



# EMI 2018

## Engineering Mechanics Institute Conference

May 29 -  
June 1, 2018

MIT

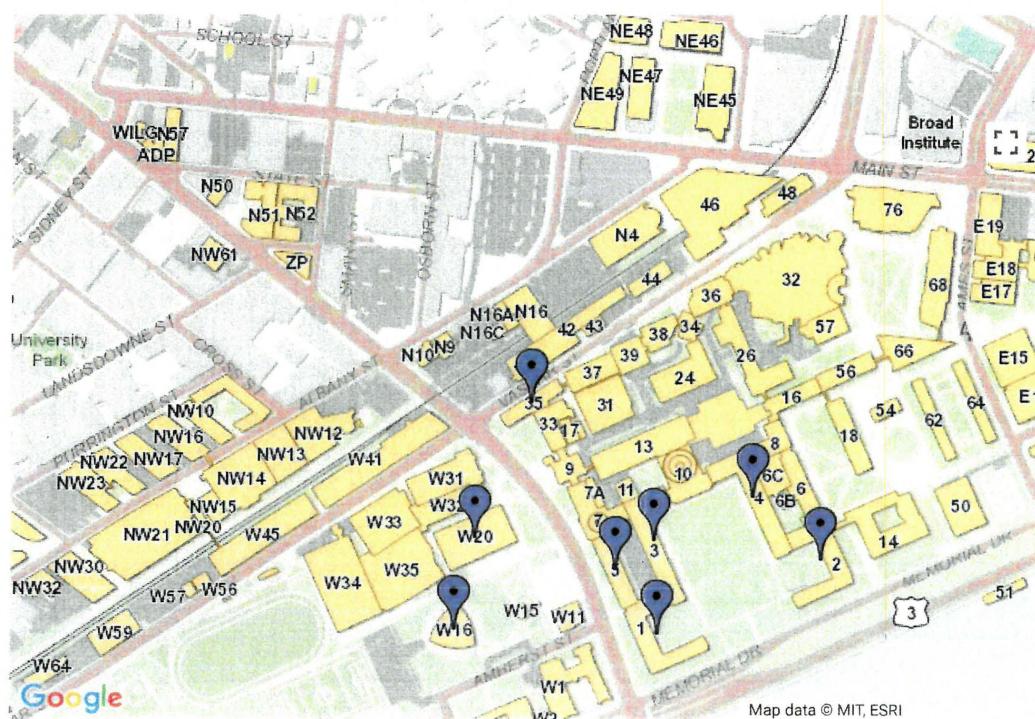
Co-organized by MIT, CNRS and UMASS DARTMOUTH

 campus map

massachusetts institute of technology • 77 massachusetts avenue • cambridge, ma 02139 • 617-253-1000

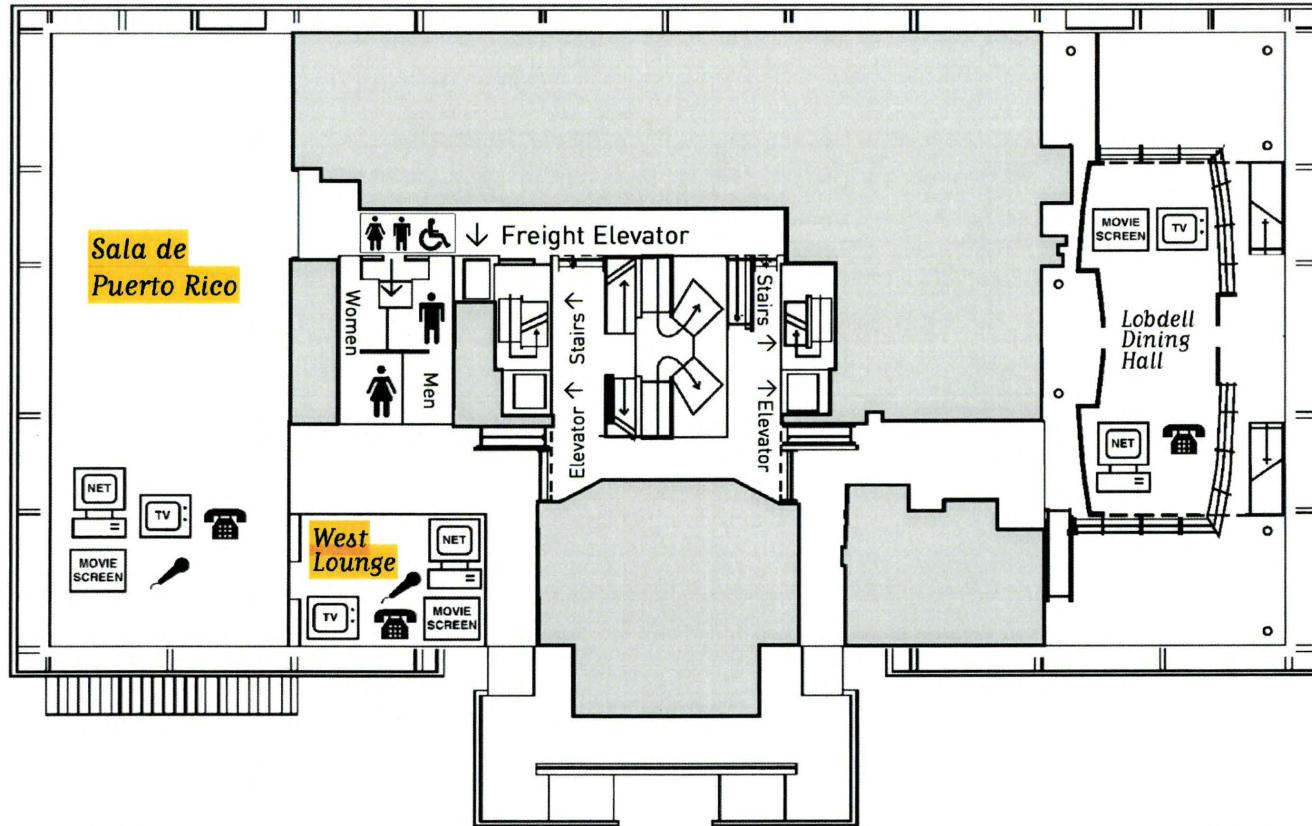
## Your Selected Markers

-  **Stratton Student Center**  
Building W20  
84 Massachusetts Avenue
-  **Kresge Auditorium**  
Building W16  
48 Massachusetts Ave (Rear)
-  **Pierce Laboratory**  
Building 1  
33 Massachusetts Avenue
-  **The Simons Building**  
Building 2  
182 Memorial Drive
-  **Maclaurin Buildings (3)**  
Building 3  
33 Massachusetts Ave (Rear)
-  **Maclaurin Buildings (4)**  
Building 4  
182 Memorial Drive (Rear)
-  **Pratt School**  
Building 5  
55 Massachusetts Avenue
-  **Sloan Laboratory**  
Building 35  
127 Massachusetts Avenue



2

STRATTON STUDENT CENTER (W20) SECOND FLOOR



Network Drop



Cable TV Drop



Microphone Jack  
(limited capability)



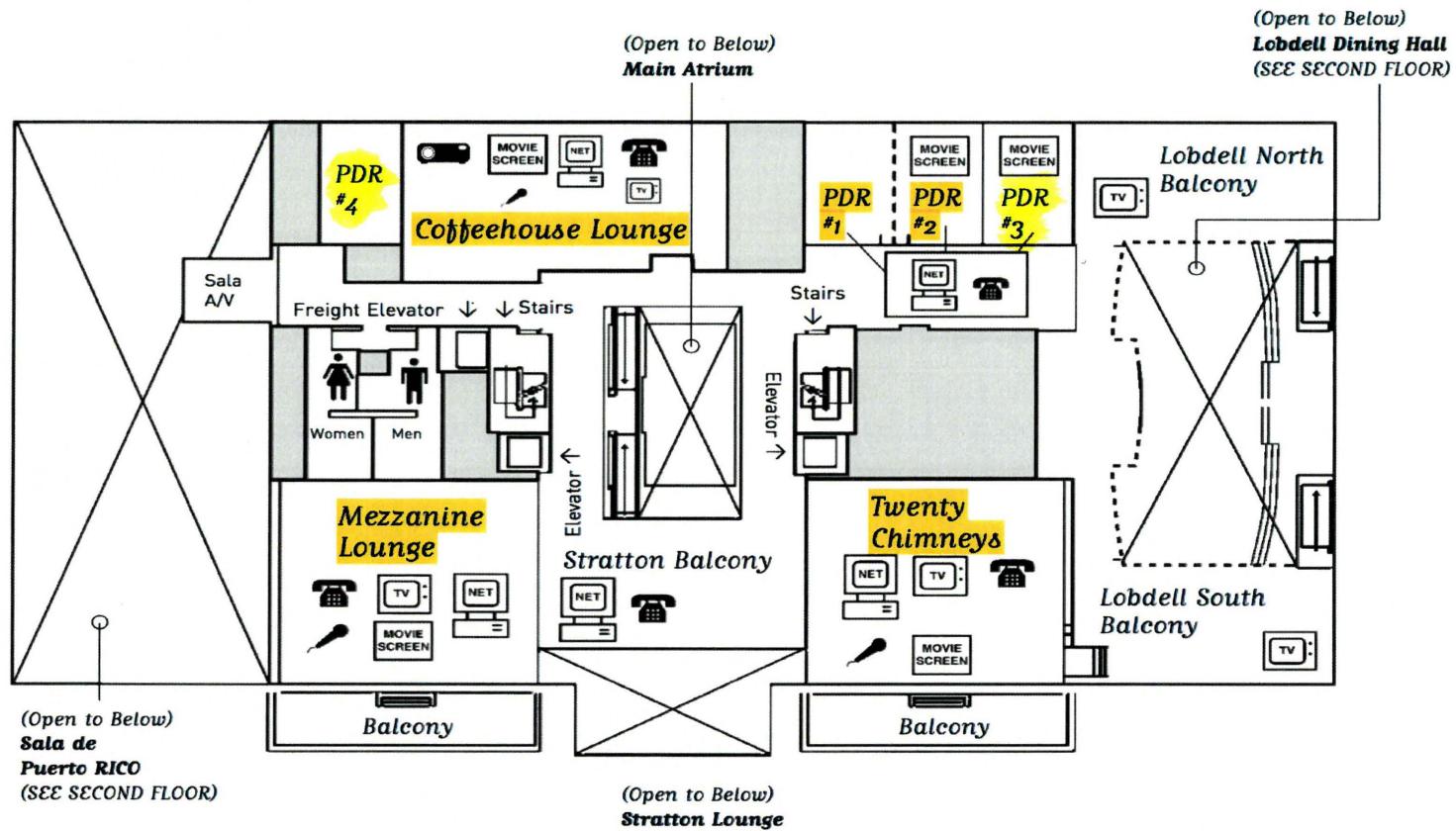
Telephone Jack



Movie Screen

STRATTON STUDENT CENTER (W20) THIRD FLOOR

3



Network Drop



Projector



Cable TV Drop



Microphone Jack  
(limited capability, except in  
Coffeehouse Lounge)



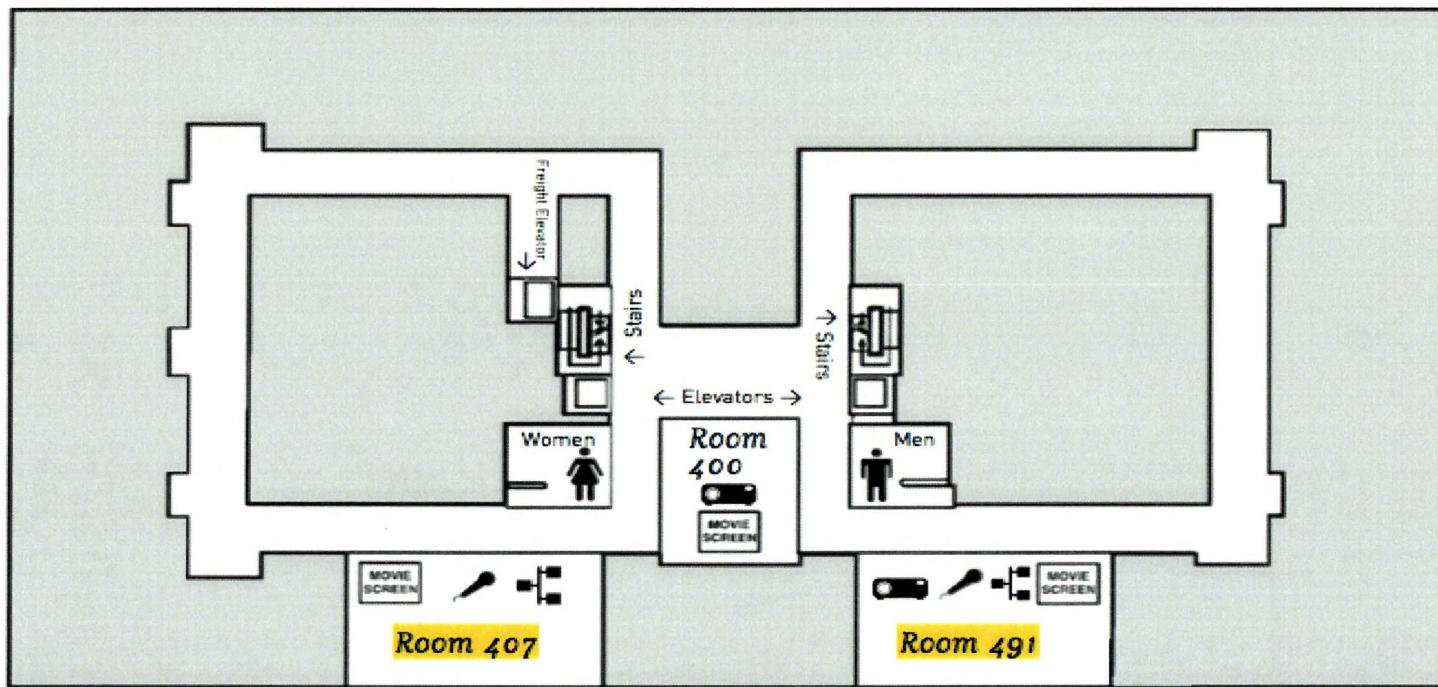
Telephone Jack



Movie Screen

4

STRATTON STUDENT CENTER (W20) FOURTH FLOOR



**Movie Screen**



**Projector**



**Microphone Jack**  
(limited capability)



**Network and  
Cable jack**

## OVERALL CONFERENCE PROGRAM

Tuesday, May 29	Wednesday, May 30	Thursday, May 31	Friday, June 1
12:00pm - 7:00pm Registration	7:00am - 5:30pm Registration  7:00am - 8:00am Continental Breakfast	7:30am-5:30pm Registration  7:30am-9:00am Continental Breakfast	7:30am-3:45pm Registration  7:30am-8:00am Continental Breakfast
	8:00am - 8:15am Welcoming Remarks	7:15am-9:00am NSF Breakfast Panel Discussion	
	8:15am - 9:15am Morning Plenary Lecture (Emanuela Del Gado)	9:00am-10:00am Morning Plenary Lecture (Roger Ghanem)	8:00am-9:00am Morning Plenary Lecture (Pedro Miguel Reis)
	8:30am - 4:30pm ASCE 49 Standards Committee Mtg		
	9:15am - 9:45am Coffee Break	10:00am-10:30am Coffee Break	9:00am-9:30am Coffee Break
	9:45am - 11:30am Technical Sessions	10:30am-12:00noon Technical Sessions	9:30am-11:30am Technical Sessions
	11:30am - 1:00pm Lunch	12:00noon-1:00pm Lunch	11:30am-1:00pm Lunch
	W20-2nd floor-Sala de Puerto Rico	W20-2nd floor-Sala de Puerto Rico	W20-2nd floor-Sala de Puerto Rico
	11:30am - 1:00pm Student Paper Competition		
	11:30am - 1:00pm Committee Meetings		
1:00pm - 7:00pm Committee Meetings	1:00pm-2:00pm Afternoon Plenary Lecture (Christian Hellmich)	1:00pm-2:00pm Afternoon Plenary Lecture (Nadia Lapusta)	1:00pm-2:00pm Afternoon Plenary Lecture (Lydia Bourouiba)
2:00pm - 6:00pm EMI Board of Governors Meeting	2:15pm-3:45pm Technical Sessions	2:15pm-3:45pm Technical Sessions	2:15pm-3:45pm Technical Sessions
		2:15pm-3:45pm Meeting with NSF Program Directors	
	3:45pm-4:15pm Coffee Break	3:45pm-4:15pm Coffee Break	
	4:15pm-5:45pm Technical Sessions	4:15pm-5:45pm Technical Sessions	
	4:15pm-5:45pm Student Poster Blitz Session		
	6:00 pm - 8:00pm Committee Meetings		
6:00pm-8:00pm Ice Breaker Reception Kresge Oval/Tent	6:00pm-9:00pm Student Poster Competition & Reception Kresge Oval/Tent	6:30pm-9:30pm Awards Banquet Hyatt Hotel	

# Minisymposium (MS) Schedule and Room Allocation

**MS:** # =Session Number, #/# =Combined Session Numbers, i.e. 4/97

**Time:** W =Wednesday, T =Thursday, F =Friday

**Location:** X-YZZ, where X =Building Number (see MIT campus map), Y =Floor Number, ZZ =Room Number

MS	Time	Location	Minisymposia Session Title	
1	T 4:15-5:45	3-133	Multifunctional Structural Components	
	F 2:15-3:45			
3	W 4:15-5:45	W20-491	Topology Optimization: from Algorithmic Developments to Applications	
	T 10:30-12:00			
	T 2:15-3:45			
4	T 2:15-3:45	5-234	Advances in Quantitative Engineering Sustainability, Physics-Based and Data-Driven Modeling and Prediction	
4/97	T 4:15-5:45			
5	W 9:45-11:30	W20-491	Architected Materials: Advances in Modeling, Design, Fabrication....	
	W 2:15-3:45			
5/63/99	T 4:15-5:45			
6	T 2:15-3:45	4-153	Multiscale Behavior of Damage and Failure Mechanics	
	T 4:15-5:45			
6/49	F 2:15-3:45			
7/46	W 4:15-5:45	4-265	Safety of Structures in Fire	
	T 10:30-12:00	4-261		
	T 2:15-3:45			
8	W 4:15-5:45	W20-407	Computational Modeling in Civil Engineering	
	T 10:30-12:00			
	T 2:15-3:45			
	T 4:15-5:45			
	F 9:30-11:30			
9	W 2:15-3:45	2-105	Coupled Processes in Subsurface Technologies	
9/92	W 4:15-5:45			

10	W 9:45-11:30 F 9:30-11:30	4-261	Modeling time-dependent behavior and deterioration of concrete
11	T 4:15-5:45	W16- Rehearsal Room A	Symposium on Progressive Damage and Failure in Structures...
12	T 2:15-3:45 T 4:15-5:45	5-217 1-390	Computer-vision based SHM using deep learning and UAV
13	W 9:45-11:30 W 2:15-3:45 W 4:15-5:45 T 10:30-12:00 F 9:30-11:30	3-270	Structural Identification and Damage Detection
14	W 2:15-3:45 W 4:15-5:45	4-261	Advances in Experimental, Theoretical and Computational Fracture Mechanics
15	W 9:45-11:30 W 2:15-3:45 W 4:15-5:45 T 10:30-12:00	W16- Rehearsal Room A	Stability and failure of structures and materials
16	W 9:45-11:30 F 9:30-11:30	4-265	Modeling and Characterization of Brittle and Quasibrittle Fracture
17/47	T 4:15-5:45	2-105	Porous Media Mechanics: Experiments and Simulation
18	W 4:15-5:45 F 9:30-11:30	3-370	Numerical Methods for Stochastic Engineering Dynamics
18/55	F 2:15-3:45		
19/31	W 9:45-11:30	3-133	Effects of Passive, Active and Semi-active Structural Control on Reliability and Sustainability of Aging Structures
20	T 2:15-3:45 F 9:30-11:30	W16- Rehearsal Room A	Nonlinear mechanics of highly deformable solids and structures
21/39	T 2:15-3:45	3-333	Vibration Control in Structures to Achieve System-Level Performance under...
22	T 10:30-12:00	W20-Twenty Chimneys	Advances in Experimental, Analytical and Computational Wind Engineering

23	F 9:30-11:30	1-390	Advanced deep learning based SHM
23/93	F 2:15-3:45		
24	W 4:15-5:45	4-159	Cementitious Materials: Experiments and Modeling Across the Scales
	T 10:30-12:00		
25	T 4:15-5:45	W16-Kresge Little	Tornadoes and Tornado-Structure Interaction Considering Impacts on Community Resilience
26	F 9:30-11:30	W20-491	Origami/Kirigami Based Systems and Adaptive Structures
	F 2:15-3:45		
27	T 2:15-3:45	4-231	Computational Geomechanics
	T 4:15-5:45		
	F 9:30-11:30		
28	T 4:15-5:45	4-261	Advances and Applications of Elasticity within Applied Mechanics
	F 2:15-3:45		
29	T 2:15-3:45	3-370	Stochastic Methods in Computational Mechanics of Random Materials
	T 4:15-5:45		
30	W 9:45-11:30	W20-407	Hierarchical and Multiscale Methods for Simulation Based Design of Materials
	F 9:30-11:30	W20-PDR 1&2	
31/19	W 9:45-11:30	3-133	Advanced Analysis for Earthquake Engineering
31	T 2:15-3:45		
32	W 9:45-11:30	4-145	Asset vs. Community Resilience, with lessons, applications, and knowledge gaps from hurricane Harvey
33	T 4:15-5:45	5-217	Analytical and experimental investigations on resilient critical infrastructure under multiple hazards
33/67	F 2:15-3:45		
34	W 2:15-3:45	5-234	Advances in computational methods for rapid uncertainty quantification.....
	W 4:15-5:45		
	T 10:30-12:00		

35	W 9:45-11:30	W20-Mezzanine Lounge	Fluid-Structure Interactions and Flow-Induced Motions
35/72	F 9:30-11:30		
36	F 9:30-11:30	W20-Twenty Chimneys	Robustness of Infrastructures
37	W 4:15-5:45	3-333	Bayesian methods for system risk assessment and management
	T 10:30-12:00	3-370	
38	F 2:15-3:45	3-270	Recent Advances in Uplifting Structures and Rocking Isolation
39	T 10:30-12:00	3-333	Dynamic Response and Performance Assessment of.....
39/21	T 2:15-3:45		
40	W 9:45-11:30	4-237	Mechanics and Physics of Granular Materials
	W 2:15-3:45		
	W 4:15-5:45		
	T 10:30-12:00		
40/90	T 2:15-3:45		
41/69	W 2:15-3:45	W20-PDR 1&2	Genome of Infrastructure Materials
42	W 9:45-11:30	2-131	Mechanics of growth in biology and engineering
43	W 2:15-3:45	3-370	Finite Element Model Updating for Structural Sensor Data Fusion
	T 4:15-5:45	3-333	
44	W 2:15-3:45	3-133	Safety Assessment of Aging Infrastructure: From Data to Decision
	W 4:15-5:45		
	T 10:30-12:00		
45	F 9:30-11:30	3-133	Innovations and Advances in Passive Structural Control

46/7	W 4:15-5:45	4-265	Structural-Fire Engineering – Past, Present, and Future	
	T 10:30-12:00	4-261		
	T 2:15-3:45			
47	T 10:30-12:00	2-105	Characterization and modeling of coupled processes in porous materials	
	T 2:15-3:45			
47/17	T 4:15-5:45			
48	W 9:45-11:30	W16-Kresge Little	Computational Methods and Applications for Solid and Structural Mechanics	
	W 2:15-3:45			
	W 4:15-5:45			
	T 10:30-12:00			
	T 2:15-3:45			
	F 2:15-3:45			
49/6	F 2:15-3:45	4-153	Computational modeling of damage and failure in solids and structures	
50	T 2:15-3:45	4-265	Computational Biomechanics: From Cell, Tissue, to Organ-Level Modeling	
	T 4:15-5:45			
51	F 9:30-11:30	2-105	Computational mechanics of nano- and bio- structures and	
52	F 2:15-3:45	W20-407	Damage modelling of engineering structures: from	
53	W 2:15-3:45	4-153	Mechanics of Wood and Wood Based Materials:	
	W 4:15-5:45			
	T 10:30-12:00			
54/60	W 9:45-11:30	4-153	Micromechanics of Granular Materials	
55/18	F 2:15-3:45	3-370	Monte Carlo simulation and equivalent linearization methods for nonlinear stochastic mechanical systems	
56	W 4:15-5:45	5-217	Complex Dynamics Modeling and Control of Structures under Multi-Hazards	
57	W 9:45-11:30	4-231	17th Symposium on Biological and Biologically Inspired Materials and Structures	
	W 2:15-3:45			
57/70/88	W 4:15-5:45			
58	W 9:45-11:30	W20-PDR 1&2	Fourth Symposium on Molecular Scale Modeling and Experimentation	
59	T 4:15-5:45	W20- Coffeehouse Lounge	Solid/fluid mechanics and probabilistic methods for offshore wind energy	
	F 2:15-3:45			

60/54	W 9:45-11:30	4-153	Advances in experimental thermo-poro-mechanics of geomaterials
61/68/76	F 9:30-11:30	W20-Coffeehouse Lounge	Nano- and microstructured materials
63/99/5	T 4:15-5:45	W20-491	Extreme mechanics of architected materials
64	W 2:15-3:45	4-145	3rd Mini-Symposium on Multiphysics-Multiscale Modeling of Engineering Materials
	W 4:15-5:45		
65	T 10:30-12:00	W20-PDR 1 &2	Latest trends in additive manufacturing technologies
67/33	F 2:15-3:45	5-217	Structural and Geotechnical Response Characterization Following Non-Naturally...
68	T 10:30-12:00	W20-Coffeehouse Lounge	The Link Between Composition, Structure, and Physical Properties of Materials
	T 2:15-3:45		
68/61/76	F 9:30-11:30		
69/41	W 2:15-3:45	W20-PDR 1&2	Materials in Cultural Heritage: Durability, Sustainability and Mechanics
70/88/57	W 4:15-5:45	4-231	Large deformation bio-poro-mechanics
71	T 10:30-12:00	4-145	Advanced Engineering Concepts, Designs, and Technologies for Aerospace and Extraterrestrial Applications
	T 2:15-3:45		
72/35	F 9:30-11:30	W20-Mezzanine Lounge	Multiphase Flow Applications in Engineering: Insights from Numerical Modeling and...
73	W 9:45-11:30	W20-Coffeehouse Lounge	Meshfree, Peridynamics, and Particle Methods: Contemporary Methods and Applications
	W 2:15-3:45		
	W 4:15-5:45		
74	W 9:45-11:30	1-390	Vision-based Studies in Structural Health Monitoring
	W 2:15-3:45		
75	F 9:30-11:30	5-217	Multi Physics/Scale Modeling and Stochastic Approaches for Critical Civil Infrastructures
76/68/61	F 9:30-11:30	W20-Coffeehouse Lounge	Mechanics of Emerging Polymers with Unprecedented Networks

78	F 2:15-3:45	W16- Rehearsal Room A	Nanomaterials and their impact on constructibility
79	T 10:30-12:00	2-131	Human-Machine Interfaces for Structural Engineering Assessment
80/81	F 9:30-11:30	2-131	Assessing Human Performance Sensing and Human-Induced Structural Responses
81/80	F 9:30-11:30	2-131	Crack detection of civil infrastructure
82	T 2:15-3:45	3-270	Forward and inverse modeling for performance and resilience assessment of civil structures
	T 4:15-5:45		
83	W 2:15-3:45	W20-Twenty Chimneys	Multi-functional composites for engineering application
84	F 9:30-11:30	5-234	Structural Monitoring for Improved Structural Design and Analysis in Field Applications
85	T 2:15-3:45	2-131	Advances in experimental mechanics: Damage detection and identification
87	W 2:15-3:45	3-333	Metamaterials for vibration mitigation
	F 9:30-11:30		
88/57/70	W 4:15-5:45	4-231	Biological and Biologically Inspired Materials and Structures
89	W 9:45-11:30	2-105	Analytical and Numerical Solutions to Problems in Petroleum Geomechanics
90/40	T 2:15-3:45	4-237	Verification and Validation of Numerical and Constitutive Modeling Techniques of Soil Response and Liquefaction
91	W 4:15-5:45	1-390	Machine Learning and Data Analytics for Infrastructure Integrity Assessment
	T 10:30-12:00		
	T 2:15-3:45		
92/9	W 4:15-5:45	2-105	Penetrating Radar and Electromagnetic Sensing of Subsurface Conditions
93/23	F 2:15-3:45	1-390	Remaining Useful Life Monitoring and Prediction of Complex Structures
94	W 9:45-11:30	W20-Twenty Chimneys	Simulation, Prediction, and Mitigation of Extreme Events
	T 2:15-3:45		
95	W 9:45-11:30	3-370	Recent Advances in Real-time Hybrid Simulation
96/98	F 9:30-11:30	4-237	Bio-inspired structures and materials for civil infrastructural applications
97/4	T 4:15-5:45	5-234	The Interface of Engineering Mechanics and Extreme Climatic Events
98/96	F 9:30-11:30	4-237	Mechanics of Soft Materials
99/5/63	T 4:15-5:45	W20-491	Mechanics of bio-inspired architected materials and interfaces

100

W 2:15-3:45

2-131

General Engineering Mechanics

EMI 2018  
2018 ENGINEERING MECHANICS INSTITUTE  
(EMI) CONFERENCE  
MIT, Cambridge, Massachusetts USA  
Tuesday, May 29 – Friday, June 1, 2018  
Organized by

Massachusetts Institute of Technology &  
University of Massachusetts Dartmouth

**CONFERENCE CO-CHAIRS**

Arghavan Louhghalam, UMASS Dartmouth  
Roland Pellenq, MIT  
Mazdak Tootkaboni, UMASS Dartmouth  
Franz-Josef Ulm, MIT

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Arghavan Louhghalam, UMASS Dartmouth  
Roland Pellenq, MIT  
Mazdak Tootkaboni, UMASS Dartmouth  
Franz-Josef Ulm, MIT

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Celine Bailly, Graphic Web-designer  
Conference Services, MIT

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Verna Jameson, ASCE/EMI

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## WELCOME FROM THE EMI 2018 PRESIDENT



Professor George Deodatis

Columbia University, New York City

Dear Participants of EMI 2018,

As I complete my first year of service as President of EMI, I would like to express my sincere thanks to the extraordinary dedication, commitment and hard work of the Board of Governors, the EMI staff, the technical committees, and our members in the U.S. and around the globe. In particular, I would like to thank Jiun-Shyan (J.S.) Chen, the Past President of EMI, for his guiding leadership over the last two years.

