Preconference Course(s): January 28, 2024
Conference: January 29 – February 1, 2024
Exposition: January 29-31, 2024

IMAC XLII
Society for Experimental Mechanics

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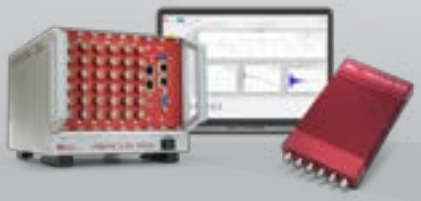

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Welcome Message: David Epp

It is my pleasure to welcome everyone to the IMAC-XLII back in Orlando, Florida this year. I am looking forward to a strong conference where we can all gather again, exchange ideas, talk to exhibitors, and learn as much as possible from each other. Since it was first held in 1982, IMAC has evolved to encompass the latest technologies supporting structural dynamics. This broad focus on structural dynamics includes topics in simulation and modeling, nonlinear dynamics, sensors, signal processing and control spanning the full range of engineering disciplines.

There are so many people who have shaped our field and contributed to IMAC throughout its history. This year we are celebrating the incredible contributions of some of those giants with our theme "Standing on the Shoulders of Giants". The conference will have all the traditional topics and information exchange we expect but will also include sessions focused on remembering David J Ewins, who passed away a year ago, and a keynote speaker recognizing the massive contributions of so many others.

I encourage everyone to look at the Awards page on the SEM website to see our history of recognizing these giants over the many years of the conference and society. The SEM Fellows and D. J. DeMichele award histories are interesting to scroll through as well as all the others to see awardees as far back as the early 1950s. David J Ewins was recognized as a Fellow in 2014 and received the D. J. DeMichele award in 1993. Our keynote speaker this year, Randy Mayes, was recognized as a Fellow in 2022 and received the D. J. DeMichele award in 2015. This recognition of worthy individual contributions to our field and the Society continues every year. All the awards for SEM are based on nominations and the SEM Honors Committee meets each summer at the Annual Conference to determine winners. To hear about the award winners this year, please join us on Wednesday for the IMAC Awards Luncheon where we will recognize a select group of awardees this year.

One of the founding tenets of IMAC is to constantly strive to be the "friendly conference." In that spirit, I would like to extend a special welcome to all our new attendees this year. As we continue to sustain and extend our community, you are the future in structural dynamics and its many related fields. As you check in, you will notice that people will be getting banners added to the bottom of their badges indicating their roles at the conference – Session Chair, Advisory Board, First Time Attendee, etc. Those are an easy way to spot people to connect with, either for experienced attendees to reach out to first timers, or for first timers to find welcoming leaders in many areas of the conference. A great opportunity is our welcome reception on Monday, please stop by to say hello and meet other new and seasoned attendees.

I also want to encourage everyone, regardless of how long you have attended IMAC, to get involved in organizing the conference. The more engagement and participation we have from the community, the stronger and more engaging we can make IMAC. There are so many opportunities to help shape the current and future conferences, including attending and participating in the Technical Divisions (TDs) at lunch on Tuesday, volunteering with the SEM staff to chair sessions at future conferences, or talking with Advisory Board members about new topics or ideas for the conference. As I already mentioned, another very important contribution that anyone can participate in is nominating key contributors for SEM Awards. Those nominations are due April 15, 2024 for recognition at the 2025 conferences. Please don't hesitate to stop to talk to me or any of the other organizers about any of these. SEM and the IMAC conference organizers are all committed to making this a successful meeting.

Welcome everyone to IMAC-XLII!

David Epp | *IMAC Conference Director* ■

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Welcome Message: Matt Allen

On behalf of the Advisory Board, welcome to the 42nd IMAC in Orlando. I look forward to the opportunity that we have each year to catch up with outstanding colleagues and to learn about the latest work in structural dynamics. For this year's program, we have elected to take time to remember the contributions and leadership of some of the giants who have shaped our field. In particular, two sessions are dedicated to the memory of David J Ewins, who passed away a year ago. This preface is too short to mention even a small fraction of the giants who have shaped our field, such as Lothar Gaul and Roy Craig, as well as the giants who are still with us but have or will soon retire from active involvement.

This year opens with three pre-conference courses on Sunday: Introduction to the Python Programming Language for Structural Dynamics Applications offered by Dan Rohe; Steve Carter; Brandon Zwink from Sandia National Laboratories, An Introduction to Machine Learning and Data Science for Engineers by Lawrence Bull from the University of Cambridge, and Equation- and Data-Driven Nonlinear Model Reduction for Solids, Fluids and Control by George Haller, Shobhit Jain and Bálint Kaszás. We have more than 80 sessions over four days covering a very broad range of technical topics. Randy Mayes, retired from Sandia National Laboratories, will be presenting our conference keynote entitled "Technical Examples of Building on the Work of Others to Fulfill Your Purpose (With Attributions to David Ewins and other IMAC Colleagues)" and Dan Rohe, also from Sandia National Laboratories, will be presenting the SAGE Publishing Young Engineer Lecture, "A Case for Using Open-Source Software in Structural Dynamics." We also have many tutorial sessions throughout the week on a broad range of topics from Dynamics Environments Testing to Rotor Dynamics and Nonlinear Dynamics. Everyone from undergraduate students to experienced engineers should find interesting topics to learn about and discuss in the program this year.

I hope that you find IMAC to be an engaging and friendly community where you can learn from cutting edge research being done all over the world and present your latest work. We encourage you to join a Focus Group or Technical Division or to talk to the conference organizers about getting involved in other ways. Your participation and ideas are needed to keep IMAC responsive to the needs of the structural dynamics community.

Matt Allen | *IMAC Advisory Board Chair* ■

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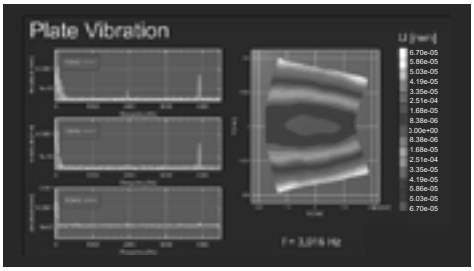
Technology Application Session *Salon 10* *Tuesday 1/30 - 9 AM*	*"FFT with DIC: Improvements in Data Processing and Vibration Visualization in VIC-3D"*
New/Young Engineer Tutorial *Salon 13* *Thursday 2/1 - 10 AM*	*"Measuring Operational Deflection Shapes with Digital Image Correlation"*



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- New FFT vibration workspace allows for the ODS' in-plane and out-of-plane amplitudes to be exaggerated for better visualization of the object behavior (shown left)
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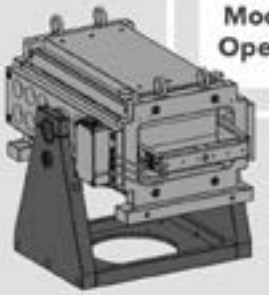

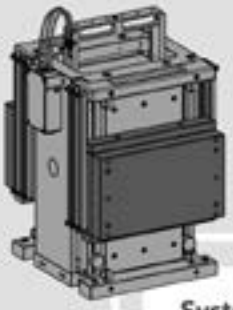

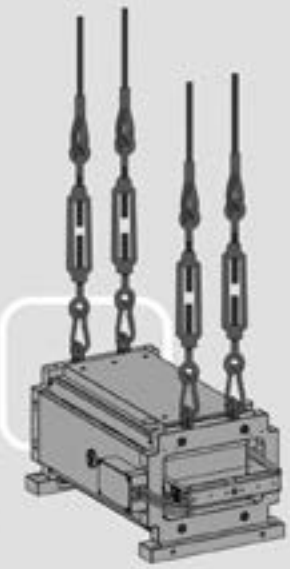

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New to IMAC?

IMAC has something to offer whether you're a student, recent graduate, in a laboratory, or you're in industry. Panels, sessions, New/Young Engineer Program and networking are just some of the benefits you can expect from attendance.

Technical Program and Presentations

At most IMACs, there are 7 concurrent rooms holding presentations every 20 minutes. Most rooms will be organized with blocks of presentations on a particular topic or track. While this may seem daunting, there is a method to the madness. Blocks of presentations occur in the early morning, late morning, early afternoon and late afternoon on similar topics (often referred to as "Tracks" or Symposia). Our Final Program and downloadable app, Whova, will have all presentations and meetings listed. Whova is a great resource for searchable content by track, author or specific presentation. Go to sem.org/imac for details.

New/Young Engineer Program

The field of Modal Analysis continues to evolve and mature. In order to allow new or young engineers in the modal field to extract meaningful information from paper presentations at the IMAC Conference, a program has been developed to familiarize the new/young engineer with some of the very basic material related to modal analysis. Held on the first day of the conference, the Basics of Modal Analysis lecture sessions are geared towards those individuals who have very limited or no experience in the modal field or need a refresher on some of the basic modal nomenclature. The material is centered on the topics of single degree of freedom theory, multiple degree of freedom theory, measurements and parameter estimation. The intent is to familiarize the new/young modal engineer with the nomenclature and basic techniques involved in modal analysis; the most basic fundamental equations will be explained in an overview sense rather than developed from a theoretical standpoint.

Welcome Reception

Everyone at IMAC-XLII is invited to attend the Welcome Reception. A staple at every IMAC, this reception is a terrific chance to reacquaint yourselves with fellow attendees, students, exhibitors, and guests, as well as meet those who are new. It is a wonderful way to begin the conference.

Technical Division Lunch

All Technical Division Groups will meet on Tuesday around noon. These gatherings are open to everyone and are a perfect opportunity to discuss area and topic specific content with individuals sharing the same interests. For a full listing of SEM's Technical Divisions, please go to sem.org/technicaldivisions.

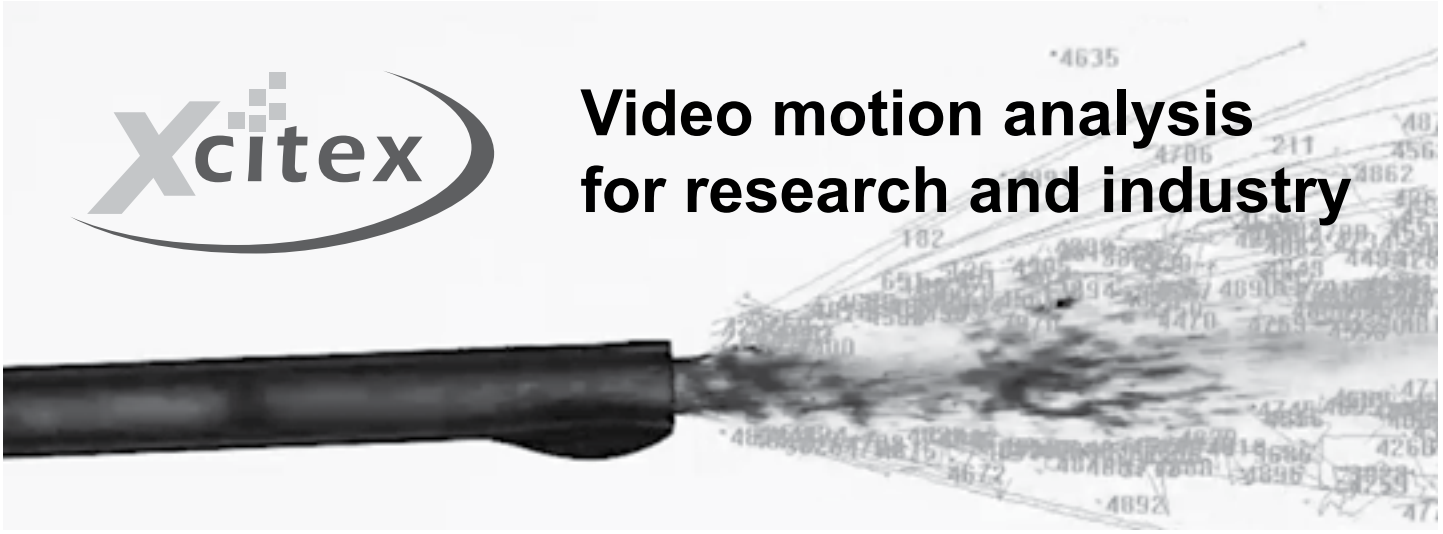
Networking

Vendors in our Exposition will have their latest technology offerings on display. Network with experts, in hardware and software, that can provide you a competitive edge. Form connections that will last throughout your career and help you along its path.

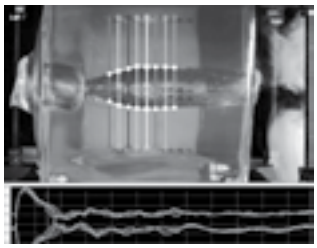
Social Event - Howl at the Moon

Social events have long been a terrific opportunity for IMAC attendees to share ideas and comradery and we are excited to continue this wonderful tradition. Get together at Howl at the Moon (walking distance from the hotel) and enjoy some cocktails, snacks, and live music while reconnecting and making new IMAC memories! ■

