b>[Keynote]</b> Microstructure Evolution of Powder Materials during Solid State Sintering: A Phase Field Study.  Vikas Tomar*, Sudipta Biswas, Daniel Schwen	Uncertainty Quantification and Sensitivity Analysis of Models of Atomic and Microstructural Evolution in Nuclear Materials.  Chaitanya Deo*	Comparison of irradiated steel dislocation and precipitate interaction models within crystal plasticity.  Stephanie A. Pitts*, Wen Jiang, Benjamin Spencer, Hussein M. Zbib	Investigating Crystal/Binder Interface Properties of HMX Based Composites Using In-Situ Computed Tomography Imaging and Cohesive Element Modeling.  David J. Walters*, Darby J. Luscher, John D. Yeager, Brian M. Patterson	Integrated Computation Materials Engineering (ICME) Development of Carbon Fiber Composites (CFRP) for Lightweight Vehicles: Multi-scale Modeling and Application  Jiaying Gao*, Zeliang Liu, Biao Liang, Wing Kam Liu	

# Monday, June 5

16:30 - 16:50	16:50 - 17:10	17:10 - 17:30	17:30 - 17:50	17:50 - 18:10	18:10 - 18:30
<b>Room: Gaslamp 4</b>		<b>MS 42</b>		<b>Advances in Experimental, Theoretical and Computational Fracture Mechanics</b>	
		<b>First Chair: Christian Hoover</b>		<b>Second Chair: Haim Waisman</b>	
Block cracking in multilayer bonded infrastructures.	Bone Fracture Toughness at the Microscopic Length Scale using Scratch Tests.	Multiscale microstructural database for elastoplastic material with damage based on self-consistent clustering analysis.	Fracture finite element investigation on bolted double-Tee connections.		
Xin He*, Fangliang Chen, Huiming Yin	Kavya Mendu*, Amrita Kataruka, Orieka Okeoghene, Jasmine Puthuvelil, Ange-Therese Akono	Zeliang Liu*, Mark Fleming, Wing Kam Liu	Sana N. El Kalash*, Elie G. Hantouche		
<b>Room: Balboa 1</b>		<b>MS 82</b>		<b>Multifunctional Materials</b>	
		<b>First Chair: Ya Wang</b>		<b>Second Chair: Yu Qiao</b>	
Heterogeneous Current Collector in Lithium-ion Battery for Thermal Runaway Mitigation.	Computational Model for Characterization of Multifunctional Energy Storage Composites under Various Loading Conditions.	Design, Characterization and Experimental Evaluation of a Novel Structural Battery Concept Based on Multifunctional Energy Storage Composites			
Meng Wang*, Anh Le, Yang Shi, Daniel Noelle, Yu Qiao	Yinan Wang*, Purim Ladpli, Fotis Kopsaftopoulos, Fu-Kuo Chang	Noel Dutree*, Alex Hussinger, Chen Liu, Cheng Liu, Tanay Topac, Yinan Wang, Fu-Kuo Chang			
<b>Room: Balboa 3</b>		<b>MS 145</b>		<b>Structural Identification and Damage Detection</b>	
		<b>First Chair: Babak Moaveni</b>		<b>Second Chair: Manolis Chatzis</b>	
Experimental Verification of LSE Structural Identification Method with Limited Data Availability.	Fusing Seismic Interferometry with Bayesian Inference for Structural Identification and Damage Detection.	Structural modeling and identification for performance and resilience assessment of civil structures.	Probabilistic Damage Identification of a Two-story RC Building using In-Situ Test Data.	Fault Detection and Classification for Wireless Sensor Network using Full-scale Monitoring Data.	Era/Okid Algorithm For The Identification Of Reinforced Concrete Base-Isolated Buildings – Theory And Applications.
Alana Lund*, Shirley J. Dyke, Ge Ou, Bin Xu	Murat Uzun*, Hao Sun, Oral Büyükoztürk	Supratik Bose, Mehdi M. Akhlaghi, Andreas Stavridis*, Babak Moaveni	Babak Moaveni*, Mingming Song, Seyedsina Yousefianmoghadam, Andreas Stavridis	Yuguang Fu*, Cheng Peng, JongWoong Park, Billie F. Spencer, Jr.	Nicholas D Oliveto*, Anastasia Athanasiou
<b>Room: Balboa 4</b>		<b>MS 153</b>		<b>Stability and failure of structures and materials</b>	
		<b>First Chair: Ahmer Wadee</b>		<b>Second Chair: Christina Völlmecke</b>	
[Keynote] On static and dynamics behaviors of microstructured membranes within nonlocal mechanics.		Instability of a Icosahedron frame.	Design Optimization of Truss Structures against Dynamic Instability.		
Noël Challamel*, Benjamin Hérissou, Vincent Picandet, Arnaud Perrot, Chien Ming Wang		Anthnoy Palazotto*	Le Cao*		

# Monday, June 5

16:30 - 16:50	16:50 - 17:10	17:10 - 17:30	17:30 - 17:50	17:50 - 18:10	18:10 - 18:30
<b>Room: Revolution 1</b> (Hard Rock Hotel)					
<b>MS 161</b>		<b>Advances in Model Development and Data Analytics for Quantitative Engineering Sustainability</b> <b>First Chair: Arghavan Louhghalam Second Chair: Franz-Josef Ulm</b>			
Planning more resilient cities.  Jacob Sobstyl*, Franz-Josef Ulm, Roland Pellenq	From monitored data to autonomous informed decisions.  Kostas Papakonstantinou*, C.P. Andriotis	A closed-form solution for road roughness-induced greenhouse gas emission.  Arghavan Louhghalam*, Mazdak Tootkaboni, Franz-Josef Ulm	Non-equilibrium dynamics in urban traffic networks.  Luis E. Olmos*, Marta C. Gonzalez	Identifying patterns in urban land use from satellite imagery.  Adrian Albert*, Marta Gonzalez	
<b>Room: Revolution 2</b> (Hard Rock Hotel)					
<b>MS 122</b>		<b>Numerical Methods for Engineering Stochastic Dynamical Systems</b> <b>First Chair: Ioannis Kougioumtzoglou Second Chair: Antonina Pirrotta</b>			
Capturing stochastic process phase dependencies for simulation of non-stationary, non-Gaussian signals.  Liam Comerford*	Compressive sampling based extrapolation of random wave field data.  Ioannis Kougioumtzoglou*, Giovanni Malara, Felice Arena	Simulation based surrogate multi- scaling for computational models of fiber-reinforced composite materials using a stochastic collocation scheme.  Anindya Bhaduri*, Lori Graham- Brady, Michael D. Shields	Surrogate Model Development with Global Sensitivity Analysis for a Nuclear Reactor Assembly subjected to Stochastic Flow- Induced Vibration.  Gregory A. Banyay*, Michael D. Shields, John C. Brigham	Seismic Performance of High- Speed Railway Bridge System under Near-Fault Effects.  Longjun Xu*, Lingkun Chen	
<b>Room: Satisfaction</b> (Hard Rock Hotel)					
<b>MS 125</b>		<b>Stochastic computational treatment of multiphysics and multiscale problems</b> <b>First Chair: Loujaine Mehrez Second Chair: Roger Ghanem</b>			
Stochastic multiscale perspective on dynamic yield of magnetorheological fluids.  Yongbo Peng*, Jie Li	Multiscale stochastic models for inelastic constitutive properties for heterogeneous media.  Loujaine Mehrez*, Roger Ghanem, Venkat Aitharaju, William Rodgers	A stochastic multiscale method applied to thermo-elasticity analyzes of polycrystalline micro- structures.  Ludovic Noels*, Ling Wu, Vincent Lucas, Jean-Claude Golinval, Stéphane Paquay	Uncertainty quantification and stochastic upscaling of mechanical behavior in concrete microstructure.  Vasav Dubey*, Arash Noshadravan	Performance Characterization of Multi-Time-Step Methods for Uncertainty Quantification in Problems with Localized Features.  Hugo Esquivel*, Arun Prakash	
<b>Room: Fame</b> (Hard Rock Hotel)					
<b>MS 93</b>		<b>Control of Structures for Multiple Hazards</b> <b>First Chair: Aly Mousaad Aly Second Chair: Yongqiang Gong</b>			
Semi-Active Control of a Variable Friction Cladding System for Multi- Hazard Mitigation.  Yongqiang Gong*, Simon Laflamme, Spencer Quiel, James Ricles, Douglas Taylor	Analytical energy-based approach to evaluate smart dampers' efficacy in wind turbines' vibration control for multi hazards.  Milad Rezaee*, Aly Mousaad Aly	Experimental Study For An Actively Controlled Double Skin Façade Damper System.  Rui Zhang*, Tat S. Fu	Multi-Hazard Combinatorial Optimization Of Building Systems With Suspended Floor Slabs.  Hussam Mahmoud*, Akshat Chulahwat	Mitigation of Offshore Wind Turbines under Multi-Hazards.  Chao Sun*	

**Tuesday, June 6**

**8:15 – 9:00**

**Plenary Lecture 3**

**Room: Grand Ballroom**

Thomas J.R. Hughes

The University of Texas at Austin

Isogeometric Analysis: Past, Present, Future

Chair: Huajian Gao



**Thomas J.R. Hughes**  
Institute for Computational  
Engineering and Sciences (ICES)  
The University of Texas at Austin

## Isogeometric Analysis: Past, Present, Future

### Abstract:

The vision of Isogeometric Analysis was first presented in a paper published October 1, 2005 [1]. Since then it has become a focus of research within both the fields of Finite Element Analysis (FEA) and Computer Aided Design (CAD) and is rapidly becoming a mainstream analysis methodology and a new paradigm for geometric design [2]. The key concept utilized in the technical approach is the development of a new paradigm for FEA, based on rich geometric descriptions originating in CAD, resulting in a single geometric model that serves as a basis for both design and analysis.

In this overview lecture I will describe some areas in which progress has been made in developing improved Computational Mechanics methodologies to efficiently solve problems that have been at the very least difficult, if not impossible, within traditional FEA. I will also describe current areas of intense activity and areas where problems remain open, representing both challenges and opportunities for future research (see, e.g., [3,4]).

### REFERENCES

- [1] T.J.R. Hughes, J.A. Cottrell and Y. Bazilevs, Isogeometric Analysis: CAD, Finite Elements, NURBS, Exact Geometry and Mesh Refinement, *Computer Methods in Applied Mechanics and Engineering*, 194, (2005) 4135-4195.
- [2] J.A. Cottrell, T.J.R. Hughes and Y. Bazilevs, *Isogeometric Analysis: Toward Integration of CAD and FEA*, Wiley, Chichester, U.K., 2009.
- [3] Special Issue on Isogeometric Analysis, (eds. T.J.R. Hughes, J.T. Oden and M. Papadrakakis), *Computer Methods in Applied Mechanics and Engineering*, 284, (1 February 2015), 1-1182.
- [4] Special Issue on Isogeometric Analysis: Progress and Challenges, (eds. T.J.R. Hughes, J.T. Oden and M. Papadrakakis), *Computer Methods in Applied Mechanics and Engineering*, 316, (1 April 2017), 1-1270.



## Tuesday, June 6, 9:30 – 11:30, Session T1

Room	MS Number	Minisymposia Session Title
Salon A	MS24	Isogeometric Methods in Computational Mechanics
Salon B	MS61	Computational Geomechanics
Salon C	MS21	Computational Methods and Applications for Solid and Structural Mechanics
Salon D	MS22	Computational Modeling in Civil Engineering
Salon E	MS53	Fluid-Structure Interaction
Gaslamp 1	MS72	Recent Trends in Granular Materials Across the Scales
Gaslamp 2	MS25	LES and DNS: Methods and Applications
Gaslamp 3	MS106	Hierarchical and Multiscale Methods for Simulation Based Design of Materials
Gaslamp 4	MS43	Damage modelling of engineering structures: from localized cracking to structural collapse
Gaslamp 5	MS44	Modeling and Characterization of Quasibrittle Fracture
Balboa 1	MS142	Human Performance Sensing and Condition Monitoring
Balboa 2	MS96	Seismic Protective Devices for Structures and Nonstructural Components
Balboa 3	MS145	Structural Identification and Damage Detection
Balboa 4	MS153	Stability and failure of structures and materials
Revolution 1 (Hard Rock Hotel)	MS11	16th Symposium on Biological and Biologically Inspired Materials and Structures
Revolution 2 (Hard Rock Hotel)	MS123	Probabilistic mechanics in damage, fracture and failure
Satisfaction (Hard Rock Hotel)	MS124	Random Functions in Engineering Mechanics and Civil Engineering
Fame (Hard Rock Hotel)	MS165	Sustainable and Resilient Structural Engineering, Mechanics, and Materials (SR-SEMM)

# Tuesday, June 6

9:30 - 9:50	9:50 - 10:10	10:10 - 10:30	10:30 - 10:50	10:50 - 11:10	11:10 - 11:30
<b>Room: Salon A MS 24</b> <b>Isogeometric Methods in Computational Mechanics</b> <b>First Chair: Artem Korobenko Second Chair: Ming-Chen Hsu</b>					
<p><b>[Keynote]</b> Construction of smooth spline functions on unstructured meshes for isogeometric analysis.</p> <p>Hendrik Speleers*, Deepesh Toshniwal, Thomas J. R. Hughes</p>	<p>IGAPack: an isogeometric hierarchical spline package using recovery-based error estimation and adaptivity.</p> <p>Cosmin Anitescu*, Md Naim Hossein, Timon Rabczuk</p>	<p>Untrimming: Precise conversion of trimmed-surfaces to tensor-product surfaces.</p> <p>Boris Van Sosin*, Fady Massarwi, Gershon Elber</p>	<p>A Parameter-Free Variational Coupling Approach For Trimmed Isogeometric Thin Shells Based On Cad Exchange Data.</p> <p>Yujie Guo*, Dominik Schillinger, Martin Ruess</p>		
<b>Room: Salon B MS 61</b> <b>Computational Geomechanics</b> <b>First Chair: Haoyan Wei Second Chair: Siavash Monfared</b>					
<p>RKPM Formulation For Fully Coupled Hydro-Mechanical Analysis Of Fluid-Saturated Porous Media.</p> <p>Haoyan Wei*, J. S. Chen, Michael Hillman</p>	<p>Mesoscale Poroelasticity of Heterogeneous Media.</p> <p>Siavash Monfared*, Hadrien Laubie, Farhang Radjai, Roland Pellenq, Franz-Josef Ulm</p>	<p>Enhanced finite elements for free-surface problems in poromechanics.</p> <p>Julia T. Camargo*, Ronaldo I. Borja</p>	<p>Simulation of delayed liquefaction in loose sand.</p> <p>Ferdinando Marinelli*, Federico Pisano', Claudio di Prisco, Giuseppe Buscarera</p>	<p>An automated upper-bound approach for three-dimensional limit analysis.</p> <p>Zhenhao Shi*, James P. Hambleton</p>	<p>Continuous field based upper bound analysis with elastic finite elements for the bearing capacity problems in undrained clay.</p> <p>Maosong Huang*, Sen Li, Jian Yu</p>
<b>Room: Salon C MS 21</b> <b>Computational Methods and Applications for Solid and Structural Mechanics</b> <b>First Chair: Haim Waisman Second Chair: Arun Prakash</b>					
<p><b>[Keynote]</b> Measuring force chains in opaque granular media under shear.</p> <p>Marteau Eloïse, José E. Andrade*</p>	<p>Experimental and numerical study of transient granular avalanche flow in a rotating drum.</p> <p>Liuchi Li*, José E. Andrade</p>	<p>A Preconditioner of Conjugate Gradient Method for Dynamic Soil-Structure Interaction using Sparse Cholesky Factorization with Structural Finite Elements.</p> <p>Toshihide Saka*, Toshihiro Koiso, Yoshiyuki Takahashi, Kazuhiko Yamada</p>	<p>Fundamental study on segregation phenomenon of boulders in debris flow using DEM.</p> <p>Toshiyuki Horiguchi*, Satoshi Katsuki</p>	<p>Computational micromechanics of coupled problems in granular materials using DEM-LBM.</p> <p>Daniel H Johnson*, Farshid Vahedifard, Bohumir Jelinek, John Peters</p>	
<b>Room: Salon D MS 22</b> <b>Computational Modeling in Civil Engineering</b> <b>First Chair: Andre Barbosa Second Chair: Petros Sideris</b>					
<p>Dowel action and bond slip modeling in finite element analysis.</p> <p>Marios Mavros*, Alexandra Kottari, Juan Murcia-Delso, P. Benson Shing</p>	<p>Three-Dimensional Numerical Evaluation Of Masonry Walls Retrofitted With Near Surface Mounted (Nsm) Reinforcing Steel Bars.</p> <p>Andre Barbosa*, Rajendra Soti</p>	<p>An engineering modeling approach for the load-deformation behavior of multi-dowel connections in timber structures.</p> <p>Michael Schweigler*, Thomas K. Bader, Georg Hochreiner, Josef Eberhardsteiner</p>	<p>Numerical Simulation of Anchorage in Concrete Podium Slabs.</p> <p>Frank Ding*, Steve Pryor</p>	<p>Effect of Thermal Creep of Steel on the Behavior of Shear Tab Connections at Elevated Temperatures.</p> <p>Hagop V. Jabotian*, Elie G. Hantouche, Mohammed A. Morovat, Michael D. Engelhardt</p>	