On behalf of EMI, I would like to thank Arghavan Louhghalam, University of Massachusetts Dartmouth, Roland Pellenq, Massachusetts Institute of Technology, Mazdak Tootkaboni, University of Massachusetts Dartmouth, and Franz-Josef Ulm, Massachusetts Institute of Technology, their colleagues, and the Massachusetts Institute of Technology for organizing and hosting this year's EMI Annual Conference which has already reached new heights, with over 950 participants as of May 2nd. The ever-increasing attendance at the EMI conferences reflects EMI's growing reputation as the premier venue for engineering mechanics. In addition to the vibrant technical programs offered over the past ten years at EMI conferences, our Institute has experienced a healthy increase in its membership and has greatly benefited from the stellar reputation of our flagship publication, the ASCE Journal of Engineering Mechanics, under the inspiring editorship of Roberto Ballarini, University of Houston.

I invite you to get more involved with our institute. EMI will further grow and thrive only if the requisite hard work is shared among its members. Opportunities for engagement include publication in the ASCE Journal of Engineering Mechanics and the Lecture Notes in Mechanics Series, active participation on technical committees, organization of conference sessions and symposia, engagement in the EMI industry collaboration, delivery of webinars, and seeking leadership roles on committees and the Board of Governors.

I wish you an enjoyable and productive conference.

Yours truly,

*Deodatis Georgios*

## WELCOME FROM THE EMI 2018 CO-CHAIRS

Dear Friends and Colleagues,

It is with great pleasure that we welcome you to the campus of the Massachusetts Institute of Technology, site of the Engineering Mechanics Institute Conference 2018 (EMI 2018) co-organized by M.I.T., C.N.R.S and the University of Massachusetts at Dartmouth. The 2018 EMI conference stays true to its long-standing tradition as the prime venue worldwide for disseminating the most recent progress in Engineering Mechanics as the core discipline of science-enabled Civil Engineering understood in the broadest sense.

We are grateful to the international scientific committee for their hard and timely peer review of more than 1,200 submitted abstracts and 100 proposed minisymposia. We are grateful to the leadership of EMI of the American Society of Civil Engineers for their guidance in organizing EMI 2018. And we are most grateful to you, the delegates, students, researchers and faculties, for engaging in defining and shaping presence and future of Engineering Mechanics through your intellectual contributions, presentations, posters, and so on.

The great interest in and dedication to this yearly EMI conference is a hallmark of a healthy community which we celebrate. But in a time when borders close, and barriers, both intellectually and physically, are put in place that challenge the very essence of science and engineering, our community is challenged, too. Therefore, while celebrating our community, we will also pause, reflect and look inward on how to shape our future. We are extremely fortunate for the support of the National Science Foundation to organize, on Thursday May 31, 2018, a NSF Breakfast Panel Discussion on fostering diversity of our engineering mechanics research community.

For what makes Engineering Mechanics great is the art of problem solving with purpose, with which we strive to translate science principles into tangible engineering solutions for the benefit of our profession and our societies worldwide.

Thank you for being a part of our community.

Welcome and Enjoy,

*Arghavan Louhghalam, UMass Dartmouth*

*Roland Pellenq, C.N.R.S. – M.I.T.*

*Mazdak Tootkaboni, UMass Dartmouth*

*Franz-Josef Ulm, M.I.T.*

## **Information about the Conference**

*All conference activities with the exception of the Banquet, will be held on the MIT campus. Please wear your conference name badge for admission to all events.*

### **Registration Desk**

Registration desk is located in the Kresge Auditorium lobby (W16). Registration hours are:

Tuesday: 12:00noon – 7:00pm

Wednesday: 7:00am – 5:30pm

Thursday: 7:30am – 5:30pm

Friday: 7:30am – 3:45pm

Regular registration includes all sessions (MIT) and conference materials, breakfast, lunch, and coffee breaks on May 30 – June 1, Ice Breaker Reception (MIT), Poster Reception (MIT) and Banquet (Hyatt Regency, 575 Memorial Dr., Cambridge).

Also, access to Conference Book of Abstracts (electronic) and EMI-only membership (for “Non-Member Full Registration”)

Student Registration does not include Banquet. Banquet tickets are available and can be purchased at the registration desk by close of registration on Wednesday, May 30, 2018.

### **Breakfast**

Continental breakfast will be served in the Kresge Lobby (W16) on Wednesday 7:00-8:00am, Thursday 7:30-9:00am, Friday 7:30-8:00am. Seating available in the Tent outside of Kresge.

### **Lunch**

Box lunches will be served in the Stratton Student Center (W20) 2<sup>nd</sup> floor, Sala de Puerto Rico room, Wednesday, 11:30-1:00pm, Thursday, 12noon-1:00pm and Friday 11:30-1:00pm. Seating is available in Sala, the outside Tent and Session meeting rooms in W20.

### **Refreshment Breaks**

Refreshment breaks will be served in the mornings of Wednesday, Thursday and Friday and in the afternoons of Wednesday and Thursday in the Kresge Lobby (W16) and the Tent outside of Kresge. Please consult the Technical Program for exact break times.

## **Program Format**

The technical program consists of 6 Plenary Lectures and 95 Minisymposia, with approximately 760 Presentations in 150 Technical Sessions.

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

Plenary Lectures will be held in the Kresge Auditorium (W16). Parallel technical sessions will be held in the Stratton Student Center (W20), Kresge Auditorium (W16), Pierce Laboratory Building 1, The Simmons Building 2, Maclaurin Building 3, Maclaurin Building 4, and the Pratt School Building 5 on the MIT campus.

## **Internet Connections**

The MIT Guest wireless network does not require authentication and is not encrypted. It is easy to connect to the MIT Guest wireless network with a wireless device. Since there are no restrictions to connecting, your device should be able to find the

network as one of the open wireless options. It should connect instantly.

## **EMI 2018 App is now available for downloading.**

1. Download the Conference4Me app to your phone. The app is available on three platforms: Android, iPhone, and Windows Phone. The app may be downloaded from the app store of each. See <http://conference4me.psnc.pl/download/> for details.
2. Open the Conference4Me app and then the app menu located in the upper left corner. Scroll to the bottom and select “Get More Conferences” under “Conference Management.”
3. Tap “Download Conferences” in the lower right corner
4. In the search bar, enter “EMI2018” (note there is no space between “EMI” and “2018”). Tap the download icon on the right.
5. You may now begin browsing the conference agenda!

## **Emergency Contact Information**

To report an emergency while you are on campus, call MIT Police at 100 from a campus phone, or 617-253-1212 from a cell phone. Additionally, scattered throughout the campus and in some perimeter locations is a network of “blue light” emergency telephones. These phones, which can be identified after dark by their distinctive blue lights, allow an immediate, direct connection to the MIT Police without the need to dial a phone number.

## **Social Events**

### **Ice Breaker Reception**

*Sponsored by the MIT Dept. of Civil and Environmental Engineering*  
Tuesday, May 29, 6:00-8:00pm  
Kresge Oval Tent

### **Poster Reception**

Wednesday, May 30, 6:00-9:00pm  
Kresge Oval Tent

## **Banquet and Award Ceremony**

Thursday, May 31, 6:30-9:30pm  
Hyatt Regency Hotel, Presidents Ballroom  
575 Memorial Drive, Cambridge, MA

## **SPECIAL EVENTS**

### **NSF Breakfast Panel Discussion**

(must have pre-registered; ticket required)  
Thursday, May 31, 7:15-9:00am  
Stratton Student Center (W20)  
2<sup>nd</sup> floor, Sala de Puerto Rico room

### **Meeting with NSF Program Directors**

Thursday, May 31, 2:15-3:45pm  
Stratton Student Center (W20)  
3<sup>rd</sup> floor, Mezzanine Lounge

### **Student Poster and Paper Competitions**

Wednesday, May 30, 2018  
See Detailed Schedule

**EMI 2018, May 31<sup>st</sup>, 2:15-3:45pm**  
**Massachusetts Institute of Technology**  
**Cambridge, MA**

**W20-3<sup>rd</sup> floor, Mezzanine Lounge**



## **MEETING WITH NSF PROGRAM DIRECTORS**

Grace Hsuan and Joy Pauschke (ECI program)  
Siddiq Qidwai (MoMS program)

This special session consists of two parts:

### **Part 1**

The program information on “Engineering for Civil Infrastructure (ECI)”, “Mechanics and Materials and Structures (MoMS), and cross agency new solicitations.

### **Part 2**

Proposal writing “Frame a proposal”. (depending on the time)

The ECI program which started on December 30<sup>th</sup>, 2017 represented a new and integrated vision for research to underpin transformative innovations for the built environment. The MoMS program supports fundamental research in mechanics as related to the behavior of deformable solid materials and structures under internal and external actions. The presentations will highlight the focuses, questions to be addressed, and frequently asked questions related to both programs. There will be Q/A time for audience at the end of the presentations.

The proposal writing will provide recommendation on how to frame a compatible proposal as well as the specific requirement in preparing a CAREER proposal.

# STUDENT COMPETITIONS

## POSTER COMPETITION

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

Sponsored by: EMI Computational Mechanics Committee  
Chair: Haim Waisman

Wednesday, May 30, 4:15-5:45pm, Kresge Auditorium  
Wednesday, May 30, 6:00-9:00pm, Tent

## PAPER COMPETITION

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

Sponsored by: EMI Probabilistic Methods Committee  
Chair: Michael Shields  
Wednesday, May 30, 11:30am-1:00pm  
W20-4<sup>th</sup> floor, Room 407

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

Sponsored by: EMI Dynamics Committee  
Chair: Michele Barbato  
Wednesday, May 30, 11:30am-1:00pm  
W20-3<sup>rd</sup> floor, Twenty Chimneys

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

Sponsored by: EMI Modeling Inelasticity & Multiscale Behavior Committee  
Chair: Chung Song  
Wednesday, May 30, 11:30am-1:00pm  
Building 35-3<sup>rd</sup> floor, Room 35-308

### **EMI Objective Resilience Committee (ORC) Student Paper Competition**

Sponsored by: EMI Objective Resilience Committee  
Chair: Mohammed M. Ettouney  
Wednesday, May 30, 11:30am-1:00pm  
W20-3<sup>rd</sup> floor, Coffeehouse Lounge

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

Sponsored by: EMI Structural Health Monitoring Control Committee  
Chair: Hay Young Noh  
Wednesday, May 30, 11:30am-1:00pm  
W20-4<sup>th</sup> floor, Room 491

## EMI COMMITTEE MEETINGS (MIT) MAY 29 - JUNE 1, 2018

DAY	COMMITTEE	CHAIR	TIME	ROOM ASSIGNMENT
Tuesday, May 29	EMI Board of Governors	Georgios Deodatis	2 - 6pm	W20-3rd floor - Mezzanine Lounge
	Objective Resilience Committee	Mohammed M. Ettouney	1 - 5pm	W20-3rd floor Coffeehouse Lounge
	ASCE 49 Standards Committee	Gregory Kopp	1 - 5pm	Building 35, 3rd floor, room 35-310
	Properties of Materials	Stefan Scheiner	1 - 6pm	W20-4th floor - Room 407
	Fluid Dynamics	Panayiotis Diplas	2 - 5pm	W20-3rd floor-PDR 3
	Dynamics	Michele Barbato	3 - 5pm	W20-3rd floor-Twenty Chimneys
	Granular Materials	Mahdia Hattab	4 - 6pm	Building 1, 2nd floor, room 1-246
	Structural Health Monitoring and Control	Babak Moaveni	4 - 6pm	W20-4th floor-Room 491
	Computational Mechanics	Haim Waisman	4 - 6pm	W20-3rd floor-PDR 1 & 2
	Mechanics of Pavements	Yong-Rak Kim	4:30 - 6pm	Building 1, 1st floor, room 1-150
	Elasticity	Anil Wijeyewickrema	5 - 6pm	W20-3rd floor-PDR 4
	Stability	Ahmer Wadee	5 - 7pm	Building 1, 2nd floor, room 1-242
Wednesday, May 30	ASCE 49 Standards Committee	Gregory Kopp	8:30am - 4:30pm	Building 35, 3rd floor, room 35-310
	Poromechanics	Giuseppe Buscarnera	11:30am - 1pm	W20-3rd floor-PDR 4
	Journal of Engineering Mechanics (JEM)	Roberto Ballarini	11:30am - 1pm	W20-3rd floor-PDR 1 & 2
	Experimental Analysis & Instrumentation	TBD	11:30am - 1pm	Building 1, 1st floor, room 1-150
	Probabilistic Methods	Lori L. Brady	6 - 8pm	W20-3rd floor-Twenty Chimneys
	Modeling Inelasticity & Multiscale Behavior	Chung Song	6 - 8pm	W20-3rd floor-Coffeehouse Lounge

## THE ENGINEERING MECHANICS INSTITUTE ANNOUNCES THE RECIPIENTS OF THE 2018 AWARDS

### ASCE Walter L. Huber Civil Engineering Research Prizes



**Prof. José E. Andrade, Ph.D., M.ASCE** (Caltech) is honored for *"revolutionizing the field of granular geomaterials by replacing heuristic methodologies with rigorous multiscale modeling approaches based on scientific understanding of the mechanics and physics across scales and for defining new frontiers for the civil engineering profession including planetary exploration."*



**Prof. Yuri Bazilevs, Ph.D., A.M.ASCE** (University of California San Diego) is honored for *"pioneering work in the development of isogeometric analysis and its applications to problems in mechanics of fluids, solids, and structures and for the development of core and special-purpose FSI methods and their pioneering applications in wind energy and extreme-events modeling."*

### Zdenek P. Bažant Medal for Failure and Damage Prevention



**Prof. Yonggang Huang, Ph.D., M.ASCE, NAE** (Northwestern University) has been selected for *"pioneering work on macro-, micro-, and nano-scale fracture, and application to transfer printing."*

### Jack E. Cermak Medal (Joint with the Structural Engineering Institute of ASCE)



**Professor Emeritus Hans-Jürgen Niemann, Dr. Ing. Habil** (Ruhr-Universität Bochum, Germany) has been selected for *"introducing the field of wind engineering to practice and his research on the interaction of wind and structures that led to the design of safe and reliable engineering structures."*

### Alfred M. Freudenthal Medal



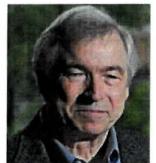
**Prof. Zdeněk P. Bažant, Ph.D., S.E., NAE, NAS, F.EMI, Hon.M.ASCE, NAE** (Northwestern University) has been selected for *"developing a comprehensive theory of probabilistic, mechanics of strength, lifetime, and size effect of quasi-brittle structures."*

### George W. Housner Structural Control and Monitoring Medal



**Prof. Oral Buyukozturk, Ph.D., M.ASCE** (M.I.T.) has been selected for “pioneering and transformative developments in video-based structural sensing and identification, interferometry-based data analytics, high-efficiency generic wireless networks, and their integration with groundbreaking engineering mechanics research and practice for enhancing civil infrastructural resilience and sustainability.”

### Raymond D. Mindlin Medal



**Prof. James R. Rice, Ph.D., M.ASCE, NAE** (Harvard University) has been selected for “pioneering work in continuum mechanics with applications to various engineering materials and natural processes.”

### Theodore von Kármán Medal



**Prof. J. N. Reddy, Ph.D.** (Texas A & M University) has been selected for “fundamental contributions to shear deformation theories of plates and shells and their applications as well as the authorship of well-received textbooks that have lasting impact on engineering mechanics education.”

### Nathan M. Newmark Medal (Joint with the Structural Engineering Institute of ASCE)



**Prof. Billie F. Spencer, Ph.D., P.E., F.ASCE** (University of Illinois at Urbana-Champaign) has been selected for “pioneering work, innovations, and leadership in the theory and application of advanced technologies to fundamental problems in structural engineering and mechanics, as well as for his unwavering commitment to education/mentoring of students and professional service.”

### EMI Leonardo da Vinci Award



**Prof. WaiChing Sun, Ph.D., A.M.ASCE** (Columbia University) has been selected “for his fundamental contributions to computational multiscale poromechanics.”

Congratulations to all the award winners!

These awards will be presented on May 31 at the banquet and awards ceremony of the [EMI 2018 conference](#) at M.I.T. in Cambridge, MA.

**Wednesday, May 30, 2018**

**8:15 - 9:15am**

**Plenary Lecture 1**

**Room: W16 – Kresge Main**

Emanuela Del Gado

Georgetown University

Sustainable concrete and cement: A soft matter in construction



## **Emanuela Del Gado**

Provost's Distinguished Associate Professor  
Department of Physics  
Georgetown University, Washington, DC

physics approaches to tackle the structural and mechanical complexity of the material over critical lengthscales. These achievements provide novel opportunities to transform cement production and use.

### **Biosketch:**

Emanuela Del Gado is a theoretical physicist working on engineering motivated problems. She uses statistical mechanics and computational physics to investigate materials with structural and dynamical complexity, from model amorphous solids, gels and glasses, to new green formulations of cement.

Prof. Del Gado received her undergraduate degree (Laurea in Physics, cum laude) at the University of Naples "Federico II" in Italy, where she also obtained a PhD in Physics in 2001. She has been a Marie Curie Fellow at the University of Montpellier II in France and a post-doctoral researcher at ETH Zurich in Switzerland, and hold visiting positions at ESPCI (France) and MIT. Before joining Georgetown University, Emanuela was the Swiss National Science Foundation professor in the Department of Civil Environmental and Geomatic Engineering at ETH Zurich.

Professor Del Gado's research interests are in the areas of statistical mechanics and computational physics; structure, cooperative dynamics and nonlinear mechanics of amorphous solids, gels and glasses; nanoscale structure and mechanics of cement gels; self-assembly of nanoparticles and fibrils at liquid interfaces; biomimetic coatings and mechanics of tissues

## **Sustainable concrete and cement: A soft matter in construction**

### **Abstract:**

Concrete and cement are the foundation of our global infrastructure and have a key role in the growth which is required to support a world population projected to surge past 9 billion by mid-century, with more than 70% living in urban areas. More than 20 billion tons of concrete are produced every year, more than any other material on Earth, such that concrete production is responsible for 10% of the whole anthropogenic production of CO<sub>2</sub>. Reducing CO<sub>2</sub> emissions for concrete production, designing and optimizing material performances, resilience and durability is hence crucial to a sustainable growth and to meet Green House Emissions reduction goals.

Strength and other mechanical properties of concrete rely on cement (its main binding agent) and the control of the formation/gelation of calcium-silicate-hydrates (C-S-H). Lack of scientific insight into the structure and mechanics of C-S-H is a major obstacle to optimizing material performances and developing greener formulations of concrete. In recent years electron microscopy imaging, nano-indentation tests, X-rays and neutron scattering, NMR analysis, and atomistic simulations have elucidated several structural and mechanical features concentrated within a few nanometers. A potential breakthrough has been combining such experimental insights with novel fundamental understanding gained through modeling and numerical simulations, which use statistical and condensed matter

## Wednesday, May 30th

9:45-10:00	10:00-10:15	10:15-10:30	10:30-10:45	10:45-11:00	11:00-11:15	11:15-11:30am
<b>Building W16</b>		<b>Wednesday: 9:45-11.30am</b>				
W16-Rehearsal Room A	MS 15	Stability and failure of structures and materials		First Chair: Ahmer Wadee Second Chair: Yang Xiang		
Numerical buckling analysis of composite cylindrical shells by hierarchical finite strip method  Jifeng Xu, Kan Feng, Caoning Su, Mufeng Duan	Experimental and Numerical Study on The Stability of Configured Composite Panels under Airtight Loads  Bo Ma, Tianliang Qin, Jifeng Xu	Buckling, postbuckling and failure of predamaged channel section columns  Tomasz Kubiak, Michal Krygier, Mariusz Urbaniak	STRUCTURAL BEHAVIOR OF SHALLOW GEODESIC LATTICE DOMES  Lawrence Virgin, Yue Guan, Daniel Helm	Recent developments in modal decomposition of instabilities  Jurgen Becque	Generalised path-following for well-behaved nonlinear structures  Rainer Groh, Daniele Avitabile, Alberto Pirrera	
W16-Kresge Little	MS 48	Computational Methods and Applications for Solid and Structural Mechanics		Chair: Timothy Truster		
Discrete Element Modeling of aggregate/cement interactions and fracture propagation in concrete  Pei Wang, Chloe Arson	Applicability on trap performance of open type check dam using distinct element method  Toshiyuki Horiguchi	Analysis of Slender Reinforced Concrete Walls Retrofitted Using Selective Weakening and Self-Centering for Seismic Resiliency  Sina Basereh, Pinar Okumus, Sriram Aaleti	PREDICTING SHEAR PERFORMANCE OF SQUAT SHEAR WALLS: A SOFTENED TRUSS MODEL WITH TENSION-STIFFENING EFFECT  Xueying WANG, J.S. KUANG	Dual Random Lattice Modeling of Backward Erosion Piping  Alessandro Fascetti, Caglar Oskay	Locking Free Isogeometric Formulations for 3-D Curved Timoshenko Beams  Guodong Zhang, Ryan Alberdi, Kapil Khandelwal	Novel Line Element-less Method for Arbitrary Shaped Plates Analysis  Giuseppe Battaglia, Alberto Di Matteo, Giorgio Micale, Antonina Pirrotta
<b>Building W20</b>		<b>Wednesday: 9:45-11.30am</b>				
W20-491	MS 5	Architected Materials: Advances in Modeling, Design, Fabrication, Characterization, and Applications		Chair: Mazdak Tootkaboni		
Design of Aperiodic Metamaterials with Anisotropic Stiffness  Frederick Sun, Jonathan Hopkins	Flaw tolerance of three-dimensional defected architected metamaterials  Simos Gerasimidis, Panos Pantidis, Andrew Gross, Katia Bertoldi	Large Scale Topology Optimization for Additive Manufacturing  Mikhail Osanov, James K. Guest	Topologically Optimized Instability-Tolerant Light Stiff Lattice Architectures  Mazdak Tootkaboni, Ladan Salari-Sharif, Alireza Asadpoure, Lorenzo Valdevit	Accessing negative stiffness via instability in mechanical metamaterials  Eder Medina, Chris Rycroft, Katia Bertoldi	Deep Learning Neuro-Membrane Neural Networks: A Training Algorithm  Mehrdad Shafiei Dizaji, Abdolreza Joghataie	

W20-407		MS 30	Hierarchical and Multiscale Methods for Simulation Based Design of Materials		First Chair: Arif Masud Second Chair: Somnath Ghosh		
Crystal Plasticity Finite Element Simulation of Fatigue Failure in Polycrystalline Al7075-T651	Data Analytics for Mining Process-Structure-Property Linkages for Hierarchical Materials	Data-informed Multiscale Modeling of Additive Materials	A novel framework for multiscale modeling of Ni based superalloys using a physics based, machine learning informed constitutive law	Multiscale modeling of cohesive-frictional interactions within the hierarchical and disordered structure of cement paste	A Stabilized DG formulation of Thermoelasticity for Problems in Additive Manufacturing	Exotic continua from asymptotic limit of extreme microstructures	
Somnath Ghosh	Surya Kalidindi	Timothy Wildey, Bart van Bloemen Waanders	Maxwell Pinz, George Weber, Somnath Ghosh	Steven David Palkovic, Kunal Kupwade-Patil, Sidney Yip, Oral Buyukozturk	Arif Masud, Pinlei Chen	Paul Barbone	
W20-Mezzanine Lounge		MS 35	Fluid-Structure Interactions and Flow-Induced Motions		Chair: Ning Zhang		
A Simplified Approach for Calculation of Fluid Pressures on Pool Walls due to Seismic Effects of Submerged Equipment	Higher derivative approach for a heated ferrofluid flow in the presence of magnetic field	Phase-averaged drag force of nonlinear waves over submerged vegetation	Rivulet dynamics and flow structures of 3D rain-wind induced vibrations of a stay cable	Implementing Small Rivers on Calcasieu Lake Hydrodynamic Models using an Immersed-Boundary Method	On predicting Dry Cable Galloping of Smooth Cables	Real-Time Aerodynamics Hybrid Simulation: A Novel Wind-Tunnel Model for Flexible Bridges	
Christine Roy, Michelle Riedman, Daniel Eggers	Krisztian Hriczo	Ling Zhu, Qin Chen	Wen-Li Chen, Dong-Lai Gao, Hui Li	Ning Zhang, Arun Yadav	Mohammad Jafari, Partha Sarkar	Teng Wu, Shaopeng Li, Mettupalayam Sivaselvan	
W20-PDR 1&2		MS 58	Fourth Symposium on Molecular Scale Modeling and Experimentation		Chair: Dinesh Katti		
The viscosity of liquid water by calculation of hydrogen bonding	Molecular interactions control permeability, compressibility and shear strength of swelling clays: Experiments and Modeling	Molecular modeling of elastin biomaterials	Hygro-thermo-mechanical behavior of softwood lignin studied by molecular dynamics	Molecular Torsion in Spider Silk Supercontraction	Polydopamine and eumelanin structural models in various oxidation states	Intrinsic Size Effect in Scaffolded Porous Calcium Silicate Particles and Mechanical Behavior of Their Self-Assembled Ensembles	
Ke Ni, Hongwei Fang, Danny Reible	Dinesh Katti, Kalpana Katti, Keshab Thapa, H. M. Nasrullah Faisal	Anna Tarakanova, Giselle C. Yeo, Clair Baldock, Anthony S. Weiss, Markus J. Buehler	chi zhang, Benoit Coasne, Sinan Keten, Dominique Derome, Jan Carmeliet	Claire Hsu, Dabiao Liu, Anna Tarakanova, Miao Yu, Shimin Zheng, Longteng Yu, Jie Liu, Yuming He, D.J. Dunstan, Markus Buehler	Chun-Teh Chen, Markus Buehler	Rouzbeh Shahsavari, Sung Hoon Hwang	

W20-Coffeehouse Lounge		MS 73	Meshfree, Peridynamics, and Particle Methods: Contemporary Methods and Applications		First Chair: J.S. Chen Second Chair: Sheng-Wei Chi		
Continuum modeling of wet granular flows across curved topologies  Guanjin Wang, Amir Riaz, Balakumar Balachandran	Peridynamic Correspondence Model using Stabilized Deformation Gradient  Hailong Chen	Immersed IGA-RKPM framework for Air-Blast-Structure Interaction: Part II – Coupling with Phase-Field Modeling of Brittle Fracture  Georgios Moutsanidis, David Kamensky, J.S. Chen, Yuri Bazilevs	The solution of incompressible elasticity using the numerical manifold method  Hong Zheng	Free Damage Propagation with Memory  Robert Lipton, Prashant Jha, Eyad Said	Immersed IGA-RKPM Framework for Air-Blast-Structure Interaction: Part I – Basic Formulation and Representative Simulations  Georgios Moutsanidis, David Kamensky, J.S. Chen, Yuri Bazilevs	A hybrid meshless/mesh-based solver for incompressible Navier-Stokes equations  Georgios Bourantas, Grand Joldes, Adam Wittek, Karol Miller	
W20-20 Chimneys		MS 94	Simulation, Prediction, and Mitigation of Extreme Events		First Chair: Sheng-Wei Chi Second Chair: Craig Foster		
Homogenous reproduction of a highly non-Gaussian random process  Xiang Yuan ZHENG	A Constitutive Model for Large Deformation of Soil Under Extreme Deformation  Craig Foster, Seyed Milad Parvaneh, Sheng-Wei Chi	Numerical Investigation of Two-Phase Debris Flows over Non-Trivial Topography with Deposition Process  Yih-Chin Tai, Yu-Chen Wu, Julian Hess, Yongqi Wang	3D free surface flow simulation of extreme hydrodynamic events  Kirill Nikitin, Kirill Terekhov, Yuri Vassilevski	From the scenario to the load case - computational challenge  Norbert Gebbeken	Fast Simulation of Multivariate Nonstationary Processes with Time-varying Correlation  Haifeng Wang, Teng Wu	Impact Load Effect on Hardened Reinforced Concrete Cladding  Mohammed Alaloula, Prodyot Basu	