Video motion analysis for research and industry



Structural Dynamics



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Schedule of Events

Start	End	Event	Room
Sunday, January 28, 2024			
8:00 a.m.	10:00 a.m.	COURSE ONLY Registration	Salon 18
9:00 a.m.	6:00 p.m.	COURSE: Introduction to the Python Programming Language for Structural Dynamics Applications Dan Rohe, Brandon Zwink, Steven Carter	Salon 14
9:00 a.m.	6:00 p.m.	COURSE: An Introduction to Machine Learning and Data Science for Engineers Lawrence Bull	Salon 13
9:00 a.m.	6:00 p.m.	COURSE: Equation- and Data-Driven Model Reduction for Nonlinear Dynamical Systems George Haller, Shobhit Jain, Bálint Kaszás	Salon 12
9:00 a.m.	3:00 p.m.	Closed SEM Executive Board Meeting	Salons 9-10
10:00 a.m.	6:00 p.m.	Speaker's Practice Room (Closed for LANL)	Green Room
4:00 p.m.	6:00 p.m.	Conference Registration	Reg Desk AB
Monday, January 29, 2024			
7:00 a.m.	4:00 p.m.	Registration	Reg Desk AB
8:00 a.m.	6:00 p.m.	Speaker's Practice Room	Green Room
8:15 a.m.	8:45 a.m.	Speaker/Chair Briefing	Ballroom CD
9:00 a.m.	11:00 a.m.	01. Linear Joints and Coupling	Salon 8
9:00 a.m.	11:00 a.m.	02. Additive Manufacturing	Salon 9
9:00 a.m.	11:00 a.m.	03. Modal & Acoustic Characterization	Salon 10
9:00 a.m.	11:00 a.m.	04. Aerospace I	Salon 11
9:00 a.m.	11:00 a.m.	05. Structural Health Monitoring I	Salon 12
9:00 a.m.	11:00 a.m.	06. Modal Analysis for the New/Young Engineer I	Salon 13
9:00 a.m.	11:00 a.m.	07. Nonlinear Vibration Fundamentals	Salon 14
11:00 a.m.	11:30 a.m.	Coffee Break	Ballroom Foyer
11:30 a.m.	12:30 p.m.	Keynote: Randy Mayes–Sandia National Laboratories (Retired)	Ballroom CD
12:30 p.m.	2:00 p.m.	Closed IMAC Advisory Board Meeting	Salon 7
12:30 p.m.	2:00 p.m.	Lunch	on own
2:00 p.m.	4:00 p.m.	08. Nonlinear Joints and Coupling	Salon 8
2:00 p.m.	4:00 p.m.	09. Uncertainty Quantification in Dynamics	Salon 9
2:00 p.m.	4:00 p.m.	10. Substructure	Salon 10
2:00 p.m.	4:00 p.m.	11. Sensors	Salon 11
2:00 p.m.	4:00 p.m.	12. Structural Health Monitoring II	Salon 12
2:00 p.m.	4:00 p.m.	13. Modal Analysis for the New/Young Engineer II	Salon 13
2:00 p.m.	4:00 p.m.	14. Nonlinear System Identification I	Salon 14
2:30 p.m.	3:30 p.m.	*Experimental Techniques* Editorial/IAB Meeting	Salon 7
4:00 p.m.	4:30 p.m.	Coffee Break	Ballroom Foyer
4:30 p.m.	6:10 p.m.	15. Modal and Frequency Based Substructuring	Salon 8
4:30 p.m.	6:10 p.m.	16. Fusion of Test and Analysis	Salon 9
4:30 p.m.	6:10 p.m.	17. Open-source Scientific Computing in Structural	Salon 10
4:30 p.m.	6:10 p.m.	18. Instrumentation	Salon 11
4:30 p.m.	6:10 p.m.	19. Dynamics of Buildings	Salon 12
4:30 p.m.	6:10 p.m.	20. Modal Analysis for the New/Young Engineer III	Salon 13
4:30 p.m.	6:10 p.m.	21. Nonlinear System Identification II	Salon 14
6:15 p.m.	7:00 p.m.	Meeting of the International Committee on Joint Mechanics	Salon 7
6:15 p.m.	7:00 p.m.	Student Meet & Greet	Mezzanine
7:00 p.m.	8:30 p.m.	Welcome Reception in the Exposition	Ballroom AB
Tuesday, January 30, 2024			
7:30 a.m.	4:00 p.m.	Registration	Reg Desk AB
8:00 a.m.	6:00 p.m.	Speaker's Practice Room	Green Room
8:15 a.m.	8:45 a.m.	Speaker/Chair Briefing	Ballroom CD
9:00 a.m.	11:00 a.m.	22. Round Robin Test Bed	Salon 8
9:00 a.m.	11:00 a.m.	23. Model Form Uncertainty incl. Round Robin Challenge	Salon 9
9:00 a.m.	11:00 a.m.	24. Technology Applications I	Salon 10
9:00 a.m.	11:00 a.m.	25. Aerospace II	Salon 11
9:00 a.m.	11:00 a.m.	26. Dynamics of Bridges and Rail	Salon 12
9:00 a.m.	11:00 a.m.	27. Testing Techniques	Salon 13
9:00 a.m.	11:00 a.m.	28. Data-driven Methods	Salon 14
9:30 a.m.	11:00 a.m.	Meeting of the Applications, Education, Research Committees	Salon 7
10:00 a.m.	5:00 p.m.	Exposition Open	Ballroom AB
11:00 a.m.	11:30 a.m.	Coffee Break in the Exposition	Ballroom AB
11:30 a.m.	12:30 p.m.	SAGE Publishing Young Engineer Lecture: Daniel Rohe–Sandia National Laboratories	Ballroom CD
12:30 p.m.	2:00 p.m.	TD/Focus Group Meetings w/Pizza Lunch	Ballroom CD
		Computer Vision and Laser Vibrometry TD	Salon 11
		Data Science TD	Salon 7
		Dynamic Environments Testing TD	Salon 10
		Dynamic Substructures TD	Salon 8
		Dynamics of Civil Structures TD	Salon 12
		Modal Analysis and Structural Dynamics TD	Salon 13
		Model Validation & Uncertainty Quantification TD	Salon 9
		Nonlinear Structures & Systems TD	Salon 14
		Jim F. Lally Sensors and Instrumentation TD	Green Room
1:30 p.m.	2:00 p.m.	Exhibit Planning Committee	Ballroom AB
2:00 p.m.	3:40 p.m.	29. Transfer Path Analysis and Force Estimation	Salon 8

Start	End	Event	Room
2:00 p.m.	3:40 p.m.	30. Recursive Bayesian System Identification	Salon 9
2:00 p.m.	3:40 p.m.	31. Technology Applications II	Salon 10
2:00 p.m.	3:40 p.m.	32. High-speed Camera Based EMA I	Salon 11
2:00 p.m.	3:40 p.m.	33. Human Structure Interaction	Salon 12
2:00 p.m.	3:40 p.m.	34. Modal Parameter Estimation	Salon 13
2:00 p.m.	3:40 p.m.	35. Joints - UQ Approaches	Salon 14
3:40 p.m.	4:40 p.m.	Dessert Break in the Exposition	Ballroom AB
4:40 p.m.	6:40 p.m.	36. Environments Definition	Salon 8
4:40 p.m.	6:40 p.m.	37. Virtual Sensing & Realtime Monitoring	Salon 9
4:40 p.m.	6:40 p.m.	38. Interface Dynamics	Salon 10
4:40 p.m.	6:40 p.m.	39. High-speed Camera Based EMA II	Salon 11
4:40 p.m.	6:40 p.m.	40. Structural Vibration Mitigation and Control	Salon 12
4:40 p.m.	6:40 p.m.	41. Vibration Reduction	Salon 13
4:40 p.m.	6:40 p.m.	42. Joints I	Salon 14
7:30 p.m.	10:00 p.m.	Women in Dynamics Board Game Night	Ballroom CD

Wednesday, January 31, 2024

7:30 a.m.	4:00 p.m.	Registration	Reg Desk AB
8:00 a.m.	6:00 p.m.	Speaker's Practice Room	Green Room
8:15 a.m.	8:45 a.m.	Speaker/Chair Briefing	Ballroom CD
9:00 a.m.	10:30 a.m.	Program Planning Committee Meeting	Salon 7
9:00 a.m.	10:40 a.m.	43. Fixture Design I	Salon 8
9:00 a.m.	10:40 a.m.	44. Surrogate Modeling and Reduced Order Models	Salon 9
9:00 a.m.	10:40 a.m.	45. System Identification and Structural Health Monitoring	Salon 10
9:00 a.m.	10:40 a.m.	46. In Memory of David Ewins I	Salon 11
9:00 a.m.	10:40 a.m.	47. Rotating Machinery I	Salon 12
9:00 a.m.	10:40 a.m.	48. Damage Detection	Salon 13
9:00 a.m.	10:40 a.m.	49. Nonlinear Model Reduction I	Salon 14
10:00 a.m.	1:00 p.m.	Exposition Open	Ballroom AB
10:40 a.m.	11:30 a.m.	Coffee Break in the Exposition	Ballroom AB
11:30 a.m.	1:10 p.m.	50. Fixture Design II	Salon 8
11:30 a.m.	1:10 p.m.	51. Applications of Machine Learning	Salon 9
11:30 a.m.	1:10 p.m.	52. Finite Element Techniques	Salon 10
11:30 a.m.	1:10 p.m.	53. Optical Systems for Rotating Structures	Salon 11
11:30 a.m.	1:10 p.m.	54. Rotating Machinery II	Salon 12
11:30 a.m.	1:10 p.m.	55. Damping	Salon 13
11:30 a.m.	1:10 p.m.	56. Nonlinear Model Reduction II	Salon 14
1:10 p.m.	2:40 p.m.	Awards Luncheon	Ballrom CD
2:00 p.m.	5:00 p.m.	Exposition Open	Ballroom AB
2:40 p.m.	4:20 p.m.	57. MIMO DET I	Salon 8
2:40 p.m.	4:20 p.m.	58. Machine Learning and Modeling of Structures	Salon 9
2:40 p.m.	4:20 p.m.	59. System Identification	Salon 10
2:40 p.m.	4:20 p.m.	60. DIC Applications	Salon 11
2:40 p.m.	4:20 p.m.	61. Biomedical Applications	Salon 12
2:40 p.m.	4:20 p.m.	62. Basics of Modal Analysis: Tutorials I	Salon 13
2:40 p.m.	4:20 p.m.	63. Nonlinear Model Reduction III	Salon 14
4:20 p.m.	5:00 p.m.	Coffee Break in the Exposition	Ballroom AB
5:00 p.m.	6:20 p.m.	64. MIMO DET II	Salon 8
5:00 p.m.	6:20 p.m.	65. Structural Modelling and Condition Assessment	Salon 9
5:00 p.m.	6:20 p.m.	67. Optical System for Additive Manufacturing and Damage Detection	Salon 11
5:00 p.m.	6:20 p.m.	68. Joints II	Salon 12
5:00 p.m.	6:20 p.m.	69. Basics of Modal Analysis: Tutorials II	Salon 13
5:00 p.m.	6:20 p.m.	70. Control of Nonlinear Systems	Salon 14
7:00 p.m.	10:00 p.m.	IMAC Social Event at Howl at the Moon	off-site

Thursday, February 1, 2024

8:00 a.m.	12:00 p.m.	Registration	Reg Desk AB
8:00 a.m.	4:00 p.m.	Speaker's Practice Room	Green Room
8:15 a.m.	8:45 a.m.	Speaker/Chair Briefing	Ballroom CD?
9:00 a.m.	11:00 a.m.	71. Shaker DET	Salon 8
9:00 a.m.	11:00 a.m.	72. Physics Informed Machine Learning	Salon 9
9:00 a.m.	11:00 a.m.	73. Condition Monitoring & Damage Detection	Salon 10
9:00 a.m.	11:00 a.m.	74. In Memory of David Ewins II	Salon 11
9:00 a.m.	11:00 a.m.	75. Experimental Techniques for Nonlinear Systems	Salon 12
9:00 a.m.	11:00 a.m.	76. Basics of Modal Analysis: Tutorials III	Salon 13
9:00 a.m.	11:00 a.m.	77. Industrial Applications	Salon 14
11:00 a.m.	11:30 a.m.	Coffee Break	Ballroom Foyer
11:30 a.m.	1:10 p.m.	78. Transient DET	Salon 8
11:30 a.m.	1:10 p.m.	80. Qualification and Durability Testing	Salon 10
11:30 a.m.	1:10 p.m.	81. Computer Vision for Civil Applications and SHM	Salon 11
11:30 a.m.	1:10 p.m.	82. Numerical Methods	Salon 12
11:30 a.m.	1:10 p.m.	84. Applications	Salon 14

Course: Introduction to the Python Programming Language for Structural Dynamics Applications

Sunday, January 28, 2024 | 9:00 a.m. - 6:00 p.m. | Salon 14

Course Description

Open-Source Tools have become widespread in several scientific disciplines. The free and open-source Python programming language has become a serious competitor to Matlab as a scripting language for performing scientific analyses. There are now several major Structural Dynamics Python packages that are in development or have been released, such as PyFBS, Rattlesnake Vibration Controller, SDynPy, and SDyPy. It is now possible to perform the entire Structural Dynamics workflow using only free and open-source software. Moving Structural Dynamics into open source provides numerous benefits: students can examine code to learn exactly how various algorithms work, researchers can tinker with the code to explore new solutions without having to code everything from scratch, and practitioners can execute their tests or analyses in software that isn't simply a "black box."

This course is designed for current Matlab users (or users with basic proficiency in other programming languages) who are interested in learning Python and how to use some of the Structural Dynamics tools that are available. This course will introduce the basics of the Python programming language with examples motivated by structural dynamics applications. A brief demonstration using Structural Dynamic packages will also be provided. Students are encouraged to attend with their own computers to work along with the tutorials. The instructors will send out instructions for installing the required tools prior to the class, so students can come prepared with the needed software already installed.

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Course Instructors

Dan Rohe

Dr. Daniel Rohe is a Principal Member of the Technical Staff at Sandia National Laboratories. Dan works in the Experimental Structural Dynamics department where he specializes in dynamic characterization testing using non-contact diagnostics and MIMO vibration control. Dan has spent the last few years writing software for structural dynamics applications which have been released open source as the Rattlesnake, a MIMO Vibration Controller, and SDynPy, a Structural Dynamics Python Library.

Steve Carter

Steven Carter is an experienced NVH and structural dynamics engineer with 10 years of experience in the automotive and aerospace industries. He currently works in the Experimental Structural Dynamics department where he specializes in inverse force estimation and MIMO vibration control. Steve has made significant contributions to the SDynPy Python library in the areas of Transfer Path Analysis and MIMO Vibration.

Brandon Zwink

Dr. Brandon Zwink currently works with Sandia National Laboratories as an independent contractor and has been studying in structural dynamics since 2007. Brandon worked as a full time Sandian for three years and has been contracting with Sandia for the last 8 years. Brandon recently completed his PhD with Dr. Pete Avitabile at the University of Massachusetts Lowell. Brandon has been using Python and the SDynPy library to solve real world structural dynamics problems, and he has also assisted in development of the SDynPy library by adding functionality and ensuring smooth integration with Apple computers.

Course Fee

The regular course fee is $500 and the student fee is $250. Course fee includes lunches, course handout material, and refreshment breaks. Lodging and additional food or materials are not included.

Cancellation Liability

If the course is cancelled for any reason, the Society for Experimental Mechanics' liability is limited to the return of the course fees.

Attendees are encouraged to bring their own laptops.
None will be provided.

Tentative Schedule

Introduction – 9:00 a.m.
- Discussion of Open-Source Software
- General overview of the Scientific Python Ecosystem

Basic Python – 9:30 a.m.
- Python Syntax
- Data Types
- Operators

Coffee Break – 10:30 a.m.

Container Data Types and Program Flow – 10:45 a.m.
- Container Objects
- NumPy Arrays
- For and While Loops
- Exceptions

Functions – 12:15 a.m.
- Function Definition and Usage
- Return Statements
- Argument Unpacking
- Keyword vs Positional Arguments

Lunch – 1:00 p.m.

Numerical Calculations with NumPy – 2:00 p.m.
- Indexing
- Broadcasting
- Finding and Using Documentation

Plotting with Matplotlib – 3:00 p.m.
- Basic Plotting
- Using Subplots

Coffee Break – 3:30 p.m.

Interactive Coding Exercise: Computing FRFs from Time Histories – 3:45 p.m.
- Loading Time Data
- Splitting up Data into Frames
- Applying Window Functions
- Computing FFTs
- Computing Power Spectra and Averaging
- Computing H1 Estimator
- Packaging into a Function for reuse
- Function Optimizations and Vectorization

Structural Dynamics Demonstration with SDynPy and Rattlesnake – 4:30 p.m.
- Load a Pre-test Finite Element Model
- Perform Sensor Optimization
- Modal Test Demonstration
- Mode Fitting
- Comparison to FEM

Class Released – 6:00 p.m.

Course: An Introduction to Machine Learning and Data Science for Engineers

Sunday, January 28, 2024 | 9:00 a.m. - 6:00 p.m. | Salon 13

Course Description

Machine Learning (ML) and data science are having a huge impact on the way modern engineering is being approached. This is due to three important factors: an exponential increase in available data from in-service systems; significant theoretical developments and new algorithms; several programming frameworks which lower the barrier of entry to these new methods. However, engineering applications still pose unique and challenging use cases for ML tasks. This course will focus on the fundamentals of ML which will allow attendees to make informed decisions about the most appropriate ways to apply this new technology to their problems.

Course Instructor

Lawrence Bull

Lawrence is a research associate in the Engineering Dept. at the University of Cambridge, within the Computational Statistics and Machine Learning group. He researches statistical methods for monitoring telemetry data from systems and infrastructure, working closely with the Cambridge Centre for Smart Infrastructure and Construction (CSIC). Previously, he worked at the Alan Turing Institute in the Data-Centric Engineering programme and the Dynamics Research Group at the University of Sheffield.

Course Fee

The regular course fee is $500 and the student fee is $250. Course fee includes lunches, course handout material, and refreshment breaks. Lodging and additional food or materials are not included.

Cancellation Liability

If the course is cancelled for any reason, the Society for Experimental Mechanics' liability is limited to the return of the course fees.

Attendees are encouraged to bring their own laptops. None will be provided.

Tentative Schedule

The course will focus on example-based seminars with the opportunity to interact with code for each case study.

Seminars

1. What is Machine Learning (ML)?

- ML with an engineering mindset
- Fundamental tasks in ML
- From engineering problems to ML solutions
  - Data exploration, preprocessing, etc.