# Tuesday, June 6

9:30 - 9:50	9:50 - 10:10	10:10 - 10:30	10:30 - 10:50	10:50 - 11:10	11:10 - 11:30
<b>Room: Salon E MS 53</b>		<b>Fluid-Structure Interaction</b> First Chair: Kenji Takizawa Second Chair: Tayfun Tezduyar			
[Keynote] Flexible FSI with Applications.  Yuri Bazilevs*	Fast partitioned methods for unsteady thermal FSI.  Philipp Birken*, Azahar Monge	Computational analysis of geometry and performance deterioration of a wind turbine blade section subjected to environmental erosion and insect deposit.  Alessio Castorri*, P. Venturini, A. Corsini, F. Rispoli, K. Takizawa, T.E. Tezduyar	Space-Time Computation Technique with Continuous Representation in Time (ST-C): Numerical Examples and Mathematical Analysis.  Yuki Ueda*, Norikazu Saito, Kenji Takizawa, Tayfun E. Tezduyar		
<b>Room: Gaslamp 1 MS 72</b>		<b>Recent Trends in Granular Materials Across the Scales</b> First Chair: Payam Poorsolhjouy Second Chair: Shunying Ji			
Combined DEM-FEM Modelling of Ice-Induced Vibration of Conical Platform Based on Sub-Structure Method.  Shunying Ji*, Shuailin Wang	Pattern transitions between compaction band and shear band in high-porosity sandstone: a computational multiscale study.  Jidong Zhao*, Huanran Wu, Ning Guo	Multi-scale Dynamic Characteristics for the process of obliquely impact of a projectile into granular Medium.  Xiaoyan Ye*, Dengming Wang, Xiaojing Zheng	Multi-scale modeling and simulation of microstructure formation and evolution during powder compaction.  Marcial Gonzalez*	Investigating internal erosion and clogging of granular media using tomography images and computer simulations.  Sai Kakuturu*	Dimensionless Input Parameters in Discrete Element Modeling and Assessment of Scaling Techniques  Tang-Tat Ng*, Ali Yousefi
<b>Room: Gaslamp 2 MS 25</b>		<b>LES and DNS: Methods and Applications</b> First Chair: Andres E. Tejada-Martinez Second Chair: Lian Shen			
[Keynote] A subgrid scale model for Large-Eddy Simulations in complex geometries with proper asymptotic behavior near solid boundaries. Applications to cardiovascular biomechanics.  Franck Nicoud*, Christophe Chnafa, Vladeta Zmijanovic, Hubert Baya Toda, Simon Mendez	A Residual Based Variational Multiscale Model for Sediment Transport: Towards the Simulation of Non-Dilute Turbidity Currents.  Fernando Rochinha*, Gabriel Guerra, Souleymane Zio, Henrique Costa, Jose Camata, Alvaro Coutinho, Renato Elias	Unified wall function for turbulence modelling of compressible fluid flow.  Andy Tak-Yee Chan*, Kian Chuan Ong			
<b>Room: Gaslamp 3 MS 106</b>		<b>Hierarchical and Multiscale Methods for Simulation Based Design of Materials</b> First Chair: Arif Masud Second Chair: Haim Waisman			
[Keynote] Effect of Passivation on Higher Order Gradient Plasticity Models for Non-Proportional Loading: Energetic and Dissipative Gradient Components.  George Z. Voyiadjis*, Yooseob Song	On two novel computational homogenization frameworks in 3D nonlinear electroelastostatics and application to dielectric elastomer composites.  Oscar Lopez-Pamies*, Victor Lefevre	Sparse and Scalable Eigenstrain-based Reduced Order Homogenization Models for Polycrystal Plasticity.  Caglar Oskay*, Xiang Zhang	Probabilistic Homogenization of Crystal Plasticity and Fatigue Crack Nucleation Models.  Shravan Kotha*, Deniz Ozturk, Somnath Ghosh	Numerical Solution of Coupled Anisothermal Advection-Diffusion-Reaction PDEs: Process Modeling of Silicon Carbide (SiC) Oxidation in One Dimension.  Marcelino Anguiano*, Harishanker Gajendran, Richard B. Hall, Arif Masud	

# Tuesday, June 6

9:30 - 9:50	9:50 - 10:10	10:10 - 10:30	10:30 - 10:50	10:50 - 11:10	11:10 - 11:30
<b>Room: Gaslamp 4</b>		<b>MS 43</b>		<b>Damage modelling of engineering structures: from localized cracking to structural collapse</b>	
		<b>First Chair: Jie Li</b>		<b>Second Chair: Jianying Wu</b>	
<b>[Keynote]</b> A geometrically regularized gradient-damage/phase-field model with energetic equivalence.	M granular flow and fragment size distribution in brittle materials after comminution.	Mesoscale Numerical Investigation of Structural Masonry based on Cohesive Zone Model.	Damage Model Based Simulation of Structural Concrete Subjected to Extreme Events	A Stochastic Study of Fatigue Damage Based on Physical Mechanism	
Jian-Ying Wu*	Amartya Bhattacharjee*, Lori Graham-Brady, Andrew Robinson	Shenghan Zhang*, Shenghan Zhang, Martin Hofmann, Nicolas Richart, Katrin Beyer	Xiaodan Ren*, Jie Li	Zhaodong Ding*, Jie Li	
<b>Room: Gaslamp 5</b>		<b>MS 44</b>		<b>Modeling and Characterization of Quasibrittle Fracture</b>	
		<b>First Chair: Jia-Liang Le</b>		<b>Second Chair: Macro Salviato</b>	
Spherocylindrical Microplane Constitutive Model for Damage: A way to Capture Orthotropy of Shale and Other materials.	Strain Localization in Cellular Solids.	A Spectral Stiffness Microplane Formulation for Damage and Fracture of Unidirectional Composites.	Modeling of a Cohesive Crack Submerged in Fluid.		
Zdenek P Bazant*, Cunbao Li	Armanj Hasanyan*, Anthony M Waas	Marco Salviato*,	Anu Tripathi*, Jia-Liang Le, Susan Mantell		
<b>Room: Balboa 1</b>		<b>MS 142</b>		<b>Human Performance Sensing and Condition Monitoring</b>	
		<b>First Chair: Mostafa Mirshekari</b>		<b>Second Chair: Kenneth J. Loh</b>	
Occupant Localization in Obstructive Indoor Setting Using Footstep-Induced Structural Vibration.	Noncontact Tomography and Multifunctional Nanocomposites for Monitoring Osseointegrated Prostheses.	Towards the Development of "Smart" Percutaneous, Osseointegrated Implants.	A hybridized approach to wearable electronics.		
Mostafa Mirshekari*, Pei Zhang, Hae Young Noh	Kenneth J. Loh*, Sumit Gupta	Michael Todd*, Joey Reed, Drew Barnett	Sheng Xu*		
<b>Room: Balboa 2</b>		<b>MS 96</b>		<b>MS 96 - Seismic Protective Devices for Structures and Nonstructural Components</b>	
		<b>First Chair: Masaru Kikuchi</b>		<b>Second Chair: Ken Ishii</b>	
Numerical model for low-shear modulus high-damping rubber isolation bearing under large shear deformation.	Seismic response analysis considering the thermal and mechanical coupling behavior of lead rubber bearings.	A Proposal of An Isolation System with Higher Seismic Safety against Input Ground Motions beyond Expectations.	Uncertainty in Friction Model Parameters for High Friction Sliding Isolation Systems.	Failure behavior of sliding isolation bearings.	
Masaru Kikuchi*, Ken Ishii, Kato Hideaki, Masahiro Nakamura	Ken Ishii*, Masaru Kikuchi, Yohei Kuroshima	Hiroki Hamaguchi*, Masashi Yamamoto, Tomotaka Wake, Masaru Kikuchi	Ezra Jampole*, Gregory Deierlein, Eduardo Miranda	Yu Bao*, Tracy Becker	

# Tuesday, June 6

9:30 - 9:50	9:50 - 10:10	10:10 - 10:30	10:30 - 10:50	10:50 - 11:10	11:10 - 11:30
<b>Room: Balboa 3</b>		<b>MS 145</b>		<b>Structural Identification and Damage Detection</b>	
		<b>First Chair: Satish Nagarajaiah</b>		<b>Second Chair: Vasilis Dertimanis</b>	
Conditional classifiers for novelty detection: application to structural health monitoring.	Environmental Effects on Output-Only Vibration Parameters of Reinforced Concrete Systems.	Statistical Modeling and Parameter Estimation of a Prototype Variable Stiffness and Damping Device.	A Data-driven Approach for Damage Detection in Wind Turbine Blades using a dense Array of Soft Elastomeric Capacitors.	Structural Health Monitoring for a Double Skin Façade Damper System.	Numerical Investigation of Higher Harmonics Generation Due to Micro-Structural Variations.
Reza Mohammadi-Ghazi*, Oral Büyükoztürk	Lauren Linderman*, Karl Gaebler, Carol Shield	Zhilu Lai*, Satish Nagarajaiah	Austin RJ Downey*, Simon Laflamme, Filippo Ubertini	Rui Zhang*, Tat S. Fu	Negar Kamali*, Sheng-Wei Chi
<b>Room: Balboa 4</b>		<b>MS 153</b>		<b>Stability and failure of structures and materials</b>	
		<b>First Chair: Dinar Camotim</b>		<b>Second Chair: C W Lim</b>	
[Keynote] Recent developments on local-global mode interaction in rectangular hollow section struts.		Imperfection sensitivity of tall wind turbine thin steel cylindrical shell towers.	Prediction of residual stresses in a wind turbine cylindrical shell tower.	Thermo-Acoustic Radiation of Free-standing Nano-thin Film in Viscous Fluid.	Stability Formulation Of Steel Columns Under Fire Loads.
Ahmer Wadee*, Jiajia Shen, Adam Sadowski		Kshitij Kumar Yadav*, Jens Lycke Wind, Simos Gerasimidis	Simos Gerasimidis*	C W Lim*, Mao Yida, Li Tianyun	Mehrdad Memari*, Hussam Mahmoud
<b>Room: Revolution 1</b> (Hard Rock Hotel)		<b>MS 11</b>		<b>16th Symposium on Biological and Biologically Inspired Materials and Structures</b>	
		<b>First Chair: Dinesh Katti</b>		<b>Second Chair: Christian Hellmich</b>	
Mechanics of Cancer Cells on Tissue Engineered Scaffolds.	A macro-micro modeling approach to estimate in-situ valve interstitial cell contractile behaviors.	Engineering mechanics for medicine and biology: multiscale elastoplasticity and news on the "cement line" in osteonal bone.	Multiscale systems biology of bone, accounting for pore space-specific mechanosensation.	MSCs and osteocytes reorganization and mechanobiology in Bone-on-Chip.	Consistent linearization for multiscale modeling of the ocular lens capsule.
Dinesh Katti*, Kalpana Katti, MD Shahjahan Molla	Michael S. Sacks*, Rachel M. Buchanan, Yusuke Sakamoto	Christian Hellmich*, Viktoria Vass, Claire Morin	Stefan Scheiner*, Maria Pastrama, Peter Pivonka, Christian Hellmich	Elisa Budyn*, Samantha Sanders, Morad Bensidhoum, Bertrand Cinquin, Patrick Tauc, Christine Chappard, Herve Petite	Richard Regueiro*, Harvey Burd
<b>Room: Revolution 2</b> (Hard Rock Hotel)		<b>MS 123</b>		<b>Probabilistic mechanics in damage, fracture and failure</b>	
		<b>First Chair: Jia-Liang Le</b>		<b>Second Chair: Lori Graham-Brady</b>	
A comparative study on characterization, stochastic realization, and fracture simulation of quasi-brittle materials.	Transverse Failure of Carbon Fiber Composites: Analytical Sensitivity with respect to the Distribution of Fiber/Matrix Interface Properties.	Rate and size effects on strength distribution of quasibrittle structures.			
Philip L Clarke*, Reza Abedi, Katherine Acton, Sarah Baxter, Bahador Bahmani	Maryam Shakiba*	Anna Gorgogianni*, Joshua Vievering, Jan Elias, Jia-Liang Le			