9:45-10:00	10:00-10:15	10:15-10:30	10:30-10:45	10:45-11:00	11:00-11:15	11:15-11:30am
<b>Building 3</b>		<b>Wednesday: 9:45-11.30am</b>				
3-270		MS 13	Structural Identification and Damage Detection		First Chair: Eleni Chatzi Second Chair: Costas Papadimitriou	
A Numerical Study on a Random-Vibration-Based Approach for Damage Detection of Steel Structures  Amin Moghadam, Asad Esmaeily, Hani Melhem	Robust Calculation of the Observability of Large Systems  Xiaodong Shi, Manolis Chatzis, Martin Williams	L1-norm based Gauss-Newton Method for solving the nonlinear inverse problem to localized damage detection  Chandler Smith, Eric Hernandez	Bayesian Spectrum Approach for Wheel Flat Identification  QIUHU ZHANG, YIQING NI	Observability of structural and mechanical systems with unknown inputs  Kristof Maes, Manolis Chatzis, Geert Lombaert	Finite element model updating using objective-consistent sensitivity-based parameter clustering and Bayesian regularization  Daniel Bartilson, Jinwoo Jang, Andrew Smyth	Output-only estimation of geometrically non-linear systems via modal derivative-based reduced-order models  Konstantinos Tatsis, Long Wu, Paolo Tiso, Eleni Chatzi

3-133	MS 31	Advanced Analysis for Earthquake Engineering		First Chair: Kevin Wong Second Chair: Ting Lin		
Estimating Inelastic Displacement in Sliding Isolation Systems Using Effective Incremental Ground Velocity  Ezra Jampole, Eduardo Miranda, Gregory Deierlein	Observations from Inelastic Response of Softening Reinforced Concrete Structures to Strong Ground Motion  Pedram Hesam, Ayhan Irfanoglu, Thomas J. Hacker	Evaluation of Ground Motion Scaling Techniques  Jayaprakash Vemuri, Subramaniam Kolluru	Design and Evaluation of Hybrid Vibration-control Using Tuned Inerter-Based Damper and Base Isolation  Hesheng Tang, Yunqian Wang, Songtao Xue	Effects of Passive Tuned Liquid Column Dampers on the Fatigue Life of Wind Turbines  Okyay Altay, Sven Klinkel	Integrated Approach to Proactive Condition Monitoring Systems  Franz Forstlechner, Christopher Rothschedl, Hanna Joechlinder	
3-370	MS 95	Recent Advances in Real-time Hybrid Simulation		First Chair: Wei Song Second Chair: Richard Christenson		
Numerical Substructures Limitations for Future Real-Time Hybrid Simulation under wind loading  Mohamed Moustafa, Azin Ghaffary	Real-time Hybrid Simulation Using Advanced Analysis Software Packages  X. Shawn Gao, Shawn You	A cyber-physical framework for structural optimization using real-time hybrid simulation  Ruiyang Zhang, Brian Phillips, Pedro Fernández-Cabán, Forrest Masters	First Generation Benchmark Controll Problem in RTHS  Christian Silva, Daniel Gomez, Shirley Dyke, Amin Maghareh	Aeroelastic Real-Time Hybrid Simulation (AeroRTHS): Validation of Vortex Induced Vibration of a Tall Building Structure  Richard Christenson, Steven Wojtkiewicz, Jie Dong, Sergio Lobo-Aguilar, Yuan Yuan	Compensation Error in A Discrete-Time Feedforward Feedback Compensation Technique  Wei Song, Saeid Hayati	Comparison of Hybrid Simulation with Model Updating to a Shake Table Test  Ge Ou, Shirley Dyke

Building 1	Wednesday: 9:45-11.30am					
1-390	MS 74	Vision-based Studies in Structural Health Monitoring		First Chair: ZhiQiang Chen Second Chair: Mohammad Jahanshahi		
Computer vision-based noncontact cable tension force measurement for cable-supported structures  Dongming Feng, Christopher Mauch, Samuel Summerville	Development and Validation of Video Analytics for Vision-based Structural Health Monitoring  Zheng Yi wu, Peng Xiao	Automated Condition Assessment and Monitoring of Infrastructures with Visual Sensing Technologies  Yujie Yan, Jerome Hajjar	Calibration and Performance Assessment of a Class of Inexpensive RGB-D Sensor for Dynamic Displacement-Field Measurement  Mohamed Abdelbarr, Yulu Chen, Sami Masri, Mohammad Jahanshahi	Image-based Imperfection Determination of Cold-formed Steel Members  Burcu Güldür Erkal	Automated Bridge Inspection Procedures via a Hybrid Machine Vision-Machine Learning Technique  Emily Miller, Stephanie Paal	Deep Learning-based Damage Assessment of Civil Infrastructure Systems  Fu-Chen Chen, Mohammad Jahanshahi

9:45-10:00	10:00-10:15	10:15-10:30	10:30-10:45	10:45-11:00	11:00-11:15	11:15-11:30am
<b>Building 4</b>						<b>Wednesday: 9:45-11.30am</b>
4-261	MS 10	Modeling time-dependent behavior and deterioration of concrete		First Chair: Roman Wan-Wendner	Second Chair: Giovanni Di Luzio	
Is Drying Creep always Greater than Basic Creep? Assessment from Flexural Creep by Experimental and Numerical Methods  Ya Wei	Modeling deterioration of mass concrete structures  Mi G Chorzepa	A multiscale framework for the prediction of self-desiccation in concrete  Madura Pathirage, Dale P. Bentz, Giovanni Di Luzio, Enrico Masoero, Gianluca Cusatis	Towards Life-time Prediction of Frost Damage Process in RC Structures Through a Multi-scale Poromechanical Approach  Fuyuan Gong, Koichi Maekawa, Mingqian Ren	Modeling corrosion of steel reinforcement in concrete  Josko Ozbolt, Emiliano Sola, Gojko Balabanic	Poromechanical damage model in cement-based materials exposed to sulfate attack  Yushan Gu, Patrick DANGLA	Effect of Alkali Silica Reaction on Concrete Mechanical Properties Evolution: Experiments and Numerical Modeling  Faysal Bousikhan, Madura Pathirage, Matthew D'Ambrosia, Gianluca Cusatis
4-265	MS 16	Modeling and Characterization of Brittle and Quasibrittle Fracture		First Chair: Jia-Liang Le Second Chair: Ravindra Duddu		
Computational advantages of the local strain energy density for fracture assessment of complex structures  Filippo Berto, Lise Sandnes, Jan Torgersen	Simulation of Localization of Parallel Thermal or Hydraulic Cracks: When It Does and Does not Occur  Hoang T. Nguyen, Zdenek P. Bazant	A review of micro and nano scale testing of materials and structures  Roberto Ballarini	Rate Dependent Weakest-Link Statistical Model of Quasibrittle Fracture  Jia-Liang Le, Anna Gorgoianni, Jan Elias	Tail Distribution of Strength Statistics of Brittle and Quasibrittle Materials  Zhifeng Xu, Jia-Liang Le	Continuum damage mechanics approach to water-filled crevasse propagation in glaciers  Stephen Jimenez, Ravindra Duddu	Random field realization and fracture simulation of rock with angular-bias in microcrack orientation  Justin Garrard, Philip Clarke, Reza Abedi
4-145	MS 32	Asset vs. Community Resilience, with lessons, applications, and knowledge gaps from hurricane Harvey			Chair: Mohammed Ettouney	
Damage Assessment of Buildings in the Wake of Hurricane Harvey  Mohammad Aghababaei, Maria Koliou, Stephanie Paal	Probabilistic simulation and resilience analysis of power transmission systems affected by hurricane events based on fragility modeling and AC power flow model  Liyang Ma, Paolo Bocchini	A Bottom-Up Simulation Model for Evaluating the Impact of Interdependencies on System Resilience  Wenjuan Sun, Paolo Bocchini, Brian Davison	Towards an analytical resilience framework of steel and concrete composite buildings  Panos Pantidis	Missing members in periodic geometries: from buildings to nanolattice materials  Simos Gerasimidis, Panos Pantidis, Andrew Gross, Katia Bertoldi	CLIMATE RESILIENCE: OBJECTIVE OUTLOOK ON APPLICATION TO CIVIL INFRASTRUCTURES  Mohammed Ettouney	Enhancing Asset Modeling and Design to Improve Community Hurricane Resilience  Chris Mullen, Prabodh Dahal

4-237	MS 40	Mechanics and Physics of Granular Materials		First Chair: Ali Daouadji Second Chair: Jidong Zhao			
Influence of biopolymers on deformation behavior of granular materials.	An Imperfect Interface Approach to Micromechanical Modeling for the Effective Thermoelastic Properties of Porous Bonded-Particle Assemblies	Understanding the interaction between debris flow and flexible barrier: a unified treatment by coupled CFD-DEM modeling	Large-scale laboratory test on geosynthetic reinforced unpaved roads on soft subgrade-Installation damage-Traffic load.	Flow characteristics of non-spherical particles in a hopper simulated with super-quadratic elements	Development of DEM-SPH coupling method for dilated polyhedral elements	Equilibrium, stability, and bifurcation pathologies in discrete granular systems	
Sanchari Mondal, Debasis Roy	Kane Bennett, Darby Luscher, Miles Buehler, John Yeager	Jidong Zhao, Xingyue Li	Nicole Khoueiry, Laurent Briançon, Ali Daouadji, Abdelkader Abdelouhab	Siqiang Wang, Shunying Ji	Shunying Ji, Lu Liu	Matthew R. Kuhn, Ali Daouadji	
4-153	MS 54	Micromechanics of Granular Materials				First Chair: Patrick Mutabaruka Second Chair: Roman Makhnenko	
Micromechanics of the granulation process in wet granular flows	In-pore solidification in porous nano-granular materials	A Numerical Approach to Simulating Grain Fracture in Granular Materials	3D modeling of aggregates degradation under scratching loading	A laboratory investigation of the thermo-hydro-mechanical properties of the Callovo-Oxfordian claystone	Towards a better understanding of the behavior of partially saturated asphalt concrete submitted to freezing condition	Thermo-poro-visco-elasticity of shale-like materials	
Thanh-Trung VO, Saeid NEZAMABADI, Patrick MUTABARUKA, Jean-Yves DELENNE, Roland PELLENQ, Edouard IZARD, Farhang RADJAI	Katerina Ioannidou, Edmond Zhou, Martin Bazant, Roland Pellenq	Anne Turner, Aashish Sharma, Dayakar Penumadu	Patrick Mutabaruka, Nicolas Berger, Farhang Radjai, Roland Pellenq, Franz J.-Ulm	Philipp Braun, Siavash Ghabezloo, Pierre Delage, Jean Sulem, Nathalie Conil	Ferhat HAMMOUM, Thang Van VU, Olivier CHUPIN, Jean-Michel PIAU	Roman Makhnenko, Yury Podladchikov	
4-231	MS 57	17th Symposium on Biological and Biologically Inspired Materials and Structures				First Chair: Christian Hellmich Second Chair: Dinesh Katti	
Looped Chains and Toughness Gains: Sacrificial Bonds and Hidden Length of a Model Fiber	Deterioration of atomistic mechanisms that bind mutated type IV collagens with integrin	Analysis of a three-dimensional spider web architecture	Imaging based multiscale material modeling of plant stems	Multi-scale modeling of mycelium based porous composite with random local density variation	Variances and in-variances in composition and micro-structure, across femoral tissues from cow, horse, emu, frog, ostrich, pig, and rabbit.	Multiscale modeling provides differentiated insights to fluid flow-driven stimulation of bone cellular activities	
Yichen Deng, Steve Cranford	Jingjie Yeo, Yimin Qiu, GangSeob Jung, Yong-Wei Zhang, David L. Kaplan, Markus J. Buehler	Isabelle Su, Zhao Qin, Tomás Saraceno, Markus Buehler	Tarun Gangwar, Jo Heuschele, Kevin Smith, Alex Fok, Dominik Schillinger	Mohammad Refatul Islam, Greg Tudry, Ronald Bucinell, Linda Schadler, Catalin Picu	Luis Zelaya-Lainez, Hawraa Kariem, Winfried Nischkauer, Andreas Limbeck, Christian Hellmich	Sarah-Jane Estermann, Stefan Scheiner	

**Building 2****Wednesday: 9:45-11.30am**

2-131	MS 42	Mechanics of growth in biology and engineering		First Chair: Tal Cohen Second Chair: Teng Zhang		
Significance of Modeling Homeostasis and the Homeostatic State in Confined Growth of Tissues with Application to Early Cardiac Morphogenesis MM Safadi, MB Rubin	Roughening of nano-pattern formation Gabriella Bognar	Kinetics of surface growth and coupled diffusion in a continuum framework Rami ABI AKL, Tal Cohen	Understanding skin growth in response to stretch at multiple scales Taeksang Lee, Elbert Vaca, Sergey Turin, Joanna Ledwon, Hanah Bae, Jolanta Topczewska, Ellen Kuhl, Arun Gosain, Adrian Buganza Tepole	Constrained Mixture Models of Soft Tissue Growth and Remodeling Jay Humphrey, Marcos Latorre		
2-105	MS 89	Analytical and Numerical Solutions to Problems in Petroleum Geomechanics			First Chair: Amin Mehrabian Second Chair: Shengli Chen	
Influences of elliptical borehole shape on the calculation of in-situ horizontal stresses Hong Xue Han, Shunde Yin	POROMECHANICS RESPONSE OF WELLBORE SUBJECT TO HYDRAULIC FRACTURING IN TRANSVERSELY ISOTROPIC ROCKS Chang Huang, Shengli Chen	Stability of Deviated Boreholes in Anisotropic Formations N. Beni Setiawan, Robert W. Zimmerman	Probabilistic multiscale modeling of microcrack-induced mechanical and transport properties in shales Vasav Dubey, Sara Abedi, Arash Noshadravan	Nano- and micro-scale assessment of electrical conductivity of partially saturated shale rocks Debora Martogi, Sara Abedi	Geertsma's subsidence solution extended to layered stratigraphy Amin Mehrabian, Younane Abousleiman	Geomechanical Assessment of Deep Geological Carbon Storage Pania Newell, Mario Martinez
9:45-10:00	10:00-10:15	10:15-10:30	10:30-10:45	10:45-11:00	11:00-11:15	11:15-11:30am

**Wednesday, May 30, 2018**

**1:00 - 2:00pm**

**Plenary Lecture 2**

**Room: W16 – Kresge Main**

Christian Hellmich

Vienna University of Technology

Towards unified hierarchical modeling of hard and soft biological tissues



## **Christian Hellmich**

Professor for Strength of Materials and Computational Mechanics  
Dept of Civil Engineering  
Vienna University of Technology (TU WIEN)  
Vienna, Austria

# Towards unified hierarchical modeling of hard and soft biological tissues

## **Abstract:**

Traditionally, the realms of hard and soft tissue biomechanics are strictly separated: hard tissue biomechanics is typically based on elasto-plastic or elasto-damage formulations in the small strain regime, while soft tissue biomechanics has its roots in hyperelastic rubber modeling. Both of these two traditional approaches face the challenge of highly scattering material parameters, which rarely allow for reliable predictions of untested situations.

In the hard tissue realm, this challenge has been met with the advent of engineering micromechanics in the early 2000s. Key ingredients of this success were the hierarchical sequencing of traditional homogenization schemes such as two-phase Mori-Tanaka and self-consistent schemes, the extension from two-phase to multi-phase systems, and the consideration of eigenstrains and their upscaling characteristics, which paved the way towards a unified vision of bone multiscale biomechanics, encompassing poro-elasticity, poro-plasticity, and creep; all based on a few “universal” mechanical properties of bone’s elementary components: collagen, hydroxyapatite, and water.

Can this success be repeated also for soft tissues? The lecture will give an affirmative answer, based on recently developed theoretical tools allowing for the modeling of load-induced changes in the tissue micro-morphology, as it evolves under large strains at different observational levels.

## **Biosketch:**

Dr. Christian Hellmich, M.ASCE, F.EMI, Full Professor at the Department of Civil Engineering of the Vienna University of Technology (TU Wien), is the director of the Institute for Mechanics of Materials and Structures. At TU Wien, he received his engineering, PhD, and habilitation degrees (in 1995, 1999, and 2004, respectively). From 2000 to 2002, he was a Max Kade Postdoctoral Fellow in the Department of Civil and Environmental Engineering at the Massachusetts Institute of Technology. He is well known for his well-validated material and (micro)structural models, in terms of theoretical foundations and applications to concrete, soil, rock, wood, bone, and biomedical implants, up the structural level (tunnels, pipelines, biological organs such as the skeleton) with complementary experimental activities if necessary. On these topics, he has directed various interdisciplinary and multinational research consortia, and he has published more than 125 papers in international refereed scientific journals.

## Wednesday, May 30th

2:15-2:30	2:30-2:45	2:45-3:00	3:00-3:15	3:15-3:30	3:30-3:45
<b>Building W16</b>					<b>Wednesday: 2:15-3:45pm</b>
W16-Rehearsal Room A		MS 15	Stability and failure of structures and materials		First Chair: Noël Challamel Second Chair: Stylianos Yiatros
Modal nudging in nonlinear elasticity: Tailoring the elastic post-buckling behaviour of engineering structures  Bradley Cox, Rainer Groh, Daniele Avitabile, Alberto Pirrera	Experimentally Probing Unstable Equilibria  Robin Neville, Rainer Groh, Alberto Pirrera, Mark Schenk	Application of Surface Nanocrystallization in the Energy Absorption Devices  Zhen Zhao, Jufang Jia, Wei Wang, Xinsheng Xu, C. W. Lim	Imperfection sensitivity of rectangular hollow section columns susceptible to local-global mode interaction  Jiajia Shen, Ahmer Wadee	Dynamic buckling of FML thin-walled profile under axial compression  Radoslaw Mania	Imperfection insensitivity of wavy cross-sectional thin cylindrical shells under bending: Effect of cross section's shape and curvature  Kshitij Kumar Yadav, Simos Gerasimidis
W16-Kresge Little		MS 48	Computational Methods and Applications for Solid and Structural Mechanics		Chair: Caglar Oskay
A machine learning enhanced data-driven approach for computational mechanics  Qizhi He, J. S. Chen	Computational Framework for Simulating the Deformation and Fracture Response of Oligocrystalline Shape Memory Alloy  Zhiyi Wang, Raul Radovitzky	3D Grain Based Fatigue Damage Simulation Considering Crack Front Evolution  Dongping Zhu, Hao Yuan, Wei Zhang	Modeling microstructure evolution in nanocrystalline alloys using phase field driven crystal plasticity  Arash Memarnahavandi, Faust Shi, Chaiyapat Tangpatjaroen, Izabela Szlufarska, Shiva Rudraraju	A sequential partly-iterative algorithm for modeling multi-ionic species transport during corrosive dissolution  Xiangming Sun, Ravindra Duddu	Flaw Tolerance of Polycrystalline Yttria-Stabilized Tetragonal Zirconia Nanopillars under Uniaxial Compression  NING Zhang, Mohsen Asle Zaeem

Building W20		Wednesday: 2:15-3:45pm			
W20-491		MS 5	Architected Materials: Advances in Modeling, Design, Fabrication, Characterization, and Applications		Chair: Alireza Asadpoure
Bioinspired design of cement-polymer composites  Jessica Rosewitz, Nima Rahbar	Carbon-based Nanolattice Materials  Jens Bauer, Lorenzo Valdevit	On the crushing of brittle foams  Sirui Bi, Stavros Gaitanaros	Tailoring Damping Properties of 3D Woven Metallic Lattices  Hak Yong Lee, James Guest	Lightweight Cellular Composites Approaching the Theoretical Bound of Stiffness-damping Pairs  Qiming Wang	Improvement of the dynamic resistance of architected materials through the use of strain rate effects of particulate matter  Rene Vogel, Florian Bittner, Hans-Josef Enders, Thomas Hipke, Stefan Szyniszewski
W20-PDR 1&2		MS 41	Genome of Infrastructure Materials		First Chair: Linbing Wang Second Chair: Yue Hou
Study on Adhesion of Clay Particle to Metals with Influence of Surface Roughness  Wenbo Ma, Cailing Qi, Shuaicheng Guo, Qingli Dai	Nanoindentation measurement of micromechanical properties of metakaolin-based alkali-activated cement with different calcium content  Ruijie Si, Qingli Dai, Guoping Zhang, Shengmin Luo, Shuaicheng Guo	A Chemo-Mechanical Relationship for Asphalt Binders in Linear Viscoelastic and Non-Linear Viscoelastic Domain  Akshay Gundla, Shane Underwood	The role of remnant lime in the durability of ancient Roman mortar  Linda Seymour, Kunal Kupwade-Patil, Janille Maragh, James Weaver, Oral Buyukozturk, Admir Masic	Analysis of Leonardo's Bridge over The Golden Horn  Victoria Sassoon, Branko Glisic	

W20-Coffeehouse Lounge		MS 73	Meshfree, Peridynamics, and Particle Methods: Contemporary Methods and Applications		First Chair: Michael Hillman Second Chair: John Foster	
A Naturally Stabilized and Nodally Integrated Meshfree Formulation for Modeling Landslides in Multiphase Porous Media  J. S. Chen, Haoyan Wei	Electroneutrality constraints in nonlocal models  Eitan Lees, Srujan Rokkam, Sachin Shanbhag, Max Gunzburger	Convergence studies in meshfree peridynamic simulations  Pablo Seleson, David Littlewood	Coupling quantum-mechanical based first-principle calculations with mesoscale modeling to investigate sensitization induced cracking in metal alloys  Xianfeng Ma, Bozhi Heng, Pablo Seleson, Stephanie TerMaath	Generalized Reproducing Kernel Peridynamics  Michel Hillman, Guohua Zhou	Consistent Strong Enforcement of Essential Boundary Conditions in Meshfree Methods  Kuan-Chung Lin, Michael Hillman	
W20-20 Chimneys		MS 83	Multi-functional composites for engineering application		First Chair: Sung-Hwan Jang Second Chair: Huiming Yin	
Smart transport roads coating system for temperature sensing and self-heating  Sung-Hwan Jang, Yong-Lae Park	Carbon nanotube coated fiber reinforced epoxy composites for oil and gas pipeline  Sung-Hwan Jang, Mohammed Al-Bahrani	Development of aluminum based functionally graded materials for building integrated photovoltaic thermal system  Fangliang Chen, Frank Pao, Huiming Yin	Foamed aluminum embedded by phase change materials for energy harvesting and temperature conditioning  Zhenhua Wei, Xiaokong Yu, Huiming Yin	Phase change materials - enhanced composite for energy-efficient building applications  Xiaokong Yu, Zhenhua Wei, Huiming Yin		

Building 5		Wednesday: 2:15-3:45pm				
5-234	MS 34	Advances in computational methods for rapid uncertainty quantification, reliability analysis and robust design of civil structures exposed to natural and man-made hazards			First Chair: Seymour Spence Second Chair: Alexandros Taflanidis	
Stochastic nonlinear vibration of rectangular membrane structure under impact load  DONG LI, ZHOU-LIAN ZHENG, MICHAEL D. TODD	Performance-based assessment of tall buildings subjected to thunderstorm downburst loads using the Wavelet-Galerkin approach  Viet Le, Luca Caracoglia	Understanding the Performance of Base-Isolated Tall Buildings under Strong Winds  Changda Feng, Xinzong Chen	Advances in surrogate modeling for storm surge prediction: storm selection and addressing characteristics related to climate change  Alexandros Taflanidis, Jize Zhang, Norberto Nadal-Caraballo, Jeff Melby	Bayesian Model Averaging Kriging  Jize Zhang, Alexandros Taflanidis	Sample-based approach for identification of critical links in seismic risk assessment of large-scale transportation networks  Zhenqiang Wang, Gaofeng Jia	

**Building 3****Wednesday: 2:15-3:45pm**

3-270	MS 13	Structural Identification and Damage Detection			First Chair: Costas Papadimitriou Second Chair: Babak Moaveni
Using data-interpretation methodologies to incorporate information iteratively for asset-management decision making  Sai G.S. Pai, Yves Reuland, Ian F.C. Smith	Delamination detection in composite beam employing unified particle swarm optimization based on vibrational response  Swarup K. Barman, Dipak K. Maiti, Damodar Maity	Damage detection of planar truss structures using self-controlled multi-stage particle swarm optimization  Subhajit Das, Nirjhar Dhang	Output-Only Bayesian Identification of Nonlinear Structural Systems  Kalil Erazo, Satish Nagarajaiah	Strain-based Damage Localization Through Statistical Feature Extraction  Charilaos Mylonas, Imad Abdallah, Vasilis Dertimanis, Eleni Chatzi	Fleet-wide operational modal analysis in the presence of harmonics rolled out in a cloud-computing environment  Nicoletta Gioia, Timothy Verstraeten, Patrick Guillaume, Ann Nowé, Jan Helsen
3-370	MS 43	Finite Element Model Updating for Structural Sensor Data Fusion			First Chair: Yang Wang Second Chair: Hae Young Noh
Non-Convexity in Finite Element Model Updating Problems  Yang Wang	Input Estimation of a Full-scale Concrete Frame Structure with Experimental Model Updating  Xi Liu, Xinjun Dong, Yang Wang	Data Validated Multi-scale Finite Element Modeling Protocol for Complex Connections of a Movable Bridge  Maryam Mashayekhizadeh, Erin Bell	Bayesian Posterior Distributions of Nonlinear Model Parameters by using Varying Seismic Responses  Thanh Tran, Mayuko Nishio	Model Update of Frame Structure Based on Equivalent Interstory Shear Forces  Dongyu Zhang	
3-133	MS 44	Safety Assessment of Aging Infrastructure: From Data to Decision			First Chair: Suparno Mukhopadhyay Second Chair: Simos Gerasimidis
Nonlinear structural system spectral identification subject to incomplete data  Ketson Roberto Maximiano dos Santos, Olga Brudastova, Ioannis Kougioumtzoglou	A robust approach for risk assessment of bridge networks under climate change and socioeconomic uncertainties  David Yang, Dan Frangopol	IMPLIED RELIABILITY IN BUILDING DESIGN ACCORDING TO IS-1893  Deepti Ranjan Majhi, Manish Shrikhande	An integrated approach for safety assessment of aging infrastructure  Guru Prakash, Sriram Narasimhan	Probabilistic life-cycle risk assessment of residential buildings in flood-prone areas  Minghui Cheng, Dan Frangopol, David Yang	

3-333	MS 87	Metamaterials for vibration mitigation	First Chair: Vasilis Dertimanis Second Chair: Eleni Chatzi		
A general framework for dynamic homogenization of wave motion at finite wavelengths and frequencies  Bojan Guzina, Shixu Meng, Othman Oudghiri-Idrissi	Rayleigh-wave isolation by periodic pile barriers  Xingbo Pu, Zhifei Shi, Hongjun Xiang	Seismic Isolation and Vibration Attenuation by Using Periodic Foundations  Zhibao Cheng, Zhifei Shi	Effectiveness of a stiff wave barrier in the soil as a mitigation measure for railway induced vibrations  Geert Degrande, Geert Lombaert	Attenuation and redirection of seismic Love waves by large-scale metasurfaces  Antonio Palermo, Farhad Zeighami, Alessandro Marzani, Dominiki Asimaki, Chiara Daraio	Surface Wave Attenuation via Resonant Metabarriers in Granular Substrates  Rachele Zaccherini, Antonio Palermo, Sebastian Krödel, Vasilis K. Dertimanis, Alessandro Marzani, Chiara Daraio, Eleni N. Chatzi