2. Regression (materials tests, wind turbine examples)

- Meaningful regression in engineering
- Linear least squares
  - Not-so-linear bases
  - Controlling complexity and domain expertise
- Maximum likelihood and Bayes's rule
  - A probability primer
  - Thinking generatively
  - Bayes Rule to encode engineering knowledge
- Bayes Linear Regression
  - Conjugate Bayesian linear regression
  - Non-conjugate – discuss don't derive

3. Classification (Acoustic emission example)

- Why group data?
- Feature selection and dimensionality reduction
  - PCA and others
- What is similarity and how to measure it?
- The K-nearest-neighbour algorithm
- Gaussian Mixture models
- Logistic regression (if we have time)

4. Clustering/Density Estimation (Acoustic emission example)

- What if labels are unknown?
- What is similarity and how to measure it?
- The K-means algorithm for clustering
- Gaussian Mixture Models for clustering
  - Distances link to probabilities
  - The EM method as an extension of K-means

5. Advanced Topics

- Semi-parametric models and physics-informed ML
- Semi-supervised approaches to clustering
- Neural Networks and Deep Learning
- Gaussian processes

Course: Equation- and Data-Driven Nonlinear Model Reduction for Solids, Fluids and Control

Sunday, January 28, 2024 | 9:00 a.m. - 6:00 p.m. | Salon 12

Course Description

The mechanical systems arising in contemporary science and engineering are growing ever more complex. As a result, the governing equations of these processes are becoming high-dimensional or even unknown. In the latter case, only data-driven modeling is a viable option. For the analysis, prediction, design and control of such equation- or data-defined processes, reduced-order models capturing the core of the underlying physical phenomena are critically important. The most frequently used model reduction methods include modal projection methods, linear approximate models and neural network-based reduction. Each method has its own success stories but also possesses limitations that prevent its general applicability.

Specifically, projection-based models for nonlinear systems are fundamentally heuristic due to their dependence on the linear modes used. Data-driven linear modeling techniques, such as dynamic mode decomposition (DMD) and its variants, are unable to capture characteristically nonlinear phenomena, such as coexisting isolated steady states. Finally, machine learning approaches tend to provide unnecessarily large models that are not interpretable and do not perform well outside their training range.

In this short course, we discuss recently developed, general model reduction techniques that do not suffer from the above shortcomings and provide accurate, low-dimensional reduced models for complex nonlinear systems. This technique is based on the theory of spectral submanifolds (SSMs) that are mathematically rigorous nonlinear continuations of linear modal subspaces in oscillatory systems. We first cover the necessary theoretical background in a format accessible to practitioners and illustrate the strength of SSM-based model reduction on select examples from solid and fluid mechanics.

We then offer a tutorial on practical SSM-reduction for high-dimensional (finite-element-grade) mechanical models via the use of the open source package SSMTool. Finally, we offer a similar tutorial on extracting SSM-reduced nonlinear models from time-varying numerical and experimental data via the open source package SSMTool.

Course Instructors

George Haller

George Haller is a professor of Mechanical Engineering at ETH Zürich, where he holds the Chair in Nonlinear Dynamics. His prior appointments include tenured faculty positions at Brown, McGill and MIT. He also served as the first director of Morgan Stanley's fixed income modeling center. Professor Haller is a former Sloan Fellow, Thomas Hughes Young Investigator (ASME) and a School of Engineering Distinguished Professor (McGill), as well as current external member of the Hungarian Academy of Science. He serves as associate editor at the Journal of Applied Mechanics, feature editor at Nonlinear Dynamics and senior editor at the Journal of Nonlinear Science. He is an elected fellow of SIAM, APS and ASME.

Shobhit Jain

Shobhit Jain is an assistant professor of Applied Mathematics at TU Delft. He obtained his undergraduate degree in Mechanical Engineering from IIT Roorkee, his M. Sc. degrees in Mechanical Engineering and Applied Mathematics from TU Delft, and his doctoral degree from ETH Zurich. Shobhit has had industrial stints at several engineering firms, gathering experience in heavy engineering, precision and microsystems engineering, and numerical simulations.

Bálint Kaszás

Bálint Kaszás earned his Bachelor's and Master's degrees in Physics from Eötvös Loránd University in Budapest, Hungary. He has obtained his Ph.D. from ETH Zurich, where he is currently a postdoctoral fellow in the research group led by George Haller. His research interests include reduced-order modeling and uncertainty quantification applied to fluid mechanical problems.

Course Fee

The regular course fee is $500 and the student fee is $250. Course fee includes lunches, course handout material, and refreshment breaks. Lodging and additional food or materials are not included.

Cancellation Liability

If the course is cancelled for any reason, the Society for Experimental Mechanics' liability is limited to the return of the course fees.

Attendees are encouraged to bring their own laptops.
None will be provided.

Keynote: Randy Mayes
Technical Examples of Building on the Work of Others to Fulfill Your Purpose
(With Attributions to David Ewins and other IMAC Colleagues)

Monday, January 29, 2024 | 11:30 a.m. - 12:30 p.m | Ballroom CD

Abstract

The theme "Standing on the Shoulders of Giants" is explored over my structural dynamics career. Some sage technical and philosophical advice from one of the giants of modal testing, David Ewins, is included to provide a technical boost to early career experimentalists. The history of building upon the work of several IMAC colleagues is related in the career-long use and exploration of the modal filter. This amazing principle has provided technical advancement and understanding in the sub-disciplines of force reconstruction, modal parameter estimation, experimental dynamic substructuring, nonlinear analysis and impedance matched multi-axis test planning. The conclusion is stimulated once again from a David Ewins premise. I extend this to the listener in an exhortation of purpose. When this pilgrim looks back over a long career, he can clearly see mileposts of purpose that were not as evident when they were originally passed.

Biography

Randy Mayes began his structural dynamics career as a finite element analyst using NASTRAN in 1979 at Sandia National Laboratories. He moved into the modal testing group in 1989 where he worked until retirement in 2020. He has always enjoyed the friendly IMAC conference of SEM. An ElliptiGO stand-up bicycle and a classical guitar provide great hobbies. His favorite paraphrased scripture from the book of James is "Count it a joyous opportunity when you have an interruption or obstacle to your plans. As you patiently watch God work it out, He will change you into a fantastic person". ■

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SAGE Publishing Young Engineer Lecture: Daniel Rohe
A Case for Using Open-Source Software in Structural Dynamics

Tuesday, January 30, 2024 | 11:30 a.m. - 12:30 p.m | Ballroom CD

Abstract

With the conference theme of "Standing on the Shoulders of Giants", we recognize that as researchers and practitioners, our contributions to the field of Structural Dynamics are often incremental, building off the ideas and contributions of those who came before us. The concept of building from previous successes is heavily reliant on having access to those previous successes, so they can be implemented, analyzed, and improved. While this concept is prevalent in publishing research, one could argue that the same concept should be prevalent in the software we use for that research. Fortunately, open-source tools are becoming widespread in several scientific disciplines. The free and open-source Python programming language has become a serious alternative to MATLAB as a scripting language for performing scientific analyses, and there are now several major Structural Dynamics Python packages that are in development or have been released, such as PyFBS, Rattlesnake Vibration Controller, SDynPy, and SDyPy. It is now possible to perform the entire Structural Dynamics workflow using only free and open-source software. Moving Structural Dynamics into open source has the potential to provide numerous benefits: students can examine code to learn exactly how various algorithms work, researchers can tinker with the code to explore new solutions without having to code everything from scratch, and practitioners can execute their tests or analyses in software that isn't simply a "black box." This lecture will make a case for moving structural dynamics into the open-source domain, presenting several successful open-source projects and success stories from using open-source tools.

Biography

Dan Rohe is a Principal Member of the Technical Staff at Sandia National Laboratories. He works in the Experimental Structural Dynamics department where he specializes in dynamic characterization testing using non-contact diagnostics and MIMO vibration control. Dan has spent the last few years writing software for structural dynamics applications which have been released open source as Rattlesnake, a MIMO Vibration Controller, and SDynPy, a Structural Dynamics Python Library. Dan received his Undergraduate and Master's degree at the University of Wisconsin under Professor Matt Allen, and his Ph.D. from the University of Massachusetts Lowell under Professors Zhu Mao and Pete Avitabile. ■

The SAGE Publishing Young Engineer Lecture recognizes a member of SEM in early to mid-career (generally 5 to 10 years after degree receipt) whose work demonstrates considerable potential in the field of Experimental Mechanics.

The Society has a number of awards which, by their nature, are intended to recognize senior members of the Society for their work in Experimental Mechanics. However, it is also important that the Society recognize members early in their career whose work demonstrates considerable potential in the field of Experimental Mechanics. That is the focus of this lecture.

As with all SEM awards, we strongly solicit nominations from the members of the Society and the IMAC community for this lecture. The nominee should be recognized for the potential of work early in his/her career, and should be a member of the Society. On the academic side, this could be someone at the Assistant or Associate Professor level. On the industrial or Government Lab side, it could be someone up to 10 years after hire. These are only guidelines and not absolute rules.

Please visit www.sem.org/awards to learn more about nominating a person for this award. ■

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Technical Divisions (TD) Committee Meetings

Tuesday, January 30, 2024 | 12:30 p.m - 2:00 p.m. | Ballroom CD

Participate in SEM Technical Divisions and Get the Most out of your Membership

The SEM Technical Divisions are the grass-roots building blocks of the Society for Experimental Mechanics. These divisions meet formally and informally at various Society events, address current practices and prepare action plans for communicating the activities in their technical area to the rest of the Society, and to groups outside the Society. This is very often accomplished by organization of technical sessions at SEM Conferences. Many of the SEM Technical Divisions have had a significant impact on SEM Conference Programs on a regular basis, i.e. Composite, Hybrid and Multifunctional Materials, Dynamic Behavior of Materials, MEMS and Nanotechnoloy at the SEM Annual Conferences and Modal Analysis/Dynamic Systems at IMAC.

Please plan to attend the Technical Committee Meetings scheduled at IMAC-XLII. Refer to the chart on opposite page to determine which Technical Division you may be interested in and then check the schedule for meeting time. *NOTE: TDs highlighted in blue will meet at SEM Annual 2024.* ■

12:30 p.m in Ballroom CD for pizza and information. At about 1:00 p.m. - move to the rooms listed below for TD Meetings.

Computer Vision and Laser Vibrometry (Salon 11)

All IMAC attendees eager to know more about the optical methods and computer vision technology and its application are invited to join the Technical Division meeting. The Technical Division also welcomes volunteers for organizing or chairing sessions in this track. The Technical Division on Computer Vision and Laser Vibrometry aims to share knowledge on advances in the area of optical measurement techniques that are applied to the area of dynamic measurements. This technical division organizes presentations that use optical techniques for operating data measurement, modal parameter estimation, model updating, full field dynamic strain extraction, damage detection, and high-speed deformation measurement.

Data Science (Salon 7)

The Data Science Technical Division needs your involvement! The TD's charter is to advocate for Data Science within SEM and the engineering community at-large, develop educational opportunities, support young professionals, and encourage practitioners and researchers to present their work. IMAC attendees are encouraged to attend the TD meeting. Everybody is welcome! The TD meeting is an opportunity to propose technical sessions and tutorials for the next IMAC (2025), suggest panel discussion and training events, discuss outreach opportunities. The TD will also solicit ideas for activities that would be beneficial to IMAC and SEM. The meeting is a great way to connect and network with IMAC attendees who share similar interest in Data Science.

Dynamic Environments Testing (Salon 10)

The purpose of this technical division is to expand upon the exciting research being done for dynamic environments testing and help to evolve advanced test techniques across both the research community and industry. Join us to discuss technical developments of the emerging methods, learn about the latest collaboration efforts underway on the Dynamics Environments Testing round robin test bed (BARC), and help us pave a path forward for future research via new challenge problems and/or test benches. We invite anyone with an interest, curiosity, or need for dynamic environments testing to join this group and participate in this exciting research—together we can help shape the future of dynamics testing!

Dynamic Substructures (Salon 8)

The Technical Division on Dynamic Substructures, is eagerly organizing sessions, keynote talks and activities of interest for both analytical and experimental substructuring. During a lunchbreak at IMAC, the annual meeting will be held. We meet to organize sessions, pre-conference courses, keynote talks and panel discussions for the next IMAC conference and to coordinate efforts on benchmark systems. All interested and curious persons are welcome to attend. For more information see: www.sem.org/tdsubstructures.

Dynamics of Civil Structures (Salon 12)

The Dynamics of Civil Structures TD is established to address the needs of its SEM community members working on civil structures and to improve structural sustainability and resiliency, safety,

continued on next page

Technical Divisions (TD) Committee Meetings *(cont)*

Tuesday, January 30, 2024 | 12:30 p.m - 2:00 p.m. | Ballroom CD

serviceability, and human-infrastructure interaction issues in the larger civil engineering professional community and related technical disciplines. The TD holds its annual meeting during IMAC highlighting the significant technical content and TD members' conference activities devoted to the study of civil structures under dynamic loads. The TD provides a unique multidisciplinary forum to disseminate and exchange information on new research and technical developments in the design, analysis, testing, monitoring, and assessment of civil structures.

TD goals include the identification of critical research needs, the validation and dissemination of emerging methods and promising technologies and growing the research and professional community that address the unique demands of the civil structures. Conference activities of the TD include organization of special sessions, program tracks, and short courses among others.

New members and conference participants are welcome to attend the TD annual meeting.

Modal Analysis and Structural Dynamics (Salon 13)

IMAC attendees interested in promoting modal analysis and dynamic systems activities within SEM are welcome to attend the annual meeting of this Technical Division. This TD is constantly seeking new ideas and volunteers to participate in activities which will further the scientific and educational knowledge of modal analysis and other aspects of dynamic systems. The Modal Analysis and Dynamic Systems TD has sponsored the Basics of Modal Analysis for the New/Young Engineer program for many years.

This TD has also developed and sponsored several special sessions and programs over the years such as Dynamic Environments Testing, Laser Vibrometry, Optical Methods, and several others. If you have ideas for special sessions or programs at IMAC bring your ideas to this meeting.

At this year's meeting, we will be making plans for IMAC 2025, the 43nd anniversary of the conference. In addition to plans for 2025, we will also be discussing how this Technical Division can serve all engineers and technicians working in the field by being a source of knowledge and information. Once again, all are welcome to attend. Please bring us your ideas.

Model Validation & Uncertainty Quantification (Salon 9)

Model Validation and Uncertainty Quantification (MVUQ) refers to a broad range of activities carried out to provide evidence that measurements and predictions are credible and scientifically defensible.

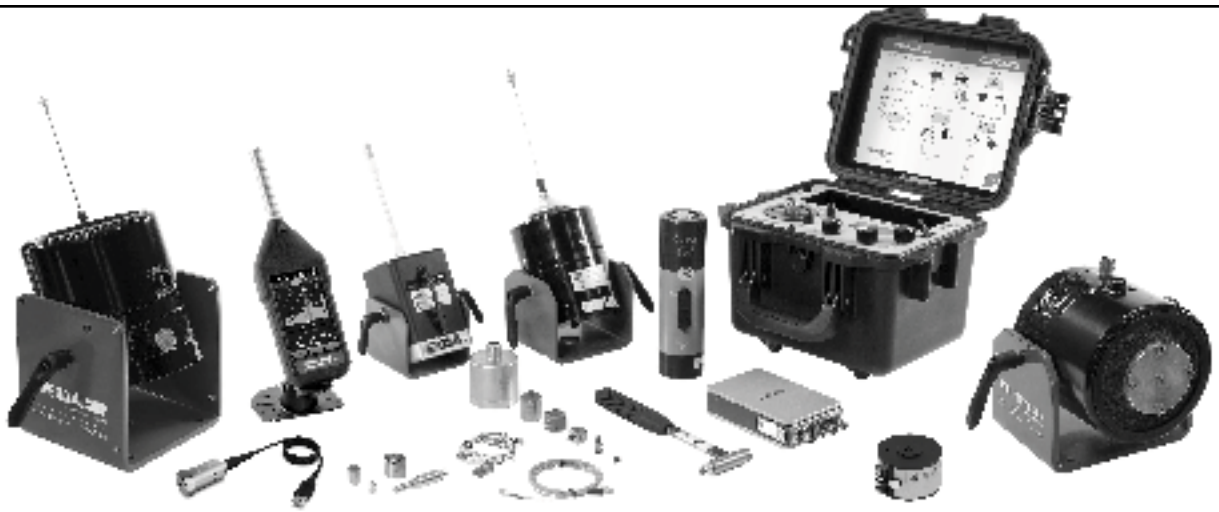
The purpose of the MVUQ Technical Division at the Society for Experimental Mechanics (SEM) is to advance the capabilities and disseminate knowledge of MVUQ methods with an emphasis on Structural Dynamics. Among the goals of the Technical Division is an aim to broaden the impact of MVUQ practices incorporating all stakeholders, from industry to academia, to ensure that MVUQ practices continue to grow and mature in a manner that benefits all. Over the past years, the TD has been very active in organizing technical sessions and tutorials at SEM conferences and awards an MVUQ Best Paper Award during IMAC. All who share our interest for MVUQ, especially the presenters and audience in this year's MVUQ sessions are welcome to attend the meeting, join the TD, and help to define its role and mission.