# Tuesday, June 6

9:30 - 9:50	9:50 - 10:10	10:10 - 10:30	10:30 - 10:50	10:50 - 11:10	11:10 - 11:30
<b>Room: Satisfaction</b> (Hard Rock Hotel)					
<b>MS 124</b>		<b>Random Functions in Engineering Mechanics and Civil Engineering</b> <b>First Chair: Paolo Bocchini    Second Chair: Michael Shields</b>			
Spectral Representation Method for simulation of random processes: Past, present, and future.  Michael Shields*, Hwanpyo Kim	Multi-scale random field modelling and time-dependent fragility analysis of deteriorating structures.  Hao Xu*, Paolo Gardoni	On the numerical inversion of the translation equation to simulate non-Gaussian functions in civil engineering.  Paolo Bocchini*, Amirali Shojaeian, Vasileios Christou	Probabilistic Analysis of the Glacier Melt Contribution to Sea-Level Rise.  Matthew Thomas*, Dr. Ting Lin	Probabilistic Service-Life Models of Corrosion in Concrete Structures using Functional Quantization.  Manuel Miranda*	
<b>Room: Fame</b> (Hard Rock Hotel)					
<b>MS 165</b>		<b>Sustainable and Resilient Structural Engineering, Mechanics, and Materials (SR-SEMM)</b> <b>First Chair: Fariborz M. Tehrani    Second Chair: Arezoo Sadrinezhad</b>			
<b>[Keynote]</b> Incorporating Resilience in Probabilistic Cost-Benefit Analysis of Civil Infrastructure under Hurricane Threat.  You Dong*, Dan Frangopol		Unbonded Post-Tensioned Precast Concrete Rocking Walls for Seismic Resilient Structures.  Maryam Nazari*, Sri Sriharan, Catherine French, Susie Nakaki, Eric Musselman, Sriram Aaleti, Qingzhi Liu	True material properties of wood with growth ring effect.  Qiliang Lin*, Fangliang Chen, Huiming Yin	New Generation of Interlocking Masonry Blocks for Sustainable Construction.  Mohammadamin Aizmi*, Fariborz M. Tehrani	

**Tuesday, June 6**  
**13:00 – 13:45**

**Plenary Lecture 4**  
**Room: Grand Ballroom**

Tayfun E. Tezduyar

Rice University

Space-Time Computational Analysis: It Adds Another Dimension

Chair: Yuri Bazilevs



**Tayfun E. Tezduyar**  
Mechanical Engineering  
Rice University

## Space-Time Computational Analysis: It Adds Another Dimension

### Abstract:

Space-Time (ST) Variational Multiscale (ST-VMS) method [1] and its predecessor ST-SUPS [2] have a good track record in computational analysis of complex fluid-structure interactions (FSI) and flows with moving boundaries and interfaces (MBI). The classes of challenging FSI and MBI problems with successful analysis range from spacecraft parachute FSI to wind-turbine aerodynamics, from flapping-wing aerodynamics of an actual locust to fluid mechanics of heart valves. When an FSI or MBI problem requires high-resolution representation of boundary layers near solid surfaces, ALE and ST methods, where the mesh moves to follow the fluid-solid interface, meet that requirement. Moving-mesh methods have been practical in more classes of complex FSI and MBI problems than commonly thought of. With a number of complementary methods introduced recently, the ST methods can now do even more.

They can handle contact between solid surfaces or other topology changes, as enabled by the ST-TC method [3], or a spinning solid surface that is in contact with a solid surface, as enabled by the ST Slip Interface TC (ST-SI-TC) method [4]. Using NURBS as basis functions in space and time is further increasing the accuracy and scope of the ST methods [5]. The ST-SI method [6], which also provides mesh generation flexibility in a general context by accurately connecting nonmatching meshes, and a general-purpose NURBS mesh generation method introduced recently make spatial NURBS basis functions more practical in ST computations with complex geometries.

### REFERENCES

- [1] K. Takizawa and T.E. Tezduyar, "Multiscale space-time fluid-structure interaction techniques", *Computational Mechanics*, 48 (2011) 247-267, doi: 10.1007/s00466-011-0571-z.
- [2] T.E. Tezduyar, "Computation of moving boundaries and interfaces and stabilization parameters", *International Journal for Numerical Methods in Fluids*, 43 (2003) 555-575, doi: 10.1002/flid.505.
- [3] K. Takizawa, T.E. Tezduyar, A. Buscher, and S. Asada, "Space-time interface-tracking with topology change (ST-TC)", *Computational Mechanics*, 54 (2014) 955-971, doi: 10.1007/s00466-013-0935-7.
- [4] K. Takizawa, T.E. Tezduyar, S. Asada, and T. Kuraishi, "Space-time method for flow computations with slip interfaces and topology changes (ST-SI-TC)", *Computers & Fluids*, 141 (2016) 124-134, doi: 10.1016/j.compfluid.2016.05.006.
- [5] K. Takizawa, T.E. Tezduyar, Y. Otoguro, T. Terahara, T. Kuraishi, and H. Hattori, "Turbocharger flow computations with the Space-Time Isogeometric Analysis (ST-IGA)", *Computers & Fluids*, 142 (2017) 15-20, doi: 10.1016/j.compfluid.2016.02.021.



## Tuesday, June 6, 14:15 – 16:15, Session T2

Room	MS Number	Minisymposia Session Title
Salon A	MS24	Isogeometric Methods in Computational Mechanics
Salon B	NSF	Meeting with NSF Program Manager
Salon C	MS21	Computational Methods and Applications for Solid and Structural Mechanics
Salon D	MS22	Computational Modeling in Civil Engineering
Salon E	MS53	Fluid-Structure Interaction
Gaslamp 1	MS72	Recent Trends in Granular Materials Across the Scales
Gaslamp 2	MS25	LES and DNS: Methods and Applications
Gaslamp 3	MS106	Hierarchical and Multiscale Methods for Simulation Based Design of Materials
Gaslamp 4	MS43	Damage modelling of engineering structures: from localized cracking to structural collapse
Gaslamp 5	MS44	Modeling and Characterization of Quasibrittle Fracture
Balboa 1	MS81	Advances and Applications of Elasticity within Applied Mechanics
Balboa 2	MS96	Seismic Protective Devices for Structures and Nonstructural Components
Balboa 3	MS147	Vision-based Studies in Structural Health Monitoring
Balboa 4	MS152	Robustness of Infrastructures (Progressive Collapse)
Revolution 1 (Hard Rock Hotel)	MS11	16th Symposium on Biological and Biologically Inspired Materials and Structures
Revolution 2 (Hard Rock Hotel)	MS123	Probabilistic mechanics in damage, fracture and failure
Satisfaction (Hard Rock Hotel)	MS26	Recent Advances in Real-time Hybrid Simulation
Fame (Hard Rock Hotel)	MS165	Sustainable and Resilient Structural Engineering, Mechanics, and Materials (SR-SEMM)

# Tuesday, June 6

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Salon A                      MS 24                      Isogeometric Methods in Computational Mechanics</b> <b>First Chair: Ming-Chen Hsu    Second Chair: Artem Korobenko</b>					
Isogeometric Interface-Tracking for Free-Surface Flows.  Stefanie Elgeti*, Florian Zwicke, Sebastian Eusterholz, Marek Behr	A multipatch coupling technique for isogeometric analysis of geometrically complex Kirchhoff-Love shells.  Laurens Coox*, Florian Maurin, Francesco Greco, Elke Deckers, Dirk Vandepitte, Wim Desmet	Isogeometric-analysis-based parametric optimization of wind turbine blade composite designs.  Austin J. Herrema*, Ming-Chen Hsu	A New Formulation for Air-Blast Fluid-Structure Interaction Based on an Immersed Isogeometric-Meshfree Approach.  Georgios Moutsanidis*, Jesus Bueno, Kazem Kamran, David Kamensky, Michael Hillman, J.S. Chen, Yuri Bazilevs		
<b>Room: Salon B                      Meeting with Drs. Kara Peters and Grace Hsuan, NSF-CMMI Program Directors</b>					
The NSF program directors (Kara Peters and Grace Hsuan) will talk about the program's direction of Mechanics of Materials and Structures Program (MOMS), Design of Engineering Material Systems (DEMS), and Structural and Architectural Engineering and Materials (SAEM) in the Civil, Mechanical and Manufacturing Innovation (CMMI) division, as well as other funding opportunities at NSF. Recommendation on developing a competitive CAREER proposal will also be presented.					
<b>Room: Salon C                      MS 21                      Computational Methods and Applications for Solid and Structural Mechanics</b> <b>First Chair: Reza Abedi    Second Chair: Timothy Truster</b>					
Multi-way coupling methods for large-scale problems in non-linear structural dynamics with multiple temporal scales.  Payton Lindsay*, Arun Prakash	Using Sobol' Decomposition in Sensitivity Analysis of Nonlinear Dynamic Behavior of Buildings with Buckling-Restrained Brace.  Mohammadreza Moradi*, Alireza Moradi	Combinatorial optimization of domain-decomposition and time-step selection using error estimators in multi-time-step methods.  Sania E. Seilabi*, Gregory Bunting, Arun Prakash, Shirley J. Dyke	Mapped Finite Element Methods: higher order solutions of problems with singularities.  Maurizio M. Chiaramonte*	Higher-Order Elements for Explicit Solid Dynamics.  Stephen Beissel*	Data-driven discrete-continuum method for partially saturated porous media  Kun Wang*, WaiChing Sun
<b>Room: Salon D                      MS 22                      Computational Modeling in Civil Engineering</b> <b>First Chair: Farzin Zareian    Second Chair: Juan Beltran</b>					
Assessment of static damaged rope response using a beam-element formulation.  Juan Beltran*, Tomas Bravo	Numerical Simulation of Induced Residual Stresses and Strains in the Galvanizing Process of High Mast Illumination Poles.  Reza Nasouri*, Arturo Montoya, Adolfo Matamoros, Caroline Bennett, Kien Nguyen, Jian Li	Component and structural modeling of braided, inflatable members.  Andrew Young*, William Davids, Joshua Clapp, Daniel Whitney, Andrew Goupee	A new approach for modeling pedestrian-structure interaction.  Albert R. Ortiz*	Semi-active Control of Building Structures.  Payel Chaudhuri*, Damodar Maity	

# Tuesday, June 6

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Salon E</b>		<b>MS 53</b>		<b>Fluid-Structure Interaction</b>	
		<b>First Chair: Philipp Birken</b>		<b>Second Chair: Artem Korobenko</b>	
Moving Boundary Methods for Massively Parallel CFD and its Application to Industrial Problems.	Vortex-induced vibration of a circular cylinder.	Dynamic augmented Lagrangian boundary condition enforcement, with application to immersedogeometric fluid--structure interaction	Prediction of the wave forces on coastal bridge decks using artificial neural networks.		
Makoto Tsubokura*, Rahul Bale, Keiji Onishi, Jun Ikeda, Koji Nishiguchi, Chung-Gang Li	Sanjay Mittal*, Navrose, Tulsi Ram Sahoo, M. Furquan	Yue Yu*, David Kamensky, Ming-Chen Hsu, Xin Yang Lu, Yuri Bazilevs, Thomas J.R. Hughes	Guoji Xu*, Qin Chen, Jianhua Chen		
<b>Room: Gaslamp 1</b>		<b>MS 72</b>		<b>Recent Trends in Granular Materials Across the Scales</b>	
		<b>First Chair: Tang-Tat Ng</b>		<b>Second Chair: Matthew R. Kuhn</b>	
The description of force chain within the top-coal and overburden.	Discrete element modeling of high-speed railway subgrade filling subject to static and dynamic load.	DEM numerical simulation of single pile-soil-cap interaction.	Grain Particle Simply in Solving Engineering Problem.		
Iiu Yang*, Jin'an Wang, Xiangang Han	Yiyue Ma*, Xilin Lu, Jiangu Qian, Yilin Liu	Honghua Zhao*, Jiuzhou Lv	Huinan Sun*, Huinan Sun, Zhuoqing Zhang		
<b>Room: Gaslamp 2</b>		<b>MS 25</b>		<b>LES and DNS: Methods and Applications</b>	
		<b>First Chair: William Anderson</b>		<b>Second Chair: Celalettin Emre Ozdemir</b>	
<b>[Keynote]</b> Simulation of Coupled Gas and Liquid Flows Interacting with Deformable Plates.		Modeling turbulent flows in the atmospheric boundary layer of Mars: application to Gale crater, Mars, landing site of the Curiosity rover.	Turbulence-resolving Two-Phase Flow Simulations of Wave- and Current Supported Turbidity Flows.	Stokes drift induced by gravity-capillary waves and its impact on scalar transfer across an air-water interface.	
Lian Shen*, Zixuan Yang, Sida He, Jiaqi Li, Luohao Wang		William Anderson*, Kenzie Day, Gary Kocurek, Gianluca Blois, Kenneth Christensen	Celalettin E Ozdemir*, Sahar Haddadian	Andres Tejada-Martinez*, Amine Hafsi, Fabrice Veron	
<b>Room: Gaslamp 3</b>		<b>MS 106</b>		<b>Hierarchical and Multiscale Methods for Simulation Based Design of Materials</b>	
		<b>First Chair: Somnath Ghosh</b>		<b>Second Chair: Oscar Lopez-Pamies</b>	
Coupling Multiple PDEs for Modeling of Materials.	Stability Analysis of Metals Capturing Brittle and Ductile Fracture through a Phase Field Method and Shear Band Localization.	Multi-scale Modeling using Mortar Methods.	Numerical Simulation of Advanced Additive Manufacturing Processes using Meshless Particle Methods.	A micromorphic computational homogenization framework for heterogeneous materials.	
Arif Masud*	Haim Waisman*, Miguel Arriaga	Tim Wildey*, Bart van Bloemen Waanders, D. Tom Seidl	Marc Russell*, Tarek Zohdi	Raja Biswas*, Leong Hien Poh	