2:15-2:30	2:30-2:45	2:45-3:00	3:00-3:15	3:15-3:30	3:30-3:45
<b>Building 1</b>			<b>Wednesday: 2:15-3:45pm</b>		
1-390	MS 74	Vision-based Studies in Structural Health Monitoring		First Chair: Mohammad Jahanshahi Second Chair: David Lattanzi	
Deep Multi-label Semantic Segmentation for Civil Infrastructure Defect Detection  Chen Feng	Learning Structural Damage from Hyperspectral Images  Sameer Aryal, Shimin Tang, ZhiQiang Chen	Real-Time Video Objects Detection Using Supervoxel Segmentation on Low-Power High-Performance Portable Computer  Gerardo Leon, Hae-Bum Yun	Vision-Based Characterization and Identification of Structural Systems  Mehrdad Shafiei Dizaji, Sara Mohamadi, Shuzhen Yang, David Lattanzi, Devin K. Harris	Pruning Deep Neural Networks for Efficient Condition Assessment of Structures Using Robotic Systems  Tarutal Ghosh Mondal, Rih-Teng Wu, Fu-Chen Chen, Mohammad Jahanshahi	

**Building 4****Wednesday: 2:15-3:45pm**

4-261	MS 14	Advances in Experimental, Theoretical and Computational Fracture Mechanics			First Chair: Ange-Therese Akono Second Chair: Christian Hoover
Material dependent crack-tip enrichment functions in XFEM for modeling interfacial cracks in bimaterials  Yongxiang Wang, Haim Waisman	Novel Bi-beam Specimen Design for Studying Stress Corrosion Cracking  Sunday Aduloju, Wenjia Gu, Timothy Truster, John Emery, Dave Reedy, Scott Grutzik	Simulating Hydraulic Fracturing within a GFEM Framework  Nathan Shauer, Carlos Duarte, Alfredo Sanchez	Non-Destructive X-ray Probes of Fracture Network and Stress Evolution in Cement-Based and Matrix-Based Composites During Loading  Ryan Hurley, Sriramya Nair, Kelly Nygren, Darren Pagan	A multiscale adaptive strategy for phase-field fracture  Lam Nguyen, Dominik Schillinger	
4-237	MS 40	Mechanics and Physics of Granular Materials			First Chair: Marcial Gonzalez Second Chair: Anil Misra
Effects of humidity and time in crushable granular materials  Rodrigo Osse Peña, Carlos Ovalle Ortega	Dilatancy phenomenon study in remolded clays – A micro-macro investigation  Qian-Feng GAO, Mohamad JRAD, Lamine IGHIL-AMEUR, Mahdia HATTAB, Jean-Marie FLEUREAU	Theoretical and experimental study on the drag force of a projectile obliquely impacting into granular media  Xiaoyan YE, Dengming Wang, Xiaojing Zheng	On the critical state friction angle of granular material  Jun Yang, Xiaodong Luo	Creep behavior of an over-consolidated clay in relation to the microstructure  Dan ZHAO, Mahdia HATTAB, Zhenyu YIN, Pierre-Yves HICHER	Influence of volume fraction on the effective friction law for transient granular avalanche  Liuchi Li, Jose Andrade
4-153	MS 53	Mechanics of Wood and Wood Based Materials: Deterministic and probabilistic approaches			First Chair: Peggy Clouston Second Chair: Markus Lukacevic
Performance investigation of wood-strand sandwich panels with bidirectional corrugated core as a sheathing material  Mostafa Mohammadabadi, Vikram Yadama, Jian Geng, Jill Bowie	Predicting strength of dowel-type timber connections with rope effect  Michael Schweigler, Thomas K. Bader	Why Does Cross Laminated Timber Crack and Delaminate so Easily  John Nairn	Mechanical Analysis of Wooden Bilayer Structures and Novel Application Possibilities in Timber Industry  Philippe Grönquist, Falk K. Wittel, Markus Rüggeberg	Numerical simulation of moisture induced cracking behaviour in wood cross sections under real climate conditions  Maximilian Autengruber, Markus Lukacevic, Josef Füssl	

4-231	MS 57	17th Symposium on Biological and Biologically Inspired Materials and Structures			First Chair: Dinesh Katti Second Chair: Christian Hellmich
Capturing cancer progression during metastasis stage on engineered bone-mimetic testbeds  Kalpana Katti, Dinesh Katti, MD Shahjahan Molla, Sumanta Kar	Towards an atomistically founded DNA beam theory  Johannnes Kalliauer, Gerhard Kahl, Stefan Scheiner, Christian Hellmich	Effects of molecular organization of the chemical components in wood cell wall on its mechanical properties  Kai Jin, Zhao Qin, Markus J Buehler	Morphological and ECM evolution during differentiation of MSCs into osteocytes in a bone-on-Chip  Elisa Budyn, Nabila Gaci, Samantha Sanders, Morad Bensidhoum, Bertrand Cinquin, Patrick Tauc, Herve Petite	Thermal Conductivity and Rectification in Asymmetric Archaeal Lipid Membranes  Sina Youssefian, Steven Van Dessel, Nima Rahbar	Nanoscale Hygromechanical Behavior of Lignin  Kristen Hess, Jason Killgore, Wil Srubar
4-145	MS 64	3rd Mini-Symposium on Multiphysics- Multiscale Modeling of Engineering Materials			First Chair: Yong-Rak Kim Second Chair: Huiming Yin
Computational Mechanics of the Size Effects and Shearbands Based on Coupled Thermo-mechanical Strain Gradient Plasticity Framework  George Z. Voyatzis, Yooseob Song	Estimation of Hydraulic Conductivity for Overconsolidated Clays Based on PCPT Results  Binyam Bekele, Chung Song, Brian Sawyer	Plastic Behavior of Fused Silica in Nanoindentation Testing  Kianoosh Koocehki, Chung Song	Micromechanics based elasto-plastic analysis of Functional Graded Materials  Qiliang Lin, Liangliang Zhang, Huiming Yin	Multiscale Experimentation-Computation to Model Inelastic Deformation and Rate-Dependent Fracture of Complex Materials  Yong-Rak Kim	Integrated Experimental-Computational Multiscale Modeling of Highly Heterogeneous Binding Materials with Pre-Existing Microcracks  Keyvan Zare-Rami, Yong-Rak Kim

Building 2				Wednesday: 2:15-3:45pm	
2-105	MS 9	Coupled Processes in Subsurface Technologies			First Chair: Shunde Yin Second Chair: Ruben Juanes
A Stabilized Mixed Discontinuous Galerkin Formulation for Double Porosity/Permeability Model  Mohammad Sarraf Josaghani, Seyedeh Hanie Seyed Joodat, Kalyana Babu Nakshatrala	Multiple-porosity and Multiple-Permeability Poroelasticity of Organic-Rich Shale  Amin Mehrabian, Younane Abousleiman	Poroleastic Behavior of Rocks under Uniaxial Strain Conditions  Robert W. Zimmerman	Modelling of solid matrix dissolution and mechanical coupling in porous medium by periodic homogenization  Jolanta Lewandowska	Fault reactivation by fluid injection considering permeability evolution in damage zones  Zhuo Yang, Alissar Yehya, James Rice	

2-131	MS 100	General Engineering Mechanics		Chair: Arghavan Louhghalam	
Observer Effect on Closed-Loop Pole Derivatives Dionisio Bernal	LONG TERM BEHAVIOR OF REINFORCED CONCRETE BEAMS STRENGTHENED WITH CFRP SHEET Ayssar Al Khafaji, Hani Salim	Nonstationarity Index of Winds: A Hilbert-Wavelet-based Approach Haifeng Wang, Teng Wu	A Semi-Analytical Approach for Derivation of a Fractional Order Ground Motion Intensity Measure Nariman L. Dehghani, Abdollah Shafieezadeh, Jamie Padgett	Finite-Element-Based Investigation of Buried Concrete Sewer Pipes Exposed to Aging and Deterioration Soroush Zamanian, Abdollah Shafieezadeh, Jieun Hur	Wirelessly controlled harvester / sensor of flow rate in a pipe Jamal Alrowajeh, Muhammad Hajj

## Wednesday, May 30th

4:15-4:30	4:30-4:45	4:45-5:00	5:00-5:15	5:15-5:30	5:30-5:45pm
<b>Building W16</b>					<b>Wednesday: 4:15-5:45pm</b>
W16-Rehearsal Room A		MS 15	Stability and failure of structures and materials		First Chair: Yang Xiang Second Chair: Jifeng Xu
Nonlinear mode interaction in thin-walled single angle struts susceptible to snap-back instabilities Li Bai, Jian Yang, Ahmer Wadee	Analysis of the postbuckling behaviour of beams with discrete restraints using variational and finite element methods Finian McCann, M Ahmer Wadee	Nonlocal beam and plate models from three-dimensional stress gradient elasticity Florian Hache, Noël Challamel, Isaac Elishakoff	Investigation of the stability and failure of steel hollow sphere assemblies in compression Stylianos Yiatros, Orestes Marangos, Renos Votsis, Feargal P. Brennan	Plastic buckling of a thick cylindrical tube under axial compression Jean Legendre, Philippe Le Grogne, Cédric Doudard, Sylvain Moyne	DYNAMIC BUCKLING BEHAVIOUR OF COMPOSITE PLATE SUBJECTED TO PULSE LOADING Susmita Mondal, L S Ramachandra
W16-Kresge Little			Computational Methods and Applications for Solid and Structural Mechanics		Chair: Timothy Truster
A finite deformation micromorphic computational homogenization framework: size effect, strain localization and parallel processing Raja Biswas, Leong Hien Poh, Amit Shedbale	Multiscale Modeling of the Interface Properties of Thermal Barrier Coatings for Aerospace Applications Liang Ying Lim, Shaker Meguid	A time quadrature element method for multi-degree-of-freedom nonlinear dynamics Minmao Liao, Wensu Fan	A variational multiscale method for dynamic and quasi-static J2-plasticity using linear tetrahedral elements Nabil Abboud, Guglielmo Scovazzi	The relevance of variational inequalities for the stability of mixed methods based on multi-field saddle point functionals Andreas Krischok, Christian Linder	Multiscale Modeling of Wave Dispersion and Attenuation in Periodic Viscoelastic Composites Ruize Hu, Caglar Oskay

**Building W20****Wednesday: 4:15-5:45pm**

<b>Building W20</b> <b>Wednesday: 4:15-5:45pm</b>					
<b>W20-491</b> <b>MS 3</b> <b>Topology Optimization: from Algorithmic Developments to Applications</b> <b>Chair: Mazdak Tootkaboni</b>					
Multi-material topology optimization with multiple constraints: a general approach with material nonlinearity  Xiaoja Shelly Zhang, Glaucio Paulino, Adeildo Ramos Jr.	Topology optimization of incompressible flow problems  Reza Behrou, James K. Guest	The use of Topology Optimization for the Development of Strut and Tie Models for Complex Structural Concrete Design Domains  Somashekhar Viswanath, Daniel Kuchma	Topology Optimization of Ceramic Elements for Civil Structures  Josephine Carstensen, Michal Ganobjak, Jackson Jewett	Robust topology optimization of geometrically imperfect frame structures  Nicholas Valm, Mazdak Tootkaboni, Alireza Asadpour	Topology Optimization of Plates and Shells Based on NURBS and Refinement-Free Trimmed Isogeometric Analysis  Renaud Danhaive, Caitlin Mueller
<b>W20-407</b> <b>MS 8</b> <b>Computational Modeling in Civil Engineering</b> <b>First Chair: Andre Barbosa</b> <b>Second Chair: Chanseok Jeong</b>					
Developing Bridge-Specific Seismic Fragility Curves Using an Image-Based Approach  Barbaros Cetiner, Ertugrul Taciroglu	Restoration and Functionality Assessment of a Virtual Community subjected to Earthquakes considering Building-Natural Gas Dependency  Mohammad R. Ameri, John W. van de Lindt	The Role of Advanced Simulations for Resilience Assessment of Critical Infrastructure  Hussam Mahmoud	Surrogate model based tsunami fragility and sensitivity analysis of a three story steel building  Sabarethnam Kameshwar, Andre Barbosa, Daniel Cox	Reliability Assessment of the Piping Failure Mechanism in Levees using a Surrogate Model Based Method  Mehrzed Rahimi, Zeyu Wang, Abdollah Shafieezadeh, Dylan Wood, Ethan J. Kubatko	Optimizing Order Picking Problem By a New Scalable Method  Arash Ghasemi, Joseph Owino, Ignatius Fomunung, Mbakisya A. Onyango
<b>W20-Coffeehouse Lounge</b> <b>MS 73</b> <b>Meshfree, Peridynamics, and Particle Methods: Contemporary Methods and Applications</b> <b>First Chair: Pablo Seleson</b> <b>Second Chair: Dongdong Wang</b>					
A Meshfree Finite Volume Method  Michael Hillman, Saili Yang	Peridynamics Modeling of Corrosion Crack Propagation, Fatigue and Failure  Srujan Rokkam, Masoud Behzadinasab, Max Gunzburger, Nam Phan, Sachin Shanbhag, Kishan Goel	A chemo-hydro-plastic constitutive model for unsaturated clay formulated via peridynamics  Xiaoyu Song, Shashank Menon	Application of Multiscale Peridynamics to Material Failure  Stewart Silling	THE METHOD OF TRANSFORMED ANGULAR BASIS FUNCTIONS FOR THE LAPLACE EQUATION  Xinxiang Li, Yong Wang, Huiqing Zhu, Jaeyoun Oh	Gradient Reproducing Kernel Collocation Method for High Order PDEs  Sheng-Wei Chi, Ashkan Mahdavi

**Building 5****Wednesday: 4:15-5:45pm**

5-234		MS 34		Advances in computational methods for rapid uncertainty quantification, reliability analysis and robust design of civil structures exposed to natural and man-made hazards		First Chair: Alexandros Taflanidis Chair: Seymour Spence	Second Chair: Seymour Spence
Quantifying inflow uncertainty in CFD predictions for wind pressure coefficients on buildings.  Catherine Gorle, Giacomo Lamberti	Development of a seismic response database and its applications to machine learning for inelastic seismic demand assessment  Taeyong Kim, Oh-Sung Kwon, Junho Song	Rapid, Real-Time Prediction of Structural Seismic Risk Based on Sensor Measurements  Ajay Saini, Iris Tien	Design as a Sequential Decision Process: A Method for Multi-Fidelity Model Selection  Jaskanwal Chhabra, Gordon Warn	Invert building performance objectives from community-level resilience goals under natural hazards  Yingjun Wang, Naiyu Wang	Development of matrix-based Bayesian Network  Ji-Eun Byun, Kilian Zwirglmaier, Junho Song, Daniel Straub		
5-217		MS 56		Complex Dynamics Modeling and Control of Structures under Multi-Hazards		Chair: Chao Sun	
Bi-directional Response Mitigation of Offshore Wind Turbines  Chao Sun, Vahid Jahangiri	Optimization of Buildings for Near Damage-Free Performance under Multiple Hazards  Hussam Mahmoud, Akshat Chulahwat	Turbulence effects on the aerodynamic flutter of long-span bridges and mitigation strategies  Shuqian Liu, C.S. Cai, Yan Han	Nonlinear Parametric Vibration with Different Orders of Small Parameters for Stayed Cables  Qin Lu, Zhi Sun, Wei Zhang	Vibrations of Periodically Supported Beams Subjected to Moving Loads: Application to Bridges and Railways  Meshkat Botshekan, Arghavan Louhghalam			

4:15-4:30	4:30-4:45	4:45-5:00	5:00-5:15	5:15-5:30	5:30-5:45pm
<b>Building 3</b>					<b>Wednesday: 4:15-5:45pm</b>
3-270	MS 13	Structural Identification and Damage Detection	First Chair: Babak Moaveni Chair: Eleni Chatzi	Second	
MODAL BASED DETECTION OF CRACKS IN RAILWAY TRACKS AND APPLICABILITY OF MOVING LASER DOPPLER VIBROMETER  Korkut Kaynadar, Arvin Ebrahimkhanlou, Salvatore Salamone	Dynamics-based testing to detect and localize macro cracking due to Alkali-Silica Reaction in Concrete  Sarah Miele, Pranav Karve, Sankaran Mahadevan	Self-sensing cementitious composites incorporated with hierarchical composite of carbon nanotube grown on carbon fiber  Siqi Ding, Yiqing Ni	Influence of piezoelectric transducer damage and disbonds on structural damage signatures using electromechanical impedance method  Mahindra Singh Rautela, Bijudas C.R.  Alana Lund, Shirley Dyke, Wei Song	Kalman Filters and the Real World: Use of the Unscented Kalman Filter Under Practical Uncertainties  Mansure Nabiyani, Hamed Ebrahimian, Babak Moaveni, Andreas Stavridis, Faramarz Khoshnoudian	Post-Earthquake Assessment of a 14-Story RC Building in Mexico City
3-370	MS 18	Numerical Methods for Stochastic Engineering Dynamics	First Chair: Ioannis Kougioumtzoglou Second Chair: Arvid Naess		
Wiener Path Integral and Wavelets for determining efficiently the non-stationary joint response PDF of nonlinear oscillators  Apostolos Psaros, Ioannis Petromichelakis, Ioannis Kougioumtzoglou	Stochastic response analysis and optimum design of nonlinear electromechanical energy harvesters: A Wiener path integral approach  Ioannis Petromichelakis, Apostolos F. Psaros, Ioannis A. Kougioumtzoglou	Non-linear 6D response statistics of a rotating shaft subjected to colored noise by path integration  Oleg Gaidai, Arvid Naess, Michael Dimentberg	Approximate transition probability density functions for a class of nonlinear stochastic differential equations  Antonios T. Meimaris, Ioannis A. Kougioumtzoglou, Athanasios A. Pantelous  Apostolos Psaros, Ioannis Petromichelakis, Ioannis Kougioumtzoglou	Wiener path integral based stochastic response determination of structural systems: The non-white excitation case  Gregory Banyay, Michael Shields, John Brigham	Global Sensitivity Analysis of a Nuclear Reactor System Finite Element Model
3-333	MS 37	Bayesian methods for system risk assessment and management	First Chair: Yongming Liu Second Chair: Sankaran Mahadevan		
Maximum Entropy method in Bayesian framework for classification and inference  Yuhao Wang, Yongming Liu	Probability measure changes in Monte Carlo simulation  Jiaxin Zhang, Michael Shields	Fatigue Reliability Updating of Orthotropic Steel Deck Based on Dynamic Bayesian Networks  Jin Zhu, Wei Zhang, Yongming Liu	A novel non-causal vehicle data assisted cost-based map-matching algorithm for sparse sampled GPS trajectories in urban environments  Patrick Alrassy, Jinwoo Jang, Andrew Smyth	Time-dependent reliability analysis of highway bridges subject to traffic growth and material deterioration using Bayesian inference  Yang Yu, Yongming Liu, C.S. Cai	Bayesian Networks with meta-models and MCMC for reliability assessment of structural and infrastructure system  ZEYU WANG, ABDOLLAH SHAFIEEZADEH

3-133	MS 44	Safety Assessment of Aging Infrastructure: From Data to Decision			First Chair: Simos Gerasimidis Second Chair: Raimondo Betti
Experimental study of guided wave and acoustic emission corrosion monitoring in post-tensioned strands and prestressed concrete  Brennan Dubuc, Arvin Ebrahimkhanlou, Vinutha Kancharla, Salvatore Salamone	Optimal instrumentation in structural identification  Debasish Jana, Dhiraj Ghosh, Suparno Mukhopadhyay, Samit Ray Chaudhuri	Updating Bridge Resilience Assessment Considering Corrosion Inspection Data  Yijian Zhang, Reginald DesRoches, Iris Tien	Deteriorated steel beam ends: Identification and selection of most common corrosion patterns  George Tzortzinis, Brendan Knickle, Alexander Bardow, Simos Gerasimidis, Sergio Brena	Cepstral coefficients as effective sensitive features discriminating damage events from temperature effects.  Eleonora Maria Tronci, Maurizio De Angelis, Raimondo Betti	

Building 1				Wednesday: 4:15-5:45pm	
1-390	MS 91	Machine Learning and Data Analytics for Infrastructure Integrity Assessment		First Chair: Hao Sun Second Chair: Oral Buyukozturk	
Sub-Nyquist Full-field Imaging of Structural Dynamics from Digital Videos by Unsupervised Machine Learning  Yongchao Yang, Charles Dorn, Charles Farrar, David Mascarenas	Automated Triggering of Networks of Bridge Monitoring Systems using Machine Learning for Truck Identification  Jerome Lynch, Rui Hou, Seongwoon Jeong, Kincho Law	Combining Computational Damage Detection Metrics via Genetic Algorithm  Chuangshuo Zeng, Elizabeth K. Ervin	Data-driven method in damage detection of long-span bridges  Shiying Wei, Hui Li	Probabilistic integration of heterogeneous data sources for increasing situational awareness for infrastructure systems and hazard events  Cynthia Lee, Iris Tien	A damage localization and comparison algorithm for indirect structural health monitoring of bridges using multi-task learning  Jingxiao Liu, Mario Berges, Jacobo Bielak, James H. Garrett, Jelena Kovacevic, Hae-Young Noh
4:15-4:30	4:30-4:45	4:45-5:00	5:00-5:15	5:15-5:30	5:30-5:45pm

**Building 4****Wednesday: 4:15-5:45pm**

4-261		MS 14	Advances in Experimental, Theoretical and Computational Fracture Mechanics		First Chair: Ali Ghahremaninezhad Second Chair: Haim Waisman	
Multi-scale Modeling of Fatigue Crack Initiation in Polycrystalline Titanium Alloys  Deniz Ozturk, Shravan Kotha, Adam L. Pilchak, Somnath Ghosh		A Multicomplex Finite Element Approach for Thermoelastic Curvilinear Progressive Fracture  Daniel Ramirez Tamayo, David Wagner, Arturo Montoya, Harry Millwater	Computational studies on the ductile-to-brittle transition during scratch testing  Ange-Therese Akono	Texture and Porosity Disorder: Impact on Fracture Properties of Porous Materials  Xuejing Wang, Meshkat Botshekan, Arghavan Louhghalam	Experimental Data Gathering to Support a Multiscale Model for Fracture in Protein Bound Soils  Isamar Rosa, Michael Lepech, David Loftus	
4-159		MS 24	Cementitious Materials: Experiments and Modeling Across the Scales		Chair: Franz J.-Ulm	
Dynamic Mechanical Properties of Cement-Soil Mixing with Different Content of Basalt Fiber and Sand  Qin-yong MA, Chang-hui GAO		Fabrication of perforated cenospheres as the admixture carrier for concrete  Peiyuan Chen, Jialai Wang, Liang Wang, Liyun Cui	CT and AE Experiments to Measure Distribution of Energy Dissipation in Ultra-High-Performance Concrete  Roman Kravchuk, Dmitry Loshkov, Eric Landis	A Theoretical Model to Describe the Physical Properties and Effects of Biochar on Concrete Mixture  Harn Wei Kua		
4-237		MS 40	Mechanics and Physics of Granular Materials		First Chair: Mahdia HATTAB Second Chair: Ranganathan Parthasarathy	
DEM Simulation of Compaction of Asphalt Mixtures Based on the Rheology of Dense Granular Slurries  Teng Man, Kimberly Hill, Jia-Liang Le		Multi-scale assessment of the effect of particle shape on soil crushability  Changbum Sohn, Mehmet Cil, Giuseppe Buscarnera	IMPACT OF FLAX FIBERS ON PLASTIC SHRINKAGE CRACKING OF EARTH CONCRETE  Nathalie Kouta, jacqueline Saliba, Nadia Saiyouri	Finite-temperature stress calculation and phonon dispersion evolution in uniaxially strained aluminum crystal  Ranganathan Parthasarathy, Anil Misra, Sitaram Aryal, Lizhi Ouyang	Continuum modeling of deformation and comminution in granular ceramics under high-strain rate loading  Mehmet Cil, Ryan Hurley, Lori Graham-Brady	Morphology-driven Performance of Cemented Granular Materials  Seung Jae Lee, Moothul Shin, Chang Hoon Lee, Sumana Bhattacharya

4-265	MS 46	Structural Safety in Fire Engineering: Past, Present and Future		First Chair: Negar Elhami Khorasani Second Chair: Ali Morovat
The National Fire Research Laboratory: Capabilities and Projects  Matthew Hoehler, Lisa Choe, Selvarajah Ramesh, Mina Seif, Chao Zhang, Rodney Bryant, Matthew Bundy	Loading Rate Effects on the Behavior of Transverse Welded Lap Joints in Fire  Ahmad El Ghor, Elie G Hantouche, Mohammed Ali Morovat, Michael D Engelhardt	Fracture Simulation of structural steel at elevated temperatures  Wenyu Cai, Mohammed A Morovat	The Disruption of Structural Fire Protection Practice in the U.S.  Kevin LaMalva	Probabilistically integrating variability in the experimentally observed response of aluminum at elevated temperature into computational models of structural performance  Aakash Bangalore Satish, Michael D. Shields

4-153	MS 53	Mechanics of Wood and Wood Based Materials: First Chair: Sanjay Arwade Deterministic and probabilistic approaches Second Chair: Josef Fussl			
From the failure mechanisms of individual wooden boards to the mechanical behavior of timber structural elements  Markus Lukacevic, Josef Fussl, Josef Eberhardsteiner	Rheological behavior of European beech ( <i>Fagus sylvatica</i> )  Tomaž Hozjan, Staffan Svensson, Robert Pešenka, Sabina Hu?	Moisture induced stresses and strains in timber members  Sabina Huc, Staffan Svensson	Influence of variable grain direction on timber beam behaviour, a simple and effective modelling strategy.  Giuseppe Balduzzi, Simone Morganti, Josef Fuessl, Alessandro Reali, Ferdinando Auricchio	Deformations of embedded fasteners determined from mechanical equilibrium in deformed state  Staffan Svensson	
4-231	MS 57	17th Symposium on Biological and Biologically Inspired Materials and Structures  First Chair: Dinesh Katti Second Chair: Christian Hellmich			
Multiscale Modelling of Transversely Isotropic and Anisotropic Planar Fiber Networks: Current Results for Elasticity and Strength of Paper, and Potential Applications to Related Materials  Pedro Miguel Jesus de Sousa Godinho, Thomas Karl Bader, Josef Eberhardsteiner, Christian Hellmich	Does collagen crosslinking stiffening effect depend on the initial hydration of cornea?  Hamed Hatami-Marbini, Sandeep Jayaram	Insights into the molecular events in a bioinspired folding of membranes  SANTHOSH MATHESAN, PIJUSH GHOSH	Simulating arterial tissue fusion with a large deformation thermoporo mechanics finite element model  Douglas Fankell, Richard Regueiro, Mark Rentschler	Printing nature: Tuning hierarchical systems inspired by biological materials using machine learning  Grace Gu, Chun-Teh Chen, Deon Richmond, Markus Buehler	Enhanced Organic-inorganic Interfaces: A Key Element in Outstanding Properties of Nacre  Sina Askarinejad, Nima Rahbar
4-145	MS 64	3rd Mini-Symposium on Multiphysics-Multiscale Modeling of Engineering Materials  First Chair: Yong-Rak Kim Second Chair: Chung Song			
An experimental study on the cracking of unidirectional carbon fiber-reinforced composite using ultrahigh sampling  Fen Du, Ting Tan	Multilevel Micromechanics Modeling of Modeled Recycled Aggregate Concrete  Weidong Wu, Joseph Owino, Ignatius Fomunung, Mbakisya Onyango	Boundary effect on the heat flux field of a semi-infinite domain containing inhomogeneities  Tengxiang Wang, Huiming Yin	Three-Dimensional Finite Element Analysis to Determine the Stress State of Bitumen in Asphalt Concrete Mixes  Ramez Hajj, Syeda Rahman, Amit Bhasin	Viscoelasticity and inclusion based boundary element modeling of asphalt  Liangliang Zhang, Gan Song, Yuhong Wang, Huiming Yin	Exact solutions for a multilayered porous plate with thermal field considered  Lianzhi Yang, Yang Li, Yang Gao

**Building 2****Wednesday: 4:15-5:45pm**

2-105	MS 9	Coupled Processes in Subsurface Technologies	First Chair: Ruben Juanes Chair: Dryver Huston	Second
Recent Advances in Hydraulic Fracturing of Shale, Water and Gas Permeability, and Crack Branching  Zdenek P. Bažant, Saeed Rahimi-Aghdam, Hoang Nguyen, Hyujin Lee, Hari Viswanathan, Srinivasan Gowri, Viet T. Chau, Esteban Rougier, William Carey	A monolithic Discontinuous Galerkin finite element solver for hydraulic fracture  Bianca Giovanardi, Anwar Koshakji, Raul Radovitzky	Application of 3D Radar for Pavement and Bridge Deck Evaluation  Kenneth Maser, Aleksey Khamzin, Keith Sorota	Compact Magnetic and Electromagnetic Sensing of Subsurface Infrastructure and Conditions  Dryver Huston, Dylan Burns, Daniel Orfeo, Robert Farrell, Tian Xia	Example Airborne Ground Penetrating Radar (GPR) Applications to Civil Infrastructure Enabled by an Innovative Small Unmanned Aerial System (sUAS)  Michael Scott, Satish Chintakunta, Shane Beams, Brent Phares, Katelyn Freeseman, Peter Taylor, Xuhau Wang
4:15-4:30	4:30-4:45	4:45-5:00	5:00-5:15	5:15-5:30
				5:30-5:45pm

**Thursday, May 31st**

10:30-10:45

10:45-11:00

11:00-11:15

11:15-11:30

11:30-11:45

11:45-12:00pm

**Building W16****Thursday: 10:30-12:00pm**

W16-Rehearsal Room A	MS 15	Stability and failure of structures and materials	First Chair: Jifeng Xu Second Chair: Finian McCann	
Instability of Axially Loaded Cylindrical Shells Induced by Material Nonlinearity	Application of Database-Assisted Design for Wind in Buckling Analysis of Cold-Formed Steel Z-Section Purlins	Virtual Testing of Experimental Continuation	STABILITY OF A MOVING CURRENT CARRYING CONDUCTIVE STRING IN A MAGNETIC FIELD	Thermal buckling and postbuckling of functionally graded graphene-reinforced composite laminated beams  Geometric Imperfection Models in Shell FE Analysis of CFS Members: Validation through Data-Driven Stochastic Models

**Thursday, May 31, 2018**

**9:00 - 10:00am**

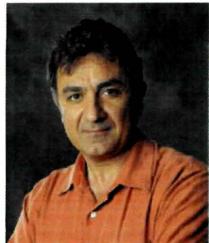
**Plenary Lecture 3**

**Room: W16 – Kresge Main**

Roger Ghanem

University of Southern California

Physics, Structure, and Uncertainty:  
Probabilistic Learning for Risk Mitigation



## **Roger Ghanem**

Professor of Engineering Technology  
Civil and Environmental Engineering and  
Aerospace and Mechanical Engineering  
University of Southern California | USC Viterbi  
School of Engineering

# Physics, Structure, and Uncertainty: Probabilistic Learning for Risk Mitigation

## **Abstract:**

Increasingly, critical decisions are demanded for situations where likelihoods are not sufficiently constrained by models. This could be caused by the lack of suitable mathematical models or the inability to compute the behavior of these models, or observe the associated physical phenomena, under a sufficient number of operating conditions. In many of these situations, the criticality of the decisions is manifested by the need to make inferences on high consequence events, which are typically rare. The setting is thus one of characterizing extreme events when useful models are lacking, computational models are expensive, or empirical evidence is sparse. We have found adaptation and learning to provide transformative capabilities in all of these settings. A key observation is that models and parameters are typically associated with comprehensive constraints that impose conservation laws over space and time, whose solution yields spatio-temporal fields, and that require comprehensive calibration with exhaustive data. Decisions typically depend on quantities of interest (QoI) that are agnostic to this complexity and that are constructed through an aggregation process over space, time, or behaviors.