Nonlinear Structures & Systems (Salon 14)

All interested people are welcome to join the Nonlinear Structures and Systems Technical Division (TD) officers to organize the tutorials and sessions for the next IMAC conference and discuss the division's future. This year, we will also hold elections for the role of Chair, Vice-Chair, and Secretaries of the TD for the next three years.

Jim F. Lally Sensors and Instrumentation (Green Room)

We encourage all that have an interest or want to learn more about the Sensor and Instrumentation technical division to attend our annual planning meeting. At this year's meeting we will again evaluate recurring session topics and encourage new participants to join us to submit their session ideas for future IMACs. Engineers and technicians of all disciplines are welcome to attend, participate, and collaborate on sessions and topics that are significant to the application and measurements of dynamic structures. ■



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Open Meetings

Meeting of the International Committee on Joint Mechanics

Monday, January 29, 2024 | 6:15 p.m. - 7:00 p.m. | Salon 7

All interested people are welcome to join the International Committee on Joint Mechanics for our annual committee meeting. The agenda will focus on a debrief from the Fifth International Workshop (held in September 2023), updates on the action items for the committee, organization of the mini-workshops throughout the spring, dissemination of information for the summer research camps, and opportunities to become involved.

Experimental Techniques Editorial/IAB Meeting

Monday, January 29, 2024 | 2:30 p.m. - 3:30 p.m. | Salon 7

Applications, Education and Research Committees Joint Meeting

Tuesday, January 30, 2024 | 9:30 a.m. - 11:30 a.m. | Salon 7

Join us for discussion on topics relevant to IMAC and SEM Annual conferences. This joint meeting of the committees will cover topics on Education: student symposia and students, including the newly implemented student ambassador program; Applications: a forum for individuals doing work on a practical level; and Research: a forum for research topics, both novel and works in progress. Bring your ideas and help guide topics and themes for future conferences.

Exhibit Planning Committee

Tuesday, January 30, 2024
1:30 p.m. - 2:30 p.m. | Ballroom AB

All exhibitors are invited to attend this open meeting to discuss opportunities, provide valuable insight/feedback, and guide future Exposition planning. Your participation is critical in making the Exposition a success and in providing the best experience for conference attendees.

Program Planning Committee

Wednesday, January 31, 2024
9:00 a.m. - 10:30 a.m. | Salon 7

The committee will meet to receive IMAC-XLII feedback from Technical Divisions, Focus Groups, and others as well as to discuss plans for IMAC-XLII. **Each Technical Division and Focus Group is asked to send a representative to this meeting if possible**. If not possible, please BE SURE to return your TD/Focus Group form to the IMAC registration desk **prior** to this meeting. ■

IMAC-XLII Welcome Reception

Monday, January 29, 2024
7:00 p.m. - 8:30 p.m. | Ballroom AB

Everyone at IMAC-XLII is invited to attend the Welcome Reception. A staple at every IMAC, this reception is a terrific chance to reacquaint yourself with fellow attendees, students, exhibitors, and guests, as well as meet those who are new. It is a wonderful way to begin the conference.

STUDENT MEET & GREET

Monday, January 29, 2024
6:15 p.m. - 7:00 p.m. | Mezzanine

All students are invited to this casual gathering to meet up and share some light bites and drinks before the Welcome Reception.

Closed Meetings

SEM Executive Board Meeting

Sunday, January 28, 2024 | 9:00 a.m. - 3:00 p.m. | Salons 9-10

IMAC Advisory Board Meeting

Monday, January 29, 2024 | 12:30 p.m. - 2:00 p.m. | Salon 7

HOWL AT THE MOON Orlando

IMAC-XLII SOCIAL EVENT

All registered attendees at IMAC-XLII are invited to attend an evening of fun at Howl at the Moon.

Social events have long been a terrific opportunity for IMAC attendees to share ideas and comradery and we are excited to continue this wonderful tradition. Let's get together and enjoy some cocktails, snacks, and live music while reconnecting and making new IMAC memories!

Wednesday, January 31, 2024

7:00 p.m. - 10:00 p.m.

Howl at the Moon Orlando is located at 8815 International Dr., Orlando, FL (walking distance from the Rosen Plaza Hotel)

Awards

2024 Awards and Recipients

SEM Fellows: Michael Todd

SAGE Publishing Young Engineer Lecture: Daniel Rohe

D. J. DeMichele: James C. Akers

SEM Gold and Silver Certificate Members

The following SEM members have reached a Silver or Gold membership milestone. We sincerely thank them for their years of service and dedication to SEM. Seeing these certificates awarded is a wonderful way to show our appreciation to these longstanding SEM members.

50 Year Members | Gold Certificate
Rodolfo Rasia
Hirosh Uozatro

25 Year Members | Silver Certificate
Paul Gloeckner
Federico Sciammarella
Sigmund Stepaniak
Michael Todd

All Society Awards Luncheon

Wednesday, January 31, 2024
1:10 p.m. - 2:40 p.m. | Ballroom CD

IMAC Conference Director, David Epp, will conduct the Awards Luncheon ceremony by presenting various awards in recognition of outstanding achievements and service to SEM/IMAC.

◀ Scan to visit the SEM Awards web page

2024 Best Papers

Computer Vision & Laser Vibrometry
sponsored by Polytec and Correlated Solutions, Inc.

1st Place: Tengjiao Jiang–Norwegian University of Science and Technology; Gunnstein Frøseth–Norwegian University of Science and Technology; Anders Rønnquist–Norwegian University of Science and Technology
For the paper #16586 - "A Six-Degree-of-Freedom Camera Motion Correction Method Based on Inertial Measurement Unit and Data Fusion"

2nd Place: Andre Green–Los Alamos National Laboratory; Moises Mello da Silva–Los Alamos National Laboratory; Alessandro Cattaneo–Los Alamos National Laboratory; David Mascarenas–Los Alamos National Laboratory
For the paper #16604 - "3D Mode-Shape Extraction through Event-Based Light Fields"

3rd Place: Ke Yuan–University of Maryland Baltimore County; Weidong Zhu–University of Maryland Baltimore County
For the paper #16721 - "Panoramic 3D Operating Deflection Shape Measurement of a Cylindrical Structure using a Mirror-Assisted 3D CSLDV System"

Data Science
sponsored by Los Alamos Dynamics, LLC

Aidan Hughes–University of Sheffield; Jack Poole–University of Sheffield; Nikolaos Dervilis–University of Sheffield; Paul Gardner–Frazer-Nash Consultancy; Keith Worden–University of Sheffield
For the paper #17020 - "Quantifying the Value of Information Transfer in Population-based SHM"

Dynamic Environments Testing

Cora Taylor–Michigan Technological University; Jason Blough–Michigan Technological University; James DeClerck–Michigan Technological University; Chuck VanKarsen–Michigan Technological University; Raymond Joshua–Honeywell, Kansas City National Security Campus
For the paper #16612 - "PDADyE Applied to a 2-attachment Fixture Case"

Dynamics of Civil Structures

Yiwen Dong–Stanford University; Jingxiao Liu–Stanford University; Sung Eun Kim–Lucile Packard Children's Hospital; Kornél Schadl–Lucile Packard Children's Hospital; Jessica Rose–Lucile Packard Children's Hospital; Hae Young Noh–Stanford University
For the paper #16682 - "Graphical Modeling of the Lower-Limb Joint Motion from the Dynamic Floor Responses under Footstep Forces"

Model Validation & Uncertainty Quantification
sponsored by Los Alamos Dynamics, LLC

Antonios Kamariotis–ETH Zürich; Eleni Chatzi–ETH Zürich
For the paper #17047 - "Bayesian Decision-theoretic Model Selection for Monitored Systems"

Nonlinear Structures and Systems

Mihai Cimpuieru–University of Michigan, Ann Arbor; Alexander Kripfgans–University of Michigan, Ann Arbor; Sean Kelly–University of Michigan, Ann Arbor; Bogdan Epureanu–University of Michigan, Ann Arbor
For the paper #16529 - "Additive Manufacturing of Resonant Vibration Absorbers for Turbomachinery Blisks"

MARK YOUR CALENDARS!

IMAC-XLIII

It's Not Just Modal Anymore

February 10-13, 2025

ROSEN PLAZA HOTEL

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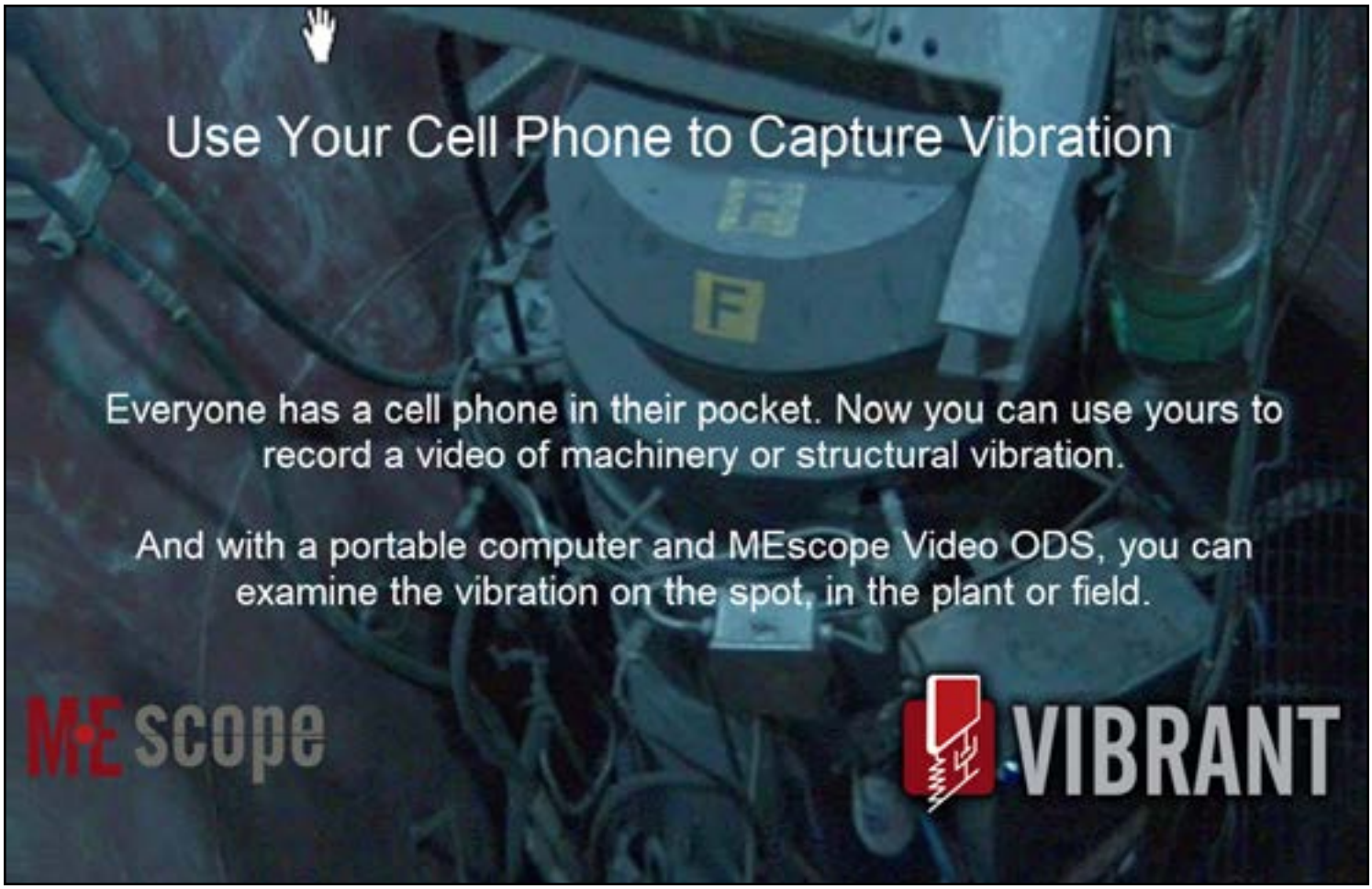

	SALON 8	SALON 9	SALON 10
TRACK	DYNAMIC SUBSTRUCTURES	ADDITIVE MANUFACTURING	MODAL ANALYSIS & STRUCTURAL DYNAMICS
SESSION	01. LINEAR JOINTS AND COUPLING	02. ADDITIVE MANUFACTURING	03. MODAL & ACOUSTIC CHARACTERIZATION
CHAIR(S)	**Annalisa Fregolent**–*Università di Roma La Sapienza;* **Nevzat Özgüven**–*Middle East Technical University*	**James De Clerck**–*Michigan Technological University;*	**Joel Sills**–*NASA;* **Greta Colford**–*University of Michigan*
9:00 a.m.	Experimental Substructuring for Linear and Nonlinear Connection Dynamics: A Tutorial (Part 1) #16482 | *Daniel J. Rixen–Technical University of Munich*	A 3D-Printed Paradigm Shift in Self-aware Smart Structures Fabrication #16791 | *Tilen Košir–University of Ljubljana; Janko Slavič–University of Ljubljana*	Tips, Tricks, and Obscure Features for Modal Signal Processing #16779 | *William A. Fladung–ATA Engineering, Inc.; Kevin L. Napolitano–ATA Engineering, Inc.*
9:20 a.m.		Damping Behavior of Trapped Powder in Additively Manufactured Steel Beams #16442 | *Jonathan K. Black–Brigham Young University; Sam Teng–Brigham Young University; Jacob Capito–Brigham Young University; Matthew S. Allen–Brigham Young University; Tracy Nelson–Brigham Young University; Nathan Crane–Brigham Young University*	Effects of Rarefied Atmosphere on Radiation Damping in an Aluminum Euler Beam #16933 | *Joshua T. Mills–Brigham Young University; Peter K. Jensen–Brigham Young University; Micah R. Shepherd–Brigham Young University*
9:40 a.m.		Dynamics of Additively-Manufactured Beams and the Influence of Static Position on the System's Nonlinear Behaviors #16783 | *Micah Cheng-Guajardo–New Mexico State University; Nicholas Hall–New Mexico State University; Trey Swan–New Mexico State University; Christopher Padilla–New Mexico State University; Matthew Vinsonhaler–New Mexico State University; Abessattar Abdelkefi–New Mexico State University*	Leveraging Phase-Based Motion Magnification for Noise Source Identification in Pressure Exchangers #16950 | *Cengizhan Taslicay–Rice University; Drithi Shetty–Rice University; Jagadish Janardhan–Flowserve Corporation; Matthew Brake–Rice University*
10:00 a.m.	Estimating Linear Joint Stiffness and Damping using a Frequency-Based Optimization Framework and the Emerging Concept of DyDis #16607 | *Marie Brøns–Technical University of Denmark/Technical University of Munich; Francesco Trainotti–Technical University of Munich; Daniel J. Rixen–Technical University of Munich*	Influence of the 3D Printing Parameters on the Dynamic Characteristics of Composite Structures #17048 | *Ali Raza–Kaunas University of Technology*	Identification of Bird Species in Large Multi-channel Data Streams using Distributed Acoustic Sensing #16978 | *Andrew Jensen–Stanford University; William Redford–Georgia Institute of Technology; Nimran Shergill–Yale Unviersity; Carly Donahue–Los Alamos National Laboratory; Luke Beardslee–Los Alamos National Laboratory*
10:20 a.m.	Comparing Different Interface Descriptions for Joint Identification using Dynamic Substructuring #16893 | *Jacopo Brunetti–Università degli Studi dell'Aquila; Walter D'Ambrogio–Università degli Studi dell'Aquila; Matteo Di Manno–Università degli Studi di Roma La Sapienza; Annalisa Fregolent–Università degli Studi di Roma La Sapienza*		Estimation of Acoustic Emission Arrival Time in Concrete Structures Using Convolutional Neural Network #16838 | *Omair Inderyas–Ege University; Ninel Alver–Ege University; Aydin Kaya–Hacettepe University; Ulas Bagci–Northwestern University*
10:40 a.m.	Expansion Techniques in the Modal Domain: Practical Implementation of M-SEMM and Comparative Study with SEREP #16640 | *Miha Pogačar–University of Ljubljana; Gregor Čepon–University of Ljubljana; Miha Boltežar–University of Ljubljana*		
11:00-11:30 a.m.	**Coffee Break**—Ballroom Foyer		
11:30-12:30 p.m.	**Keynote: Randy Mayes—Sandia National Laboratories**—Ballroom CD		
12:30-2:00 p.m.	**Lunch**—On Own		
12:30-2:00 p.m.	**Closed IMAC Advisory Board Meeting**—Salon 7		

Full detailed event schedule available on the Whova app.