# Tuesday, June 6

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Gaslamp 4</b>		<b>MS 43</b>		<b>Damage modelling of engineering structures: from localized cracking to structural collapse</b>	
		<b>First Chair: Xiaodan Ren</b>		<b>Second Chair: Decheng Feng</b>	
[Keynote] Using Entropy to Unify Mechanics and Thermodynamics.  Cemal Basaran*	Effect of softening damage and plasticity on the shape and extension of failure zone around deep galleries in quasi-brittle rocks.  Amade Pouya*, Edoardo Trivellato, Darius Seyedi, Minh Ngoc Vu	New Force-based element with axial-flexure-shear interaction based on softened damage-plasticity model.  De-Cheng Feng*, Gang Wu	Plastic-damage constitutive model for concrete under triaxial and cyclic loading.  Ji Zhang*	Numerical and experimental analysis of Compression After Impact tests.  Pawel Czapski*, Tomasz Kubiak	
<b>Room: Gaslamp 5</b>		<b>MS 44</b>		<b>Modeling and Characterization of Quasibrittle Fracture</b>	
		<b>First Chair: Macro Salviato</b>		<b>Second Chair: Jia-Liang Le</b>	
Experimental Analysis of Fracturing Damage of Fiber Composites.  Viet Chau*, Weixin Li, Marco Salviato, Zdenek P. Bazant, Gianluca Cusatis	Experimental evaluation of the fracture energy of concrete: "width and size effect".  Christian Carloni*, Mattia Santandrea, Roman Wendner	Estimation of the Internal Length Scale of the Weakest-Link Model for Quasi-Brittle Structures.  Zhifeng Xu*, Jia-Liang Le, Jan Elias	Meso-Scale Modeling of Shear Failure in Scaled GFRP Reinforced Concrete Beams without Stirrups.  Sina Khodaie*, Fabio Matta, Mohammed G. Alnaggar		
<b>Room: Balboa 1</b>		<b>MS 81</b>		<b>Advances and Applications of Elasticity within Applied Mechanics</b>	
		<b>First Chair: Euclides de Mesquita Neto</b>		<b>Second Chair: John C. Brigham</b>	
[Keynote] Boundary Element Formulation for Thermoelasticity with Variable Time Step Sizer  Martin Schanz*	On convergence of the generalized Maxwell scheme for periodic materials.  Mogilevskaya Sonia*, Volodymyr I Kushch, Dmitry Nikolski	On the elastic, far-field response of a two-dimensional coated circular inhomogeneity: Analysis and applications.  Anna Zemlyanova*, Sofia Mogilevskaya, Mattia Zammarchi	Generalized modal analysis of time-dependent problems: key features, advantages and issues.  Ney Augusto Dumont*	TRANSIENT RESPONSE OF A RIGID FOUNDATION PARTIALLY SUPPORTED BY PILES AND BY THE SOI.  Euclides Mesquita*, Luis Filipe do Vale Lima, Josue Labaki,	
<b>Room: Balboa 2</b>		<b>MS 96</b>		<b>Seismic Protective Devices for Structures and Nonstructural Components</b>	
		<b>First Chair: Dimitrios Konstantinidis</b>		<b>Second Chair: Philip Scott Harvey Jr.</b>	
Seismic Performance of Medical Equipment on Wheels/Casters in Fixed-Base and Base-Isolated Buildings.  Dimitrios Konstantinidis*	Multi-unit rolling isolation system arrays: Analytical model and experimental validation.  Philip Scott Harvey Jr.*, Corey D. Casey, Wei Song	Seismic Performance Assessment of Hybrid Sliding-Rocking Bridges of Various Designs under Different Loading Conditions.  Mohammad Salehi*, Petros Sideris, Abbie B. Liel	Bio-inspired control of civil infrastructure using real-time frequency decomposition.  Courtney Peckens*, Anne O'Donnell	Stochastic Risk-Based Control Methods for Nonlinear Structures Exposed to Seismic Hazard.  Omar El-Khoury*, Abdollah Shafieezadeh	Optimal Clipped Linear Strategies for Controllable Damping: Design of a Verification Experiment.  Qian Fang*, Erik A Johnson, Patrick T. Brewick, Steve F. Wojtkiewicz

# Tuesday, June 6

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Balboa 3</b>		<b>MS 147</b>		<b>Vision-based Studies in Structural Health Monitoring</b>	
		<b>First Chair: Mohammad Jahanshahi</b>		<b>Second Chair: Shirley Dyke</b>	
<b>[Keynote]</b> Visual Data Analytics for Monitoring Construction and Operations in the Built Environment.  Mani Golparvar*	From Point Clouds to IFC/BIM for Bridges: Component Segmentation, Detection, and Classification.  Patricio A. Vela*, Yi-Pu Zhao	Leveraging 3D Imaging for Structural Assessments.  David Lattanzi*	Real-Time Hyperspectral Imaging and 4D Geospatial-Spectral Modeling of Civil Infrastructure and Materials.  ZhiQiang Chen*, Shimin Tang	Image localization for computer-enhanced visual Inspection of civil infrastructure.  Shirley J. Dyke*, Chul Min Yeum, JongSeong Choi	
<b>Room: Balboa 4</b>		<b>MS 152</b>		<b>Robustness of Infrastructures (Progressive Collapse)</b>	
		<b>First Chair: Panos Pantidis</b>		<b>Second Chair: Negar Elhami-Khorasani</b>	
<b>[Keynote]</b> Progressive collapse response investigation of a 3D 20-story steel framed prototype building.  Panos Pantidis*, Simos Gerasimidis	A comparison of prescriptive and performance-based designs for fire as a primary or secondary event.  Negar Elhami-Khorasani*, Chenyang Fang, Bryce Haase	Stability sensitivity of low-rise steel moment frames to asymmetric distributed damage states.  Chris Mullen*, Trey Powell, Prabodh Dahal			
<b>Room: Revolution 1</b> (Hard Rock Hotel)		<b>MS 11</b>		<b>16th Symposium on Biological and Biologically Inspired Materials and Structures</b>	
		<b>First Chair: Christian Hellmich</b>		<b>Second Chair: Dinesh Katti</b>	
Modeling and Simulation as a Conduit for Translational Research in Osteoarthritis.  Bruce P. Ayati*, Georgi I. Kapitanov, James A. Martin	A continuum micromechanics approach to the strength of planar fiber networks: applications to paper materials.  Pedro Miguel J. S. Godinh*, Thomas K. Bader, Christian Hellmich	Capturing the full hygromechanical behavior of a biopolymeric nanocomposite, namely wood, by MD and poromechanics.  Dominique Derome*, Chi Zhang, Sinan Keten, Jan Carmeliet	Programming function into mechanical forms by directed assembly of structural biopolymers.  Benedetto Marelli*	Stress-dilatancy behavior of biocemented sand.  Jian Chu*	
<b>Room: Revolution 2</b> (Hard Rock Hotel)		<b>MS 123</b>		<b>Probabilistic mechanics in damage, fracture and failure</b>	
		<b>First Chair: Lori Graham-Brady</b>		<b>Second Chair: Jia-Liang Le</b>	
Geometric imperfection model validation through data-driven stochastic modeling for reliable analysis of thin-walled structures.  Mazdak Tootkaboni*, Mohammadshafee Farzarian, Benjamin W. Schafer	Spatial randomness and its effect on ductile fracture prediction in structural steel components.  Vincente Pericoli*, Amit Kanvinde	Stochastic Multiscale Modeling of Damage Accumulation in Metal Foams during Lifetime.  Maximilian Geissendoerfer*, Carsten Proppe	Defects, material properties and mechanics of cross-laminated timber with eastern hemlock as a constituent.  Fiona O'Donnell*, Hamid Kaboli, Pegg L Clouston, Sanjay R. Arwade		

# Tuesday, June 6

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Satisfaction</b> (Hard Rock Hotel)		<b>MS 26</b>		<b>Recent Advances in Real-time Hybrid Simulation</b> First Chair: Wei Song    Second Chair: Cheng Chen	
[Keynote] Experimental Evaluation of Targeted Energy Transfer System using Real-time Hybrid Simulation.  Amin Maghareh*, Christian Silva, Shirley Dyke	Frequency-domain system identification of a multi-actuator loading assembly for multi-axial real-time hybrid simulation testing.  Gaston Fermandois-Cornejo*, Billie F. Spencer, Jr.	Discrete-Time Compensation Technique for Real-time Hybrid Simulation.  Saeid Hayati*, Wei Song	Evaluation of Parameter Estimation on Stability and Accuracy of Structural Property Dependent Integration Algorithms.  Maryam Khan*, Cheng Chen		
<b>Room: Fame</b> (Hard Rock Hotel)		<b>MS 165</b>		<b>Sustainable and Resilient Structural Engineering, Mechanics, and Materials (SR-SEMM)</b> First Chair: Arezoo Sadrinezhad    Second Chair: Maryam Nazari	
Influence of Micro Level Properties on Macro Level Performance of Fly Ash and Recycled Aggregate Based Concrete.  Sushree Sunayana*, Sudhirkumar V Barai	A Numerical Solution of the Flexural Behavior of Tire Derived Aggregate Concrete.  John Abel Carreon*, Fariborz M. Tehrani	Robust passive floor vibration mitigation using a gravity compensated nonlinear energy sink.  Nicholas E. Wierschem*, James Ramsey			

## Tuesday, June 6, 16:30 – 18:30, Session T3

<b>Room</b>	<b>MS Number</b>	<b>Minisymposia Session Title</b>
Gaslamp 1	MS52	Flows With Moving Boundaries and Interfaces
Gaslamp 2	MS101	Coupled Environmental-Mechanical Response of Civil Infrastructures and Materials
Gaslamp 3	MS102	Multiphysics and Multiscale Modeling of Engineering Materials
Gaslamp 4	MS43	Damage modelling of engineering structures: from localized cracking to structural collapse
Gaslamp 5	MS31	Cementitious Materials: Experiments and Modeling Across the Scales
Balboa 1	MS81	Advances and Applications of Elasticity within Applied Mechanics
Balboa 2	MS45	Multiscale Behavior of Damage and Failure Mechanics
Balboa 3	MS147	Vision-based Studies in Structural Health Monitoring
Balboa 4	MS152	Robustness of Infrastructures (Progressive Collapse)
Revolution 1 (Hard Rock Hotel)	MS12	Computational Biomechanics for Biological Tissues & Human Body Systems
Revolution 2 (Hard Rock Hotel)	MS62	Genome of Stone-based Civil Infrastructure Materials
Satisfaction (Hard Rock Hotel)	MS26	Recent Advances in Real-time Hybrid Simulation
Fame (Hard Rock Hotel)	MS111	Nano- and micro-scale evolution of infrastructure materials under load, humidity, or radiation

# Tuesday, June 6

16:30 - 16:50	16:50 - 17:10	17:10 - 17:30	17:30 - 17:50	17:50 - 18:10	18:10 - 18:30
<b>Room: Gaslamp 1</b>		<b>MS 52</b>		<b>Flows With Moving Boundaries and Interfaces</b>	
		<b>First Chair: Tayfun Tezduyar</b>		<b>Second Chair: Kenji Takizawa</b>	
<b>[Keynote]</b> On the Dynamics of Living Behavioral Fluids Near Walls and Obstacles: Modeling and Simulations.  Nicola Bellomo*, Livio Gibelli	<b>[Keynote]</b> A Robust Parallel Sparse Linear System Solver.  Ahmed H. Sameh*, Zhengyi Zhang	<b>[Keynote]</b> Numerical Simulations of Icing Phenomena in Jet Engine.  Makoto Yamamoto*	Wave-Energy Air Turbine Analysis with the SUPG/PSPG Stabilization and DCDD.  Alessandro Corsini*, Lucio Cardillo, Giovanni Delibra, Franco Rispoli, Tayfun E. Tezduyar	Characteristics of fluid forces of three swimming fish in diamond and staggered-arrangement.  Yoichi Ogata*, Sota Matsubara, Daiki Kawagashira, Syota Ando, Kazunori Hosotani	The Numerical Simulation of the Wing Kinematic Effects on Near Wake Structure in Hovering Drosophila Flight.  Belkis Erzincanli*, Ezgi Dilek, Mehmet Sahin
<b>Room: Gaslamp 2</b>		<b>MS 101</b>		<b>Coupled Environmental-Mechanical Response of Civil Infrastructures and Materials</b>	
		<b>First Chair: Silvia Caro</b>		<b>Second Chair: Masoud Darabi</b>	
Viscoelastic-viscoplastic model coupled to continuum damage-healing for asphalt materials.  Romain Balieu*, Nicole Kringos	Constitutive Modelling of Intrinsic Cross-Anisotropic Viscoelastic Response of Asphalt Concrete.  Mohammad M*, Karimi, Masoud K. Darabi, Omid Omid	Understanding the effect of relative humidity on the mechanical response of HMA materials.  Silvia Caro*, Eduardo Rueda, Bernardo Caicedo	Predicting Rutting Performance of Flexible Airfield Pavements using Enhanced PANDA-AP: Pavement Analysis using Nonlinear Damage Approach-Airfield Pavements.  Rashmi Kola*, Masoud K Darabi, Dallas N Little, Navneet Garg		
<b>Room: Gaslamp 3</b>		<b>MS 102</b>		<b>Multiphysics and Multiscale Modeling of Engineering Materials</b>	
		<b>First Chair: Huiming Yin</b>		<b>Second Chair: Yong-Rak Kim</b>	
<b>[Keynote]</b> Hydro-thermo-electro-chemico-kinetico-elasto-plastic coupled relations for soils.  Seunghye Kim*, Chung R. Song, Jongwan Eun	An inclusion based boundary element method (iBEM) for virtual experiments and cross-scale modeling of particulate composites.  Huiming Yin*	A framework to model flow in porous media with multiple pore-networks.  Seyedeh Hanie Seyed Jooda*, Kalyana Babu Nakshatrala, Roberto Ballarini	Two-way Linked Multiscale Modeling of Interphase Behavior in Cementitious Mixtures.  Keyvan Zare Rami*, Mahdieh Khedmati, Yong-Rak Kim, Sayyed-Soroosh Amelian, Gabriel Nsengiyumva, Santosh-Reddy Kommidi		
<b>Room: Gaslamp 4</b>		<b>MS 43</b>		<b>Damage modelling of engineering structures: from localized cracking to structural collapse</b>	
		<b>First Chair: Hao Yuan</b>		<b>Second Chair: Amartya Bhattacharjee</b>	
Collapse assessment of high-rise reinforced concrete structures with uncertainties.  Hao Zhou*, Jie Li	Fatigue Crack Growth Simulation for Pressurized Vessels and Pipes : from Microstructurally Short Crack to Full Penetration.  Hao Yuan*, Fang Pan, Wei Zhang, Song Han	Investigation of seismic collapse of super-tall structures using incremental dynamic analysis.  Tiancan Huang*, Ziqi Wang, Zhishan Li	A two-phase random medium model for simulating the cracking and failure process of concrete  Li Jie*, Liang Shixue		