A regularization can thus be imposed by allowing the QoIs to drive the complexity of the problem. But then one has to learn the QoIs.

This talk will describe recent procedures for probabilistic learning of QoIs using both orthogonal projections and manifold learning. Both approaches are applied to science and engineering problems where models are either too expensive to compute or too inconclusive to provide acceptable interpolation to data. In both cases, probabilistic inferences are possible as required by risk assessment and probability-based design.

## **Biosketch:**

Roger Ghanem is the Gordon S. Marshall Professor of Engineering Technology at the University of Southern California. He works in probabilistic modeling and numerics. Ghanem is past president of EMI, and currently serves on the Executive Council of the USACM and as Chair of the SIAM Special Interest Group on Uncertainty Quantification. He is a fellow of EMI, USACM and AAAS.

**Building 2****Wednesday: 4:15-5:45pm**

2-105	MS 9	Coupled Processes in Subsurface Technologies		First Chair: Ruben Juanes Chair: Dryver Huston	Second
Recent Advances in Hydraulic Fracturing of Shale, Water and Gas Permeability, and Crack Branching	A monolithic Discontinuous Galerkin finite element solver for hydraulic fracture	Application of 3D Radar for Pavement and Bridge Deck Evaluation	Compact Magnetic and Electromagnetic Sensing of Subsurface Infrastructure and Conditions	Example Airborne Ground Penetrating Radar (GPR) Applications to Civil Infrastructure Enabled by an Innovative Small Unmanned Aerial System (sUAS)	
Zdenek P. Bažant, Saeed Rahimi-Aghdam, Hoang Nguyen, Hyujin Lee, Hari Viswanathan, Srinivasan Gowri, Viet T. Chau, Esteban Rougier, William Carey	Bianca Giovanardi, Anwar Koshakji, Raul Radovitzky	Kenneth Maser, Aleksey Khamzin, Keith Sorota	Dryver Huston, Dylan Burns, Daniel Orfeo, Robert Farrell, Tian Xia	Michael Scott, Satish Chintakunta, Shane Beams, Brent Phares, Katelyn Freeseman, Peter Taylor, Xuhau Wang	
4:15-4:30	4:30-4:45	4:45-5:00	5:00-5:15	5:15-5:30	5:30-5:45pm

**Thursday, May 31st**

10:30-10:45

10:45-11:00

11:00-11:15

11:15-11:30

11:30-11:45

11:45-12:00pm

**Building W16****Thursday: 10:30-12:00pm**

W16-Rehearsal Room A	MS 15	Stability and failure of structures and materials		First Chair: Jifeng Xu Second Chair: Finian McCann	
Instability of Axially Loaded Cylindrical Shells Induced by Material Nonlinearity	Application of Database-Assisted Design for Wind in Buckling Analysis of Cold-Formed Steel Z-Section Purlins	Virtual Testing of Experimental Continuation	STABILITY OF A MOVING CURRENT CARRYING CONDUCTIVE STRING IN A MAGNETIC FIELD	Thermal buckling and postbuckling of functionally graded graphene-reinforced composite laminated beams	Geometric Imperfection Models in Shell FE Analysis of CFS Members: Validation through Data-Driven Stochastic Models

Ruben Adorno, Anthony N. Palazotto	Kermelos Woldeyes, Yared Shifferaw	Mark Schenk, Rainer Groh, Robin Neville, Alberto Pirerra	Jalil Hasanyan	Hui-Shen Shen, Yang Xiang, Feng Lin	Shafee Farzanan, Arghavan Louhghalam, Benjamin W. Schafer, Mazdak Tootkaboni
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W16-Kresge Little

MS 48

Computational Methods and Applications for Solid and Structural Mechanics

Chair: Ravindra Duddu

New Automated Computational Framework for Simulating the Mechanical Behavior of Non-Woven Entangled Materials  Ming Yang, Mingshi Ji, Soheil Soghrati	A Conforming to Interface Structured Adaptive Mesh Refinement technique for modeling complex morphologies  Anand Nagarajan, Bowen Liang, Ming Yang, Hossain Ahmadian, Soheil Soghrati	Discontinuous Galerkin method and interface element insertion for periodic boundary conditions  Timothy Truster, Sunday Adulolu	The Shifted Boundary Method for Embedded Domain Computations: Examples in Solid Mechanics  Guglielmo Scovazzi, Nabil Atallah, Alex Main	The Shifted Interface Method for Embedded Interface Computations  Kangan Li, Alex Main, Guglielmo Scovazzi	A morphologically informed variational method for polycrystalline media  Nicolas Venkovic, Lori Graham-Brady
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**Building W20**

**Thursday: 10:30-12:00pm**

W20-491

MS 3

Topology Optimization: from Algorithmic Developments to Applications

Chair: James Guest

Topology Optimization with Overhang Constraints: Eliminating the Need for Support Structures in AM  Reza Behrou, Andy Gaynor, James Guest	Failure Resistant Topology Optimization of Structures using Nonlocal Elastoplastic-Damage Model  Lei Li, Guodong Zhang, Kapil Khandelwal	Topology Optimization in the Classic Game of Tetris  Michael Kane	Topology Optimization of Discrete Structures and Lattices with Improved Manufacturability Constraints  Alireza Asadpoure, Mojtaba Harati, Mazdak Tootkaboni	Topology Optimization for Lightweighting Components and Systems  Cristopher Moen, James Guest	Topology optimization of nonlinear truss structures based on hysteretic finite elements  Navid Changizi, Gordon Warn
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W20-407

MS 8

Computational Modeling in Civil Engineering

First Chair: Seymour Spence  
Second Chair: Andre Barbosa

A building envelope performance assessment framework for systems subject to extreme wind and rain hazards  Zhicheng Ouyang, Seymour Spence	Failure Mode Analysis of Lattice Transmission Towers Considering Unbalanced Loadings due to Conductor Breakage under Extreme Wind Hazards  Yousef Mohammadi Darestani, Kyunghwa Cha, Abdollah Shafeezadeh	Application Fluid-Structure Interaction Modeling in Predicting Aerodynamic Changes and Deformations in Thin-Walled Structures Under Wind Loading  Kermelos Woldeyes, Yared Shifferaw	Verification of A Simple Model for Rolling Isolation System Response  Aarthi Sridhar, Henri Gavin, Karah Kelly	Intelligent model for cyclic behavior of moment connections in hybrid test simulations under monotonically increasing load based on phenomenology  Alireza Asgari Hadad, Syed Murtuza Abbas, Gian Andrea Rassati	Analysis of Composite Cylinders using 3-D Degenerated Shell Elements Under Dynamic Loading  Pratik Tiwari, Dipak Kumar Maiti, Damodar Maity
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W20-20 Chimneys		MS 22	Advances in Experimental, Analytical and Computational Wind Engineering		Chair: Aly Mousaad Aly	
Investigations on non-deterministic aeroelastic instabilities of wind turbine blades using efficient numerical stochastic solvers Shaoning Li, Luca Caracoglia	Recent developments at the NHERI Wall of Wind Experimental Facility Maryam Refan, Amal Elawady, Arindam Gan Chowdhury, Ioannis Zisis, Peter Irwin	Numerical modeling and experimental validation of low-rise building response under wind loading Jing He, Fang Pan, C.S. Cai, Arindam Chowdhury, Filmon Habte	Computational and Experimental Atmospheric Boundary Layer Processes for Open-Jet Testing Hamzeh Gol Zaroudi, Aly Mousaad Aly	Enhancement of lateral wind force resisting systems in low-rise residential townhouses Kermelos Woldeyes, Trevor Rabare, Yared Shifferaw	Aerodynamic Mitigation of Wind-Induced Loads on Low-Rise Buildings by Varying Parapet Height Matthew Thomas, Aly Mousaad Aly, Hamzeh Gol Zaroudi	
W20-PDR 1&2		MS 65	Latest trends in additive manufacturing technologies		Chair: Sofiane Guessasma	
Printability of varieties of polymers using Fused Deposition Modelling Sofiane Guessasma, Sofiane Belhabib	Measuring and Improving Environmental Impacts of Digital Light Projection Printing Jeremy Faludi, Katy Van Lieshout, Emily Tseng, Robin Jensen	Looking into the microstructural imperfections driven by additive manufacturing using X-ray microtomography Hedi Nouri, Sofiane Guessasma, Sofiane Belhabib	3D Printed Polymers for Enhanced Fracture Properties Jun Li, Sen Yang, Dapeng Li, Vijaya Chalivendra	State of the art and qualification plans for Wire + Arc Additive Manufacture Filomeno Martina, Jialuo Ding, Stewart Williams		
W20-Coffeehouse Lounge		MS 68	The Link Between Composition, Structure, and Physical Properties of Materials		First Chair: Mohammad Javad Abdolhosseini Qomi, Second Chair: Mathieu Bauchy	
An XFEM model of fracture propagation in concrete repaired by epoxy informed by Molecular Dynamics Koochul Jl, Chloe Arson	Toward a fully-stochastic, multi-scale framework for plastic deformation in amorphous solids Michael Shields, Christopher Rycroft, Dihui Ruan, Darius Alix-Williams, Dimitris Giovanis, Michael Falk	Statistical physics of the carbonation reaction in Calcium Silicate Hydrate and Portlandite Siavash Zare, Andreas Funk, Mohammad Javad Abdolhosseini Qomi	Multi-scale modeling of carbon materials derived from hydrothermal processing of biomass Diego López Barreiro, Jingjie Yeo, Francisco J. Martín-Martínez, Markus J. Buehler	Clay layer flexibility and its impact on microstructure Laurent Brochard, Tulio Honorio, Huaxiang Zhu, Matthieu Vandamme, Arthur Lebée, Jean-Noël Roux	Nucleation of Gypsum to Hemihydrate for Removal of Water Sarah Balaian, Mohammad Javad Abdolhosseini Qomi, Ali Morshedi, Sydney Do	
10:30-10:45	10:45-11:00		11:00-11:15	11:15-11:30	11:30-11:45	11:45-12:00pm
<b>Building 5</b>						
5-234		MS 34	Advances in computational methods for rapid uncertainty quantification, reliability analysis and robust design of civil structures exposed to natural and man-made hazards		First Chair: Alexandros Taflanidis Second Chair: Seymour Spence	
Regional hurricane analysis using Hazard Quantization	Simulating and Managing Hurricane Evacuation Process: the case of Hurricane Irma (2017)	Performance-based design optimization of large-scale wind-excited system: A data-driven Kriging-enabled approach	Probabilistic surrogate modeling via Bayesian neural networks	A New Approach to Estimate the Error of Reliability Analysis Based on Adaptive Kriging		

Vasileios Christou, Paolo Bocchini	Kairui Feng, Ning Lin	Arthriya Suksuwan, Seymour Spence	Xihaier Luo, Ahsan Kareem	ZEYU WANG, ABDOLLAH SHAFIEEZADEH	
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## Building 3

Thursday: 10:30-12:00pm

3-270	MS 13	Structural Identification and Damage Detection			First Chair: Babak Moaveni Second Chair: Costas Papadimitriou
Hierarchical Bayesian Model Calibration of a Wing-Engine Structure Using Experimentally Identified Nonlinear Normal Modes  Mingming Song, Ludovic Renson, Jean-Philippe Noël, Babak Moaveni, Gaetan Kerschen	Instrumentation Sufficiency of a Vertical Lift Bridge for Modal System Identification by Frequency Domain Analysis  Milad Mehrkash, Vahid Shahsavari, Erin Bell	Flaw detection in shell structures under dynamic loading using the eXtended Finite Element Method and an inverse formulation  Konstantinos Agathos, Sergio Nicoli Sergio, Konstantinos Tatsis, Eleni Chatzi	Post-Earthquake Performance Assessment of a Damaged RC Building in Nepal Using Vibration and Point Cloud Data  Mehdi M. Akhlaghi, Supratik Bose, M. Ebrahim Mohammadi, Babak Moaveni, Andreas Stavridis, Richard L. Wood	Deep reinforcement learning for data-driven decision-making in engineering systems  C.P. Andriotis, K.G. Papakonstantinou	Operational Modal Identification of a Bridge and Insights from Smartphones in Moving Vehicles  Thomas Matarazzo, Paolo Santi, Shamim Pakzad, Carlo Ratti, Babak Moaveni
3-370	MS 37	Bayesian methods for system risk assessment and management			First Chair: Sankaran Mahadevan Second Chair: Pingfeng Wang
Probabilistic Model Validation of the Isolation layer of a Full-Scale Four-Story Base-Isolated Building  Subhayan De, Tianhao Yu, Agnimitra Dasgupta, Erik Johnson, Steven Wojtkiewicz	Probabilistic Calibration of Hydro-Mechanical Soil Properties of Levees using Integrated Kriging Meta-Models and Likelihood Function  Mehrzed Rahimi, Abdollah Shafieezaheh, Dylan Wood, Ethan J. Kubatko	Exploration of Network Systems: Priority Measures for Binary Components  Chaochao Lin, Matteo Pozzi, Junho Song	Pipe strength probabilistic estimation using Bayesian network inference studies  Sonam Dahire, Yuhao Wang, Yongming Liu	Prediction of discrepancies in dynamic system models using Bayesian estimation  Sankaran Mahadevan, Abhinav Subramanian	Uncertainty quantification of soil dynamics properties via Bayesian model updating  Cesar Pajaro, Vicente Mercado, Albert R. Ortiz, Rodrigo Astroza
3-333	MS 39	Dynamic Response and Performance Assessment of Structures Subject to Single or Multiple Hazards			Chair: Michele Barbato
Energy-Based Analytical Framework for Stochastic Multi-Hazard Vulnerability Analysis of Structures  Tathagata Roy, Vasant Matsagar	Assesment of the performance of wood-frame houses subject to hurricane hazard under changing climate conditions  Mirsardar Esmaeili, Michele Barbato	A Time-domain Method for Predicting Wind-induced Buffeting Response of Tall Buildings  Fangwei Hou, Partha Sarkar	PERFORMANCE ASSESSMENT OF A REAL-WORLD BASE-ISOLATED BUILDING  Nicholas Oliveto, Anastasia Athanasiou, Athanasios Markou	Probability-Based Demand Evaluation of the Bridge Tidal Turbine Deployment System Subject to Environmental Events  Chao Yang, Erin Bell, Vahid Shahsavari, Milad Mehrkash	Laser Doppler Vibrometer Mounted Unmanned Aerial Systems for Dynamic Displacement Measurement  Piyush Garg, Fernando Moreu, Dilendra Mahajan

3-133	MS 44	Safety Assessment of Aging Infrastructure: From Data to Decision		First Chair: Raimondo Betti Second Chair: Suparno Mukhopadhyay
Updating deterioration models based on data from Structural Health Monitoring and Non-Destructive Evaluation  Leandro Iannaccone, Paolo Gardoni	A statistical analysis through the Inner Product Vector theory for structural damage detection  Marcello Morgantini, Raimondo Betti	Probabilistic risk-based life-cycle management framework for fatigue-sensitive structures considering corrosion-fatigue interaction  Xu Han, David Yang, Dan Frangopol	Reliability-based optimum maintenance planning for fatigue-prone components  Jasmine Gulati, Arash Noshadravan	Bridge impairment detection utilizing dynamic response influence lines extracted from passing vehicle response profiles  Yasha Zeinali, Jase D. Sitton, Brett A. Story

Building 1			Thursday: 10:30-12:00pm		
1-390	MS 91	Machine Learning and Data Analytics for Infrastructure Integrity Assessment	First Chair: Oral Buyukozturk Second Chair: Hao Sun		
Automated Structural Damage Detection Based on Bayesian Dynamic Model  Y.W. Wang, Y.Q. Ni	Deep learning enabled structural seismic fragility analysis and resilience assessment  Ruiyang Zhang, Zhao Chen, Hao Sun, Max Stephens	Automatic Seismic Damage Identification and Evaluation of Reinforced Concrete Columns Using Region-based Deep Convolutional Neural Networks by Images  Yang Xu, Shiyin Wei, Hui Li	Learning Full-Scale Structures via Deconvolution Functions  Murat Uzun, Hao Sun, Justin Chen, Oral Buyukozturk	Data-Based Damage Identification Using Augmented Data  Zhiming Zhang, Chao Sun	Machine learning classifiers for phase identification in post-fire structural steels  Dayakar Naik, Ravi Yellavajjala
10:30-10:45	10:45-11:00	11:00-11:15	11:15-11:30	11:30-11:45	11:45-12:00pm

Building 4			Thursday: 10:30-12:00pm		
4-159	MS 24	Cementitious Materials: Experiments and Modeling Across the Scales	Chair: Christian Hellmich		
Understanding the Influence of Hydration Products on Mechanical Properties Recycled Aggregate Concrete Using Thermogravimetric Analysis	Noncontact Stress Sensing for UHPC Using Raman Piezospectroscopy	A Modified Pullout Method to Characterize Fiber-Matrix Interactions for Natural Fibers	Drying-Induced Atomic Structural Rearrangements in Alkali-activated Materials and the Mitigating Effects of Nanoparticles	Calcium-Silicate-Hydrate interactions from ion-ion correlations	

Subhasis Pradhan, Shailendra Kumar, Sudhirkumar V. Barai	Elham Eslami, Le Zhou, Hae-Bum Yun	Achintyamugdha Sharma, Rajender Chada, Ravi Yallavajjala, Todd Sirotiak	Kengran Yang, Ongun Ozcelik, Nishant Garg, Kai Gong, Claire White	Abhay Goyal, Katerina Ioannidou, Roland Pellenq, Emanuela Del Gado	
4-237		MS 40	Mechanics and Physics of Granular Materials		First Chair: Shunying Ji Second Chair: Payam Poorsolhjouy
Allometric Investigation of Granular Materials Behavior  Seung Jae Lee, Sumana Bhattacharya, Moothul Shin, Chang Hoon Lee, Yu-Feng Su	A particle mechanics approach for particle-binder systems  Caroline Baker, Marcial Gonzalez	Connecting Macroscopic Anisotropic Behavior with Microscopic Grain Properties  Payam Poorsolhjouy, Marcial Gonzalez	Modeling Granular Media Response Using the Discrete Element and a Lattice Boltzmann Solution to Volume-Averaged Navier-Stokes Equations  Mourad Zeghal, Bo Li	Discrete element simulation on the ordered array of carbon fiber with ultrasonic vibration assisting in SLS  Yuanqiang Tan, Jufang Liu, Yuntian Feng	
4-261		MS 46	Structural Safety in Fire Engineering: Past, Present and Future		First Chair: Mohammed Ali Morovat Second Chair: Negar Elhami-Khorasani
Characterization of concrete at elevated temperatures  Manisha Malik, Sriman Kumar Bhattacharyya, Sudhirkumar Barai	Probabilistic Collapse Assessment of Beams under Localized Fires  Hussam Mahmoud, Mona Hemmati	Post-Fire Mechanical Properties of Structural Steels  Hizb Sajid, Ravi Yallavajjala	Towards Performance-Based Structural-Fire Design: Understanding the High-Temperature Creep Buckling Phenomenon  Mohammed Morovat, Michael Engelhardt	Need of Active Boundary Conditions for Fire Testing  Ramla Qureshi, Negar Elhami Khorasani, Thomas Gernay	
4-153		MS 53	Mechanics of Wood and Wood Based Materials: Deterministic and probabilistic approaches		First Chair: Markus Lukacevic Second Chair: Josef Fussl
Prediction of moisture state in prefabricated Timber-Concrete Composite Elements subjected to varying climate in early age  Johan Pyykkö, Staffan Svensson	A Probabilistic Model for the Distribution of Knot Defects in Cross Laminated Timber Lamstock  Fiona O'Donnell, Sanjay Arwade, Peggy Clouston, Hamid Kaboli	Materially nonlinear analysis of composite timber-concrete beams with deformable shear connection using a new three-field mixed finite element  Miguel Ferreira, Anísio Andrade, Paulo Providência, Fabian Cabrera	Parameterized and adaptive modelling of structural behaviour of innovative modular-based multi-storey timber buildings of wood  Sigurdur Ormarsson	Analytical Mechanics of Structurally Optimized Timber Beams  Paul Mayencourt, Caitlin Mueller	

4-145	MS 71	Advanced Engineering Concepts, Designs, and Technologies for Aerospace and Extraterrestrial Applications			First Chair: Ramesh Malla Second Chair: Melissa Sampson
Advancement in 3D Automated Additive Construction using Polymer Concretes  Robert Mueller, Nathan Gelino, Bradley Buckles	Lunar Polar Ice Mining Feasibility Study  George Sowers, Christopher Dreyer, Yitz Finch, Hunter Williams	Extraterrestrial Drilling  Jared Atkinson, Kris Zacny	Predicting Micrometeoroid Damage of Extraterrestrial Structures  Maria I. Allende, Eric L. Christiansen, David J. Loftus, Michael D. Lepech	Enhancing the design of tensegrity structures through self-stress state and internal mechanism consideration  Omar Aloui, Jessica Flores, David Orden, Landolf Rhode-Barbarigos	Structural Analysis of a Long-Term Frame Membrane Lunar Habitat Subjected to Extreme Diurnal Temperature Variation  Ramesh Malla, Kevin Brown

Building 2				Thursday: 10:30-12:00pm	
2-105	MS 47	Characterization and modeling of coupled processes in porous materials			First Chair: Giuseppe Buscarnera Second Chair: Manolis Veveakis
Pore-scale modelling of drainage processes in disordered porous media  Yixiang Gan	Geomechanical analysis of fluid injection into sedimentary reservoirs  Cheng Zhu, Paul Ogwari, Zhiqiang Fan, Peter Eichhubl	Thermodynamics of adsorption-deformation coupling in porous media  Yida Zhang	Experimental Characterization of Kaolinite Deposition in a Silica Sand Matrix  Jongmuk Won, Susan Burns	Chemo-hydro-mechanics and phase-field modeling of cracking and damage from crystallization in pores  Jinhyun Choo, WaiChing Sun	Application of artificial intelligence and probabilistic analysis in the estimation of in-situ horizontal stresses from borehole deformation  Hong Xue Han, Shunde Yin
2-131	MS 79	Human-Machine Interfaces for Structural Engineering Assessment			First Chair: Fernando Moreu Second Chair: David Mascarenas
Virtual tours and informational modeling as a human-machine interface for structural engineering assessment  Rebecca Napolitano, Branko Glisic	Augmented Reality Tools for Enhanced Structural Inspection  Chih-Yu Shen, Fernando Moreu, David Mascarenas	User-centered augmented reality design: Using cognitive science to help design effective augmented reality apps for infrastructure inspection  Nick Flor	Dynamic Digital Twinning of Structural Systems  Sara Mohamadi, David Lattanzi	Robust Surface Defect Detection from Point Cloud Data  Mohammad Ebrahim Mohammadi, Richard L Wood	Dancing and Engineering: real-time visualization of data for dancers performance  Dilendra Maharjan, Selene Diaz, Marlon Aguero, Emmanuel Ayorinde, Fernando Moreu

**Thursday, May 31, 2018**

**1:00 - 2:00pm**

**Plenary Lecture 4**

**Room: W16 – Kresge Main**

Nadia Lapusta

California Institute of Technology

Under the hood of the earthquake machine



## **Nadia Lapusta**

Professor of Mechanical Engineering and Geophysics  
Department of Mechanical and Civil Engineering & Seismological Laboratory  
California Institute of Technology

# Under the hood of the earthquake machine

### **Abstract:**

Many major faults, such as the San Andreas in California, separate two tectonic plates that slowly move past each other in opposite directions. Some of the faults remain locked for many years and then slip in sudden dramatic rupture events perceived as earthquakes. These occasional dynamic motions co-exist with much slower, quasi-static fault slips that can now be imaged by geodetic methods. We will present the current physical understanding and numerical modeling of these processes that incorporate laboratory-derived fault friction laws, shear heating, and effects of pore fluids. The models can reproduce all stages of the past behavior of some fault segments – including locked, slowly moving, and earthquake-producing – with remarkable qualitative, and often quantitative, agreement. In part, they reveal the potential physics behind the unexpected extreme events, such as the 2011 Mw 9.0 Tohoku earthquake in Japan that caused up to 40-meter tsunami and numerous casualties. Such continuum-mechanics-based models, when further developed, will enable us to incorporate our increasing understanding of earthquake source physics into the assessment of seismic hazards and seismicity response to perturbations of natural or anthropogenic origins.

### **Biosketch:**

Nadia Lapusta is a Professor of Mechanical Engineering and Geophysics at the California Institute of Technology. She has received her undergraduate education in Applied Mathematics and Mechanics from Kiev State University in Ukraine and the PhD degree in Engineering Sciences from Harvard University. Her interdisciplinary research group works in the areas of computational mechanics of geomaterials, earthquake source physics, fundamentals of friction and fracture, and solid-fluid interactions. She serves as the leader of the Fault and Rock Mechanics group of the Southern California Earthquake Center (SCEC) and the Vice Chair of the Executive Committee of Deformation Experimentalists at the Frontier of Rock and Mineral Research (DEFORM).