SALON 11	SALON 12	SALON 13	SALON 14
AEROSPACE	DYNAMICS OF CIVIL STRUCTURES	BASICS OF MODAL ANALYSIS	NONLINEAR STRUCTURES & SYSTEMS
04. **AEROSPACE I**	05. **STRUCTURAL HEALTH MONITORING I**	06. **MODAL ANALYSIS FOR THE NEW/YOUNG ENGINEER I**	07. **NONLINEAR VIBRATION FUNDAMENTALS**
Eric Stasiunas–*NASA - Marshall Space Flight Center;* **Kevin Napolitano**–*ATA Engineering*	**Kirk Grimmelsman**–*FDH Infrastructure Services;* **Knut Andreas Kvåle**–*Norwegian University of Science and Technology*	**Jon Furlich**–*ATA Engineering;* **Brandon Dilworth**–*MIT Lincoln Laboratory*	**Matthew Brake**–*Rice University*
Noncontact Modal Testing of Structures with Closely Spaced Modes Using Multireference Impact Testing and Scanning Laser Vibrometry #16973 | *Benjamin L. Martins–ATA Engineering, Inc.; Joseph M. Jaeckels–ATA Engineering, Inc.*	A Data Set from Response and Load Monitoring of a Steel Bridge Subject to Imposed Damage for Damage Detection and Structural Health Monitoring #16749 | *Bjørn T. Svendsen–Norwegian University of Science and Technology; Gunnstein T. Frøseth–Norwegian University of Science and Technology; Ole Øiseth–Norwegian University of Science and Technology; Anders Rønnquist–Norwegian University of Science and Technology*	Single and Multiple Degree of Freedom Theory #17187 | *Chad M. Walber–Michigan Technological University*	Tutorial: Fundamentals of Nonlinear Oscillations #16956 | *Paolo Tiso–ETH Zürich*
Vibration Analysis of Morphing Wings #16506 | *Derek J. Willis–University of Michigan; Daniel J. Inman–University of Michigan*	Operational Modal Analysis of a Pedestrian Bridge Using Ultra-Sensitive Wireless Accelerometers Under Different Structural Scenarios #17070 | *Furkan Luleci–University of Central Florida; Abdulrahman Algadi–University of Central Florida; Matthieu Perrault–Sercel; Laurent Guerineau–Sercel; Necati Catbas–University of Central Florida*		
An Enhanced Study of an Acoustic Damage Detection Method for Unmanned Aircraft #16776 | *William Semke–University of North Dakota; Djedje-Kossu Zahui–University of North Dakota; Clement Tang–University of North Dakota*	Performance Evaluation of Light Pole Structures through SHM #17054 | *David Zambrano–FDH Infrastructure Services; Kirk A Grimmelsman–FDH Infrastructure Services*		
Operational Modal Analysis of the Artemis I Dynamic Rollout Test and Wet Dress Rehearsal #16581 | *James C. Akers–NASA GRC; James P. Winkel–NASA LaRC; Alexander W. Chin–NASA LaRC; Russel A. Parks–NASA MSFC; Dana E. Chandler–NASA MSFC; Eric C. Stasiunas–NASA MSFC; Matthew S. Allen–ATA Engineering*	An Investigation of Common Damage Types for Marine Structures in the Context of Structural Health Monitoring #16748 | *Bjørn T. Svendsen–Ramboll Energy/Norwegian University of Science and Technology; Niels Dollerup–Ramboll Energy*		More than Joints - Prof. Lothar Gaul's Contributions to IMAC #16555 | *Kai I. Willner–FAU Erlangen-Nuremberg*
Strain-Data Driven Force Reconstruction Using Pseudo-Inverse Matrix #16784 | *Aditya Panigrahi–The University of Texas at Austin; Alexander Q. Nguyen–The University of Texas at Austin; Marc A. Eitner–The University of Texas at Austin; Jayant Sirohi–The University of Texas at Austin*	Keynote: On the Role of Structural Monitoring and Structural Health Monitoring in Asset Management and Improved Design of Bridges #18031 | *Ole A. Øiseth–Norwegian University of Science and Techonology; Øyvind W. Petersen–Norwegian University of Science and Techonology; Gunnstein T. Frøseth–Norwegian University of Science and Techonology; Anno C. Dederichs–Norwegian University of Science and Techonology; Aksel Fenerci–Norwegian University of Science and Techonology; Bjørn T. Svendsen–Norwegian University of Science and Techonology; Gabriel A. del Pozo–Norwegian University of Science and Techonology; Knut A. Kvåle–Norwegian University of Science and Techonology; Anders Rønnquist–Norwegian University of Science and Techonology*		Hyper-Reduced and Very Efficient Consideration of Small Sliding Contact in Arbitrarily Fined Meshed FE Models of Jointed Structures #16504 | *Wolfgang Witteveen–Upper Austria University of Applied Sciences; Lukas Koller–Upper Austria University of Applied Sciences*
			Nonlinear Wave-Based Vibration Approach for Analytical Determination of Periodic Solutions and Stability in Jointed Bars, Beams, and Frames #16500 | *Michael J. Leamy–Georgia Tech; Nidish N. Balaji–University of Stuttgart; Matthew R. Brake–Rice University*

Coffee Break—Ballroom Foyer

Keynote: Randy Mayes—Sandia National Laboratories—Ballroom CD

Lunch—On Own

Closed IMAC Advisory Board Meeting—Salon 7

Full detailed event schedule available on the Whova app.

	SALON 8	SALON 9	SALON 10
TRACK	DYNAMIC SUBSTRUCTURES	MODEL VALIDATION & UNCERTAINTY QUANTIFICATION	MODAL ANALYSIS & STRUCTURAL DYNAMICS
SESSION	08. NONLINEAR JOINTS AND COUPLING	09. UNCERTAINTY QUANTIFICATION IN DYNAMICS	10. SUBSTRUCTURE
CHAIR(S)	**Daniel Rixen**–*Technische Universitat Munchen;* **Jacopo Brunetti**–*University of L'Aquila*	**Babak Moaveni**–*Tufts University;* **Costas Papadimitriou**–*University of Thessaly*	**TBA**
2:00 p.m.	Experimental Sub-structuring for Linear and Nonlinear Connection Dynamics: A Tutorial (Part 2) #17178 | *H. Nevzat Özgüven–Middle East Technical University*	A Structured Knowledge Graph for a Geometric and Behavioral Digital Twin in the Context Of Modal Testing #16658 | *Xiaoxue Shen–University of Sheffield; Prajwal Devaraja–University of Sheffield; David Wagg–University of Sheffield; Matthew Bonney–Swansea University*	Strain-based Damage Localization on Plate Structures using Cross-domain Hybrid Expansion Method #16897 | *Brett C. Daniels–University of Massachusetts Lowell; Alessandro Sabato–University of Massachusetts Lowell; Peter Avitabile–University of Massachusetts Lowell; Raymond Joshua–Kansas City National Security Campus*
2:20 p.m.		Uncertainty Quantification of Bending Moments with Characterization of Strain Measurement Error on Offshore Wind Turbines #16969 | *Eleonora Tronci–Northeastern University; Anna Haensch–Tufts University; Georgios Georgalis–Tufts University; Babak Moaveni–Tufts University*	Influences of Bolt Location, Torqueing, and Lifetime on Dynamical Characteristics of Bolted Joint Structures #16668 | *Tharwat Elkabani–New Mexico State University; Andres Tiede–New Mexico State University; Abdessattar Abdelkefi–New Mexico State University*
2:30-3:30 p.m.	***Experimental Techniques* Editorial/IAB Meeting**—Salon 7		
2:40 p.m.		Continuous Monitoring of the First Two Offshore Wind Farms in the US #17058 | *Babak Moaveni–Tufts University; Eric Hines–Tufts University*	Exploring Modal Analysis for Characterizing Impact of Making Process on the Properties of Woods used in Musical Instruments #16497 | *Romain Viala–Institut Technologique Européen des Métiers de la Musique; Jérémy Cabaret–Institut Technologique Européen des Métiers de la Musique*
3:00 p.m.	Linear Joint Identification for Frictional Rotor Shaft-to-Hub Connections using Frequency-Based Substructuring #16808 | *Michael Kreutz–Technical University of Munich; Daniel J. Rixen–Technical University of Munich*	Universal Upper Estimate for Prediction Errors Under Moderate Model Uncertainty #16812 | *Bálint Kaszás–ETH Zurich; George Haller–ETH Zurich*	Reconstruction of Unsteady Lift Force Measurements using Non-Dimensional Scaling Optimization #16481 | *Zachary T. Jones–Pennsylvania State University; Nicholas A. Vlajic–Pennsylvania State University*
3:20 p.m.	Iterative Coupling of Multiple Moderate Nonlinear Numerical and/or Experimental Subsystems via FRFs #16502 | *Wolfgang Witteveen–Upper Austria University of Applied Sciences; Lukas Koller–Upper Austria University of Applied Sciences*	Unveiling New Insights for Uncertainty Propagation in Frequency-based Substructuring #16923 | *Javier del Fresno Zarza–KU Leuven; Francesco Trainotti–Tecnical Universität München; Frank Naets–KU Leuven*	
3:40 p.m.	Nonlinear Subcomponent Attachments for the Technical Division on Dynamic Substructuring Benchmark Structure #17027 | *Daniel R. Roettgen–Sandia National Labs; Benjamin Moldenhauer–Sandia National Labs; Andreas Linderholt–Linneaus University*		
4:00-4:30 p.m.	**Coffee Break**—Ballroom Foyer		

Full detailed event schedule available on the Whova app.

SALON 11	SALON 12	SALON 13	SALON 14
SENSORS & INSTRUMENTATION	DYNAMICS OF CIVIL STRUCTURES	BASICS OF MODAL ANALYSIS	NONLINEAR STRUCTURES & SYSTEMS
11. **SENSORS**	12. **STRUCTURAL HEALTH MONITORING II**	13. **MODAL ANALYSIS FOR THE NEW/YOUNG ENGINEER II**	14. **NONLINEAR SYSTEM IDENTIFICATION I**
Chad Walber–*Michigan Technological University;* **Matthew Stefanski**–*U.S. Air Force Research Laboratory*	**Matthew Whelan**–*UNC Charlotte*	**Michael Mains**–*The Modal Shop*	**Gaetan Kerschen**–*University of Liege*
Piezoelectric Accelerometer Sensor Faults and Failures #17016 | *Chad M. Walber–Michigan Technological University*	Transfer Learning for Structural Damage Classification: Transfer the Knowledge from Cyber to Physical Systems #17096 | *Burak Duran–University of New Hampshire; Yashar Eftekhar Azam–University of New Hampshire*	Modal Measurements #17197 | *Brandon J. Dilworth–MIT Lincoln Laboratory*	Identifying Localised Nonlinearities: Nonlinear Restoring Force Surface in Piecewise Multi-degree-of-freedom Systems #16645 | *Cristiano Martinelli–University of Strathclyde; Andrea Coraddu–Delft University of Technology; Andrea Cammarano–University of Glasgow*
Comparison of Calibration Techniques for Piezoelectric Force Sensors #16659 | *Michael L. Mains–The Modal Shop; Marco Peres–The Modal Shop; Chad Kallmeyer–The Modal Shop; Mike Dillon–The Modal Shop; Cole Weaver–The Modal Shop; Rick Bono–The Modal Shop*	A Comprehensive Dataset of a Population of Experimental Bridges under Changing Environmental Conditions for PBSHM #16974 | *Valentina Giglioni–University of Perugia; Jack Poole–University of Sheffield; Robin S. Mills–University of Sheffield; Nikolaos Dervilis–University of Sheffield; Ilaria Venanzi–University of Perugia; Filippo Ubertini–University of Perugia; Keith Worden–University of Sheffield*		Enhanced Adaptive Linear Chirplet Transform for Multi-Component Signals with Intersecting Instantaneous Frequencies #16770 | *Cristian F. López–University of Nebraska-Lincoln; Keegan J. Moore–University of Nebraska-Lincoln*
***Experimental Techniques* Editorial/IAB Meeting**—Salon 7			
Considerations for Thermocouple Installation on Metallic Materials #16616 | *Caitlin M. Jenkins–U.S. Air Force Research Laboratory*	Expanding IE Model Applications with Real-World Case Studies of Bridge Structures #16741 | *Connor Kent–Queen's University Belfast; Daniel S. Brennan–The University of Sheffield; Zou Zhu–University of Exeter; David Hester–Queen's University Belfast; Su Taylor–Queen's University Belfast; Roger Woods–Queen's University Belfast; Connor O'Higgins–Queen's University Belfast*		Nonlinear System Identification with Multiple Data Sets for Structures with Bolted Joints #16895 | *Josh Blackham–Brigham Young University; Alexandre Spits–University of Liège; Michael Lengger–Friedrich-Alexander-Universität; Sina Safari–Bournemouth University; Drithi Shetty–Rice University; Christoph Schwingshackl–Imperial College London; Matthew S. Allen–Brigham Young University; Jean-Philippe Noël–KU Leuven; Matthew Brake–Rice University*
Methods and Procedures for Predicting Cable Roll-off in Bridge-Based Sensor Measurements #16965 | *Alan Szary–Precision Filters, Inc.; Thomas Gerber–Precision Filters, Inc.; Douglas Firth–Precision Filters, Inc.*	Preliminary Design and Analysis of a Smart Building Structural Dynamics Sensing System #16848 | *Andrew T. Gothard–Tennessee Technological University; Jacob Hott–Tennessee Technological University; Sam Fisher–Tennessee Technological University; Craig Henderson–Tennessee Technological University; Steven R. Anton–Tennessee Technological University*		Combining Experimental Modal Analysis and Finite Element Modeling with Nonlinear Orthogonal Projections for Nonlinearity Localization #16809 | *Giancarlo Kosova–University of Liège/Siemens Digital Industries Software; Emilio Di Lorenzo–Siemens Digital Industries Software; Bart Peeters–Siemens Digital Industries Software; Gaetan Kerschen–University of Liège*
Jim Lally, The Heart of Experimental Modal Testing #17015 | *Chad M. Walber–Michigan Technological University*		Excitation Considerations (Part 1) #16494 | *Timothy C. Marinone–ATA Engineering*	In-Situ Testing to Characterize the Dynamics of Elastomers #16960 | *Drithi Shetty–Rice University; Lewis Le–Rice University; Matthew Brake–Rice University*
			Automatic Differentiation Applied to Model Updating of Nonlinear Dynamical Systems #16989 | *Christopher Van Damme–ATA Engineering Inc.*
Coffee Break—Ballroom Foyer			

Full detailed event schedule available on the Whova app.