# Tuesday, June 6

16:30 - 16:50	16:50 - 17:10	17:10 - 17:30	17:30 - 17:50	17:50 - 18:10	18:10 - 18:30
<b>Room: Gaslamp 5</b>		<b>MS 31</b>		<b>Cementitious Materials: Experiments and Modeling Across the Scales</b>	
		<b>First Chair: Guoqing Geng</b>		<b>Second Chair: Sutapa Deb</b>	
Densification of the interlayer spacing governs the nanomechanical properties of calcium-silicate-hydrate (C-S-H).	Elastic property estimation of the hydrated cement paste.	Effect of hydration and confinement on micro-structure of calcium-silica-hydrate gels.	Measuring adhesion between the cement paste and steel using particle probe scanning force microscopes.	The effect of water-aggregate interaction on creep of hydrating mortars and concretes.	
Guoqing Geng*, Rupert J. Myers, Mohammad Javad Abdolhosseini Qomi, Paulo J. M. Monteiro	Sutapa Deb*, Prodip Kumar Sarkar, Nilanjan Mitra, Subhasish Basu Majumder	Mija Helena Hubler*, Harish Kumar Gadde, Roland Pellenq	Ting Tan*	Bernhard Pichler*, Markus Königsberger, Mohammad Irfan-ul-Hassan, Christian Hellmich	
<b>Room: Balboa 1</b>		<b>MS 81</b>		<b>Advances and Applications of Elasticity within Applied Mechanics</b>	
		<b>First Chair: Sonia Mogilevskaya</b>		<b>Second Chair: Ney Augusto Dumont</b>	
A Numerical Investigation of Shape-Based Objective Functions for Optimal Design of a Smart Material Morphing Structure.	A Generalized Approach to Reconstructing the Three-Dimensional Shape of Slender Structures- An Application of the Cosserat Beam Theory.	Accurate Stress-Strain Curves for Modeling Prestressing Wires in Railroad Ties.			
Robert Zupan*, John Brigham, Dale Clifford, Richard Beblo	Mayank Chadha*, Michael D. Todd	YuSzu Chen*, Hayder A. Rasheed, Robert J. Peterman			
<b>Room: Balboa 2</b>		<b>MS 45</b>		<b>Multiscale Behavior of Damage and Failure Mechanics</b>	
		<b>First Chair: Lizhi Sun</b>		<b>Second Chair: George Voyiadjis</b>	
Decomposition of Healing Tensor In Continuum Damage and Healing Mechanics.	Phase Field Based Coupled Gradient Damage - Viscoplasticity Model For Ductile Materials.	Development of dielectric elastomer nanocomposites as stretchable and flexible actuating materials.			
George Z. Voyiadjis*, Peter I. Kattan	Navid Mozaffari*, George Z. Voyiadjis	Lizhi Sun*, Yu Wang			
<b>Room: Balboa 3</b>		<b>MS 147</b>		<b>Vision-based Studies in Structural Health Monitoring</b>	
		<b>First Chair: Yongchao Yang</b>		<b>Second Chair: Richard L. Wood</b>	
Computing Structural Deformation Profiles from Lidar Data.	RC Beam Load and Damage State Estimation from Surface Crack Patterns Using Machine Vision.	Convolutional neural network based concrete crack detection.	Convolutional Neural Network with Naïve Bayes and Spatial-Temporal Clustering for Video-based Crack Detection on Metallic Surfaces.	Modal Analysis using Segmented Computer Vision.	Full-field Imaging and Modeling of Structural Dynamics from Digital Videos.
Richard L Wood*, Mohammad Ebrahim Mohammadi	Rouzbeh Davoudi*, Gregory R. Miller, J. Nathan Kutz	Young Jin Cha, Wooram Choi*, Oral Buyukozturk	Mohammad Jahanshahi*, Fu-Chen Chen	Vedhus Hoskere*, Jongwoong Park, Hyungchul Yoon, Billie F. Spencer Jr.	Yongchao Yang*, Charles Farrar, David Mascarenas

# Tuesday, June 6

16:30 - 16:50	16:50 - 17:10	17:10 - 17:30	17:30 - 17:50	17:50 - 18:10	18:10 - 18:30
<b>Room: Balboa 4</b>		<b>MS 152</b>		<b>Robustness of Infrastructures (Progressive Collapse)</b>	
		<b>First Chair: Brian Petruzzi</b>		<b>Second Chair: David Padilla-Llano</b>	
Localized Hardening of Existing Building Columns to Prevent Progressive Collapse.	Cyclic Fracture Simulation Framework for Modeling Collapse in Steel Structures.	A Performance-Based Approach to Assess Steel Bridge Robustness Against Fire Hazard.			
Brian Petruzzi*, Peggy Van Eepoel, Shawn Ozuna, Amy Allen	David Padilla-Llano*, Jerome F. Hajjar	Jenny Sideri*, Pierre Ghisbain, Reza Imani, Luciana Balsamo, Ali Ashrafi			
<b>Room: Revolution 1 (Hard Rock Hotel)</b>		<b>MS 12</b>		<b>Computational Biomechanics for Biological Tissues &amp; Human Body Systems</b>	
		<b>First Chair: Ming-Chen Hsu</b>		<b>Second Chair: Yue Yu</b>	
<b>[Keynote]</b> Computational Evaluation of a Shape Analysis Based Inverse Problem Solution Approach to Estimate In Vivo Mechanical Properties of the Heart Wall from Untagged Images.	A Variational multiscale Method for incompressible solid dynamics with particular reference to patient-specific modeling in biological tissues.	Micro-CT based finite cell analysis of vertebral bodies.	Constitutive model form and parameter sensitivity analysis of an FE model of the human head subjected to blast loading.	A variational segmentation approach for the autonomous transfer of CT data into analysis-suitable voxel finite elements.	
John Brigham*, Jing Xu, Marc Simon, Timothy Wong	Ju Liu*, Vijay Vedula, Alison L. Marsden	Mohamed Elhaddad*, Stefan Kollmannsberger, Alexander Valentinitich, Jan S. Kirschke, Martin Ruess, Ernst Rank	Patrick Brewick*, Kirubel Teferra	Tarun Gangwar*, Jeff Calder, Takashi Takahashi, Joan E. Bechtold, Dominik Schillinger	
<b>Room: Revolution 2 (Hard Rock Hotel)</b>		<b>MS 62</b>		<b>Genome of Stone-based Civil Infrastructure Materials</b>	
		<b>First Chair: Yong-Rak Kim</b>		<b>Second Chair: Ting Tan</b>	
<b>[Keynote]</b> Solidification Theory Based Creep Model In High Performance Concrete (HPC).	Molecular Dynamics Modeling and Simulation of Bitumen Chemical Aging.	Statistical analyses of aggregate mineral-binder adhesion measured using particle probe scanning force microscopes.	Analysis of Thermal Performance of Porous Concrete with Heterogeneous Microstructure.		
Will Hansen*, Bo Meng, Zhichao Liu, Eduarduous A.B. Koenders, Ya Wei	Yong-Rak Kim*, Farshad Fallah, Hamzeh Haghshenas, Fardin Khabaz	Yujie Li*	Jiaqi Chen*, Hao Wang		
<b>Room: Satisfaction (Hard Rock Hotel)</b>		<b>MS 26</b>		<b>Recent Advances in Real-time Hybrid Simulation</b>	
		<b>First Chair: Cheng Chen</b>		<b>Second Chair: Wei Song</b>	
Experimental Validation of Parallel Real-Time Hybrid Simulation Using CyberMech.	Modeling Analytical Substructure through Polynomial Chaos Expansion for Hybrid Simulation.	Hybrid Simulation of a Three-Story K-eccentrically Braced Frame – a Comparison with Shake Table Testing.			
Johnny Condori*, James Orr, David Ferry, Amin Maghareh, Sania E. Seilabi, Shirley Dyke, Arun Prakash	Yifeng Xu*, Chaoyu Qiu, Cheng Chen	Xiuyu'Shawn' Gao*, Shawn You, Yan Sui			

# Tuesday, June 6

16:30 - 16:50	16:50 - 17:10	17:10 - 17:30	17:30 - 17:50	17:50 - 18:10	18:10 - 18:30
<b>Room: Fame</b> <small>(Hard Rock Hotel)</small>					
<b>MS 111</b>					
<b>Nano- and micro-scale evolution of infrastructure materials under load, humidity, or radiation</b> <b>First Chair: Christian Hoover    Second Chair: Mathieu Bauchy</b>					
Analyses and Investigations of Double-Slip in Axially-Loaded Iron Crystals in Tension and Compression.  Kerry Havner*, Patrick Franciosi	Irradiation-Induced Damage in Concrete: The Enthalpy Landscape Viewpoint.  Mathieu Bauchy*, N. M. A. Krishnan, B. Wang, G. Sant, Y. Le Pape	Experimental Investigation of Fracture Mechanics of Cementitious Materials.  Christian Hoover*	Load and humidity induced phase dissolution in cement paste: mechanisms of time-dependent deformation.  Zachary Grasley*, Xiaodan Li		

**Wednesday, June 7**  
**8:15 – 9:00**

**Plenary Lecture 5**  
**Room: Grand Ballroom**

Mary Baker

ATA Engineering, Inc.

Hybrid Time- and Frequency-Domain Methods for Simulation of Dynamic  
Environments with the Goal of Understanding the Statistics and  
Uncertainty of the Result

Chair: Gianluca Cusatis



**Mary Baker**  
President and Founder  
ATA Engineering, Inc.

## **Hybrid Time- and Frequency-Domain Methods for Simulation of Dynamic Environments with the Goal of Understanding the Statistics and Uncertainty of the Result**

### **Abstract:**

Much of the challenge of mechanical design of structures, ground vehicles, and spacecraft lies in the use of measured data from previous events to define a new vehicle or structure that will perform successfully in that environment. Historically, the direct use of hours of acceleration measurements to perform analysis of a new design has not been feasible. In the 1960s, a breakthrough in methods for this type of design analysis came in the concept of random analysis, defined by Steven Crandall of MIT, through which many hours of data of a road surface, turbulence for an airplane, or vibration from a rocket motor burn could be condensed into a concise definition of the environment based on the statistical variations documented as a random process. Decades before random analysis, however, other frequency-domain methods were developed.

In particular, shock response analysis and Fourier analysis made it possible to understand massive amounts of acceleration measurements by forming a shock response spectrum or a frequency response function that could be used with the appropriate analysis methods to design a structure. Today, the standard methods in commercially available software for dynamic analysis are tied to these specific types of frequency-domain analyses, which make vast amounts of measured data manageable but also result in the loss of the statistics of the results. The limitations of these methods become clearest when the real environment includes multiple types of dynamics environments. For example, measured dynamic environments for a helicopter or a liquid rocket engine include not only specific sine tones with well-defined deterministic amplitudes and frequencies but also random excitation that is known only statistically. The combined result from these specific frequency-domain analyses is neither statistical nor deterministic and suffers from the loss of stress tensor understanding as well.

This presentation explores a revised approach that maintains the advantage of the various types of frequency-domain analyses in condensing and understanding the environmental measurements but utilizes the time domain to perform the analysis. In this way, the statistics as well as the full stress tensor can be maintained for better understanding of the material response to the dynamic environment. But even more importantly, the statistics of the result can be maintained and uncertainty propagated such that the design evaluation gives not just a margin of safety but a probability of success. The future challenge in design of structures for extreme dynamic environments is not to predict the worst possible case but to shape the design to reach a selected probability of achieving the desired performance.

## Wednesday, June 7, 9:30 – 11:30, Session W1

<b>Room</b>	<b>MS Number</b>	<b>Minisymposia Session Title</b>
Salon A	MS28	Topology Optimization; from Algorithmic Developments to Applications
Salon B	MS45 MS41	Multiscale Behavior of Damage and Failure Mechanics Advances in Computational Failure of Composites
Salon C	MS21	Computational Methods and Applications for Solid and Structural Mechanics
Salon D	MS46	Simulation-based Natural Disaster Prediction and Mitigation
Salon E	MS52	Flows With Moving Boundaries and Interfaces
Gaslamp 1	MS71	Degradation and healing in particulate systems
Gaslamp 2	MS101	Coupled Environmental-Mechanical Response of Civil Infrastructures and Materials
Gaslamp 3	MS102	Multiphysics and Multiscale Modeling of Engineering Materials
Gaslamp 4	MS105	The Link Between Composition, Structure, and Physical Properties of Materials
Gaslamp 5	MS31	Cementitious Materials: Experiments and Modeling Across the Scales
Balboa 1	MS91	Advanced Analysis for Earthquake Engineering
Balboa 2	MS92	Analytical and experimental investigation of the resiliency of the critical infrastructures under multiple hazards
Balboa 3	MS147	Vision-based Studies in Structural Health Monitoring
Balboa 4	MS146	Vibration measurement, modal analysis and model updating of structures
Revolution 1 (Hard Rock Hotel)	MS12	Computational Biomechanics for Biological Tissues & Human Body Systems
Revolution 2 (Hard Rock Hotel)	MS14	Mechanics of Soft Materials
Satisfaction (Hard Rock Hotel)	MS54	Flow Induced Motions
Fame (Hard Rock Hotel)	MS63	Recent Advances in Constitutive Modeling for Geotechnical Engineering

# Wednesday, June 7

9:30 - 9:50	9:50 – 10:10	10:10 – 10:30	10:30 – 10:50	10:50 – 11:10	11:10 – 11:30
<b>Room: Salon A</b>		<b>MS 28</b>			
<b>Topology Optimization; from Algorithmic Developments to Applications</b> First Chair: Mehdi Jalalpour Second Chair: Mazdak Tootkaboni					
Topology Optimization of Energy Absorbing Elastoplastic Structures with Rate-Dependent Behavior.  Kapil Khandelwal*, Ryan Alberdi	Microstructures design considering connectivity.  Zongliang Du*, Raghavendra Sivapuram, Hyunsun Alicia Kim	Lattice topologies with optimized specific stiffness and improved stability performance.  Alireza Asadpoure*, Mazdak Tootkaboni, Lorenzo Valdevit	Design of Fracture Resistant Energy Absorbing Structures using Elastoplastic Topology Optimization.  Kapil Khandelwal*, Lei Li		
<b>Room: Salon B</b>		<b>MS45: Multiscale Behavior of Damage and Failure Mechanics</b>		<b>MS41: Advances in Computational Failure of Composites</b>	
First Chair: Leong Hien Poh Second Chair: Isamar Rosa					
<b>[MS45]</b> Localizing gradient damage model for the quasi-brittle fracture of concrete.  Leong Hien Poh*	<b>[MS45]</b> A homogenized localizing gradient damage model with micro inertia effect.  Zhao Wang*, Leong Hien Poh	<b>[MS45]</b> Rigid Body Spring Model for Fracture Modeling of Protein Bound Soils.  Isamar Rosa*, Tamon Ueda, Yoshiaki Fujii, Micheal Lepech	<b>[MS41]</b> Strength Properties of Particulate Potassium Based Geopolymer Composites: A Computational Study.  Amrita Kataruka*, Erman Guleryuz, Seid Koric, Waltraud M. Kriven, Ange-Therese Akono	<b>[MS41]</b> Numerical and experimental analysis of thin-walled composite profiles under uniaxial compression.  Sylwester Samborski*, Hubert Debski	
<b>Room: Salon C</b>		<b>MS 21</b>			
<b>Computational Methods and Applications for Solid and Structural Mechanics</b> First Chair: John Brigham Second Chair: Arturo Montoya					
Relevance and Applications of Generalized Disclination Theory in Defect Mechanics.  Chiqun Zhang*, Amit Acharya	A Two-Scale Generalized FEM for Parallel Simulations of Spot Welds in Large Structures.  Haoyang Li*, C. Armando Duarte	Reduced Order Variational Multiscale Enrichment Method with Hybrid Multiscale Integrators (ROVME-H).  Shuhai Zhang*, Caglar Oskay	An algorithm for elastoplastic models of materials and bridge bearing systems with friction elements.  Li-Wei Liu*, Kuang-Yen Liu		
<b>Room: Salon D</b>		<b>MS 46</b>			
<b>Simulation-based Natural Disaster Prediction and Mitigation</b> First Chair: Sean Vitousek Second Chair: Sheng-Wei Chi					
<b>[Keynote]</b> Development of fluid-solid interacting reproducing kernel particle method for the modeling of flow and scouring under pipelines.  Pai-Chen Guan*, Onlei Annie Kwok, Chien-Ting Sun	A Soil Constitutive Model for Extreme Deformation Dynamics.  Craig D. Foster*, Seyed Milad Parvaneh, Sheng-Wei Chi, Ashkan Mahdavi	Coupled Lagrangian And Semi-Lagrangian RKPM.  Marco Pasetto*, J. S. Chen, Haoyan Wei	u-p Semi-Lagrangian Reproducing Kernel Formulation for Landslide Modeling.  Sheng-Wei Chi*, Thanakorn Siriaksorn, Ashkan Mahdavi, Craig Foster		