## Thursday, May 31st

2:15-2:30	2:30-2:45	2:45-3:00	3:00-3:15	3:15-3:30	3:30-3:45pm
<b>Building W16</b>					<b>Thursday: 2:15-3:45pm</b>
<b>W16-Rehearsal</b> Room A					Nonlinear mechanics of highly deformable solids and structures <b>Chair: Tal Cohen</b>
A comprehensive measurement model for strain gauges attached to slender rod-like structures subjected to finite strain and large deformation  Mayank Chadha, Michael D. Todd	MS 20  Tuan Hoang, Eliot Fried	Stability of a magnetic ring subject to a point dipole  Designing buckling patterns by leveraging kinematic incompatibilities in non-periodic perforated sheets  Paolo Celli, Connor McMahan, Brian Ramirez, Christina Naify, Douglas Hofmann, Basile Audoly, Chiara Daraio	Size effects in mechanical metamaterials exhibiting instability-induced pattern transformations  Maqsood Mohammed Ameen, Ondrej Rokoš, Ron Peerlings, Marc Geers	A novel rate-dependent viscoelastic constitutive model for filled elastomers and its finite element implementation  Srikanth Krishnakumar, Krishna Kannan, Manoj Pandey	Theoretical investigation of shear shock propagation  Chockalingam Senthilnathan, Tal Cohen
<b>W16-Kresge Little</b> MS 48					Computational Methods and Applications for Solid and Structural Mechanics <b>Chair: Caglar Oskay</b>
Adaptive updating strategy of a domain decomposition preconditioner for shear bands and crack propagation  Lampros Svolos, Luc Berger-Vergiat, Haim Waisman	Stabilized finite element formulation of fracture propagation using cohesive interface elements  Gourab Ghosh, Chandrasekhar Annavarapu, Ravindra Duddu	Efficient jump boundary condition for wave propagation in 3-D viscous fracture networks  Qiwei Zhan, Qing Huo Liu	A Multiscale Generalized FEM for Three-Dimensional Crack Propagation in Fiber Reinforced Composites  Phillipe Alves, Carlos Duarte	XFEM method to study the fracture of 3D printed polymers considering layer interfaces  Rojin Ghandriz, Jun Li	Failure Analysis of a Bioreversible Composite Subject to Three-Point Bending  Haotian Sun, Dianyun Zhang
<b>Building W20</b>					<b>Thursday: 2:15-3:45pm</b>
<b>W20-491</b> MS 3					Topology Optimization: from Algorithmic Developments to Applications <b>Chair: Alireza Asadpoure</b>
Polynomial Dimensional Decomposition for Robust Topology Optimization  Xuchun Ren, Xiaodong Zhang	An innovative method for avoiding pseudo-modes in discrete topology optimization  Seyed Ardalan Nejat, Mazdak Tootkaboni, Alireza Asadpoure	Smart component-placement optimization of organic stretchable electronic devices  Reza Rastak, Christian Linder	System-level topology optimization of uncertain and dynamic wind-excited systems subject to stochastic loads  Arthriya Suksuwan, Seymour Spence	Topology Optimization of Discrete Structures Considering Constructability, Stress, and Stability Constraints  May Thu Nwe Nwe, Christopher Moen, James Guest	Topology optimization of buildings subjected to stochastic dynamic base motion  Fernando Gomez, Billie Spencer

W20-407		MS 8	Computational Modeling in Civil Engineering		First Chair: Ioannis Koutromanos Second Chair: Petros Sideris	
Softening visco-elasto-plastic response of polyurethanes for damage-resistant structures: Experimental characterization and constitutive modeling  Mohammad Taghi Nikoukalam, Petros Sideris	Multi-Node Gradient Inelastic Beam-Column Element Formulation for Analysis of Softening Structures  Mohammad Salehi, Petros Sideris	Hybrid beam element formulation based on exact kinematics and nonlinear programming  C.M. Lyritsakis, C.P. Andriotis, K.G. Papakonstantinou	Minimal potential energy push-over analysis of cross laminated timber shear walls  Shiling Pei	Physic-Based Component Fragility Model for Near-Coast Residential Wood Building Subjected to Hurricane Wave and Surge  Trung Do, John van de Lindt, Daniel Cox	Updates to the ASCE 41 Standard for Nonlinear Modeling of Light-Frame Wood Walls for Performance-Based Earthquake Engineering  Maria Koliou, John W. van de Lindt, Ronald O. Hamburger	
W20-Coffeehouse Lounge		MS 68	The Link Between Composition, Structure, and Physical Properties of Materials		First Chair: Mathieu Bauchy Second Chair: Konrad Krakowiak	
Early Hydration of Tricalcium Silicate by Atomistic Simulation  K. M. Salah Uddin, Andreas Funk, Bernhard Middendorf	Modeling the evolution of microtextured regions during alpha/beta processing using the crystal plasticity finite element method  Ran Ma, Timothy Truster	Simulations of microstructural evolution during the geopolymserisation reaction  Kumaran Coopamootoo, Francesca Lolli, Enrico Masoero	Metamodel based optimization of the mechanical properties of assembled hairy nanoparticle composites  Sinan Keten, Nitin Krishnamurthy Hansoge, Tianyu Huang, Wenjie Xia, Robert Sinko, Wei Chen	Incremental Stress Marching on Rugged Synthetic Enthalpy Landscapes  Ali Morshedifard, Mohammad Javad Abdolhosseini Qomi	Capillary Condensation Induced Stress In Complex Multiscale Porous Materials  Tingtao Zhou, katerina ioannidou, Enrico Masoero, Mohammad Mirzadeh, Roland Pellenq, Martin Bazant	
W20-20 Chimneys		MS 94	Simulation, Prediction, and Mitigation of Extreme Events		First Chair: Sheng-Wei Chi Second Chair: Sean VITUOUSEK	
Semi-Lagrangian Reproducing Kernel Formulation for Rainfall-Induced Landslide Modeling  Mohammed Atif, Sheng-Wei Chi, Thanakorn Siriaksorn, Ashkan Mahdavi	An Environment-dependent Hurricane Climatology Model  Ning Lin, Renzhi Jing, Dazhi Xi	A State-based Godunov-Peridynamics Formulation for Shocks in Solids  Guohua Zhou, Michael Hillman	Sea-level rise and the increase in frequency of extreme coastal flooding events  Sean Vitousek, Mohsen Taherkhani	A Lifecycle Cost Framework for Identification of Optimal Strengthening Strategies for Wood Poles in Electric Power Distribution Lines Subjected to Hurricanes  Yousef Mohammadi Darestani, Ehsan Fereshtehnejad, Abdollah Shafieezadeh	High-Order Finite Element Methods for Efficient High-Rate Solid Dynamics  Kent Danielson, Mark Adley, Eric Lynd	

<b>Building 5</b>						<b>Thursday: 2:15-3:45pm</b>
5-234	MS 4	Advances in Quantitative Engineering Sustainability and Resilience, Physics-Based and Data-Driven Modeling and Prediction			First Chair: Arghavan Louhghalam Second Chair: Marta Gonzalez	
Global Sensitivity of Roughness-Induced Pavement-Vehicle Interaction to Road Surface Parameters and Car Dynamic Characteristics	Dissipation- versus Detachment-Induced Pavement - Vehicle Interactions Revisited	PAC-Algorithms for Reliability Estimation of Complex Systems	A novel optimization tool to enhance the resilience of bridge networks	Life-cycle Facility Management and Optimization By Incorporating Building Information Models	Efficient Stochastic Analysis of Infrastructure Systems Using Compressive Sampling	
Meshkat Botshekan, Mazdak Tootkaboni, Arghavan Louhghalam	Lev Khazanovich, Kairat Tuleubekov	Roger Paredes, Leonardo Dueñas-Osorio	Ning Zhang, Alice Alipour	Jie Wu, Michael Lepech, Bo Shen, Mette Geiker, Alexander Michel	Negin Alemazkoor, Hadi Meidani	
5-217	MS 12	Computer-vision based SHM using deep learning and UAV			First Chair: Young-Jin Cha Second Chair: Oral Buyukozturk	
Autonomous UAV for damage detection using deep faster R-CNN and ultrasonic beacon	Using deep learning neural network-based techniques for concrete crack detection from unmanned aerial system 	Image-Based Infrastructure Distress Detection Using Deep Convolutional Neural Networks	Accelerated Disaster Reconnaissance Using Automatic Traffic Sign Detection with UAV and AI	Automated estimation of operating deflection shape vectors from motion-magnified videos		
Dongho Kang, Young-Jin Cha	Sattar Dorafshan, Marc Maguire, Cal Coopmans	Mohamad Alipour, Devin K. Harris	Yichang Tsai, Yifei Fan, Cheng Chieh Wei	Aral Sarrafi, Zhu Mao		
2:15-2:30	2:30-2:45	2:45-3:00	3:00-3:15	3:15-3:30	3:30-3:45	
<b>Building 3</b>						<b>Thursday: 2:15-3:45pm</b>
3-370	MS 29	Stochastic Methods in Computational Mechanics of Random Materials			First Chair: Johann Guilleminot Second Chair: Michael Shields	
Multi-scale approach for integrated estimation of effective material properties	Stochastic Mesoscale Modeling of Crack Propagation in Random Heterogeneous Media	Representative volume element size determination for viscoplastic polycrystalline materials	Mesoscopic characterization of SVEs and macroscopic field realization for fracture and elastic properties	Stochastic Modeling of the Residual Radius of Corroded Steel Reinforcing Bars Using Measurements Taken from a Reinforced Concrete Bridge	Uncertainty Quantification of Data Collection and Data Processing in Materials Characterization	
Inna Gitman, Mikhail Gitman, Valeriy Stolbov	Anthony Hun, Johann Guilleminot, Julien Yvonnet, Michel Bornert	Justin Dirrenberger, Shaobo Yang, Eric Monteiro, Nicolas Ranc	Reza Abedi, Philip Clarke, Bahador Bahmani, Ming Yang, Arash Noshadravan, Anand Nagarajan, Soheil Soghrati, Katherine Acton	Haijun Zhou, Qi Wen, George Deodatis, Feng Xing	Noah Wade, Lori Graham-Brady	

3-133	MS 31	Advanced Analysis for Earthquake Engineering			First Chair: Ting Lin Second Chair: Kevin Wong
PERFORMANCE OF BASE-ISOLATED BUILDINGS EXCITED BY FAR AND NEAR-FIELD EARTHQUAKES  S. D. Bharti, M. K. Shrimali, Mohit Bhandari, T. K. Datta	Mathematical formulation for prediction of structural collapse based on dynamical systems theory  Shivang Pathak, Safat Al-Deen, Amar Khennane	Comparison of near-fault and far-fault ground motion effect on dam-reservoir system  Soumya Gorai, Damodar Maity	Displacement-based heuristic estimation of quasi-static and dynamic earth pressures on rigid walls  Joaquin Garcia-Suarez, Domniki Asimaki	A New Analytical Technique for Solving Nonlinear Stability Problems of Framed Structures  Kevin Wong	Methodologies of Structural Uncertainty Quantification in Seismic Fragility and Risk Assessment  Da-Gang Lu
3-333	MS 39	Dynamic Response and Performance Assessment of Structures Subject to Single or Multiple Hazards			Chair: Michele Barbato
Multi-hazard performance-based design and life-cycle cost benefit analysis of steel buildings with special moment resisting frames  ALEXANDROS NIKELLIS, KALLOL SETT, ANDREW S. WHITTAKER	ROBUST-TO-CHANGE DESIGN OR WHY TALL CACTI AND GIANT SEQUOIAS ARE CYLINDRICAL  Arzhang Alimoradi, Johannes Tausch	Vibration Suppression in High-Rise Buildings to Achieve System-Level Performance under Multiple Hazards  Suvash Chapain, Aly Mousaad Aly	Kalman Filter based hybrid control of multi-span bridges using sliding mode controller.  NEETHU B, DIPTESH DAS	A Game Theory and Neural Dynamic Methodology for Earthquake Hazard Mitigation of Irregular Structures  Mariantonieta Gutierrez Soto, Hojjat Adeli	Design of d-MTMDs for response control of buildings subjected to wind or earthquake excitation  Said Elias
3-270	MS 82	Forward and inverse modeling for performance and resilience assessment of civil structures			First Chair: Hamed Ebrahimian Second Chair: Joel Conte
Modeling Post-Disaster Functionality Recovery of Community Building Portfolios: A Stochastic Approach  Peihui Lin, Naiyu Wang	Guided Preventive Power System Operation During Hurricanes with Structural Vulnerability Analysis  Jiayue Xue, Yuanrui Sang, Ge Ou, Mostafa Sahraei-Ardakani	A Multi-Hazard Resilience Assessment Framework for Interdependent Networks  Kate Duffy, Lizzy Warner, Lindsey Bressler, Udit Bhatia, Auroop Ganguly	Using building functionality metrics for performance and resilience assessment of energy infrastructure  Dorothy Reed, Amy Kim, Shuoqi Wang	A marginalized unscented Kalman filter for efficient parameter estimation in systems represented by finite element models  Audrey Olivier, Andrew Smyth	A stochastic model for long-term structural degradation  Ajay Saini, Iris Tien

**Building 1****Thursday: 2:15-3:45pm**

1-390	MS 91	Machine Learning and Data Analytics for Infrastructure Integrity Assessment		First Chair: Hao Sun Second Chair: Oral Buyukozturk	
Proposed Universal Resilience Index Using Data Science Techniques: Application to Blackout Event  May Haggag, Ahmad Siam, Wael El-Dakhakhni	Structural Dynamic Response Estimation Using Deep Convolution Neural Networks  Rih-Teng Wu, Mohammad Jahanshahi	Data-driven modeling of ambient environmental effect on building's characteristics  Hao Sun, Aurelien Mordret, Murat Uzun, Zhao Chen, Ruiyang Zhang, Oral Oral Buyukozturk	Exploring deep learning for characterisation of induced seismic events.  James Long, Murat Uzun, Hao Sun, Oral Buyukozturk	Identification of Significant Uncertain Parameters for Crack Formation in Concrete Sewer Pipes Using a Sensitivity Analysis Based on BART  Soroush Zamanian, Abdollah Shafeezadeh, Jieun Hur	A machine-learning approach for self-diagnosis of bridge monitoring system  Yang Qin, Gang Liu, Zhu Mao

**Building 4****Thursday: 2:15-3:45pm**

4-153	MS 6	Multiscale Behavior of Damage and Failure Mechanics		First Chair: Lizhi Sun Second Chair: Glaucio Paulino	
A discrete approach to microcracking and shear banding in argillaceous rocks  Özge Dinç Gö?ü?, Luc Scholtès	An implicit non-local damage to crack transition framework for ductile materials involving a cohesive band model  Julien Leclerc, Ling Wu, Van-Dung Nguyen, Ludovic Noels	A phase field model for viscoelastic fracture accelerated by viscous energy dissipation  Rilin Shen, Haim Waisman, Licheng Guo	Microstructural Damage and Failure Analysis of Freeze-thawed Concrete  Yijia Dong, Chao Su, Pizhong Qiao, Lizhi Sun	Interfacial morphology of impact welded, additively manufactured 15-5 PH stainless steel  Bert Liu, Anthony Palazotto, Ali Nassiri, Varun Gupta	Determination of Representative Volume Elements for Small Cracks in Heterogeneous Domains  Karen DeMille, Ashley Spear
4-261	MS 7	Structural Safety in Fire Engineering: Past, Present and Future		First Chair: Ali Ashrafi Second Chair: Luciana Balsamo	
Sustainability & Performance based Fire Engineering  Jean-Baptiste SCHLEICH, Prof.	Modelling timber-concrete composite beams exposed to fire  Robert Pecenko, Sabina Huc, Tomaz Hozjan	Effects of Internal Fire Whirl in a Vertical Shaft Repaired by Basalt Fibre Reinforced Polymer  W.K. Chow, S.S. Han	Experimental Investigation of the Mechanical Behavior of High-Strength Steel Suspension Bridge Wires Under Elevated Temperature Conditions  Jumari Robinson, Matthew Sloane, Adrian Brugger, Raimondo Betti	Definition of Damage Functions within the Framework of Performance Based Fire Engineering  Luciana Balsamo, Pierre Ghisbain, Jenny Sideri, Reza Imani, Ali Ashrafi	Influence of functionally graded sheathing material on the stability and strength of cold-formed steel columns under elevated temperature  Elias Ali, Yared Shifferaw

4-231	MS 27	Computational Geomechanics			First Chair: WaiChing Sun Chair: Jinhyun Choo	Second
Numerical Modeling of Elastoplastic Reservoir Compaction and Land Subsidence in a Gas Field in Coastal Louisiana  Yaneng Zhou, George Z. Voyatzis	Evolution of compaction bands in high-porosity sandstones: a hydro-mechanical coupled multiscale modeling  Huanran Wu, Ning Guo, Gioacchino Viggiani, Jidong Zhao	XFEM framework for three-dimensional modeling of hydraulic fracturing and rate-and-state friction faults  Ehsan Haghhighat, Ruben Juanes	Developing an Early-Warning System for Tailings Dams Liquefaction  Utkarsh Mital, Kami Mohammadi, Daniel Arthur, Jose Andrade, Domniki Asimaki	Coupling phase-field and plasticity for unified modeling of brittle and ductile failures in geomaterials  Jinhyun Choo, WaiChing Sun	Towards a physical description of granular length scales: Discrete and enhanced continuum juxtaposed  Konstantinos Karapiperis, Jose Andrade	
4-237	MS 40	Mechanics and Physics of Granular Materials			First Chair: Mourad Zeghal Chair: Anthony Rosato	Second
Density difference-driven erosion-deposition features in a granular column collapse over an erodible surface  Dengming Wang, Yesheng Wu	Machine learning and level set based particle shape reconstruction from X-ray computed tomography  Qiushi Chen, Zhengshou Lai	Analysis and simulation of continuum, discrete and reduced mathematical models for granular flow dynamics  Denis Blackmore, Anthony Rosato, Christopher Windows-Yule	Development of Soil Shear Strip Loading Test Equipment  Jiliang Li	Validation of numerical modeling of soil liquefaction: Significance of small spatial variability of centrifuge specimens  Majid Manzari, Mohamed ElGhoraiby	Calibration of a Continuum-Discrete Model of Saturated Soils Using Centrifuge Test Data  Li Bo, Mourad Zeghal	
4-265	MS 50	Computational Biomechanics: From Cell, Tissue, to Organ-Level Modeling			First Chair: Chung Hao Lee Second Chair: John Brigham	
A Layer-specific Constitutive Model for Atrioventricular Valve Leaflets  Dr. Anju R. Babu, Katherine E. Kramer, Dr. Ming-Chen Hsu, Dr. Ankush Aggarwal, Dr. Yi Wu, Dr. Chung-Hao Lee	A SHAPE-BASED COMPUTATIONAL METHOD FOR ESTIMATION OF IN VIVO MECHANICAL MATERIAL PROPERTIES OF THE MYOCARDIAL WALL  Jing Xu, Timothy Wong, Marc Simon, John Brigham	Finite cell analysis of vertebral bodies: a validation study  Mohamed Elhaddad, Stefan Kollmannsberger, Peter Foehr, Alexander Valentinitisch, Jan Kirschke, Thomas Baum, Martin Ruess, Ernst Rank	Development of a Multiscale Computational Model for the Tricuspid Valve - Linking Valvular Interstitial Cell Mechanobiology with Organ-Level Function  Devin Laurence, Yi Wu, Chung-Hao Lee	Biaxial mechanical testing and constitutive model development of atrioventricular valve leaflets  Samuel Jett, Devin Laurence, Katherine Kramer, Anju Babu, Yi Wu, Chung-Hao Lee		

4-145	MS 71	Advanced Engineering Concepts, Designs, and Technologies for Aerospace and Extraterrestrial Applications			First Chair: Robert Mueller Second Chair: Landolf Rhode-Barberigous
Development of Lunar Impact Categories for Use in Lunar Life Cycle Assessments  Tyler M. Harris, Pragnya L. Franki, Amy E. Landis	United Launch Alliance Overview & Innovation  Melissa Sampson	Selecting, Designing and Testing of Low-Cost Sensing of Commercial Space Launch Vehicles  Ian Benjamin, Emily Scrimshaw, Ali Ozdagli, Fernando Moreu	Nano-Fidget Spinners: Computational Characterization of Molecular Rotors  Kalon Boston, Steve Cranford	An Integrated Multi-Physics Processing Model for Predicting Residual Stress Development in Fiber-Reinforced Composites  Weijia Chen, Dianyun Zhang	Hydrodynamic Performance of Optimal Flexible Hydrofoil Kinematics for Biomimetic Design  Hisham Shehata, Prof Muhammad R Hajj

Building 2				Thursday: 2:15-3:45pm	
2-105	MS 47	Characterization and modeling of coupled processes in porous materials		First Chair: Jean-Michel Pereira Second Chair: Nicolas Espinoza	
Coupling flow and deformation in evolving salt basins  Maria A Nikolinakou, Mahdi Heidari, Peter B. Flemings, Michael R. Hudec	A comparative study on sorption-induced deformation and related hysteresis of micro- and mesoporous materials  Mingyang Chen, Benoit Coasne, Robert Guyer, Jan Carmeliet, Dominique Derome	Microstructure and thermo-poro-mechanical couplings influence on strain localization phenomena  Hadrien Rattez, Ioannis Stefanou, Jean Sulem, Manolis Veveakis, Thomas Poulet	Modelling pressure equilibration across a reactivated impermeable fault  Martin Lesueur, Manolis Veveakis, Thomas Poulet	Simulation of unstable compaction due to fluid injection  Yanni Chen, Ferdinando Marinelli, Giuseppe Buscarnera	Statistical characterization of the heterogeneity of porous media subjected to reactive-transport  Ghassan Shahin, Mehmet Cil, Giuseppe Buscarnera
2-131	MS 85	Advances in experimental mechanics: Damage detection and identification		First Chair: Mija Hubler Second Chair: Dryver Huston	
Acoustic Emissions Measurements of Prestressed Concrete Girders during Fabrication and Transport  Dryver Huston, Robert Worley II, Dan Orfeo, Tian Xia, Mandar Dewoolkar, Dylan Burns	Robustness of Resonant Frequency Test for Strength Estimation of Concrete Masonry Units  Sikandar Sajid, Luc Chouinard	Group Velocity Relationship in Collinear Mixing of Nonlinear Lamb Waves  Peng Zhang, Jianmin Qu	Acoustic Emission Monitoring of a Nuclear Containment Wall during Post-tensioning: Data Mining and Knowledge Discovery  Arvin Ebrahimkhanlou, Jongkwon Choi, Trevor Hrynyk, Salvatore Salamone, Oguzhan Bayrak	Delta-T Acoustic Source Localisation for Welded Plate  Wee Hoe Ng, Chan Ghee Koh	
2:15-2:30	2:30-2:45	2:45-3:00	3:00-3:15	3:15-3:30	3:30-3:45

## Thursday, May 31st

4:15-4:30	4:30-4:45	4:45-5:00	5:00-5:15	5:15-5:30	5:30-5:45pm
<b>Building W16</b>					<b>Thursday: 4:15-5:45pm</b>
W16-Rehearsal Room A	MS 11	Symposium on Progressive Damage and Failure in Structures and Materials: Testing and Simulation			First Chair: Cemal Basaran Second Chair: Andreas Stavridis
Finite element analysis of reinforced concrete slab-column and beam-column-slab connections	Progressive Damage Prediction without Curve Fitting	Damage Assessment in Materials with Entropic Measures	PROGRESSIVE COLLAPSE ANALYSIS OF SINGLE LAYER SADDLE-SHAPED RETICULAR SHELL BASED ON MICROMECHANICAL FRACTURE PREDICTION METHOD	Influence of Excitation Characteristics and Evolving Damage on the Nonlinear Dynamic Behavior of an Actual Two-Story Infilled RC Building	A damage-plasticity approach to simulate brace failure due to cyclic loading
Aikaterini Genikomsou	CEMALETTIN BASARAN	Huisung Yun, Mohammad Modarres	Jihui Xing, Yanyu Li, Ravi Kiran, Hizb Ullah Sajid	Seyedsina Yousefianmoghadam, Andreas Stavridis, Babak Moaveni	ATRI NATH, SARTHAK JAIN, SUDHIRKUMAR V. BARAI
W16-Kresge Little	MS 25	Tornadoes and Tornado-Structure Interaction Considering Impacts on Community Resilience			First Chair: David Roueche Second Chair: Franklin Lombardo
Damage Modeling of Manufactured Home under Tornado Load	Large Scale Experimental Simulation and Exploration of Tornado-like Vortices	Examining the Effects of Cross- Dependencies among Critical Infrastructure on Population Outmigration in the Aftermath of a Tornado	Aerodynamics of tornado like vortices around a low-rise building	Procedures and outcomes of tornado damage surveys	Experimental and Numerical Investigation of Internal Pressure in a Low-Rise Building Due to a Translating Tornado-like Vortex
Sudhan Banik, Peter Vickery, Lawrence Twisdale, Marc Levitin	Maryam Refan, Horia Hangan	Hassan Masoomi, John van de Lindt	Jubayer Chowdhury, Horia Hangan	Franklin T. Lombardo, Justin Nevill, Daniel Rhee, Antonio Zaldivar de Alba, Guangzhao Chen, Alexander Zickar	David Roueche, Partha Sarkar, Maciej Dutkiewicz

**Building W20****Thursday: 4:15-5:45pm**

W20-491		MS 5	Architected Materials: Advances in Modeling, Design, Fabrication, Characterization, and Applications			Chair: James Guest
Computational Homogenization of Architectured Materials Undergoing Finite Deformations using RVE-Based Multiscale Models and Isogeometric Analysis	Ryan Alberdi, Kapil Khandelwal	Merger of Energetic Affinity and Optimal Geometry Provides New Class of Boron-Nitride Based Sorbents with Unprecedented Hydrogen Storage Capacity	Mode mixing and exceptional points in 3D printed discrete resonator lattices	Experimental and numerical study on fiber reinforced cement composite subjected to impact and explosion extreme loadings	Mechanical Deformation of Bio-Inspired Structures	
W20-407		MS 8	Computational Modeling in Civil Engineering			First Chair: Chanseok Jeong Second Chair: Andre Barbosa
System identification of soil-structure interaction mechanisms for building structures.	Danilo Kusanovic, Elnaz Esmaeilzadeh Seylabi, Domniki Asimaki	Effect of Inclined waves on deeply embedded nuclear facilities	A Distributed Lumped Parameter Approach for Evaluating Earth Pressure behind Retaining Walls	A Quantitative Assessment of the NCHRP 611 Method for Soil-Structure Analysis of Buried Structures	Formulation of an Algorithm for Dynamic Vehicle-Track-Structure Interaction Analysis and Its Implementation into Existing Structural Analysis Software	Toward Joint Inversion for Simultaneous Identification of Structural Anomalies of a Roadway System and Moving Traffic Loads
W20-Coffeehouse Lounge		MS 59	Solid/fluid mechanics and probabilistic methods for offshore wind energy			First Chair: Sanjay Arwade Second Chair: Andrew Myers
Lifetime Reliability Evaluation of Spar-type Offshore Floating Wind Turbine using Copula Model	Xuan Li, Wei Zhang, Di Wu	Frequency Domain Analysis for Offshore Wind Structures Subject to Loading from Multiple Hazards	Long-term joint probability estimation for multiple offshore hazards induced by hurricanes	Characterization of Wave Actuation Methods in the Laboratory Environment for Use in Subsurface Investigation of Offshore Sites	Multiline Anchors for Floating Offshore Wind Turbines on a Commercial Farm Scale	
		Andrew Summerfield, Andy Myers	Chi Qiao, Andrew Myers	Leah E. Fletcher, John T. Germaine, Laurie G. Baise, Douglas M. Matson	Casey Fontana, Sanjay Arwade, Spencer Hallowell, Don DeGroot, Melissa Landon, Charles Aubeny, Andrew Myers, Senol Ozmutlu	

**Building 5****Thursday: 4:15-5:45pm**

5-234		MS 4	Advances in Quantitative Engineering Sustainability and Resilience, Physics-Based and Data-Driven Modeling and Prediction		First Chair: Arghavan Louhghalam, Second Chair: Mohammad Javad Abdolhosseini Qomi	
Sensitivity Analysis of Structural Uncertainties for the Hurricane Performance of Transmission Towers using BART  Kyunghwa Cha, Yousef Mohammadi Darestani, Soroush Zamanian, Abdollah Shafeezadeh	Multi-Dimensional Infrastructure Resilience Modeling: A Data-driven Approach  Roshanak (Roshi) Nateghi	Insights from smart meter data for optimal energy technology adoptions  Edward Barbour, Marta Gonzalez	Taxi driver learns dynamic spatial equilibrium  Ruda Zhang, Roger Ghanem	Assessing and Mitigating Hurricane Storm Surge Risk in a Changing Environment  Ning Lin, Eric Shullman, Siyuan Xian, Kairui Feng	POTENTIAL-OF-MEAN-FORCE APPROACH FOR MOLECULAR DYNAMICS-BASED RESILIENCE ASSESSMENT OF STRUCTURES  Konstantinos Keremidis, Mohammad Javad Abdolhosseini Qomi, Roland Pellenq, Franz-Josef Ulm	
5-217		MS 33	Analytical and experimental investigations on resilient critical infrastructure under multiple hazards		First Chair: Asad Esmaeily Second Chair: Bernhard Pichler	
Semi-Markov Processes and Their Application Toward Hazard Resilience Modeling  Somayajulu Dhulipala, Madeleine Flint	Estimating travel time reliability of degraded links subjected to multiple hazards  Guangyang Hou, Suren Chen	Resilligent (Resilient-Intelligent) Cities: An Adaptive Data-driven Systemic Risk Preparedness Framework  Shady Salem, Ahmad Siam, Michael Tait, Wael El-Dakhakhni, Waleed Mekky	Analytical probability propagation method for risk assessment of general complex networks under hazards  Yanjie Tong, Iris Tien	Measuring Internal Stresses in Hexagonally Packed Wire Strands using Neutron Diffraction  Adrian Brügger, Seung-Yub Lee, Raimondo Betti, Ismail Cevdet Noyan	An Objective Decision Making Protocol for Lift Bridge Operation Subjected to High Wind Loads  Timothy Nash, Erin Bell, Milad Mehrkash, Vahid Shahsavari	