	SALON 8	SALON 9	SALON 10
TRACK	DYNAMIC SUBSTRUCTURES	MODEL VALIDATION & UNCERTAINTY QUANTIFICATION	HIGHLIGHTS
SESSION	15. MODAL AND FREQUENCY BASED SUBSTRUCTURING	16. FUSION OF TEST AND ANALYSIS	17. OPEN-SOURCE SCIENTIFIC COMPUTING IN STRUCTURAL DYNAMICS
CHAIR(S)	**John Seymour**–*University of Massachusetts Lowell;* **Francesco Trainotti**–*Technical University of Munich*	**Ibrahim Sever**–*Rolls-Royce;* **Scott Ouellette**–*Los Alamos National Laboratory*	**Janko Slavič**–*University of Ljubljana;* **Daniel Rohe**–*Sandia National Laboratories*
4:30 p.m.	Guaranteeing Real Positive Modal Frequencies in Experimental Substructure Uncoupling of a Transmission Simulator #16511 | *Randy L. Mayes–Randall L Mayes Consulting*	Propagation of Systematic Sensor Errors into the Frequency Domain - A Matlab Software Framework #16818 | *Manuel Rexer–Technische Universität Darmstadt; Peter F. Pelz–Technische Universität Darmstadt; Maximilian MG Kuhr–Technische Universität Darmstadt*	Modal Testing using the Rattlesnake Vibration Controller #16569 | *Daniel P. Rohe–Sandia National Laboratories*
4:50 p.m.	Configuration-dependent Substructuring to Predict the Set of Critical Frequencies of a 3D Printer's Cartesian Mechanism #16962 | *Gabrio Antonelli–Università degli Studi dell'Aquila; Jacopo Brunetti–Università degli Studi dell'Aquila; Walter D'Ambrogio–Università degli Studi dell'Aquila; Annalisa Fregolent–Università degli Studi di Roma La Sapienza*	Spectral Model Fusion for Input Identification #17076 | *Brecht Geutjens–KU Leuven; Karl Meerbergen–KU Leuven; Frank Naets–KU Leuven*	Simulating Imager-Based Sensor Networks for Structural Dynamics Applications with Open-Source Software #16656 | *Allison M. Davis–Los Alamos National Laboratory; Andre Green–Los Alamos National Laboratory; Moises F. Silva–Los Alamos National Laboratory; Alessandro Cattaneo–Los Alamos National Laboratory; David Mascarenas–Los Alamos National Laboratory*
5:10 p.m.	A Priori Interface Reduction using Polynomials for Structural Dynamic Analysis #16655 | *Jon D. Young–Penn State; Andrew S. Wixom–Penn State; Rebekah D. Saxena–Penn State*	Experimental Methods to Validate a Kalman-Based Aerodynamic Identification Procedure #16714 | *Sebastian Reymert–Norwegian University of Science and Technology; Øyvind W. Petersen–Norwegian University of Science and Technology; Ole A. Øiseth–Norwegian University of Science and Technology; Anders Rønnquist–Norwegian University of Science and Technology*	LDaq: An Open-Source Python Package for Data Acquisition and Signal Generation #16792 | *Tilen Košir–University of Ljubljana; Klemen Zaletelj–University of Ljubljana; Janko Slavič–University of Ljubljana*
5:30 p.m.	Impedance to Modal Substructuring: Experimental Applications #16751 | *John A. Seymour–University of Massachusetts at Lowell; Peter Avitabile–University of Massachusetts at Lowell; Ray Joshua–Honeywell*		pyFBS: A Python Package for Frequency Based Substructuring #16796 | *Miha Kodrič–University of Ljubljana; Domen Ocepek–University of Ljubljana; Miha Pogačar–University of Ljubljana; Francesco Trainotti–Technical University of Munich; Tomaž Bregar–Gorenje d.o.o.; Ahmed El Mahmoudi–Technical University of Munich; Gregor Čepon–University of Ljubljana; Miha Boltežar–University of Ljubljana; Daniel Rixen–Technical University of Munich*
5:50 p.m.	Direct FRF Expansion #16752 | *John A. Seymour–University of Massachusetts at Lowell; Peter Avitabile–University of Massachusetts at Lowell; Ray Joshua–Honeywell*		
6:15-7:00 p.m.	**Meeting of the Int'l Committee on Joint Mechanics**—Salon 7		
6:15-7:00 p.m.	**Student Meet & Greet**—Mezzanine		
7:00-8:30 p.m.	**Welcome Reception**—Exposition		

Full detailed event schedule available on the Whova app.

SALON 11	SALON 12	SALON 13	SALON 14
SENSORS & INSTRUMENTATION	DYNAMICS OF CIVIL STRUCTURES	BASICS OF MODAL ANALYSIS	NONLINEAR STRUCTURES & SYSTEMS
18. **INSTRUMENTATION**	19. **DYNAMICS OF BUILDINGS**	20. **MODAL ANALYSIS FOR THE NEW/YOUNG ENGINEER III**	21. **NONLINEAR SYSTEM IDENTIFICATION II**
Matthew Stefanski–*U.S. Air Force Research Laboratory;* **Chad Walber**–*Michigan Technological University*	**Milad Roohi**–*University of Nebraska-Lincoln;* **Yiwen Dong**–*Stanford University*	**Jon Furlich**–*ATA Engineering*	**Gaetan Kerschen**–*University of Liege;* **Nevzat Özgüven**–*Middle East Technical University*
Implementation of a Monitoring System for Condition Monitoring and Fatigue Life Estimation in CAT 793D Mining Haul Truck #16688 | *Leonardo Blanco–Mincka Engineering; Alejandro Duarte–Mincka Engineering; Fidel Gonzalez–Mincka Engineering; Nicolas Yaya–Mincka Engineering*	Identification of Modal Parameters of Multi-storey Timber Buildings from Ambient Vibration Tests #16592 | *Saule Tulebekova–Norwegian University of Science and Technology; Kjell Arne Malo–Norwegian University of Science and Technology; Anders Rønnquist–Norwegian University of Science and Technology*	Excitation Considerations (Part 2) #17181 | *Timothy C. Marinone–ATA Engineering*	Comparative Study of Energy Dissipation Quantification Techniques using Measurements from Nonlinear Force Appropriation Testing #16519 | *Benjamin R. Pacini–Sandia National Laboratories; Robert J. Kuether–Sandia National Laboratories*
A Vibration Exciter for the MHz Range #17086 | *Michael Mende–SPEKTRA GMBH; Martin Iwanczik–SPEKTRA GMBH*	Operational Modal Analysis of Doria Castle's Tower in Vernazza #16804 | *Carlotta Rossi–Università di Parma; GianMarco Battista–Università di Parma; Daniele Ferretti–Università di Parma; Gianfranco Zucconi–Studio Ing. Zucconi; Marcello Vanali–Università di Parma*	Modal Parameter Estimation #16657 | *Michael L. Mains–The Modal Shop*	Advancing Secondary Resonance Characterization in Nonlinear Systems via Phase-Locked-Loop Testing #16523 | *Tong Zhou–University of Liege; Gaëtan Kerschen–University of Liege*
	Finite Element Modeling and Modal Testing of a Wind Turbine Lattice Tower Component with Interference Pin Connections #16730 | *Weidong Zhu–University of Maryland, Baltimore County; Kyle Glazier–University of Maryland, Baltimore County; Ke Yuan–University of Maryland, Baltimore County; Yongfeng Xu–University of Cincinnati; David T. Will–University of Maryland, Baltimore County*		Extension and Experimental Verification of an Efficient Re-Analysis Method for Modified Nonlinear Structures #16560 | *E. Ceren Ekinci–Middle East Technical University; Taylan Karaağaçlı–The Scientific & Technological Research Council of Turkey; Furkan Kaan Çelik–The Scientific & Technological Research Council of Turkey; M. Bülent Özer–Middle East Technical University; H. Nevzat Özgüven–Middle East Technical University*
	Algorithm Development to Detect Vortex Shedding in Tubular Pole Structures #17011 | *Adam Bryan–FDH Infrastructure Services; Kirk A. Grimmelsman–FDH Infrastructure Services*		Evaluating New Nonlinear System Identification Methods on Curved Beams #16611 | *Thomas Breunung–University of Maryland, College Park; Michael Kwarta–ANSYS Inc.; Matthew S. Allen–Brigham Young University*
	Enhancing Vision-based Structural Displacement Measurement of Civil Structures through Optical Multiplexing #16857 | *Matthew J. Whelan–University of North Carolina at Charlotte; Youngjin Park–University of North Carolina at Charlotte*		Amplitude-dependent Modal Parameters Idenfication on Multiple-Output Structures with Close Natural Frequencies #16635 | *Sheng-Wei Tseng–National Chung Hsing University; Hugh Goyder–Cranfield University; Yum Ji Chan–National Chung Hsing University*

Meeting of the Int'l Committee on Joint Mechanics—Salon 7

Student Meet & Greet—Mezzanine

Welcome Reception—Exposition

Full detailed event schedule available on the Whova app.

		SALON 8	SALON 9	SALON 10
	TRACK	DYNAMIC SUBSTRUCTURES	MODEL VALIDATION & UNCERTAINTY QUANTIFICATION	HIGHLIGHTS
	SESSION	22. ROUND ROBIN TEST BED	23. MODEL FORM UNCERTAINTY INCL. ROUND ROBIN CHALLENGE	24. TECHNOLOGY APPLICATIONS I
	CHAIR(S)	**Dan Roettgen**–*Sandia National Laboratories;* **Andreas Linderholt**–*Linnaeus University*	**Roland Platz**–*Deggendorf Institute of Technology;* **Alana Lund**–*University of Waterloo*	**Chad Walber**–*Michigan Technological University;* **Matthew Stefanski**–*U.S. Air Force Research Laboratory*
9:00 a.m.		Validated Finite Element Models Representing Components Building up the Technical Division's Substructuring Benchmark Structure. #16579 | *Andreas K. Linderholt–Linnaeus University*	Tutorial and Application of Bayesian Statistics on Assessing Model Form Uncertainty in Vibration Isolation #16938 | *Roland Platz–Deggendorf Institute of Technology*	FFT with DIC: Improvements in Data Processing and Vibration Visualization #16617 | *Bluejay Robinson–Correlated Solutions, Inc.; Alistair Tofts–Correlated Solutions, Inc.*
9:20 a.m.		Effect of Different Junctions on Dynamic Substructuring Results using the Transmission Simulator Procedure #16883 | *Jacopo Brunetti–Università degli Studi dell'Aquila; Walter D'Ambrogio–Università degli Studi dell'Aquila; Annalisa Fregolent–Università degli Studi di Roma La Sapienza*	Stochastic Model Correction for the Adaptive Vibration Isolation Round-Robin Challenge #16881 | *Rileigh J. Bandy–University of Colorado Boulder; Teresa N. Portone–Sandia National Labratories; Rebecca E. Morrison–University of Colorado*	Advancements in the Data Acquisition Field with Multi Measurement Strategies #16736 | *Kalyan Vitta–Data Physics Corp.*
9:30-11:00 a.m.		**Meeting of the Applications, Education, Research Committees**—Salon 7		
9:40 a.m.		A Preliminary Quantification of Uncertainties in Dynamic Substructuring and the Frame-Wing Problem #16998 | *Teresa N. Portone–Sandia National Laboratories; Daniel R. Roettgen–Sandia National Laboratories; Kyle D. Neal–Sandia National Laboratories; Bert J. Debusschere–Sandia National Laboratories*	Analyzing the Influential Factors on ICaF Performance in Bayesian Model Calibration and Forecasting #16925 | *Xinyue Xu–The Pennsylvania State University; Yishuang Wang–The Pennsylvania State University; Roland Platz–Deggendorf Institute of Technology; Sez Atamturktur–Clemson University*	Enhancing Experimental Modal Analysis Workflow: Supporting Occasional and Expert Users #16700 | *Denis Beljan–Head Acoustics GmbH; Tim Kamper–Head Acoustics GmbH; Matthias Wegerhoff–Head acoustics GmbH; Haiko Bruecher–Head acoustics GmbH*
10:00 a.m.	EXPOSITION OPEN	Comparing Frequency-based and Modal-based Substructuring on the Dynamic Substructuring Round Robin Benchmark #16780 | *Francesco Trainotti–Technical University of Munich; Ji Qi–Technical University of Munich; Daniel J. Rixen–Technical University of Munich*	Bayesian Decision-theoretic Model Selection for Monitored Systems #17047 | *Antonios Kamariotis–ETH Zürich; Eleni Chatzi–ETH Zürich*	Sensing Technology and Electrical Interface Selection for Areas with High EMI/RFI Intensity #17266 | *Kevin Westhora–Dytran Instruments; Denis Varak–Dytran Instruments; Brian Johnson–Dytran Instruments*
10:20 a.m.	EXPOSITION OPEN	Hybrid Modelling of the Round-Robin Test bed using Virtual Points, EMA, SEMM and PRANK #17128 | *Maarten V. van der Seijs–VIBES.technology; Steven WB Klaassen–VIBES.technology*	Model Class and Parameter Selection for Bayesian Filtering with Application to a Modular Active Spring-Damper System: Round-Robin Challenge #17098 | *Aleem Ullah–University of Nebraska–Lincoln; Milad Roohi–University of Nebraska–Lincoln*	Flexible And Cost-Effective Measurements With Python, MATLAB, GNU Octave, And ChatGPT-Powered Coding Using USB Digital Sensors #17484 | *Michael L. Mains–The Modal Shop, Inc.; Marco A. Peres–The Modal Shop, Inc.; Chad G. Kallmeyer–The Modal Shop, Inc.*
10:40 a.m.	EXPOSITION OPEN			Feasibility of using GPS to synchronize Data Acquisition Systems (DAQ) for Acoustic and Vibration measurements. #18074 | *Robert Eaton–MECALC Technologies*
11:00-11:30 a.m.	EXPOSITION OPEN	**Coffee Break**—Exposition		
11:30-12:30 p.m.	EXPOSITION OPEN	**SAGE Publishing Young Engineer Lecture:** **Daniel Rohe—Sandia National Laboratories**—Ballroom CD		
12:30-2:00 p.m.	EXPOSITION OPEN	**TD Meetings**—All Attendees Welcome! (see page 19 for details)		

Full detailed event schedule available on the Whova app.