# Wednesday, June 7

9:30 - 9:50	9:50 – 10:10	10:10 – 10:30	10:30 – 10:50	10:50 – 11:10	11:10 – 11:30
<b>Room: Salon E</b>		<b>MS 52</b>		<b>Flows With Moving Boundaries and Interfaces</b>	
		<b>First Chair: Alessandro Corsini</b>		<b>Second Chair: Yoichi Ogata</b>	
Interface Capturing on Unstructured Meshes using a Control Volume Finite Element Method.	Isogeometric analysis of multi-phase flows with surface tension and its application to bubble dynamics.	Compressible flows on moving domains: Stabilized methods, weakly enforced essential boundary conditions, and sliding interfaces.	Novel numerical models for multi-component/phase compressible flows with moving interfaces and chemical reactions.	Numerical model for moving interfacial flows using multi-moment finite volume method.	
Gregory Wagner*, Stephen Lin, Jinhui Yan	Jinhui Yan*, Stephen Lin, Greg Wagner, Yuri Bazilevs	Fei Xu*, Ming-Chen Hsu, Muthuvel Murugan, Anindya Ghoshal, Yuri Bazilevs	Xi Deng*, Bin Xie, Peng Jin, Feng Xiao	Peng Jin*, Bin Xie, Xi Deng, Feng Xiao	
<b>Room: Gaslamp 1</b>		<b>MS 71</b>		<b>Degradation and healing in particulate systems</b>	
		<b>First Chair: Mahdia Hattab</b>		<b>Second Chair: Ranganathan Parthasarathy</b>	
Cracking of unsaturated clays under indirect tensile strength test by bending.	Modeling compression of granular soils including the effect of particle breakage.	Enhanced grain breakage in surface-reactive environments.	Influence of Soil Microorganisms on Biogeochemical Reaction Rates and Calcite Precipitation Microstructure in Bio-cemented Sands.	Water-compatible photo-initiator: A means to delay the degradation of adhesive/dentin bond.	Separated Temporal and Spatial (SETS) Framework for Stress Calculations in Atomic Models.
Mahdia Hattab*, Lamine Ighil Aneur	Mehrashk Meidani*, Ching Shung Chang	Yida Zhang*, Giuseppe Buscarnera	Mike Gomez*, Jason DeJong	Farhana Abedin*, Qiang Ye, Kyle Camarda, Paulette Spencer	Ranganathan Parthasarathy*, Sitararam Aryal, Anil Misra, Lizhi Ouyang
<b>Room: Gaslamp 2</b>		<b>MS 101</b>		<b>Coupled Environmental-Mechanical Response of Civil Infrastructures and Materials</b>	
		<b>First Chair: Maryam Shakiba</b>		<b>Second Chair: Yon-Rak Kim</b>	
Microstructure Characteristics, Nanomechanical Properties, and Chemical Mapping of Interphase Region in Cementitious Mixtures.	A new methodology to assess durability of elastomer-concrete interface.	Diffusive Transport of Volatile Organic Compounds Coupled with Temperature and Chemical Change through Composite Liner System.			
Mahdieh Khedmati*, Hani Alanazi, Yong-Rak Kim	Nicolas Gay*, Bruno Fayolle, Frédéric Skoczylas, Franck Agostini, Mathias Brieu	Jongwan Eun*, Craig H. Benson, James M. Tinjum			
<b>Room: Gaslamp 3</b>		<b>MS 102</b>		<b>Multiphysics and Multiscale Modeling of Engineering Materials</b>	
		<b>First Chair: Chung Song</b>		<b>Second Chair: Huiming Yin</b>	
A coupled SPH-DEM simulation of particle sedimentation toward functionally graded material fabrication.	Coupled Soil-Structure Behavior Under Impact Load.	Stability Analysis of Truss Structures through Multiscale Analysis.	Predicting Mechanical Behavior of Bone Subjected to Viscoelastic Deformation and Fracture Damage Using Three-Dimensional (3D) Multiscale Modeling.		
Zhenyu Shou*, Fangliang Chen, Huiming Yin	Chung Song*, Tewodros Y. Yosef, Ronald K. Faller, Karla A. Lechtenberg	Le Cao*	Taesun You*, Yong-Rak Kim		



# Wednesday, June 7

9:30 - 9:50	9:50 – 10:10	10:10 – 10:30	10:30 – 10:50	10:50 – 11:10	11:10 – 11:30
<b>Room: Gaslamp 4</b>		<b>MS 105</b>		<b>The Link Between Composition, Structure, and Physical Properties of Materials</b> First Chair: <b>Mohammad Javad Abdolhosseini Qomi</b> Second Chair: <b>Mathieu Vandamme</b>	
Failure of cement hydrates: freeze-thaw.  Katerina Ioannidou*, Emanuela Del Gado, Franz-Josef Ulm, Roland Pellenq	A multi-method micromechanical approach to predict the creep behaviour of early age concrete.  Michael Haist*, Thibaut Divoux, F.-J. Ulm	Densification in calcium silicate hydrate.  Ali Morshedifard*, Mohammad Javad Abdolhosseini Qomi	Modification of Microprestress-Solidification theory.  Saeed Rahimi Aghdam*, Zdenek P. Bazant	Competition between mesoscale packing and cohesive-frictional interactions in colloidal calcium-silicate-hydrates.  Steven D. Palkovic*, Sidney Yip, Oral Buyukozturk	
<b>Room: Gaslamp 5</b>		<b>MS 31</b>		<b>Cementitious Materials: Experiments and Modeling Across the Scales</b> First Chair: <b>Günther Meschke</b> Second Chair: <b>Hunain Alkhateb</b>	
Multi-scale model for ASR damage and moisture transport in concrete.  Günther Meschke*, Jithender J. Timothy, Tagir Iskhakov	Magnesium Oxysulfate Binders Multiscale Evaluation and Optimization Using Artificial Neural Networks.  Hunain Alkhateb*, Hatem Almasaeid, Jennifer Edmunson, Michael Fiske, Yacoub Najjar, Ahmed Al-Ostaz	Large-Scale Micron-Order 3D Surface Chemical Imaging of Ancient Roman Concrete.  Janille Maragh*, Admir Masic, James C. Weaver	On the physical origin of long-term autogenous shrinkage.  Abudushalamu Aili*, Matthieu Vandamme, Jean-Michel Torrenti, Benoit Masson		
<b>Room: Balboa 1</b>		<b>MS 91</b>		<b>Advanced Analysis for Earthquake Engineering</b> First Chair: <b>Kevin Wong</b> Second Chair: <b>Ting Lin</b>	
Modification of stochastic ground motion models for probabilistic hazard compatibility.  Alexandros Taflanidis*, Alexandra Tsioulou, Carmine Galasso	Fragility functions from a statistical learning perspective.  Charalampos Andriotis*, Kostas Papakonstantinou	Urban Earthquake Disaster Prevention & Reduction Ability Assessment of Buildings and Its Applications.  Bo Chen*, Zengping Wen, Fang Wang	Characterization of Energy in Nonlinear Structures Subjected to Earthquake Excitations.  Kevin Wong*, Steven McCabe		
<b>Room: Balboa 2</b>		<b>MS 92</b>		<b>Analytical and experimental investigation of the resiliency of the critical infrastructures under multiple hazards</b> First Chair: <b>Sungmoon Jung</b> Second Chair: <b>Wei Zhang</b>	
Resilient Bridge Design to Extreme Events.  Shalva Marjanishvili*	Resiliency of Coastal Residential Buildings subjected to Wind and Flood.  Wei Zhang*, Jeffery Weston, Di Wu, Fang Pan	Network performance and emergency response reliability of degraded transportation system subjected to hazards.  Yangyang Wu*, Suren Chen			

# Wednesday, June 7

9:30 - 9:50	9:50 - 10:10	10:10 - 10:30	10:30 - 10:50	10:50 - 11:10	11:10 - 11:30
<b>Room: Balboa 3</b>		<b>MS 147</b>		<b>Vision-based Studies in Structural Health Monitoring</b>	
		<b>First Chair: Necati Catbas</b>		<b>Second Chair: Mohammad Jahanshahi</b>	
Free Vibration And Static Measurements Using Photogrammetry Techniques In Model Calibration.	Dynamic Deformation-Field Measurement Using Color and Depth Data Fusion.	Marker Free Development of Computer Vision based Structural Dynamic Monitoring and Modal Analysis.	Applications of Motion Magnification to Structural Health Assessment.		
Mohsen Maniat*, Mohammad Farshchin, Charles V Camp	Mohamed Abdelbarr*, Yulu Chen, Mohammad Jahanshahi, Sami Masri	Chuan-Zhi Dong*, Ozan Celik, F. Necati Catbas	Justin G. Chen*, Murat Uzun, Neal Wadhwa, Abe Davis, Frédo Durand, William T. Freeman, Oral Büyükoztürk		
<b>Room: Balboa 4</b>		<b>MS 146</b>		<b>Vibration measurement, modal analysis and model updating of structures</b>	
		<b>First Chair: Heung-Fai Lam</b>		<b>Second Chair: Jia-Hua Yang</b>	
[Keynote] A New Component-sampling-based Bayesian Operational Modal Analysis Method.		Bayesian Modal Identification using Asynchronous 'Output-Only' Ambient Data.	Efficient Output-Only Based Vibration Monitoring Applied to I35-W Bridge Testbed.	Bayesian model updating of rail-sleeper-ballast system using measured field vibration data of in-situ sleeper.	
Jia-Hua Yang*, Heung-Fai Lam		Yi-Chen Zhu*, Siu-Kui Au	Karl Gaebler*, Carol Shield, Lauren Linderman	Stephen Adeyemi Alabi*, H.F Lam	
<b>Room: Revolution 1</b> (Hard Rock Hotel)		<b>MS 12</b>		<b>Computational Biomechanics for Biological Tissues &amp; Human Body Systems</b>	
		<b>First Chair: Chung-Hao Lee</b>		<b>Second Chair: Ming-Chen Hsu</b>	
[Keynote] A Novel Numerical-Experimental Inverse Modeling Approach to Investigate the Three-Dimensional Mechanical Properties of Ovine Myocardium.	Coupled Left Ventricular Biomechanics and Flow Simulations with Immersed FSI Valves.	How hydration influence the stiffening effects of corneal UVA collagen cross-linking treatment?	An Inverse Modeling-Based Framework for In Vivo Modeling of the Heart Valves With Investigations of the Pre-strain Effects.	Computational modeling of tumor growth with peridynamics.	Effect of occlusion relationships on structural and mechanical behaviors of skulls under masticatory action.
Michael S. Sacks*, David Li, Reza Avazmohammadi, Joao Soares, Joseph H. Gorman, III, Robert C. Gorman	Adarsh Krishnamurthy*, Chenglong Wang, Arian Jafari, Fei Xu, Ming-Chen Hsu	Hamed Hatami-Marbini*, Sandeep Mysore, Rachith Thipperri	Chung-Hao Lee*, Michale S. Sacks	Emma Lejeune*, Christian Linder	Yeokyeong Lee*, Heesun Kim, Jaeyong Park
<b>Room: Revolution 2</b> (Hard Rock Hotel)		<b>MS 14</b>		<b>Mechanics of Soft Materials</b>	
		<b>First Chair: Ali Ghahremaninezhad</b>		<b>Second Chair: Nima Rahbar</b>	
Thermal Conductivity of DPPC Lipid Bilayer Membranes around the Phase Transition Temperature.	Chemical-mechanical interactions between pH responsive hydrogels and porous cementitious matrices.	Two-Potential Constitutive model for rubber viscoelastic materials.	A systematic study of swelling-induced instabilities of hydrogels.	Influence of Processing Parameters on Mechanical Properties of Stereolithography based 3D Printed Parts.	
Nima Rahbar*, Sina Youssefian, Steven Van Dessel	Ali Ghahremaninezhad*, Khashayar Farzarian	Aditya Kumar*, Oscar Lopez-Pamies	Berkin Dortdivanlioglu*, Andreas Krischok, Ali Javili, Christian Linder	Ravi Kiran*, Dayakar L. Naik	

# Wednesday, June 7

9:30 - 9:50	9:50 - 10:10	10:10 - 10:30	10:30 - 10:50	10:50 - 11:10	11:10 - 11:30
<b>Room: Satisfaction (Hard Rock Hotel) MS 54</b>					
<b>Flow Induced Motions</b> <b>First Chair: Ning Zhang    Second Chair: Panayiotis (Panos) Diplas</b>					
<p>[Keynote] Initiation of particle movement description via the use of velocity quadrant sequence methodology.</p> <p>Panayiotis (Panos) Diplas*, W.-R. Shih</p>	<p>Simulations of Flow over Moving Grass Leaves using an Immersed Boundary Method.</p> <p>Ning Zhang*</p>	<p>Wind induced vibration in tall tapered tubular structures.</p> <p>Hossein Qarib*</p>			
<b>Room: Fame (Hard Rock Hotel) MS 63</b>					
<b>Recent Advances in Constitutive Modeling for Geotechnical Engineering</b> <b>First Chair: Samuel Yniesta    Second Chair: Katerina Ziotopoulou</b>					
<p>Constitutive Modelling of Gas Production from Hydrate Bearing Sediments.</p> <p>Mehdi Teymouri*, Marcelo Sanchez, J. Carlos Santamarina</p>	<p>Correlation between Self-Consolidation and Soil Water Retention.</p> <p>Yi Dong*, Ning Lu</p>	<p>An elastoplasticity model for municipal solid waste considering particle compressibility.</p> <p>Xinle Zhai*, Xilin Lu, Maosong Huang</p>	<p>Mapping of Yield and Plastic Potential Surfaces Using Undrained Perturbations in Triaxial Compression.</p> <p>Mohammad M. Eslami*, Daniel Pradel, Scott J. Brandenburg</p>	<p>Fabric Basis of Post-Liquefaction Shear Deformation of Sand.</p> <p>Rui Wang*, Pengcheng Fu, Jian-Min Zhang, Yannis F. Dafalias</p>	<p>A Constitutive Model for Site Response.</p> <p>Samuel Yniesta*</p>

**Wednesday, June 7**  
**13:00 – 13:45**

**Plenary Lecture 6**  
**Room: Grand Ballroom**

Lori Graham-Brady

Johns Hopkins University

Uncertainty in the context of materials by design: key roles for stochastic mechanics

Chair: Dan Frangopol



**Lori Graham-Brady**  
Civil Engineering and  
Mechanical Engineering  
Johns Hopkins University

## **Uncertainty in the context of materials by design: key roles for stochastic mechanics**

### **Abstract:**

The vision for the development of new structural materials is that models, experiments, characterization, and processing will come together to enable rapid design of new materials with unprecedented capabilities. Closure of this so-called materials-by-design loop requires closing communication gaps that exist between the various participants in the process. For example, the modeler can identify which constitutive parameters have a significant effect on the predicted response of a material within a given structural application; however, the materials processor can rarely control these constitutive parameters directly.