4:15-4:30

4:30-4:45

4:45-5:00

5:00-5:15

5:15-5:30

5:30-5:45pm

**Building 3****Thursday: 4:15-5:45pm**

3-133		MS 1	Multifunctional Structural Components		First Chair: An Chen Second Chair: Simon Laflamme	
Fungi-Mediated Self-Healing Concrete for Sustainable and Resilient Infrastructure  Congrui Jin	Investigation of a Novel Variable Friction Cladding Connection subjected to Multi-hazard Excitations  Yongqiang Gong, Liang Cao, Simon Laflamme, Spencer Quiel, James Ricles, Douglas Taylor	Model-assisted crack detection and localization in multifunctional concrete doped with MWCNTs  Austin Downey, Antonella D'Alessandro, Filippo Ubertini, Simon Laflamme	BEHAVIOR OF MULTI-WYTHES INSULATED SANDWICH PANELS  Mohammed Bazroun, An Chen			

3-370	MS 29	Stochastic Methods in Computational Mechanics of Random Materials	First Chair: Lori Graham-Brady Second Chair: Kirubel Teferra		
Development of an efficient surrogate based sampling algorithm using gradient information  Anindya Bhaduri, Lori Graham-Brady, Cameron Abrams	An Efficient Solution Approach for High-Dimensional Random PDEs Using Stochastic Gradient Descent and Deep Neural Networks  Mohammad Amin Nabian, Hadi Meidani	Adaptive variance-based multi-element simplex stochastic collocation with model order reduction for high-dimensional response  Dimitris Giovanis, Michael Shields	Probabilistic validation of material models  Agnimitra Dasgupta, Subhayan De, Kirubel Teferra, Erik Johnson, Steven Wojtkiewicz, Lori Graham-Brady	Uncertainty-informed design of material characterization tests  Erfan Asaadi, P. Stephan Heyns, Mazdak Tootkaboni	
3-333	MS 43	Finite Element Model Updating for Structural Sensor Data Fusion		First Chair: Hae Young Noh Second Chair: Yang Wang	
Sparse Bayesian learning for quantification of structural changes with data interferometry  Zhao Chen, Jingwei Zheng, Hao Sun	Hierarchical Bayesian Model Updating for Assessment and Response Prediction of a Two-story Reinforced Concrete Building under Different Excitation Levels  Mingming Song, Babak Moaveni, Costas Papadimitriou, Andreas Stavridis	Integration of Mechanics-Based Models with Data: Untangling the Dynamics of Soil-Structure Interaction in Building Structures  Hamed Ebrahimian, S. Farid Ghahari, Domniki Asimaki, Ertugrul Taciroglu	Physical Attribute Guided Iterative Transfer Learning for Indoor Occupant Identification through Footstep-Induced Floor Vibration  Shijia Pan, Mostafa Mirshekari, Tong Yu, Susu Xu, Ole Mengshoel, Pei Zhang, Hae Young Noh		
3-270	MS 82	Forward and inverse modeling for performance and resilience assessment of civil structures		First Chair: Babak Moaveni Second Chair: Joel Conte	
Empirical model of residential resilience to tornado damage: Naplate, IL  Justin Nevill, Franklin T. Lombardo, Daniel Rhee, Antonio Zaldivar de Alba, Guangzhao Chen, Alexander Zickar	Community Assessment of Wildland Urban Interface Fire Risk  Akshat Chulahwat, Hussam Mahmoud	An elastic waveform-tomography approach to NDE of spent nuclear fuel casks  Othman OUDGHIRI-IDRISSI, Bojan B. Guzina	Mechanism Design for Sharing Risks Related to Extreme Events  Lorenzo Tomaselli, Matteo Pozzi, Bruno Sinopoli	Reliability-Based Assessment of In-Situ Pile Capacity  Nathan Davis, Masoud Sanayei	

**Building 1****Thursday: 4:15-5:45pm**

1-390	MS 12	Computer-vision based SHM using deep learning and UAV		First Chair: Young-Jin Cha Second Chair: Oral Buyukozturk	
Deep Convolutional Neural Networks for Crack Classification  Mohsen Maniat, Charles Camp	Crack Identification of Concrete Structures using Computer Vision and Machine Learning  Sung-Han Sim, Hyunjung Kim	Damage Identification and Damage Quantification using Time-Variant Visual Images  Young Hoon Kim, Jice Zeng	Automated Post-Disaster Structural Inspections using Deep-Learning  Vedhus Hoskere, Billie F. Spencer Jr.	Bridges Health Assessment Using Combined Unmanned Aerial Vehicles and Optically-Based Approaches  Alessandro Sabato, Christopher Nierzrecki	Automated Color-Based Structural Damage Detection Using Photometric Invariant Computer Vision and UAVs  Ali Khaloo, David Lattanzi

**Building 4****Thursday: 4:15-5:45pm**

4-153	MS 6	Multiscale Behavior of Damage and Failure Mechanics		First Chair: George Voyatzis Second Chair: J. Woody Ju	
From nonlocal enhanced micro-crack damage to macro cohesive fracture - a coupled computational tool using XFEM  Wencheng Jin, Chloe Arson	Anisotropic damage evolution due to micro-cracking in quasi-brittle materials.  Nitin Daphalapurkar, Daniele Versino, Darby Luscher	Anisotropic micro-macro model of mechanical healing in halite  Xianda Shen, Chloé Arson	Framework for Two-Dimensional Elastic Analysis of Reflective Cracking in Airport Pavement Asphalt Overlays  Kairat Tuleubekov, David Brill	Comparison of interfacial and bulk damage models for dynamic brittle fracture  Bahador Bahmani, Reza Abedi, Philip Clarke, Katherine A. Acton	Image-based multi-scale modeling of effects of microstructural features on the failure response of adhesive-bonded joints  Bowen Liang, Anand Nagarajan, Soheil Soghrati

**4-231****MS 27****Computational Geomechanics****First Chair: Jose Andrade  
Second Chair: Majid Manzari**

Multiscale modeling of wave propagation in granular soils and seismic ground response analysis  Ning Guo, Jidong Zhao	Deep Learning Enabled Computational Modeling of Granular Materials  Yanhui Jiang, Yang Liu	Multiscale unsaturated poromechanics enhanced by deep learning  Kun Wang, Nikolaos Vlassis, WaiChing Sun	Modeling dynamic responses brittle porous media with fracture opening and closure  SeonHong Na, Chukwudi Chukwudzie, WaiChing Sun	A multi-phase-field/crystal Plasticity for crystalline salt with brine inclusions  SeonHong Na, WaiChing Sun	Critical state plasticity model with data-driven hardening and flow rules  Kun Wang, WaiChing Sun
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4-261		MS 28	Advances and Applications of Elasticity within Applied Mechanics		First Chair: John Brigham Second Chair: Euclides de Mesquita Neto	
DISTRIBUTED LOADS ON A BEAM ELEMENT WITH A 3D RESPONSE  Mauro Schulz	The Gurtin-Murdoch and Steigmann-Ogden models vis-à-vis the Benveniste-Miloh interface regimes  Sofia Mogilevskaya, Anna Zemlyanova	A NOMOGRAM FOR SECOND ORDER TENSOR PRINCIPAL VALUES AND GEOMETRIC REPRESENTATION  Mehmet Sahin	A Minimal Integrity Basis for the Elasticity Tensor  Marc Olive, Boris Kolev, Nicolas Auffray	Evaluation of Airfoil Considering Flapping Motion at Flutter Frequency  Joshua Lee, Anthony Palazotto	Boundary integral equation method in the theory of thermoelasticity for materials with a triple porosity structure  Merab Svanadze	
4-265		MS 50	Computational Biomechanics: From Cell, Tissue, to Organ-Level Modeling		First Chair: Chung-Hao Lee Second Chair: Ki Moo Lim	Second
Subject-Specific Analysis of Intra-arterial Nanoparticle Delivery for Glioma Treatments  Shaolie Hossain, Shailendra Joshi	Pressure dependence of shear wave speed in incompressible poroelastic media  Navid Nazari, Paul Barbone	Strain-State Dependent Viscoelastic Behavior of Tendon-to-Bone Insertion  Sergey Kuznetsov, Hsiao-Ying Shadow Huang	Isogeometric Analysis of Transcatheter Heart Valves  Michael C.H. Wu, Ming-Chen Hsu	A Constitutive Model for Jugular and Saphenous Venous Tissue  Nayyan Kaul, Hsiao-Ying Shadow Huang	Computational Prediction of Ventricular Electromechanical Responses under KCNQ1 Mutation using 3D FE Model  Ki Moo Lim, Daun Jeong, Chung Hao Lee, Natalia Trayanova	

<b>Building 2</b>		<b>Thursday: 4:15-5:45pm</b>				
2-105		MS 47	Characterization and modeling of coupled processes in porous materials		First Chair: Manolis Veveakis Second Chair: Nicolas Espinoza	
Bishop coefficients in elastic and plastic regimes for unsaturated porous media  Jean-Michel Pereira, Patrick Dangla	Electric conductivity of clay containing graphene layers under load  Claudiane Ouellet-Plamondon	UNDRAINED WELLBORE STABILITY ANALYSIS IN ANISOTROPIC CRITICAL STATE SHALES  Shengli Chen, Kai Liu	Source Shale Anisotropy Manifested at Nano- and Microscales during SEM/TEM Cantilever Beam Testing  Katherine Hull, Younane Abousleiman, Peter Hosemann, Evan Kendall-Still, David Frazer			

**Friday, June 1, 2018**

**8:00 - 9:00am**

**Plenary Lecture 5**

**Room: W16 – Kresge Main**

Pedro Miguel Reis

Ecole Polytechnique Federale de Lausanne (EPFL)

Shell-buckling revisited: “Everybody loves a buckling problem!”



## **Pedro Miguel Reis**

Flexible Structures Laboratory  
Institute of Mechanical Engineering  
École Polytechnique Fédérale de Lausanne (EPFL),  
Switzerland

# Shell-buckling revisited: “Everybody loves a buckling problem!”

## **Abstract:**

From viral capsids and fuel tanks, to architectural domes, slender shells are ubiquitous in natural and engineered structures. The mechanics of shells is tightly intertwined with the underlying geometry and the onset for instability is a classic problem in structural mechanics. Since the golden era of shell buckling in the 1960’s, a plethora of theoretical and computational studies have addressed this canonical problem, but there is a striking lack of precision experiments to corroborate the multitude of predictions. We have recently revisited this old field by introducing a framework of precision model experiments to thoroughly quantify both the buckling onset, as well as the postbuckling regime of pressurized spherical shells. Central to this effort, we have devised a robust, versatile, and precise fabrication mechanism to rapid prototype thin shells of nearly constant thickness that contain precisely designed geometric imperfections. By systematically varying the amplitude of these defects, we study the effect that these imperfections have on the buckling strength of our spherical shells. Small deviations from the spherical geometry result in large reductions in the buckling pressure and our experimental results agree well with some existing theories. We then perform a broader exploration for other classes of defects, for which theoretical predictions are yet to be developed. Our ultimate goal is to develop a predictive foundation for the mechanisms that affect the knockdown factors of spherical shells towards a rational design framework that goes beyond the prevailing empirical status quo.

## **Biosketch:**

Pedro M. Reis is a Professor of Mechanical Engineering at the École Polytechnique Fédérale de Lausanne (EPFL), Switzerland. His research group, the Flexible Structures Laboratory, is dedicated to the fundamental understanding of the mechanics of slender structures and their intrinsic geometric nonlinearities. Prof. Reis received a B.Sc. from the University of Manchester, UK (1999), a Certificate of Advanced Studies in Mathematics (Part III Maths) from St. John’s College and DAMTP, University of Cambridge (2000) and a Ph.D. from the University of Manchester (2004). He postdoc positions at the City College of New York (2004-05) at the ESPCI in Paris (2005-07). He joined MIT in 2007 as an Instructor in Applied Mathematics in the Department of Mathematics. In 2010 he moved to MIT’s School of Engineering, with dual appointments in Mechanical Engineering and Civil & Environmental Engineering, first as the Esther and Harold E. Edgerton Assistant Professor and after 2014 as Gilbert W. Winslow Associate Professor. In October 2013, the Popular Science magazine named Prof. Reis to its 2013 “Brilliant 10” list of young stars in Science and Technology. He has also received the 2014 CAREER Award (NSF), the 2016 Thomas J.R. Hughes Young Investigator Award (Applied Mechanics Division of the ASME), the 2017 GSOFT Early Career Award for Soft Matter Research (APS) and he is a Fellow of the APS.

More information on the activities of his research group can be found in the following link: <https://flexlab.epfl.ch/en/>

## Friday, June 1st

9:30-9:45	9:45-10:00	10:00-10:15	10:15-10:30	10:30-10:45	10:45-11:00	11:00-11:15	11:15-11:30am
<b>Building W16</b>							<b>Friday: 9:30-11:30am</b>
W16-Rehearsal Room A	MS 20	Nonlinear mechanics of highly deformable solids and structures				Chair: Tal Cohen	
Surface creasing of soft elastic continua as a Kosterlitz-Thouless transition  J. M. Schwarz, T. A. Engstrom	Swelling-induced surface instabilities of hydrogels  Berkin Dordivanioglu, Christian Linder	Early onset of dynamic cavitation and nonlinear oscillation in finite elastic spheres  Zhantao Chen, Tal Cohen	Data-enabled model reduction for morphing 3D printed structures  Teng Zhang, Lining Yao	Phase Field Modelings of Damage in Elastomeric Materials  Yunwei Mao, Lallit Anand	Phase transitions in a compressed CNT forest  Prashant Purohit	A Visco-hyperelastic Constitutive Model for Fiber-Reinforced Rubber Composites  Rui Li, Dianyun Zhang	Instabilities and Pattern Formations in Soft Composites  Stephan Rudykh, Viacheslav Slesarenko, Pavel
W16-Kresge Little	MS 25	Tornadoes and Tornado-Structure Interaction Considering Impacts on Community Resilience				First Chair: David Roueche Second Chair: David Prevatt	
A SIMPLIFIED GENERIC NUMERICAL TORNADO MODEL FOR COMMON INTERPRETATION OF VARIOUS EXPERIMENTAL SIMULATORS  Anant Gairola, Girma Bitsuamlak	Garage Door Failures during tornadoes and high winds  Murray Morrison, Tanya Brown-Giammanco, Rachel Kovar, Franklin Lombardo	Mapping of the United States Tornado Risk  Weichiang Pang, Fanfu Fan	Overview of Methods Used in the Development of Tornado Risk Maps  Lawrence Twisdale, Marc Levitan, Long Phan	Community Level Damage and Recovery Hindcast: The 2011 Joplin Tornado  John van de Lindt, Navid Attary, Hussam Mahmoud, Steve Smith, Stephanie Pilkington, Maria Koliou, Sammy Zahran, Harvey Cutler, Sara Hamideh, Elaina Sutley, Walter Peacock, Nathanael Rosenheim, Yu Xiao, Maria Watson	Analysis of failure wind speeds for residential garage doors in tornadoes  Aaron Jaffe, Guillermo Riveros, Gregory Kopp	Interviews Offer Insight into Homeowners' Wind-protection Decisions: Breaking the Wind Damage Cycle  Rodrigo Castillo-Perez, Keith Florig, David B. Roueche, David O. Prevatt	

**Building W20****Friday: 9:30-11:30am**

W20-407		MS 8	Computational Modeling in Civil Engineering		First Chair: Petros Sideris Second Chair: Ioannis Koutromanos			
Finite Element Analysis of Reinforced Concrete Structures Under Seismic Loads	NONLINEAR FINITE ELEMENT ANALYSIS OF PLANAR AND NONPLANAR STRUCTURAL WALLS	Towards an Efficient and Robust Simplified Micro-model for analyzing Masonry Shear Wall	Three-dimensional modelling of fiber reinforced concrete	Data-driven Load-drift Backbone Model for Reinforced Concrete Columns and Fragility estimates	Optimum Design of Reinforced Concrete Plane Frames with Automated Grouping of Columns	DECISION SUPPORT SYSTEM FOR DESIGN OF POST-TENSIONED SLABS	A stochastic dynamic model of train-track-bridge coupled system based on probability density evolution method	
Mohammadreza Moharrami, Ioannis Koutromanos	Kamal Ahmed, Laura Lowes, Dawn Lehman	NITIN KUMAR, Michele Barbato	Sahar Ghanem	Zhenliang Liu, Anxin Guo, Suchao Li, Hui Li	Juliana Boscardin, Moacir Kripka	GAURAV SANCHETI, RAVINDRA NAGAR	Jianfeng Mao, Zhiwu Yu	
W20-491		MS 26	Origami/Kirigami Based Systems and Adaptive Structures		First Chair: Katia Bertoldi Second Chair: John Brigham			
The effect of kirigami on rigid-foldability	Inflatable origami-inspired structure	Kirigami inspired-metamaterials: from morphable structures to soft robots	Bloch wave framework for structures with nonlocal interactions: Application to the design of origami acoustic metamaterials	Computational Evaluation of the Optimal Design of a Smart Material Adaptive Reconfigurable Building Surface Tile	Analysis of steel origami tube with nonlinear rotational hinge stiffness	Smart wood actuators for climate adaptive architecture	BisKiTs: Bistable Kirigami Tessellations	
Zeyuan He, Simon Guest	David Melancon, Chuck Hoberman, Katia Bertoldi	Katia Bertoldi, Ahmad Rafsanjani	Phanisri Pratapa, Phanish Suryanarayana, Glaucio Paulino	Robert Zupan, Richard Beblo, Dale Clifford, John Brigham	Quan Shi, Joseph Gattas	Markus Rueggeberg, Chiara Vailati, Philippe Groenquist, Adrian Wick, Falk K Wittel	Yves Klett	

W20-PDR 1&2		MS 30	Hierarchical and Multiscale Methods for Simulation Based Design of Materials		First Chair: Somnath Ghosh Second Chair: Arif Masud		
Mechanics-guided, deterministic 3D assembly	Integrated Computational Framework for Modeling Materials with Complex Microstructures	Energy renormalization for achieving temperature transferable coarse-graining of polymers	Multiscale Prediction of Crack Initiation in Titanium Alloy, Ti-6242S	Multiscale modeling of thermo-mechanical powder bed fusion process in additive manufacturing	Modeling of Bubble Growth/Decay and Migration in a Thermodynamically Consistent Variational Framework	Integrated stochastic approach for multiscale-based materials design	
Yonggang Huang	Soheil Soghrati, Anand Nagarajan, Bowen Liang, Hossein Ahmadian, Ming Yang	Wenjie Xia, Frederick Phelan, Jack Douglas, Sinan Keten	Yang Liu, Caglar Oskay, Xiang Zhang, Adam Pilchak	Yang Liu, Yanhui Jiang	Ahmad AlNaseem, Arif Masud	Loujaine Mehrez, Roger Ghanem, Venkat Aitharaju, William Rodgers	
W20-Mezzanine Lounge		MS 35	Fluid-Structure Interactions and Flow-Induced Motions			Chair: Teng Wu	
Shape dependence of particle transport in blood flow: from margination to adhesion	A Preliminary Reduced-Order Model for the Stochastic Aeroelastic Instability of Wind-Turbine Blades	Fluid-structure interaction for nano-ribbon shell structures based on slender-ribbon theory	Evaluating Wind Effects on Flexible Roofing System	Transport and Redistribution of Sediments in Galveston Bay and Port of Houston by Coastal Hazards	Three dimensional calculation of sediment dunes by large eddy simulation	Towards the development of a boundary shear stress-bedload transport constitutive relation	
Huilin Ye, Zhiqiang Shen, Ying Li	Luca Caracoglia	Michael Braun, Raul Radovitzky	Ashkan Rasouli, Mauricio Chavez, Kee Ping Ko, Maryam Refan, Bas Baskaran, Arindam Gan Chowdhury	James Kaihatu, Mikyoung Jun, Terry Wade, Anthony Knap	Guojian He, Hongwei Fang, Yan Liu	Panayiotis (Panos) Diplas, WuRong Shih	
W20-20 Chimneys		MS 36	Robustness of Infrastructures			First Chair: Simos Gerasimidis Second Chair: George Deodatis	
An Approximate Dynamic Programming Approach to Community Recovery Management	The role of shear connections in the progressive collapse response of 3D gravity framed systems	Analysis of the Post-Hurricane Collapse of Cold-Formed Steel Industrial Buildings	Development of Civil Infrastructure Resilience Assessment Framework (CIRAF) and its Application to Nuclear Power Plant System	A partial-distributed damage method for progressive collapse of 3D steel and concrete composite buildings	Comparison of Stability Sensitivity of RC Moment Resisting Frame and Steel Frame in terms of Asymmetric Hazard Independent Damage Scenarios	Cyclic Fracture Modeling for Structural Damage Simulation in Steel Structures	Evaluation on the Effect of Bottom Bar Splice Location on Performance of Beams in Reinforced Concrete Perimeter Frames
Saeed Nozhati, Bruce Ellingwood, Hussam Mahmoud, Yugandhar Sarkale, Edwin Chong, Nathanael Rosenheim	Thomas Hill, Panagiotis Pantidis, Simos Gerasimidis	Adrianna Early, Richard Wood, Kara Peterman	Tarun Kumar Singhal, Oh-Sung Kwon, Evan Bentz, Constantin Christopoulos	Fani Derveni, Panos Pantidis, Simos Gerasimidis, Kara Peterman	Prabodh Dahal	David Padilla-Llano, Jerome Hajjar	Jorge Rivera, Sergio Breña, Simos Gerasimidis

W20- Coffeehouse Lounge	MS 68	The Link Between Composition, Structure, and Physical Properties of Materials	First Chair: Enrico Masoero Second Chair: Andreas funk				
New Insights into the Early Age Structure and Properties of Calcium-Silicate-Hydrates  Tao Du, Hui Li, Mathieu Bauchy	Investigating chemo-mechanical properties of microstructure phases in blended-cement pastes with the NI-QEDS method  William Wilson, Luca Sorelli, Zhao Chen, Arezki Tagnit-Hamou	Transport of Volatile Organic Compounds through Cementitious Materials  Payam Hosseini, Sultan Alhomair, Detlef Knappe, Mohammed Gabr, Mohammad Pour-Ghaz	Effect of particles injection on the fracture toughness of cracked well cement paste  Shahlaa Al Wakeel, Mija Hubler	Low velocity impact behaviour of a Glass fiber/Acrylic woven composite laminates: experimental study and multi-scale modelling  Rodrigue MATADI BOUMBIMBA, Gbessilo KINVI-DOSSOU, Napo BONFOH, Pierre GERARD	Unveiling Mechanics of High Strength and Low Stiffness in Nanoscale Metal-Oxide Dispersed Polymeric Composite through Molecular Dynamics Simulations  Ying Li	Understanding the Interfacial Self-healing of Nanocomposite Hydrogel through Coarse-grained Molecular Dynamic Simulation  Zhiqiang Shen, Huilin Ye, Ying Li	

Building 5	Friday: 9:30-11:30am		
5-217	MS 75	Multi Physics/Scale Modeling and Stochastic Approaches for Critical Civil Infrastructures	First Chair: Masoud Darabi Second Chair: Silvia Caro

Multiscale Experimental Evaluation of Geopolymeric Materials as an Alternative Binder on the Characteristics of Interphases in Cementitious Mixtures with Recycled Aggregates  Mahdieh Khedmati, Yong-Rak Kim, Capri Keeler, Sussan Moussavi	Induction Heating of Asphalt Concrete under Electromagnetic Radiation- Experimental Studies and Constitutive Modeling  Masoud Darabi, Mohammad Karimi	Time-Dependent Drucker-Prager-CAP Model Coupled with PANDA (Pavement Analysis Using Nonlinear Damage Approach) to Predict Rutting Performance of Airfield Pavements  Rashmi Kola, Masoud K Darabi, Dallas N Little, Navneet Garg	A Straightforward Procedure to Characterize Viscoplastic and Hardening-relaxation Viscoplastic Response of Asphalt Concrete at High Temperatures  Mohammad Bazzaz, Masoud K. Darabi, Dallas N. Little, Navneet Garg	Probabilistic Assessment of Continuum Damage Model for Asphalt Concrete  Padmini Gudipudi, Shane Underwood	Effects of Porosity Characteristics on the coupled Moisture-Mechanical Response of Asphalt Concrete  Maryam Shakiba, Aimane Najmeddine	Standalone PANDA-AP: a finite element software for mechanistic-based numerical simulation of airfield pavements  Omid Omidi, Masoud Darabi, Dallas Little, Navneet Garg	
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5-234	MS 84	Structural Monitoring for Improved Structural Design and Analysis in Field Applications		First Chair: Charles DeVore Second Chair: Tat Fu			
Event-driven monitoring of civil infrastructure using wireless smart sensors	STRUCTURAL MONITORING OF FLOOR-BEAM/STIFFENER CONNECTIONS ON THE BENICIA MARTINEZ BRIDGE	Extraction of Structural Modal Information of an In-Service Highway Bridge using Infrasound Measurements and Machine Learning	EVALUATION AND TRACKING OF THE COEFFICIENT OF THERMAL EXPANSION OF A BUILT CONCRETE STRUCTURE FOR A TEMPERATURE BASED METHOD OF STRUCTURAL HEALTH MONITORING.	Case Studies on Monitoring of Adjacent Buildings in New York City	Design of Machine Isolation System for Vibration Mitigation at Nearby Sensitive Receiver	Retrofit Options for Long span Floor Structure Subject to Harmonic Loads	Vibration Testing for Design Verification of a Pedestrian Bridge

Building 3				Friday: 9:30-11:30am			
3-270	MS 13	Structural Identification and Damage Detection	First Chair: Costas Papadimitriou Second Chair: Babak Moaveni				
Automatic relevance determination priors in Bayesian model selection: Application to nonlinear fluid-structure interaction systems  Rimple Sandhu, Mohammad Khalil, Chris Pettit, Dominique Poirel, Abhijit Sarkar	Bayesian Selection of Optimal Physics-Based Model and Modeling Error for Nonlinear Dynamical Systems  Philippe Bisaillon, Rimple Sandhu, Mohammad Khalil, Chris Pettit, Dominique Poirel, Abhijit Sarkar	Response Estimation of Large-Scale Structures with Multiple Modes  Riley Brown, Carol Shield, Lauren Linderman	Sampling based Branch-and-Bound Method for System Identification of Complex Structures  Se-Hyeok Lee, Junho Song	Detection of Damage in Three-Dimensional Conductive Jute/Epoxy Composites Under Shear Loading  Sen Yang, Vijaya Chalivendra, Yong Kim	Combining modal parameter estimators and machine learning algorithms to track the evolution of modal parameters  Pieter-Jan Daems, Nicoletta Gioia, Jan Helsen	On the Merit of Nonlinear Feedback for Enhanced Sensitivity  Esmaeil Memarzadeh, Dionisio Bernal	AUTONOMOUS DAMAGE DETECTION IN DOUBLE TRACK STEEL RAILWAY BRIDGES  Saeed Eftekhar Azam, Ahmad Rageh, Daniel Linzell

3-370	MS 18	Numerical Methods for Stochastic Engineering Dynamics		First Chair: Antonina Pirrotta Second Chair: Athanasios Pantelous			
Stochastic analysis of multiple support effect of bridge with modified large mass method	Pole-residue method for computing response statistics of uncertain oscillators to earthquake loading	Translation-based time and space probabilistic model with application to wind pressure field	Rapid uncertainty quantification and performance assessment of inelastic wind-excited structures	Extracting hidden structural damage state dynamics using recurrent neural networks	Reduced Fractional Order Models for Dynamic Representation of MDOF Structures	Global sensitivity analysis for nonlinear aeroelastic vibrations of a cantilever with structural and aerodynamic nonlinearities	Performance Characterization of Adaptive gPC Schemes in Problems of Structural Dynamics
Luyu Li, Han Qin	Qianying Cao, Sau-Lon James Hu, Huajun Li	Haoran Zhao, Mircea Grigoriu	Wei-Chu Chuang, Seymour Spence	C.P. Andriotis, K.G. Papakonstantinou	Nariman L. Dehghani, Abdollah Shafeezadeh, Jamie Padgett	Brandon Robinson, Rimple Sandhu, Mohammad Khalil, Chris Pettit, Dominique Poirel, Abhijit Sarkar	Hugo Esquivel, Arun Prakash, Guang Lin
3-133	MS 45	Innovations and Advances in Passive Structural Control		First Chair: Nicholas Wierschem Second Chair: P. Scott Harvey			
Passive realization of rate-independent linear damping	Enhanced Passive Isolation under Extreme Seismic Loading: An Optimal Control Approach	Robust Design of Double-Layer Isolation Devices	Effects of Pulse Motions and the Use of Innovative Experimental Techniques for Seismically Isolated Structures	Decentralized H2 Optimization of Rotational Inertia Double-tuned Mass Dampers	Numerical study of the vibration suppression performance of a single-sided vibro-impact track nonlinear energy sink considering base structure vertical dynamics	Model and Experimental Verification of a Novel Eddy Current Damper	Tuned liquid multiple column damper for mitigating structure vibration
Kohju Ikago, Ashkan Keivan, Brian Phillips	Mohammad Tehrani, Philip Harvey	Skylar Calhoun, Philip Harvey, Mohammad Tehrani	Lakshmi Priya Lakshmi Pathy, Jenna Wong	Abdollah Javidalesaadi, Nicholas Wierschem	Wenke Li, Nicholas Wierschem, Xinhui Li, Tiejun Yang	Manuel Miranda, Alexander Pesch, Tamunomiesya LongJohn	Hao Wu, Liang Cao, Simon Laflamme, An Chen