SALON 11	SALON 12	SALON 13	SALON 14
AEROSPACE	DYNAMICS OF CIVIL STRUCTURES	MODAL ANALYSIS & STRUCTURAL DYNAMICS	NONLINEAR STRUCTURES & SYSTEMS
25. **AEROSPACE II**	26. **DYNAMICS OF BRIDGES AND RAIL**	27. **TESTING TECHNIQUES**	28. **DATA-DRIVEN METHODS**
William Semke–*University of North Dakota;* **James Akers**–*NASA Glenn Research Center*	**Bjorn Svendsen**–*NTNU;* **Anika Sarkar**–*University of Tennessee*	**Jon Furlich**–*ATA Engineering;* **Kaitlin Spak**–*Exponent*	**Alex Elliott**–*Cranfield University;* **Andrea Cammarano**–*University of Glasgow*
Green Run Modal Test of the NASA Space Launch System Core Stage #16863 | *Eric C. Stasiunas–NASA Marshall Space Flight Center; Russel A. Parks–NASA Marshall Space Flight Center; Brendan D. Sontag–NASA Marshall Space Flight Center; Dana E. Chandler–NASA Marshall Space Flight Center*	Vibration Testing of an All-Steel Modular Floor Assembly #16859 | *Onur Avci–West Virginia University; Sahabeddin Rifai–West Virginia University; Feras Abla–West Virginia University; Benjamin Opie–West Virginia University; Matthew Eatherton–Virginia Polytechnic Institute and State University; Benjamin Schafer–Johns Hopkins University; W. Samuel Easterling–Iowa State University; Jerome Hajjar–Northeastern University; Joshua Mouras–Magnusson Klemencic Associates; Ron Klemencic–Magnusson Klemencic Associates*	Nonlinear Dynamics Introduced by Modal Shakers #16528 | *Dana D. Figueroa–Sandia National Laboratories; Benjamin R. Pacini–Sandia National Laboratories*	A Tutorial on Data-Driven Methods in Nonlinear Dynamics #17003 | *Keith Worden–University of Sheffield; Elizabeth J. Cross–University of Sheffield*
Dynamic Topology Optimization of Rigid-Flex PCB Robotic Systems #16652 | *Ryan Semler–Clemson University; Daniel Carlson–Clemson University; John Crowder–Clemson University; Laura Redmond–Clemson University*	Showcasing a Framework for Modal Analysis, Mode Tracking, and Novelty Detection on a Suspension Bridge #16819 | *Anno C. Dederichs–Norwegian University of Science and Technology NTNU; Gabriel A. Del Pozo–Norwegian University of Science and Technology NTNU; Ole Øiseth–Norwegian University of Science and Technology NTNU*	Novel Technique for Reducing Shaker-Structure Interactions In Modal Analysis #16697 | *Steven Vreys–KU Leuven; Jean-Philippe Noël–KU Leuven*	
Meeting of the Applications, Education, Research Committees—Salon 7			
X-57 Cruise Motor GVT using Fixed-Base Correction Technique #16676 | *Keerti K. Bhamidipati–NASA Armstrong Flight Research Center; Natalie D. Spivey–NASA Armstrong Flight Research Center; Scott L. Stebbins–NASA Armstrong Flight Research Center; Samson S. Truong–NASA Armstrong Flight Research Center; Benjamin C. Park–NASA Armstrong Flight Research Center*	Dynamics of End-Diaphragm Systems for Prestressed Concrete Bridges in Seismic Regions #17108 | *Esteban Villalobos Vega–University of Oklahoma; Philip S. Harvey, Jr.–University of Oklahoma; Royce W. Floyd–University of Oklahoma*	Modal Testing of Large Wind Turbine Blades #16720 | *Emilio Di Lorenzo–Siemens Industry Software; Davide Mastrodicasa–Siemens Industry Software; Esben Orlowitz–Siemens Gamesa Renewable Energy; Bart Peeters–Siemens Industry Software*	
Control of Liquid Fuel Sloshing using Low Order Mechanical Modeling #16473 | *Jiwoong Kim–Sunchon National University; Morgan Choi–University of Science and Technology; Huinam Rhee–Sunchon National University*	Development of TVF-ARX Model for Separation of Crack Opening Dependent Stiffness Reduction and Vehicle Bridge Interaction Effect #17060 | *Naohiro Ida–Osaka University; Kodai Matsuoka–Railway Technical Research Institute; Kiyoyuki Kaito–Osaka University*	Method Development for Experimental Characterization of Dynamic Strength of Aluminum Structures #17061 | *Natalie Schaal–California State University, Northridge (CSUN); Peter L. Bishay–California State University, Northridge (CSUN); Erik Serrano–California State University, Northridge (CSUN); J. Brent Knight–NASA Marshall Space Flight Center*	Data-Driven Model Reduction of Jointed Assemblies using Spectral Submanifolds #16708 | *Ahmed Morsy–ETH Zürich; Zhenwei Xu–ETH Zürich; Paolo Tiso–ETH Zürich; George Haller–ETH Zürich*
Analysis for Equipment Offset Center of Gravity Relative to Vibration Isolation Plane using Energy Methods #16844 | *Joseph W. Shaffer–Quartus Engineering Incorporated*	Parametric Resonance of a Five Kilometres Long End-supported Pontoon Bridge #16778 | *Knut Andreas Kvåle–Norwegian University of Science and Technology, NTNU; Aksel Fenerci–Norwegian University of Science and Technology, NTNU; Ole Øiseth–Norwegian University of Science and Technology, NTNU*	Comparison of FRF Estimates Obtained Using Various SIMO and MIMO Pneumatic Excitation Configurations #17066 | *Akhil Sharma–University of Cincinnati; Pranjal Vinze–University of Cincinnati; Randall J. Allemang–University of Cincinnati; Allyn W. Phillips–University of Cincinnati; Aimee Frame–University of Cincinnati*	Modeling Nonlinear Beam Vibrations - A Comparison Between Classical and Data-Driven Approaches #16764 | *Sebastian Tatzko–Leibniz University Hannover; Thomas Breunung–University of Maryland; Hannes Wöhler–Leibniz University Hannover; Alwin Förster–Leibniz University Hannover; Gleb Kleyman–Leibniz University Hannover*
Frequency Domain Analysis of Aeroelastic Flutter Problem of Planar Structures Using Generalized Differential Quadrature Method #16871 | *Doğuhan N. Kılıçarslan–Middle East Technical University; Gunes Kosterit–Middle East Technical University; Ender Cigeroglu–Middle East Technical University*		Design and Analysis of Resonant Bar Fixtures for Multi-Axis Shock Response Testing #16563 | *Adam Bouma–Sandia National Laboratories; Tyler Schoenherr–Sandia National Laboratories; David Soine–Sandia National Laboratories*	Effect of Loss Functions on the Learning Capabilities of Physics-Informed Neural Networks in Mechanical Systems #17025 | *Cristiano Martinelli–University of Strathclyde; Alexander Elliott–Cranfield University; Andrea Cammarano–University of Glasgow*

Coffee Break—Ballroom Foyer

SAGE Publishing Young Engineer Lecture:
Daniel Rohe—Sandia National Laboratories—Ballroom CD

TD Meetings—All Attendees Welcome! (see page 19 for details)

Full detailed event schedule available on the Whova app.

		SALON 8	SALON 9	SALON 10
	TRACK	DYNAMIC SUBSTRUCTURES	MODEL VALIDATION & UNCERTAINTY QUANTIFICATION	HIGHLIGHTS
	SESSION	29. TRANSFER PATH ANALYSIS AND FORCE ESTIMATION	30. RECURSIVE BAYESIAN SYSTEM IDENTIFICATION	31. TECHNOLOGY APPLICATIONS II
	CHAIR(S)	**Maarten van der Seijs**–*VIBES technology;* **Steven Carter**–*Sandia National Laboratories*	**Yashar Eftekhar Azam**–*University of New Hampshire;* **Eleni Chatzi**–*ETH Zurich*	**Matthew Stefanski**–*U.S. Air Force Research Laboratory;* **Chad Walber**–*Michigan Technological University*
2:00 p.m.	EXPOSITION OPEN	A Characterization of the Uncertainty in Force-Control Testing for Aerospace Applications #16985 | *Katie E. Hart–Rice University; Edwina P. Lewis–Clemson University; Shanell J. Sinclair–Montana State University; Garrison S. Flynn–Los Alamos National Laboratory; Keegan J. Moore–University of Nebraska–Lincoln; Colin M. Haynes–Los Alamos National Laboratory*	Physics-informed Information Field Theory Approach to Dynamical System Parameter and State Estimation in Path Space #17028 | *Kairui Hao–Purdue Univeristy; Ilias Bilionis–Purdue University*	ARTeMIS Modal – It is Not Just Operational Modal Analysis Anymore #17186 | *Palle Andersen–Structural Vibration Solutions A/S*
2:20 p.m.		Thoughts on Using Sparse Inverse Solutions in Transfer Path Analysis #16447 | *Steven Carter–Sandia National Laboratories*	Experimental Validation of Alternative Gaussian Process Kernels for Input-State Estimation via Latent Force Models #16839 | *Silvia Vettori–Siemens Digital Industries Software/ETH Zurich; Emilio Di Lorenzo–Siemens Digital Industries Software; Bart Peeters–Siemens Digital Industries Software; Eleni Chatzi–ETH Zurich*	Virtual Modal Testing #17189 | *Eddy Dascotte–Dynamic Design Solutions (DDS); Hugo Faustino–Dynamic Design Solutions (DDS)*
2:40 p.m.		Different displacement reduction spaces for the use in admittance-based TPA methods #16636 | *Domen Ocepek–University of Ljubljana; Francesco Trainotti–Technical University of Munich; Gregor Čepon–University of Ljubljana; Miha Boltežar–University of Ljubljana; Daniel J. Rixen–Technical University of Munich*	Identification of Railway Bridge Modal Properties via Acceleration Data from Traversing Trains #16945 | *Charikleia Stoura–ETH Zürich; Vasilis Dertimanis–ETH Zürich; Eleni Chatzi–ETH Zürich*	Modal Analysis in Minutes: Camera-based Modal Analysis with Motion Amplification #17259 | *Jeff Hay–RDI Technologies*
3:00 p.m.		Exploiting the Capabilities of a Parametric Reduced Order Model for Full-Assembly Design Optimization in a Component-Based TPA Framework #16807 | *Fabio Bianciardi–Siemens Industry Software NV; Nicolò Salamone–Siemens Industry Software NV/KU Leuven; Daniel De Gregoriis–Siemens Industry Software NV; Sjoerd van Ophem–KU Leuven/Flanders Make; Patrick Corbeels–Siemens Industry Software NV; Karl Janssens–Siemens Industry Software NV*	Non-Linear Extension for an Output-only Bayesian State Estimator for Partially Observed Structural Systems #17088 | *Martin Masanes Didyk–University of New Hampshire; Mohsen Ebrahimzadeh Hassanabadi–University of Sydney; Yashar Eftekhar Azam–University of New Hampshire*	Modal Test Advancements and Implementation #16565 | *Timothy C. Marinone–ATA Engineering*
3:20 p.m.		Inverse Source Estimation Tools in SDynPy, an Open-Source Python Package #16446 | *Steven Carter–Sandia National Laboratories; Daniel Rohe–Sandia National Laboratories*	Implementation of Bayesian Model Updating in Five-Story Building using Different Observations #17121 | *Oscar D. Hurtado–Universidad del Valle; Albert R. Ortiz–Universidad del Valle; Daniel Gomez–Universidad del Valle; Rodrigo Astroza–Universidad de los Andes*	Non-Mass Loaded Excitation Technique #18059 | *Peter G. Blaschke–NV-Tech-Design GmbH*
3:40-4:40 p.m.		**Dessert Break**—Exposition		

Full detailed event schedule available on the Whova app.

SALON 11	SALON 12	SALON 13	SALON 14
COMPUTER VISION FOR STRUCTURAL DYNAMICS	DYNAMICS OF CIVIL STRUCTURES	MODAL ANALYSIS & STRUCTURAL DYNAMICS	NONLINEAR STRUCTURES & SYSTEMS
32. HIGH-SPEED CAMERA BASED EMA I	33. HUMAN STRUCTURE INTERACTION	34. MODAL PARAMETER ESTIMATION	35. JOINTS - UQ APPROACHES
Janko Slavič–*University of Ljubljana;* **Alessandro Cattaneo**–*Los Alamos National Laboratory*	**Hae Young Noh**–*Stanford University;* **Fernando Moreu**–*University of New Mexico*	**Kevin Napolitano**–*ATA Engineering;* **William Fladung**–*ATA Engineering*	**Matthew Brake**–*Rice University*
Computationally Efficient Camera-Based EMA with High SNR and High Frequency Range #16870 | *Yonggang Wang–Flanders Make@KU Leuven; Thijs Willems–Flanders Make@KU Leuven; Frank Naets–Flanders Make@KU Leuven; Matteo Kirchner–Flanders Make@KU Leuven*	Graphical Modeling of the Lower-Limb Joint Motion from the Dynamic Floor Responses under Footstep Forces #16682 | *Yiwen Dong–Stanford University; Jingxiao Liu–Stanford University; Sung Eun Kim–Lucile Packard Children's Hospital; Kornél Schadl–Lucile Packard Children's Hospital; Jessica Rose–Lucile Packard Children's Hospital; Hae Young Noh–Stanford University*	Calculation of Mass-Normalized Modes for Frequency Response Functions Using Acceleration Degrees of Freedom as References #16386 | *Kevin L. Napolitano–ATA Engineering, Inc.; Peter A. Kerrian–ATA Engineering*	The Impact of Non-unique Residual Tractions on the Nonlinear Dynamics of Jointed Structures: Probabilistic Perspectives #16556 | *Nidish N. Balaji–University of Stuttgart; Erhan Ferhatoglu–University of Stuttgart*
High-frequency Response DIC Measurements with Low-Speed Cameras and Periodic Sine Sweep #16701 | *Daniele Botto–Politecnico di Torino; Serena Occhipinti–Politecnico di Torino; Christian M. Firrone–Politecnico di Torino; Alessandro Bruno–Politecnico di Torino; Paolo Neri–University of Pisa*	Influence of the Ground Reaction Force Prediction on the Human Structure Interaction Phenomenon: An Application of a Bipedal Model #16854 | *Rafaela L. Silva–Federal University of Paraíba; Roberto L. Pimentel–Federal University of Paraíba; Aleksandar Pavic–University of Exeter; Pawel Hawryszków–Wroclaw University of Science and Technology*	Efficient Local Reduced Order Model for Thermoelastic Structural Vibrations #16725 | *Alexander Saccani–ETH Zürich; Paolo Tiso–ETH Zürich*	Effects of Non-unique Residual Traction on the Non-repeatability of the Dynamics of Jointed Structures #16576 | *Arati Bhattu–Rice University; Yi-Chun Lo–National Chung Hsing University; Gianmarco Zara–Politecnico di Torino; Patrick Hippold–University of Stuttgart; Daniel Fochler–University of Stuttgart; Johann Groß–University of Stuttgart; Matthew Brake–Rice University; Malte Krack–University of Stuttgart; Erhan Ferhatoglu–University of Stuttgart*
3D Mode-Shape Extraction through Event-Based Light Fields #16604 | *Andre W. Green–Los Alamos National Laboratory; Moises F. Mello da Silva–Los Alamos National Laboratory; Alessandro Cattaneo–Los Alamos National Laboratory; David L. Mascarenas–Los Alamos National Laboratory*	Another Brick in the Wall: The Importance of Partitions in Structural Dynamic Modelling #16932 | *Michael J. Wesolowsky–Thornton Tomasetti; Muhammad Rahman–Thornton Tomasetti; Brad A. Pridham–Thorntont Tomasetti; Rabih Alkhatib–Thornton Tomasetti; Ali Siami–Thornton Tomasetti*		Dynamics of Probabilistically-Modelled Jointed Assemblies Considering Manufacturing Tolerances #16835 | *Ahmed Morsy–ETH Zürich; Paolo Tiso–ETH Zürich*
High-Speed Camera Experimental Modal Analysis Based on Pixel Intensities #16554 | *Ivan Tomac–University of Split; Janko Slavič–University of Ljubljana; Domen Gojrup–University of Ljubljana*			Experimental Backbone Curves from Bolted Interfaces with Measured As-Built Surface Topography #16983 | *Connor G. Davis–Sandia National Laboratories; Benjamin J. Moldenhauer–Sandia National Laboratories; Daniel R. Roettgen–Sandia National Laboratories; Benjamin R. Pacini–Sandia National Laboratories; Robert J. Kuether–Sandia National Laboratories; David A. Najera-Flores–ATA Engineering, Inc.*
High-speed IR Camera Based Strain Modal Shapes Identification #16795 | *Klemen Zaletelj–University of Ljubljana; Janko Slavič–University of Ljubljana; Miha Boltežar–University of Ljubljana*			Mathematical Modeling of the Nonlinear Dynamics of Bolted Joint Loosening #16782 | *Felipe Camargo de Oliveira Kobayashi–University of Nebraska-Lincoln; Aryan Singh–University of Nebraska-Lincoln; Keegan J. Moore–University of Nebraska-Lincoln*
Dessert Break—Exposition			

Full detailed event schedule available on the Whova app.