Therefore, it is of greater value to use a model that explicitly includes parameters, such as microstructural features, that the materials processor might be able to control. Materials-by-design is further challenged by the many uncertainties that pervade this process, from the random microstructure that drives localization of failure, to the errors introduced by inexact measurements in characterization and testing, to the environmental uncertainties that affect the formation of the material during processing. Both of these challenges present significant opportunities for the stochastic mechanics community. Probabilistic evaluation of materials characterization data highlights characteristics of the microstructure that can inform the model. Novel stochastic simulation tools for generating sample microstructures from this data enable micromechanically-based assessment of the degree to which localized material behavior varies within the structure. Surrogate models allow randomness in the microstructure to be efficiently upscaled into a macro-scale structural model with appropriate underlying stochastic spatial variations of the physically based parameters that directly relate to materials processing. This talk will discuss all of these tools in the particular context of brittle materials under high-rate compression, with a brief discussion of other applications in composite materials and polycrystalline metals.

## Wednesday, June 7, 14:15 – 16:15, Session W2

Room	MS Number	Minisymposia Session Title
Salon A	MS28	Topology Optimization; from Algorithmic Developments to Applications
Salon C	MS21	Computational Methods and Applications for Solid and Structural Mechanics
Salon D	MS46	Simulation-based Natural Disaster Prediction and Mitigation
Salon E	MS141	Fatigue damage monitoring, diagnosis and prognosis
Gaslamp 1	MS95	Recent Advances in Uplifting Structures and Rocking Isolation
Gaslamp 3	MS104	Multiscale Mechanics and Physics of Shale
Gaslamp 4	MS105	The Link Between Composition, Structure, and Physical Properties of Materials
Gaslamp 5	MS33	The mechanical failure of hard/soft materials: from yogurt to cement
Balboa 1	MS91	Advanced Analysis for Earthquake Engineering
Balboa 2	MS92	Analytical and experimental investigation of the resiliency of the critical infrastructures under multiple hazards
Balboa 3	MS143	Infrastructure system integrity through damage precursor sensing
Balboa 4	MS146	Vibration measurement, modal analysis and model updating of structures
	MS131	Advances in system safety and reliability for risk assessment and management of energy infrastructure developments
Revolution 1 (Hard Rock Hotel)	MS12	Computational Biomechanics for Biological Tissues & Human Body Systems
Revolution 2 (Hard Rock Hotel)	MS14	Mechanics of Soft Materials

# Wednesday, June 7

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Salon A</b>		<b>MS 28</b>		<b>Topology Optimization; from Algorithmic Developments to Applications</b>	
		<b>First Chair: Alireza Asadpoure</b>		<b>Second Chair: Mazdak Tootkaboni</b>	
Shape and Topology Optimization of Low Porosity Architected Structures for High Stress and Strain Applications.	Stress-based topology optimization of frames under uncertainty.	Topology optimization of structures subjected to transient loading.	Frequency-domain-based topology optimization of structures subjected to stochastic stationary dynamic base motion.		
Jiazhen Leng*, Gerard Reynolds, Genevieve Bourgeois, Megan Schaezner, Minh Quan Pham, Ali Shanian, Damiano Pasini	Mehdi Jalalpour*, Navid Changizi	Reza Behrou*, James K. Guest	Fernando Gomez*, Billie F. Spencer Jr.		
<b>Room: Salon C</b>		<b>MS 21</b>		<b>Computational Methods and Applications for Solid and Structural Mechanics</b>	
		<b>First Chair: Ertugrul Taciroglu</b>		<b>Second Chair: Arturo Montoya</b>	
A dynamic variational multiscale method for viscoelasticity using linear tetrahedral elements.	Analysis of arbitrarily shaped plates via meshfree LEM solution.	Corrected conforming kernels for rapid design-to-analysis.	Satisfying stability estimates for multi-field variational principles by means of energetic conditions in incremental form.	Isogeometric Analysis for the Prediction of the Damage Growth in Composite Laminates Subjected to Low-Velocity Impact.	Shear response model of RC panel-an improvement in the modified compression field theory.
Nabil Abboud*, Oriol Colomes, Guglielmo Scovazzi	Antonina Pirrotta*, Giuseppe Battaglia, Alberto Di Matteo, Giorgio Maria Micale	Jacob Koester*, J.S. Chen	Andreas Krischok*, Christian Linder	Marco Simone Pigazzini*, Yuri Bazilevs, Hyonny Kim, Andrew Ellison	Xu Chao*
<b>Room: Salon D</b>		<b>MS 46</b>		<b>Simulation-based Natural Disaster Prediction and Mitigation</b>	
		<b>First Chair: Pai-Chen Guan</b>		<b>Second Chair: Craig Foster</b>	
The Coastal Storm Modeling System (CoSMoS) to predict flooding, shoreline erosion, and cliff failure in Southern California.	Multi-Hazard Sustainability Considering Probabilistic Sea-Level Rise Hazard Analysis.	Reduction of Uncertainty in Post-Event Seismic Loss Estimates through Bayesian Inference Using Observation Data.			
Sean Vitousek*, Patrick L. Barnard, Patrick Limber, Li Erikson, Blake Cole	Ting Lin*	Maura Torres*			
<b>Room: Salon E</b>		<b>MS 141</b>		<b>Fatigue damage monitoring, diagnosis and prognosis</b>	
		<b>First Chair: Jin Zhu</b>		<b>Second Chair: Xiangxiang Kong</b>	
Fatigue damage assessment of an existing coastal slender bridge under multiple dynamic loadings.	A large-area strain sensing technology for monitoring high-cycle fatigue cracks in steel bridges.	Multi-Objective Probabilistic Optimum Inspection Planning Considering Fatigue Damage Detection.	Structural Damage and Crack Detection from Point clouds via Discrete Differential Geometry.	Fatigue Usage Monitoring in Wind Excited Structures.	
Jin Zhu*, Wei Zhang	Xiangxiang Kong*, Jian Li, William Collins, Caroline Bennett, Simon Laflamme	Sunyong Kim*, Dan M. Frangopol	Richard L Wood*, Mohammad Ebrahim Mohammadi	Eric M. Hernandez*, Benjamin Leblanc	

# Wednesday, June 7

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Gaslamp 1</b>		<b>MS 95</b>		<b>Recent Advances in Uplifting Structures and Rocking Isolation</b>	
		<b>First Chair: Nicos Makris</b>		<b>Second Chair: Christine Wittich</b>	
<b>[Keynote]</b> Earthquake Response of a Yielding Frame Coupled with a Rocking Wall.  Nicos Makris*, Mehrdad Aghagholizadeh	Shake Table Tests of Freestanding Single and Dual-Body Systems.  Christine Wittich*, Tara C. Hutchinson	Integrated Capacity Design Optimization of Rocking Braced Frames.  Amory Martin*, Gregory G. Deierlein	Precast, Rocking Columns For Resilient Bridge System And Rapid Construction  Islam Mantawy*, David Sanders, Travis Thonstad, John Stanton, Marc Eberhard	Simplified seismic response predictions of controlled rocking columns for bridges  Jian Zhang*, Yazhou Xie, Gang Wu	Performance Assessment of Bridges with Polyurethane Damage-Resistant End Column Segments under Extreme Seismic Effects  Mohammad T. Nikoukalam*, Petros Sideris
<b>Room: Gaslamp 3</b>		<b>MS 104</b>		<b>Multiscale Mechanics and Physics of Shale</b>	
		<b>First Chair: Younane Abousleiman</b>		<b>Second Chair: Amin Mehrabian</b>	
Rate-Independent Fracture Toughness of Organic-Rich Shale.  Pooyan Kabir*, Ange-Therese Akono	Failure Behavior of Kerogen-Rich Shale (KRS) Composites from Micro- to Milli-meter Scales.  Mohammad H Haque*, Yanhui Han, Katherine L. Hull, Younane N. Abousleiman	Numerical Analysis of the Fracture-permeability Behavior of Shale.  Weixin Li*, Faysal Bousikhane, Gianluca Cusatis, J. William Carey	Undrained Cylindrical Cavity Expansion In Anisotropic Critical State Soils.  Shengli Chen*, Kai Liu	Coupled LBM-MPM pore-scale modeling of multi-phase flow in stressed porous media considering hydrophobicity.  ZhiQiang Chen*, Hao Chen, Yuchuan Chu, Xiaoming He	
<b>Room: Gaslamp 4</b>		<b>MS 105</b>		<b>The Link Between Composition, Structure, and Physical Properties of Materials</b>	
		<b>First Chair: Mathieu Vandamme</b>		<b>Second Chair: Mohammad Javad Abdolhosseini Qomi</b>	
Intrinsic site-dependence of cement carbonation.  Andreas Funk*, K. M. Salah Uddin, Mohammad Javad Abdolhosseini Qomi	Chemically induced strains in CO2 geological storage.  David Nicolas Espinoza*, Hojung Jung, Michael Aman, Igor Shovkun	Nanoscale modelling and simulation of metakaolin geopolymer binders.  Francesca Lolli*, Enrico Masoero, Hegoi Manzano	Measurement of adsorption-induced mechanical stresses in intact and reconstituted coal samples.  Mathieu Vandamme*, David Nicolas Espinoza, Jean-Michel Pereira, Patrick Dangla, Sandrine Vidal-Gilbert		
<b>Room: Gaslamp 5</b>		<b>MS 33</b>		<b>The mechanical failure of hard/soft materials: from yogurt to cement</b>	
		<b>First Chair: Aikaterini Ioannidou</b>		<b>Second Chair: Roland Pellenq</b>	
The Potential of Mean Force concept for bridging (length and time) scales in the modeling of complex porous materials.  Roland Pellenq*, Katerina Ioannidou, Benoit Carrier, Matthieu Vandamme	Yielding and plastic processes in amorphous materials under tension.  Emanuela Del Gado*, Joyjit Chattoraj, Corey Hardin, Ramaswami Krishnan	Microscopic dynamics and failure precursors during the creep of a colloidal gel.  Stefano Aime*, Laurence Ramos, Luca Cipelletti			



# Wednesday, June 7

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Balboa 1</b>		<b>MS 91</b>		<b>Advanced Analysis for Earthquake Engineering</b> First Chair: Ting Lin Second Chair: Kevin Wong	
Effect of Severe Scour on Seismic Vulnerability of Aging Highway Bridges.  Prabodh Dahal*, Trey Powell, Chris Mullen	Finite Element Modeling of Reinforced Concrete Walls.  Kristijan Kolozvari*, Ross Miller, Kutay Orakcal	Nonlinear Response Prediction of an Infilled RC Building During the 2015 Nepal Earthquake.  Andreas Stavridis, Supratik Bose*, Mehdi M. Akhlaghi, Babak Moaveni			
<b>Room: Balboa 2</b>		<b>MS 92</b>		<b>Analytical and experimental investigation of the resiliency of the critical infrastructures under multiple hazards</b> First Chair: Wei Zhang Second Chair: Sungmoon Jung	
Agent-based Simulation of Pedestrian Evacuation in a Metro Station.  Qiling Zou*, Suren Chen	Traffic simulation of disrupted transportation systems.  Guangyang Hou*, Suren Chen	A New Approach for Road Closure Probability Estimation Caused By Hurricanes Winds.  Sungmoon Jung*, Grzegorz Kakareko, Eren Erman Ozguven, Sylwia Weresa	Lifecycle Resilience Assessment of Infrastructures Subjected to Multiple Types and Occurrences of Hazards.  Ehsan Fereshtehnejad*, Abdollah Shafieezadeh	Numerical investigation on the blast response of functionally graded pipes.  Elias Ali*, Yared Shifferaw, Girum Urgessa	Agent-based Simulation of Pedestrian Evacuation in a Metro Station.  Qiling Zou*, Suren Chen
<b>Room: Balboa 3</b>		<b>MS 143</b>		<b>Infrastructure system integrity through damage precursor sensing</b> First Chair: Marcus Rutner Second Chair: Ed Habtour	
[Keynote] A Fiber Optic Conjugate Stress Sensor for Structural Health Monitoring of a Polymer Composite Material.  Jonathan Kordell*, Miao Yu, Abhijit Dasgupta, Harsh Baid, Anisur Rahman, Ed Habtour		Sensing Sheet: searching for optimal strain transfer for crack detection.  Branko Glisic*, Matthew J. Gerber	Damage Precursor Sensing in Thick Metal Plates.  Marcus P. Rutner*, Dimitri Donskoy, Sophia Hassiotis, Majid Ramezani Goldyani	Experimental assessment of railroad bridge critical infrastructure using shake tables.  Fernando Moreu*	Active monitoring of fracturing in quasi-brittle solids: an experimental study.  Fatemeh Pourahmadian*
<b>Room: Balboa 4</b>		<b>MS 146 / MS 131</b>		<b>Vibration measurement, modal analysis and model updating of structures</b> First Chair: Heung-Fai Lam Second Chair: Jia-Hua Yang <b>Advances in system safety and reliability for risk assessment and management of energy infrastructure developments</b>	
[MS146] Field investigation and long-term monitoring of wind-induced vibrations of high-mast light poles.  Miguel Hernandez*, Mazen Wahbeh, Sami F. Masri	[MS146] Estimating Rayleigh Damping and Dynamic Soil Stiffness of Building Structures using Nonlinear Finite Element Model Updating.  Hamed Ebrahimian*, Danilo Kusanovic, Domniki Asimaki	[MS131] System reliability analysis of multiliner floating offshore wind farms.  Spencer Hallowell*, Casey M Fontana, Sanjay R. Arwade, Don J DeGroot, Charles Aubeny, Melissa Landon, Brian Diaz	[MS131] Multiline anchor forces for offshore wind: structural dynamics, directionality and cyclic effects.  Casey M. Fontana*, Spencer Hallowell, Sanjay R. Arwade, Don J. DeGroot, Charles Aubeny, Melissa Landon, Senol Ozmtlu		

# Wednesday, June 7

14:15 - 14:35	14:35 - 14:55	14:55 - 15:15	15:15 - 15:35	15:35 - 15:55	15:55 - 16:15
<b>Room: Revolution 1</b> (Hard Rock Hotel)		<b>MS 12</b>		<b>Computational Biomechanics for Biological Tissues &amp; Human Body Systems</b>	
		<b>First Chair: Adarsh Krishnamurthy</b>		<b>Second Chair: Chung-Hao Lee</b>	
A Framework for Patient-Specific Bioprosthetic Heart Valve Design and Analysis.	An Inverse Modeling Approach to Estimate In-Vivo Strains in the Healthy and Diseased Mitral Valve.	Multi-resolution Modeling of the Mitral Heart Valve for Image-based Biomechanical Simulations.			
Ming-Chen Hsu*, Fei Xu, Sahiti Nallagonda, Nelson M. Wiese	Bruno V. Rego*, Salma Ayoub, Amir H. Khalighi, Andrew Drach, Joseph H. Gorman, Robert C. Gorman, Michael S. Sacks	Amir Khalighi*, Andrew Drach, Michael S. Sacks			
<b>Room: Revolution 2</b> (Hard Rock Hotel)		<b>MS 14</b>		<b>Mechanics of Soft Materials</b>	
		<b>First Chair: Qiming Wang</b>		<b>Second Chair: Ali Ghahremaninezhad</b>	
Understanding Self-healing of Nanocomposite Hydrogels.	A computational study of strain-induced crystallization in rubber.	A Permanent Set Constitutive Model For Exogenously Cross-Linked Collagenous Tissues.	Enhancing dry adhesion through soft composite elastomer structures.		
Qiming Wang*	Reza Rastak*, Christian Linder	Will Zhang*, Michael S. Sacks	Milad Tatari*, Amir Mohammadi Nasab, Kevin Turner, Wanliang Shan		