3-333	MS 87	Metamaterials for vibration mitigation	First Chair: Eleni Chatzi Second Chair: Vasilis Dertimanis				
Inverse metamaterial design for user-defined band gaps  Heedong Goh, Loukas Kallivokas	Concept Comparison for Seismic Metabarriers  Pierre Ghisbain, Heather Reed, Jeffrey Cipolla	3D elastic phononic crystal structure with ultra-wide bandgap  Luca D'Alessandro, Edoardo Belloni, Valentina Zega, Raffaele Ardito, Francesco Braghin, Alberto Corigliano	On the nonlinear mechanisms induced by hyperelasticity in locally resonant metamaterials  Priscilla Silva, Varvara Kouznetsova, Michael Leamy, Marc Geers	Frequency Domain Measurements of Topologically Protected Elastic Wave Propagation in Flexible Phononic Crystals  Jialun Han, Ziwei Wang, Oluwaseyi Balogun	Optimal design of seismic lattices in the presence of uncertainties  Paul Wagner, Vasilis Dertimanis, Eleni Chatzi, James Beck	Seismic Base Isolation of Engineering Structures Using Metamaterials  YL Mo, Witarto Witarto, S. J. Wang, C. Y. Yang, K.C. Chang, Yu Tang, Robert Kassawara	Spatial correlation of real-scale seismic ground motion in an array of resonator: implication for engineering seismology  Philippe GUEGUEN, Philippe Roux

Building 1								Friday: 9:30-11:30am	
1-390		MS 23		Advanced deep learning based SHM		First Chair: Young-Jin Cha Second Chair: Oral Buyukozturk			
Deep Semi-Supervised Generative Adversarial Fault Diagnostics for Rolling Element Bearings	Bolt-Loosening Detection using Laser Vibrometer based SHM	Deep Faster R-CNN-based automated multiple types of damage localization	Localization of acoustic emission sources in plate-like structures using a stack of autoencoders and a convolutional neural network: a single-sensor comparison	Innovative Sensing with Deep Learning: Fatigue Life Estimation from Acceleration Data	Investigating most common deep learning architectures for concrete crack detection	Civil Infrastructure Serviceability Evaluation Using GPR-enabled Deep Learning	Using AI to Automatically Classify Asphalt Pavement Distress Severity – Raveling		
David Verstraete, Enrique Drogue, Mohammad Modarres, Viviana Meruane	Donghyun Lee, Hyong Chu Lee, Jung-Hoon Kim	Gahyun Suh, Oral Buyukozturk, Young-Jin Cha	Arvin Ebrahimkhanlou, Salvatore Salamone	Nur Sila Gulgec, Martin Takac, Shamim N. Pakzad	Sattar Dorafshan, Marc Maguire	Yu Liang, Dalei Wu	Yichang Tsai, Yipu Zhao, Anirban Chatterjee, Zhaohua Wang		
9:30-9:45	9:45-10:00	10:00-10:15	10:15-10:30	10:30-10:45	10:45-11:00	11:00-11:15	11:15-11:30am		

**Building 4****Friday: 9:30-11:30am**

4-261	MS 10	Modeling time-dependent behavior and deterioration of concrete		First Chair: Mohammed Alnaggar Second Chair: Giovanni Di Luzio				
Statistical Inverse Analyses to Filter Out Multi-Decade Autogenous Shrinkage and Ill-defined Initial Strain from Creep and Shrinkage Database	Coupled multi-physics simulation of chloride diffusion in concrete : A discrete modeling approach	Numerical analysis of bonded anchors in concrete under sustained load	Experimental investigation of two interfaces bond properties for bonded anchor systems	Experimental evaluation of Anchor bond degradation in Alkali-Silica Reaction affected concrete	Refinement of Microprestress-Solidification Theory for Concrete Creep	Viscoelastic properties of aging porous materials under drying as the only external solicitation.	Shear Behavior of Ultra-high-performance Concrete Prismatic Beams with Various Fiber Contents : Experiments and Numerical Simulations	Tathagata Bhaduri, Shady Gomaa, Mohammed Alnaggar
Mohammad Rasoolinejad, Zden?k Bažant	Ying Zhang, Mohammed Alnaggar	Serena Gambarelli, Josko Ozbolt, Jan Hofmann	Marco Marcon, Jan Vorel, Krešimir Nin?evi?, Roman Wan-Wendner	Shady Gomaa, Marco Marcon, Roman Wan-Wendner, Mohammed Alnaggar	Saeed Rahimi-Aghdam, Zdenek P. Bazant	Hamza SAMOUEH		
4-265	MS 16	Modeling and Characterization of Brittle and Quasibrittle Fracture		First Chair: Marco Salviato Second Chair: Ravindra Duddu				
Fishnet statistics for failure probability of nacreous staggered laminar materials	Energy-Based Coarse Graining of the Lattice Discrete Particle Model	Phase-field approach to brittle fracture propagation in glaciers	Containing Delamination Failure in Polymeric Matrix Composites using Additive Manufacturing - An Integrated Computational and Experimental Study	Analytical model of the transition of a comminuted material to a granular medium and the associated evolution of the void ratio	Study on the Mesh Dependency of GraFEA	Characterization and modeling of graphene nanoplatelets reinforced composites during curing	Remarks on process zone and size effect in rock	
Wen Luo, Zden?k Bažant	Mohammed Abdellatef, Mohammed Alnaggar	Stephen Jiménez, Vignesh Kumar Devendiran, Ravindra Duddu	Vinay Damodaran, Matthew Milostan, Pavana Prabhakar	Amartya Bhattacharjee, Lori Graham-Brady	Parisa Khodabakhshi, J.N. Reddy, Arun Srinivasa	Yao Qiao, Marianna Maiaru, Marco Salviato	Ali Tarokh, Roman Makhnenko, Ali Fakhimi, Joseph Labuz	

4-231	MS 27	Computational Geomechanics	First Chair: Ronaldo Borja Second Chair: Richard Regueiro				
A coupled anisotropic critical state and eigenreson theory for capturing the anisotropic plasticity and fractures in shale.	Fast contact detection of general irregular-shaped particles	Calibration and Validation of Effective Solid Potentials of Heterogeneous Porous Media – Bridging the Gap Between Lab Measured Mechanical Testings and High Resolution Imaging Techniques	Modeling Rock Block-Fluid Interaction using Coupled 3-D Discrete Element and Lattice Boltzmann Methods	High-Performance Distinct Element Analyses of Fault Rupture-Soil-Foundation-Structure Interaction			
Eric Bryant, WaiChing Sun	Zhengshou Lai, Qiushi Chen	Siavash Monfared, Hadrien Laubie, Franck Radjai, Mija Hubler, Roland Pellenq, Franz-Josef Ulm	Michael Gardner, Nicholas Sitar	Fernando Garcia, Jonathan Bray			
				Particle size distribution and compression of crushable granular materials			
				Spatio-Temporal Uncertainty Quantification of Local Kinematic Phenomena of Boundary Displacement Fields Observed on a Series of Triaxial Sand Compression Specimens			
				Yichuan Zhu, Zenon Medina-Cetina, Amy Rechenmacher			
4-237	MS 98	Mechanics of Soft Materials	First Chair: Ali Ghahremaninezhad Second Chair: Nima Rahbar				
Hyperelastic Modeling of the Brain Tissue: Effect of Boundary Conditions and the Role of Compressibility	Understanding large deformation of fruit tissue during drying using a microscale hygro-thermo-mechanical modeling	Computational tools for data-driven design of soft robots	Synthesis and Characterization of Aliphatic Urethane Shape Memory Polymers for Endovascular Embolization of Intracranial Aneurysms	Nonlinear viscoelasticity and generalized failure criterion for polymer gels	Adaptive building envelope achieved through pressure regulated metamaterials	Bamboo: from atoms to culm	Engineering living building materials: multiscale mechanics of biogenic cements from genetically modified bacteria
Aref Samadi-Dooki, George Voyatzis	Kevin Prawiranto, Thijs Defraeye, Dominique Derome, Jan Carmeliet	Mohammad Khalid Jawed	Robert Kunkel, Donnie Robinson, Devin Laurence, Joshua Scherrer, Jingyu Wang, Bradley Bohnstedt, Yingtao Liu, Chung-Hao Lee	Thibaut Divoux, Bavand Keshavarz, Sebastien Manneville, Gareth McKinley	Yawen He, Zhenglai Shen, Hongyu Zhou	Nima Rahbar	Chelsea Heveran, Liya Liang, Aparna Nagarajan, Juan Pablo Gevaudan, Sherri Cook, Jeffrey Cameron, Ryan Gill, Wil Srubar III

9:30-9:45	9:45-10:00	10:00-10:15	10:15-10:30	10:30-10:45	10:45-11:00	11:00-11:15	11:15-11:30am
<b>Building 2</b>						<b>Friday: 9:30-11:30am</b>	
2-105	MS 51	Computational mechanics of nano- and bio- structures and materials for engineering applications				First Chair: Shu-Wei Chang	
						Second Chair: Seunghwa Ryu	
Mechanics of Multi-Layer Graphene and Graphene/Polymer based Nanocomposites	Multiscale modeling of the elastic behaviour of a thermoset nanocomposite containing agglomerated and wavy CNTs	Structural characteristics of 8-oxoguanine during DNA replication: a molecular dynamics approach	Molecular mechanisms of the inhibitory effect of HyA-HEAL+ on collagen degradation	A multiscale study on the role of heterogeneity in natural bamboo	On the cyclic and biaxial behavior of carbon nanotubes by molecular dynamics simulation	Multiscale Simulation Study on the Mechanical Properties of Cu-Graphene Multilayer Composites	
Zhaoxu Meng, Sinan Keten	Shaker Meguid, Ahmed Alian	Hsin-Chin Li, Shu-Wei Chang	Yi-Ching Lai, Ting-Yu Shih, Shu-Wei Chang	Huali Hao, Denvid Lau	Li-Wei Liu, Shu-Wei Chang, Slavomir Parma	Seunghwa Ryu, Hadi Ghafarian, Heeyoung Jeong	
2-131	MS 100	General Engineering Mechanics				First Chair: Wei Song	
						Second Chair: Jian Li	
Wearable electronics for healthcare: from the skin to below the skin	AmishTrack: Human Health Tracking through Gait-induced Floor Vibrations Across Different Structures	Identification of human gait using neural networks	Experimental characterization of Alkali-silica reaction damage in concrete prism samples using nonlinear ultrasonic waves	Crack Detection Using Imaging Techniques	Dense capacitive sensor arrays for monitoring distortion-induced fatigue cracks in steel bridges	Thermal modulation of nonlinear acoustic wave for microcracking damage evaluation in concrete	
Sheng Xu	Mostafa Mirshekari, Jonathon Fagert, Shijia Pan, Pei Zhang, Hae Young Noh	Juan Caicedo, Nicholas Haerens	Taeho Ju, Jan Achenbach, Laurence Jacobs, Jianmin Qu	Shanglian Zhou, Wei Song	Xiangxiong Kong, Jian Li, Caroline Bennett, William Collins, Simon Laflamme, Hongki Jo	Jinying Zhu, Hongbin Sun	

**Friday, June 1, 2018**

**1:00 - 2:00pm**

**Plenary Lecture 6**

**Room: W16 – Kresge Main**

Lydia Bourouiba

Massachusetts Institute of Technology

Unsteady fluid fragmentation



## **Lydia Bourouiba**

Esther and Harold E. Edgerton Career  
Development Professor  
Assistant Professor, Civil and Environmental  
Engineering and Mechanical Engineering  
Affiliate Faculty of the Institute for Medical  
Engineering and Science, Harvard-MIT Health  
Sciences and Technology (HST) Faculty

## **Unsteady fluid fragmentation**

### **Abstract:**

Understanding secondary droplet formation from fluid fragmentation is critical for industrial, environmental, and health processes including for predicting and controlling the transport of pathogen-bearing droplets created from contaminated fluids or surfaces. Despite the complexity and diversity of modes of unsteady fluid fragmentation into secondary droplets, universality across geometry and fluid systems emerges. We will discuss results from our recent joint experimental and theoretical investigations elucidating the role of unsteadiness in shaping a ubiquitous, yet neglected class of fluid fragmentation problems. In particular, we revisit fundamental assumptions of hydrodynamic instability and reveal how unsteadiness and multi-scale dynamics couple to select the sizes and speeds of secondary droplets generated. The implications for human health and food safety will be discussed.

### **Biosketch:**

Prof. Lydia Bourouiba is the Esther and Harold E. Edgerton Career Development Professor at the Massachusetts Institute of Technology. She directs the Fluid Dynamics of Disease Transmission Laboratory. Her research specializes in joining advanced mechanical, physical, and biological experiments and applied mathematics to elucidate the fundamental fluid dynamics governing the multiscale dynamics of pathogen transmission in human, animal, and plant populations where drops, multiphase, and complex flows are at the core. Such understanding is important to develop novel disease mitigation and pathogen control strategies in human health and agriculture. More on her recent work can be found at [lbourouiba.mit.edu](http://lbourouiba.mit.edu)

## Friday, June 1st

2:15-2:30	2:30-2:45	2:45-3:00	3:00-3:15	3:15-3:30	3:30-3:45pm
<b>Building W16</b>		<b>Friday: 2:15-3:45pm</b>			
<b>W16-Kresge Little MS 48</b>		<b>Computational Methods and Applications for Solid and Structural Mechanics</b>			Chair: Timothy Truster
Thermal conductivity of composite ellipsoid assemblages with low conducting interfaces  Napo BONFOH, Florence DINZART, Antoine JEANCOLAS, Hafid SABAR, Marius MIHALUTA	Response of ceramic composite armour systems to high velocity impact: A comparative study between phenomenological and micromechanics based model  Saptarshi Kumar Lahiri, L S Ramachandra, Amit Shaw	Composite Manufacturing and 3D Printing Based on Frontal Polymerization: A Computational Study  Elyas Goli, Mostafa Yourdkhani, Jia E Aw, Nil A. Parikh, Scott R. White, Philippe H. Geubelle	An Elastic-viscoplastic Interface Constitutive Model for Polymer Interfaces  Muhammed Imam, Trisha Sain	Mean-strain 10-node Tetrahedron with Energy-Sampling Stabilization for Nonlinear Deformation  Alireza Pakravan, Phi Nguyen, Nahid Majd, Petr Krysl	Electron transport through metal/metal compression interfaces  Brice Jonckheere, Robert Bouzerar, Nicolas Foy, Thomas Bausseron
<b>W16-Rehearsal Room A MS 78</b>		<b>Nanomaterials and their impact on constructibility</b>			First Chair: Rabah Hamzaoui Second Chair: Ouali Amiri
Mechanosynthesis and their applications in civil engineering  Rabah Hamzaoui, Othmane Bouchenafa, Abdelkrim Bennabi, Johan Colin	Mechanosynthesis and geopolymmerization of coproducts (fly ash and slag)  Othmane BOUCHENAFA, Rabah Hamzaoui, Abdelkrim BENNABI, Johan Colin	Durability of cement based materials containing fly ashes and slag obtained by mechanosynthesis and modified by PCA  Ouali Amiri, Othmane Bouchenafa, Rabah Hamzaoui	Probabilistic Model for Flexural Strength of Carbon Nanotube Reinforced Cement-based Materials  Mahyar Ramezani, Young Hoon Kim, Zihui Sun	Solidification/stabilization (S/S) treatment of zinc contaminated soil using commercial stabilizer and nanostructured-zeolite  Nick Hytiris, Abdelkrim Bennabi, Rabah Hamzaoui	Contaminated soil and sediment treatment based on the use of structurally modified pozzolanic materials.  Abdelkrim Bennabi, Nicholas Hytiris, Rabah Hamzaoui, Baba Hassane Ahmed Hisseini

**Building W20****Friday: 2:15-3:45pm**

W20-491		MS 26	Origami/Kirigami Based Systems and Adaptive Structures		First Chair: Katia Bertoldi Second Chair: Evgeni Filipov	Second
The mechanics of folding curved crease origami  Evgeni Filipov, Steven Woodruff	Topology Optimization of Auxetic Origami Structures  Andrew Gillman, Kazuko Fuchi, Alexander Cook, Alexander Pankonien, Philip Buskohl	Design and analysis of an active-material-enabled reconfigurable origami reflector antenna  Sameer Jape, Gregory Wilson, Edwin Peraza-Hernandez, Dimitris Lagoudas, Darren Hartl	Mechanical Characteristics of Origami Hypars  Maria Redouey, Evgeni Filipov	Design tensegrity systems with controllable characteristics through cellular multiplication  Omar Aloui, Jessica Flores, David Orden, Landolf Rhode-Barbarigos	Origami-inspired cellular structure with highly anisotropic mechanics  Soroush Kamrava, Ashkan Vaziri	
W20-407		MS 52	Damage modelling of engineering structures: from localized cracking to structural collapse		Chair: Xiaodan Ren	
Nonlocal fiber-based frame model for simulating the post-peak response of reinforced concrete beam-columns  Maha Kenawy, Sashi Kunnath, Amit Kanvinde	Failure mechanism of flexure-shear competition for reinforced concrete beams  Xiangling Gao, Jie Li, Xiaodan Ren	3D elastoplastic-damage model for concrete in triaxial compression and reversed cyclic loading  Ma Lu, Ji Zhang	Two-scale consistent secant method for simulation of cyclic behaviors  Xiaodan Ren, Jie Li	Unified Stochastic Damage Model for Quasi-Brittle Materials Based on Multi-scale Modeling  De-Cheng Feng, Xiao-Dan Ren		
W20-Coffeehouse Lounge		MS 59	Solid/fluid mechanics and probabilistic methods for offshore wind energy		First Chair: Sanjay Arwade Second Chair: Don DeGroot	
Optimizing Robustness in Multiline Anchorage Systems for Floating Offshore Wind Turbines  Spencer Hallowell, Sanjay Arwade, Brian Diaz, Charles Aubeny	Uncertainties in the Reconstruction of Irregular Wave Surfaces  Spencer Hallowell, Sanjay Arwade, Andrew Myers	Geospatial statistical modeling in offshore geotechnical site investigation  Ning Luo, Anand Patel, Sanjay R. Arwade, Don J. DeGroot	Impact of Foundation Selection on Wind Turbine Operations  Daniel Kuchma, Amin Nozari			

2:15-2:30	2:30-2:45	2:45-3:00	3:00-3:15	3:15-3:30	3:30-3:45pm
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## Building 5

**Friday: 2:15-3:45pm**

5-217	MS 33	Analytical and experimental investigations on resilient critical infrastructure under multiple hazards		First Chair: Asad Esmaeily	Second Chair: Bernhard Pichler
Detailed FEA for considering the influence of nonstructural members in coastal buildings  Xiaolong Ma, Wei Zhang	Exploring the Role of Natural Ecosystems on Coastal Resilience Through Experimental Testing  Diego Lirman, Brian Haus, Andrew Baker, Landolf Rhode-Barbarigos	Empirical and Analytical Assessment Models for Flood Damage and Loss on the Residential Building Structures  Derya Deniz, Bruce Ellingswood, Abbie Liel, Shideh Dashti	Full Scale 13-Story Building Implosion: Monitoring, Observations, and Modeling  Kanchan Devkota, Chen Fang, Christine Wittich, Richard Wood, Daniel Linzell	Structural response of steel columns subject to close-in detonation with and without protective layers  Yongwook Kim, Jithu Alexander	Damage Characterization for Extreme Impact and Fire Loads to Reinforced-Concrete Highway Bridges  Garrett P Martindale, Mohammad Ebrahim Mohammadi, Richard L Wood, Christine E Wittich, J. Arn Womble

## Building 3

**Friday: 2:15-3:45pm**

3-133	MS 1	Multifunctional Structural Components		First Chair: Simon Laflamme Second Chair: An Chen
Multifunctional Carbon Fiber-Reinforced Polymer as structural capacitor for strain sensing  Jin Yan, Sammy Hassan, Austin Downey, An Chen, Simon Laflamme	Noncontact Absolute Stress Measurement in Rail Using Fluorescence Spectroscopy: Thermite Weld As Natural Passive Stress Sensor  Hae-Bum Yun, Kyoung Chan Lee, Young Joo Park, Sung-il Kim	Multifunctional microcapsules based on cenospheres for concretes  Yi Fang, Jialai Wang, Sudipta Halder	Progress towards a sensing skin enabling self-sensing for structural components  Austin Downey, Mohammadkazem Sadoughi, Jin Yan, Simon Laflamme, Chao Hu, An Chen	

3-370	MS 18	Numerical Methods for Stochastic Engineering Dynamics		First Chair: Antonina Pirrotta Second Chair: Athanasios Pantelous	
Nonlinear MDOF system non-stationary stochastic response determination via statistical linearization and complex modal analysis  Ioannis P. Mitseas, Ioannis A. Kougioumtzoglou, Michael Beer	Nonlinear stochastic dynamic analysis for PBEE by Gaussian mixture-based equivalent linearization method (GM-ELM)  Sang-ri Yi, Ziqi Wang, Junho Song	Seismic Reliability Analysis of Energy-dissipation Structures with Viscous Dampers based on Dimension-reduced Explicit Iteration Scheme  Jianhua Xian, Cheng Su	Efficient Hypercomplex Finite Element Method for Rapid Uncertainty Quantification in Manufacturing Processes  Arturo Montoya, Randal Fielder, Harry Millwater, Patrick Golden	Hamiltonian Monte Carlo-Subset Simulation (HMC-SS) method for structural reliability analysis: theory and applications  Marco Broccardo, Ziqi Wang, Junho Song	
3-270	MS 38	Recent Advances in Uplifting Structures and Rocking Isolation		Chair: Nicos Makris	
Dynamic response of inelastic frames coupled with vertically restrained rocking walls  Mehrdad Aghagholidzadeh, Nicos Makris	Rocking Structures Supported on Surfaces with Defects  Christine Wittich, Tara Hutchinson	Minimum Conditions for Single Block Rocking and Overturning  Gebran Karam, Mazen Tabbara	Rigid blocks coupled with a pendulum mass damper on deformable ground under impulsive excitation  Alessandro Contento, Paolo Gardoni, Angelo Di Egidio, Andrea Matteo de Leo	Seismic Performance Enhancement of Structures Using Rocking Components  Yi Peng, Jian Zhang, Yazhou Xie, Gang Wu	

Building 1	Friday: 2:15-3:45pm				
1-390	MS 23	Advanced deep learning based SHM		First Chair: Young-Jin Cha Second Chair: Oral Buyukozturk	
Using Deep Convolutional Neural Network to Develop Full-Depth Transverse Crack  Kwanghee Won, Chungwook Sim	Element-by-element Seismic Damage Diagnosis and Prognosis in Minimally  Milad Roohi, Eric Hernandez, David Rosowsky	Estimating Remaining Fatigue Life Using Minimum Global Response  Benjamin LeBlanc, Eric Hernandez	Monitoring wind turbines failures targeted at RUL predictions  Jan Helsen, Cédric Peeters, Yi Guo, Nicoletta Gioia, Shuangwen Sheng, Jonathan	Development of Noncontact Corrosion Mapping for Drone-Aided Inspection Using  Zijie Zhou, Jeong Hoon Park, Gyu-Hong Kang, Hae-Bum Yun	

**Building 4****Friday: 2:15-3:45pm**

4-153	MS 6	Multiscale Behavior of Damage and Failure Mechanics	First Chair: Glaucio Paulino Second Chair: Leong H. Poh		
Reduced-Order Microstructure-Sensitive Models for Damage Initiation in Two-Phase Composites  Surya Kalidindi, David Montes de Oca Zapiain, Evdokia Popova, Fadi Abdeljawad, James Foulk, Hojun Lim	Multiscale Modeling of the Elastic and Fracture Behavior of Polycrystalline Graphene  Ahmed Alian, Shaker Meguid	A localizing gradient damage model with micro inertia  Leong Hien Poh	A gradient-enhanced damage model for localized failure problems  QUOC TINH BUI, Sohichi Hirose  Microplane Model with Relaxed Kinematic Constraint in the Framework of Micro Polar Cosserat Continuum  Joško Ožbolt, Serena Gambarelli		
4-261	MS 28	Advances and Applications of Elasticity within Applied Mechanics	First Chair: Sofia Mogilevskaya Second Chair: Ney Dumont		
A generalized wave impedance for the coupling of multiple domains in the discontinuous Galerkin algorithm  Qiwei Zhan, Mingwei Zhuang, Qing Huo Liu	DYNAMIC RESPONSE OF A FOUNDATION SUPPORTED BY PILES TO A VERTICALLY INCIDENT WAVE FIELD  Luis Filipe do Vale Lima, Josue Labaki, Euclides Mesquita	The consistent, collocation boundary element method: formulation, convergence theorem and highly accurate numerical quadrature for 2D problems of any topology and shape  Ney Dumont	Second-order asymptotic homogenization of the wave motion in media with both micro- and macro-scale material heterogeneities  Danial Panahandeh-Shahraki, Bojan Guzina	Stress distribution in structures reinforced by fibers following curvilinear paths: closed form solutions and tips for damage tolerant design  Marco Salvato	ANTIPLANE ELASTIC WAVE CLOAKING OF A CIRCULAR CYLINDRICAL ELASTIC INCLUSION  Porjan Tuttipongsawat, Anil C. Wijeyewickrema, Sasikorn Leungvichcharoen

**Building 2****Friday: 2:15-3:45pm**

2-105	MS 51	Computational mechanics of nano- and bio- structures and materials for engineering applications		First Chair: Shu-Wei Chang Second Chair: Seunghwa Ryu		
Mechanics of Multi-Layer Graphene and Graphene/Polymer based Nanocomposites	Multiscale modeling of the elastic behaviour of a thermoset nanocomposite containing agglomerated and wavy CNTs	Structural characteristics of 8-oxoguanine during DNA replication: a molecular dynamics approach	Molecular mechanisms of the inhibitory effect of Hyaluronan-HEAL+ on collagen degradation	A multiscale study on the role of heterogeneity in natural bamboo	On the cyclic and biaxial behavior of carbon nanotubes by molecular dynamics simulation	Multiscale Simulation Study on the Mechanical Properties of Cu-Graphene Multilayer Composites
Zhaoxu Meng, Sinan Keten	Shaker Meguid, Ahmed Alian	Hsin-Chin Li, Shu-Wei Chang	Yi-Ching Lai, Ting-Yu Shih, Shu-Wei Chang	Huali Hao, Denvid Lau	Li-Wei Liu, Shu-Wei Chang, Slavomir Parma	Seunghwa Ryu, Hadi Ghafarian, Heeyoung Jeong
2-131	MS 100	General Engineering Mechanics			First Chair: Wei Song Second Chair: Jian Li	
Wearable electronics for healthcare: from the skin to below the skin	AmishTrack: Human Health Tracking through Gait-induced Floor Vibrations Across Different Structures	Identification of human gait using neural networks	Experimental characterization of Alkali-silica reaction damage in concrete prism samples using nonlinear ultrasonic waves	Crack Detection Using Imaging Techniques	Dense capacitive sensor arrays for monitoring distortion-induced fatigue cracks in steel bridges	Thermal modulation of nonlinear acoustic wave for microcracking damage evaluation in concrete
Sheng Xu	Mostafa Mirshekari, Jonathon Fagert, Shijia Pan, Pei Zhang, Hae Young Noh	Juan Caicedo, Nicholas Haerens	Taeoh Ju, Jan Achenbach, Laurence Jacobs, Jianmin Qu	Shanglian Zhou, Wei Song	Xiangxiong Kong, Jian Li, Caroline Bennett, William Collins, Simon Laflamme, Hongki Jo	Jinying Zhu, Hongbin Sun



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**Engineering Mechanics Institute**  
International Conference 2018



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**November 2 - 4, 2018**

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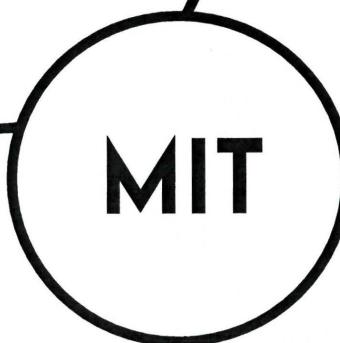




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