### Wednesday, June 7, 16:30 – 18:30, Session W3

Room	MS Number	Minisymposia Session Title
Salon A	MS132	Safety Assessment of Aging Infrastructure: From Data to Decision
Salon B	MS27	Third Symposium on Molecular Scale Modeling and Experimentation
Salon C	MS112	Nano- and Microstructured Materials
Salon E	MS144	Inverse problems for tomographic imaging and remote sensing applications in engineering
Gaslamp 4	MS105	The Link Between Composition, Structure, and Physical Properties of Materials
Balboa 3	MS143	Infrastructure system integrity through damage precursor sensing
Revolution 2 (Hard Rock Hotel)	MS13	Mechanics of Bioinspired Materials and Structures
Fame (Hard Rock Hotel)	MS98	Wind Engineering in Natural Hazards

# Wednesday, June 7

16:30 - 16:50	16:50 - 17:10	17:10 - 17:30	17:30 - 17:50	17:50 - 18:10	18:10 - 18:30
<b>Room: Salon A</b>		<b>MS 132</b>		<b>Safety Assessment of Aging Infrastructure: From Data to Decision</b> First Chair: Raimondo Betti Second Chair: Suparno Mukhopadhyay	
<b>[Keynote]</b> System identification of bridge structural system using a mobile actuator-sensor pair: Application to damage detection.  Rajdip Nayek*, Suparno Mukhopadhyay, Sriram Narasimhan	Deconvolution Interferometry-based Reliability Assessment of Buildings.  Hao Sun*, Oral Buyukozturk	Damage assessment on a base-excited frame structure using modal identification and flexibility-based deflections.  Raimondo Betti*, Giacomo Bernagozzi, Luca Landi, Pier Paolo Diotallevi	Imprecise Probability and Uncertainty Quantification for Nonlinear Static Procedure (NSP) and NSP-based Fragility Analysis.  ZhiQiang Chen*, Mostafa Badroddin	Wireless Crack Monitoring for Damage Detection in Existing Buildings.  Charles E. DeVore*, Lauren E. Linderman, Jennifer A. Rice	Fast Health Monitoring of Railway Bridges under Train Load including Operational Variability.  Suparno Mukhopadhyay*, Riya C. George, Sudib K. Mishra
<b>Room: Salon B</b>		<b>MS 27</b>		<b>Third Symposium on Molecular Scale Modeling and Experimentation</b> First Chair: Kalpana Katti Second Chair: Sinan Keten	
Coarse-Graining of Polymer Dynamics via Energy Renormalization.  Wenjie Xia*, Jake Song, Frederick R. Phelan Jr., Jack F. Douglas, Sinan Keten	Experimental evaluation of nanoscale structure and mechanics from healthy and osteogenesis imperfecta bone.  Kalpana S. Katti*, Scott Payne, Chunju Gu, Dinesh R. Katti	Interface Mechanics between Graphene and Tobermorite 14Å via Molecular Dynamics Simulations.  Baig Abdullah Al Muhit*, Florence Sanchez	Investigation of the mechanical properties of geopolymer binders using molecular dynamics simulation.  Yue Cui*, Ange-Therese Akono, Erman Guleryuz, Waltraud Kriven	Materials Genome for POSS-Cement Nanocomposites.  Hunain Alkhateb*, Ahmed Al-Ostaz, Hashem Almashaqbeh, Michael Daves, Alexander H-D Cheng	
<b>Room: Salon C</b>		<b>MS 112</b>		<b>Nano- and Microstructured Materials</b> First Chair: Marcus Rutner Second Chair: Michael J Demkowicz	
<b>[Keynote]</b> Annealing studies of metal nanocomposite joint.  Majid Ramezani Goldyani*, Michael J. Demkowicz, Marcus P. Rutner	Experimental and computational microscale characterization of hollow sphere mechanics.  Sanjay R. Arwade*, J Song, Guoping Zhang, Simos Gerasimidis	Size effects in fcc crystals during the high rate compression test.  George Z. Voyiadjis*, Mohammadreza Yaghoobi	Size and strain rate effects in metallic samples of confined volumes: Dislocation length distribution.  Mohammadreza Yaghoobi*, George Z. Voyiadjis	Non-dissipative Energy Absorption Mechanism of Liquid Nanofoam.  Weiyi Lu*, Mingzhe Li	Mechanical Metamaterials - Recent Advances and Applications.  Eduard Karpov*, Larry Danso
<b>Room: Salon E</b>		<b>MS 144</b>		<b>Inverse problems for tomographic imaging and remote sensing applications in engineering</b> First Chair: Tyler Tallman Second Chair: Beiwen Li	
A Comparison of Regularization Norms on Strain and Damage Visualization via Electrical Impedance Tomography in Carbon Nanofiber Composites.  Tyler Tallman*	3D dynamic strain measurement of inextensible thin membrane using structure light 3D imaging and geodesic computation.  Beiwen Li*, Song Zhang	Post-wildfire Vegetation Loss Mapping using Bitemporal Synthetic Aperture Radar Images.  ZhiQiang Chen*, Benoit de Patoul	Monitoring distributed damage in inflatable space structures using nanocomposite fabric sensors  Sumit Gupta, Long Wang*, Kenneth J. Loh		

# Wednesday, June 7

16:30 - 16:50	16:50 - 17:10	17:10 - 17:30	17:30 - 17:50	17:50 - 18:10	18:10 - 18:30
<b>Room: Gaslamp 4</b>		<b>MS 105</b>		<b>The Link Between Composition, Structure, and Physical Properties of Materials</b> First Chair: Konrad KrakowiaK Second Chair: Mohammad Javad Abdolhosseini Qomi	
Tunable phononic bandgaps for auxetic lattice.  Shivam Sharma*, Siladitya Pal	Reduced Order Modeling for Microstructure Sensitive High Cycle Fatigue Prediction.  Cheng Yu*, Zeliang Liu, Orion Kafka, Wing Kam Liu	Aspects of RVE topology, mesh discretization and boundary conditions in practical multiscale modeling for matrix inclusion composites.  Konrad Schneider*, Benjamin Klusemann, Swantje Bargmann			
<b>Room: Balboa 3</b>		<b>MS 143</b>		<b>Infrastructure system integrity through damage precursor sensing</b> First Chair: Marcus Rutner Second Chair: Branko Glisic	
Damage Precursor Sensing in Composites.  Behnoush Golchinfar*, Dimitri Donskoy, Marcus P. Rutner	Precursor Damage Estimation for Material State Awareness of Composites.  Sajan Shrestha*, Sourav Banerjee, Subir Patra				
<b>Room: Revolution 2 (Hard Rock Hotel)</b>		<b>MS 13</b>		<b>Mechanics of Bioinspired Materials and Structures</b> First Chair: Nima Rahbar Second Chair: Qiming Wang	
Analytical and Experimental Studies on Organic-inorganic Interface in Nacreous Materials.  Sina Askarinejad*, Nima Rahbar	The Achilles Heel of Nacre.  Saleh Alghamdi*	Buckling profile of a thin elastic rod embedded in a fractured elastic medium.  Wanliang Shan*, Amir Mohammadi Nasab, Dong Wang, Zi Chen	Layered elastomeric fibrous networks: An in-silico study of the achievable range of mechanical behaviors  Michael Sacks*, Gregory Rodin		
<b>Room: Fame (Hard Rock Hotel)</b>		<b>MS 98</b>		<b>Wind Engineering in Natural Hazards</b> First Chair: Aly-Mousaad Aly Second Chair: Changda Feng	
Accounting for climate change effects in performance-based hurricane engineering.  Michele Barbato*, Mirsardar Esmaeili	Dynamic Interaction of Wind and Rain Fields in the Boundary Layer of a Tropical Cyclone.  Teng Wu*, Reda Snaiki	Behavior of lightweight steel roof and wall systems due to spatiotemporally-varying wind loading.  Yared Shifferaw*, Kermelos Woldeyes			

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- Complimentary subscription to the EMI monthly newsletter
- Receive priority consideration to serve on EMI Technical Committees:

- Biomechanics
- Computational Mechanics
- Dynamics
- Elasticity
- Experimental Analysis & Instrumentation
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- Granular Materials
- Mechanics of Pavements
- Modeling Inelasticity & Multiscale Behavior
- Nanomechanics & Micromechanics
- Objective Resilience
- Poromechanics
- Probabilistic Methods
- Properties of Materials
- Stability
- Structural Health Monitoring & Control

### Awards

- Bažant, Zdeněk P. Medal for Failure & Damage Prevention
- Biot, Maurice A. Medal
- Cermak, Jack E. Medal
- Freudenthal, Alfred M. Medal
- Housner, George W. Medal
- Mindlin, Raymond D. Medal
- Newmark, Nathan M. Medal
- Scanlan, Robert H. Medal
- Shinozuka, Masanobu Medal
- von Kármán, Theodore Medal
- The EMI Leonardo da Vinci Award

### Upcoming Conferences

1. EMI 2018  
May 29 - June 1  
Massachusetts Institute of Technology (MIT)  
Cambridge, MA
2. EMI International Conference 2018  
November 2018  
Tongji University  
Shanghai, China

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For more information contact us at [emi@asce.org](mailto:emi@asce.org)



## Recommended Restaurants:

### **Werewolf**

627 4th Ave  
San Diego, CA 92101  
b/t G St & Market St  
Gaslamp

### **Searsucker**

611 5th Ave  
San Diego, CA 92101  
b/t G St & Market St  
Gaslamp

### **Cafe 21**

802 5th Ave  
San Diego, CA 92101  
b/t E St & F St  
Gaslamp

### **La Puerta**

560 4th Ave  
San Diego, CA 92101  
b/t Island Ave & Market St  
Gaslamp

### **Barleymash**

600 5th Ave  
San Diego, CA 92101  
b/t G St & Market St  
Gaslamp

### **Rustic Root**

535 5th Ave  
San Diego, CA 92101  
b/t Island Ave & Market St  
Gaslamp

### **Osteria Panevino**

722 5th Ave  
San Diego, CA 92101  
b/t G St & F St  
Gaslamp

### **Lou & Mickey's**

224 5th St  
San Diego, CA 92101  
b/t K St & L St  
Gaslamp

### **Meze Greek Fusion**

345 6th Ave  
San Diego, CA 92101  
b/t K St & J St  
Gaslamp, East Village

### **Spike Africa's Fresh Fish Grill & Bar**

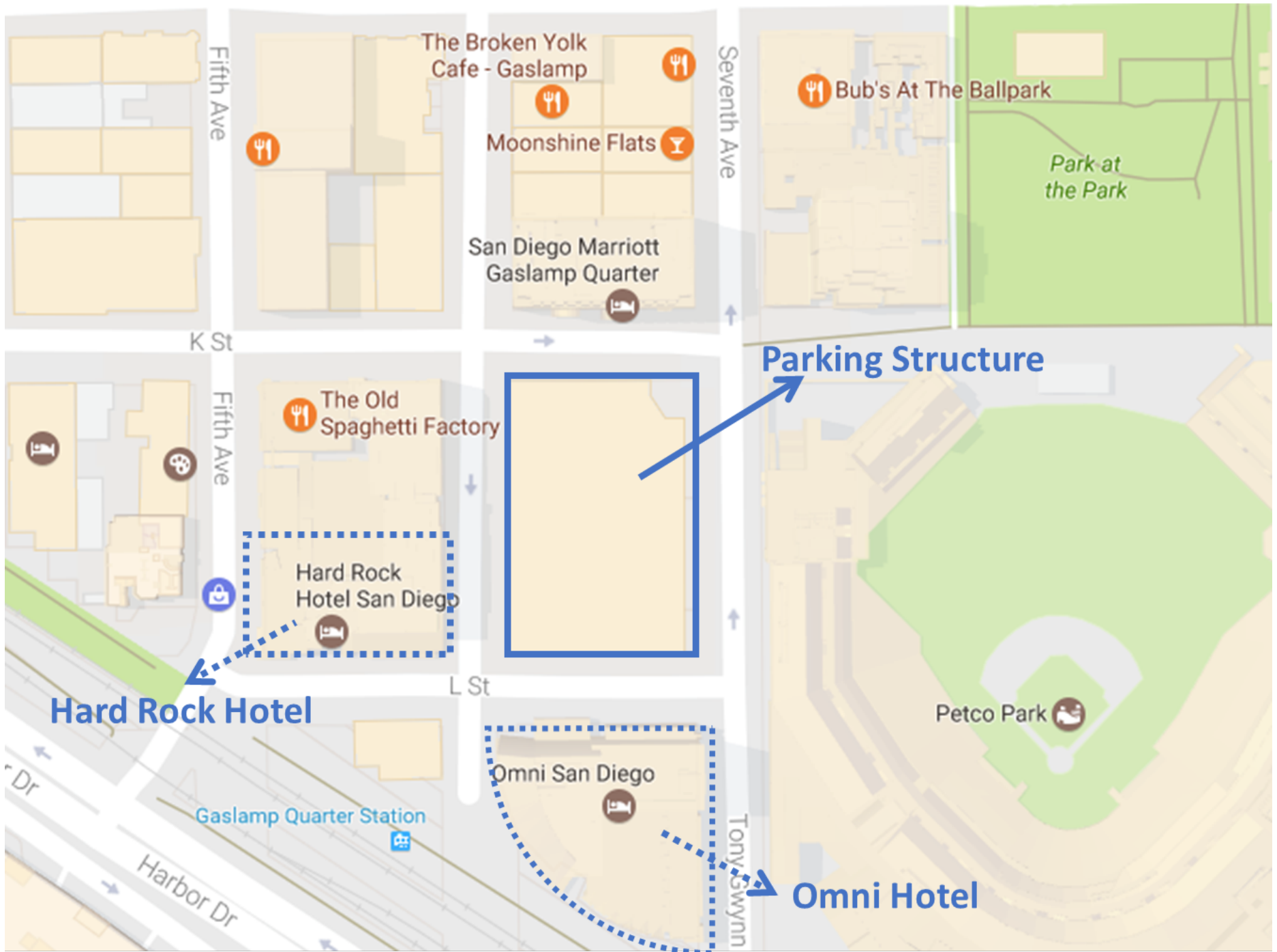
411 Broadway Ave  
San Diego, CA 92101  
b/t State St & 4th Ave  
Gaslamp

### **Cafe Sevilla**

353 5th Ave  
San Diego, CA 92101  
b/t K St & J St  
Gaslamp

### **Blue Point Coastal Cuisine**

565 5th Ave  
San Diego, CA 92101  
b/t Island Ave & Market St  
Gaslamp





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