		SALON 8	SALON 9	SALON 10
	TRACK	DYNAMIC ENVIRONMENTS TESTING	MODEL VALIDATION & UNCERTAINTY QUANTIFICATION	DYNAMIC SUBSTRUCTURES
	SESSION	36. ENVIRONMENTS DEFINITION	37. VIRTUAL SENSING & REALTIME MONITORING	38. INTERFACE DYNAMICS
	CHAIR(S)	**Pablo Tarazaga**–*Texas A&M University*	**Scott Cogan**–*CNRS*	**Matthew Allen**–*Brigham Young University;* **Marcus Behling**–*Brigham Young University*
4:40 p.m.	EXPO OPEN	Practical Virtual Sensor Deployment for Indirect Torque Estimation in a Range Rover Drivetrain #16467 | *Luis M. Zapata–KU Leuven; Théo Tuerlinckx–Flanders Make; Yves Perremans–Flanders Make; Frank Naets–KU Leuven*	Time-Normalized Unitless Metrics for Quantifying the Value of an SHM System Throughout the Structure's Lifecycle #16609 | *Mayank Chadha–University of California San Diego; Zhen Hu–University of Michigan-Dearborn; Michael D. Todd–University of California San Diego*	Prediction of Mount Dynamics Using Inverse Substructuring and Dimensional Analysis #17084 | *Jelle Boelens–VIBES Technology; Steven WB Klaassen–VIBES Technology*
5:00 p.m.		Using Modal Projection Error to Optimize Accelerometer Locations for a Modal Filter #16507 | *Tyler F. Schoenherr–Sandia National Laboratories*	Digital Twinning of the Physical System and Integration with Data for Predicting Strain Measurements for Offshore Wind Turbines #16997 | *Eleonora Maria Tronci–Northeastern University; Babak Moaveni–Tufts University; Anna Haensch–Tufts University; Eric Hines–Tufts University*	Investigation of Isolated Branches in Nonlinear Oscillators Using Real-Time Hybrid Testing #16831 | *A. Mario Puhwein–c; Markus J. Hochrainer–University of Applied Sciences*
5:20 p.m.		Test Techniques for Floor Vibration Criteria with a Portable Test Platform #16898 | *Jon E. Furlich–ATA Engineering Inc.; Tim C. Marinone–ATA Engineering Inc.*	Wind Load Estimation of an Operational 6 MW Offshore Wind Turbine: Uncertainty Evaluation of Purely Physics-based vs. Physics Informed Neural Network #17095 | *Azin Mehrjoo–Tufts University; Eleonora M. Tronci–Tufts University/ Northeastern University; Babak Moaveni–Tufts University; Eric M. Hines–Tufts University*	
5:40 p.m.		Comparative Analysis of Dynamic Response Expansion Using SEREP and Pseudo-Force Estimation #16966 | *Brandon R. Zwink–Sandia National Laboratories; Glen T. Throneberry–Sandia National Laboratories; Ryan A. Schultz–Sandia National Laboratories*	An Elephant in the Room: Forecasting Using Validated Physics-based Simulations #17107 | *Rafael Teloli–Universit´e de Franche-Comté; Scott Cogan–Universit´e de Franche-Comté; François Hemez–Lawrence Livermore National Laboratory*	
6:00 p.m.		Using Modal Analysis and ODS Correction to Identify Mechanical Faults in Rotating Machinery #16425 | *Mark H. Richardson–Vibrant Technology, Inc.; Brian H. Schawarz–Vibrant Technology, Inc.; Shawn C. Richardson–Vibrant Technology, Inc.; Patrick H. McHargue–Vibrant Technology, Inc.*	Uncertainty Quantification for Deep Learning-Based Automatic Crack Detection in the Underwater Environment #16601 | *Zihan Wu–University of California San Diego; Zhen Hu–University of Michigan Dearborn; Michael Todd–University of California San Diego*	
6:20 p.m.			Informing Design of Nuclear Deterrence Systems with Surrogate Model Sobol' Sensitivity Analysis #17050 | *Shane J. McMurray–Sandia National Labs; Jake Gonzales–Sandia National Labs; Sofie Schunk–Sandia National Labs; Jonathan Smith–Sandia National Labs*	
7:30-10:00 p.m.		**Women in Dynamics Board Game Night**—Ballroom CD		

Full detailed event schedule available on the Whova app.

SALON 11	SALON 12	SALON 13	SALON 14
COMPUTER VISION FOR STRUCTURAL DYNAMICS	DYNAMICS OF CIVIL STRUCTURES	MODAL ANALYSIS & STRUCTURAL DYNAMICS	NONLINEAR STRUCTURES & SYSTEMS
39. **HIGH-SPEED CAMERA BASED EMA II**	40. **STRUCTURAL VIBRATION MITIGATION AND CONTROL**	41. **VIBRATION REDUCTION**	42. **JOINTS I**
Daniel Rohe–*Sandia National Laboratories;* **Alessandro Sabato**–*University of Massachusetts Lowell*	**Scott Harvey**–*University of Oklahoma;* **Nicholas Wierschem**–*University of Tennessee*	**Michael Mains**–*The Modal Shop;* **Brandon Dilworth**–*MIT Lincoln Laboratory*	**Christoph Schwingshackl**–*Imperial College London*
Pattern-less Stereophotogrammetry for Structural Dynamic Measurements #16518 | *Fabio Bottalico–University of Massachusetts Lowell; Alessandro Sabato–University of Massachusetts Lowell*	**Cable-Based Adaptive Restoring Force Device for Horizontal Seismic Isolation of Acceleration-Sensitive Equipment #16977** | *Kenneth K. Walsh–Ohio University; Claudia Marin-Artieda–Howard University*	**Design and Evaluation of Beams with Periodic Material Removal for Vibration Reduction #16743** | *Vania Gonzales–Universidad de Chile; Viviana Meruane–Universidad de Chile; Olivier Robin–Universidad de Sherbrooke*	**Hysteretic Manifold-Based Harmonic Balance for Efficient Frequency Domain Calculation of Hysteretic Systems #16550** | *Rafael Teloli–University of Bourgogne Franche-Comté; Ahmed Morsy–ETH Zurich; Valeria Pinto–Politecnico di Torino; Justin Porter–Rice University; Johann Gross–University of Stuttgart; Malte Krack–University of Stuttgart; Matthew RW Brake–Rice University*
A Six-Degree-of-Freedom Camera Motion Correction Method Based on Inertial Measurement Unit and Data Fusion #16586 | *Tengjiao Jiang–Norwegian University of Science and Technology; Gunnstein T. Frøseth–Norwegian University of Science and Technology; Anders Rønnquist–Norwegian University of Science and Technology*	**Investigation of the Impact of Slider Mass Stiffness on the Behavior of the Variable Inertia Rotational Mechanism for Structural Vibration Mitigation #16866** | *Anika Sarkar–University of Tennessee; Nicholas Wierschem–University of Tennessee*	**On the Application of Vibration Absorbers Based on Acoustic Black Holes to the Handlebar of a Low-cost Motorcycle #17117** | *Jorge I. Valdes-Ceron–Centro de Investigacion y de Estudios Avanzados del I.P.N.; Gerardo Silva-Navarro–Centro de Investigacion y de Estudios Avanzados del I.P.N.*	**Tracking Superharmonic and Internal Resonances in Frictional Systems #16396** | *Justin H. Porter–Rice University; Matthew RW Brake–Rice University*
Analyzing Spider-web Structural Dynamics: An Enhanced High-Speed Camera-Based EMA Approach #16644 | *Thijs CP Masmeijer–University of Washington; Klemen Zaletelj–University of Ljubljana; Janko Slavič–University of Ljubljana; Ed Habtour–University of Washington*	**Nonlinear Behavior of a Rolling Pendulum Isolation System Subject to 3D Excitations #17032** | *Esteban Villalobos Vega–University of Oklahoma; Philip S. Harvey–University of Oklahoma; Erika N. Vanderheiden–University of Oklahoma*	**Non-resonant Targeted Energy Transfer Local with Vibro-Impact Nonlinearity #16928** | *Joshua R. Tempelman–University of Illinois at Urbana Champaign; Alexander F. Vakakis–University of Illinois at Urbana Champaign; Kathryn H. Matlack–University of Illinois at Urbana Champaign*	**Tribo-Dynamics Digital Twins (TDDT): Prediction of Friction and Frequency Response Function (FRF) in a Dry Sliding Tribological Contact #16694** | *Saeid Taghizadeh–The University of Sheffield; Matthew S. Bonney–Swansea University; David Wagg–The University of Sheffield*
Smartphone-based Digital Image Correlation for vibrating structures. #16890 | *Serena Occhipinti–Politecnico di Torino; Tristan Chevreau–Ecole Centrale de Lyon; Paolo Neri–Università di Pisa; Christian M. Firrone–Politecnico di Torino; Daniele Botto–Politecnico di Torino*	**Semi-active Control of a Banded Rotary Friction Device #17080** | *Parker Huggins–University of South Carolina; Liang Cao–Lehigh University; Austin Downey–University of South Carolina; James Ricles–Lehigh University; Simon Laflamme–Iowa State University*	**Experimental Demonstration of Superimposed Orthogonal Two-Dimensional Structure-borne Traveling Waves #17106** | *William C. Rogers–Texas A&M University; Amirhossein Omidi Soroor–Texas A&M University; Trevor C. Turner–Texas A&M University; Mohammad I. Albakri–Texas A&M University; Pablo A. Tarazaga–Texas A&M University*	**Validation of Nonlinear Reduced Order Models with As-Built Surface Geometry in Bolted Joints #16646** | *Robert J. Kuether–Sandia National Laboratories; David A. Najera-Flores–ATA Engineering, Inc.; Benjamin Moldenhauer–Sandia National Laboratories; Benjamin R. Pacini–Sandia National Laboratories; Daniel R. Roettgen–Sandia National Laboratories*
Innovative Tools for Experimental Modal Analysis of Brake Discs #16768 | *Jacob F. Krause–Society for the Advancement of Applied Computer Science; Daniel Herfert–Society for the Advancement of Applied Computer Science; Maik Gollnick–Society for the Advancement of Applied Computer Science; Kai Henning–Society for the Advancement of Applied Computer Science*	**Structural Vibration Control Performance of Semi-Active Cam-Lever Friction Devices Under Multiple Friction Surfaces #17120** | *Alejandro Palacio-Betancur–The Pennsylvania State University; Daivik Manickmalar–The Pennsylvania State University; Rayyan RS Alwaneen–The Pennsylvania State University; Mariantonieta Gutierrez Soto–The Pennsylvania State University*		**Modeling Bolted Joints in the S4 Beam at Various Preloads with Discrete Iwan Elements #16535** | *Suzanna Gilbert–Brigham Young University; Carson Wynn–Brigham Young University; Cameron Stoker–Brigham Young University; Samuel Clawson–Brigham Young University; Matthew S. Allen–Brigham Young University*
			A Non-Parametric Iwan Model Derived from Measurements of Amplitude-dependent Frequency and Damping #16971 | *Drithi Shetty–Rice University; Samuel Clawson–Brigham Young University; Matthew Allen–Brigham Young University*

Women in Dynamics Board Game Night—Ballroom CD

Full detailed event schedule available on the Whova app.

		SALON 8	SALON 9	SALON 10
	TRACK	DYNAMIC ENVIRONMENTS TESTING	MODEL VALIDATION & UNCERTAINTY QUANTIFICATION	SYSTEM IDENTIFICATION
	SESSION	43. FIXTURE DESIGN I	44. SURROGATE MODELING AND REDUCED ORDER MODELS	45. SYSTEM IDENTIFICATION AND STRUCTURAL HEALTH MONITORING
	CHAIR(S)	**Cora Taylor**–*Michigan Technological University;* **Tyler Schoenherr**–*Sandia National Laboratories*	**Zhen Hu**–*University of Michigan-Dearborn;* **Kyle Neal**–*Sandia National Laboratories*	**Zhu Mao**–*Worcester Polytechnic Institute;* **Robert Coppolino**–*Measurement Analysis Corporation*
9:00-10:30 a.m.		**Program Planning Committee Meeting**—Salon 7		
9:00 a.m.		Mode Switching and Nonlinear Characteristics of BARC Systems due to Scalability #16670 | *Ezekiel Granillo–New Mexico State University; Jonah Madrid–New Mexico State University; Christopher L. Padilla–New Mexico State University; Jorge L. Perez–New Mexico State University; Abdessattar Abdelkefi–New Mexico State University*	Keynote: Uncertainty Quantification in Machine Learning for Prognostics and Health Management: Challenges and Opportunities #17151 | *Chao Hu–University of Connecticut*	Population-based Mode Shape Identification of Structures via Graph Neural Networks #17043 | *Xudong Jian–ETH Zurich/Singapore-ETH Centre; Gregory Duthé–ETH Zurich; Eleni Chatzi–ETH Zurich*
9:20 a.m.		Evaluation of the Characteristics of BARC Systems under Single and Multi-Axis Excitations #16679 | *Ezekiel Granillo–New Mexico State University; Sevren Jackson–New Mexico State University; Jonah Madrid–New Mexico State University; Jorge Perez–New Mexico State University; Abdessattar Abdelkefi–New Mexico State University*		A Practitioner's Guide to Local FRF Estimation #16939 | *Keaton Coletti–University of Georgia; Ryan Schultz–Sandia National Laboratories; Steven Carter–Sandia National Laboratories*
9:40 a.m.		Dynamics and Nonlinear Characterization of BARC Systems with Varying Central cut Widths #16740 | *Christopher L. Padilla–New Mexico State University; Antonio Flores–New Mexico State University; Kyle W. Girven–New Mexico State University; Ezekiel Granillo–New Mexico State University; Jonah Madrid–New Mexico State University; Abdessattar Abdelkefi–New Mexico State University*	Surrogate Modeling of Dynamic Systems with Material Nonlinearity #16888 | *Manuel A. Vega–Los Alamos National Laboratory; Joshua W. Dyer–Los Alamos National Laboratory; Joseph ED Hess–Los Alamos National Laboratory; Zhen Hu–University of Michigan-Dearborn*	Data-Driven State-Space Identification of the Nonlinear Vibrations of an F-16 Aircraft Structure #16544 | *Merijn Floren–KU Leuven; Jan Swevers–KU Leuven; Jean-Philippe Noël–KU Leuven*
10:00 a.m.	EXPOSITION OPEN	Best Practices for Modeling Bolted Joints: Calibrating the BARC System #17056 | *Tyler Alvis–Sandia National Laboratories; Tyler Schoenherr–Sandia National Laboratories*	Multiscale Corrosion Damage Diagnostics and Prognostics for a Miter Gate #16495 | *Guofeng Qian–University of California San Diego; Zihan Wu–University of California San Diego; Zhen Hu–University of Michigan Dearborn; Michael Todd–University of California San Diego*	Comparison of Data-Driven Methods on Discovering the Dynamics of the Unforced Multi-Axis Cart System #16567 | *Hunter R. Kramer–Duke University; Sam A. Moore–Duke University; Brian P. Mann–Duke University*
10:20 a.m.		A Genetic Algorithm-Based Approach for Designing a Fixture that Preserves the Desired Dynamics of a Connecting Part #16775 | *Janette J. Meyer–Vanderbilt University; Ray Joshua–Honeywell, Kansas City National Security Campus; Pranav M. Karve–Vanderbilt University; Sankaran Mahadevan–Vanderbilt University; Douglas E. Adams–Vanderbilt University*	Dynamic State Estimation via Likelihood-Free Bayesian Inference Based on Conditional Invertible Neural Networks #16571 | *Jice Zeng–University of Michigan-Dearborn; Michael D. Todd–University of California, San Diego; Zhen Hu–University of Michigan-Dearborn*	A PCA/Natural Frequencies Based Approach for Damage Detection: Implementation on a Laboratory Structure Subjected to Environmental Variability #16802 | *Stefano Pavoni–Università di Parma; Marta Berardengo–Università di Genova; Stefano Manzoni–Politecnico di Milano; Francescantonio Lucà–Politecnico di Milano; Marcello Vanali–Università di Parma*
10:40-11:30 a.m.		**Coffee Break**—Exposition		

Full detailed event schedule available on the Whova app.

SALON 11	SALON 12	SALON 13	SALON 14
COMPUTER VISION FOR STRUCTURAL DYNAMICS	ROTATING MACHINERY	MODAL ANALYSIS & STRUCTURAL DYNAMICS	NONLINEAR STRUCTURES & SYSTEMS
46. **IN MEMORY OF DAVID EWINS I**	47. **ROTATING MACHINERY I**	48. **DAMAGE DETECTION**	49. **NONLINEAR MODEL REDUCTION I**
Dario Di Maio–*University of Twente;* **Jip van Tiggelen**–*University of Twente*	**Jason Blough**–*Michigan Technological University;* **Brian Damiano**–*Oak Ridge National Laboratory*	**Sourabh Sangle**–*Texas A&M University*	**Paolo Tiso**–*ETH Zürich*
Program Planning Committee Meeting—Salon 7			
Continuous Scanning LDV: A Raison D'être #16527 | *Dario Di Maio–University of Twente*	History of Digital Order Tracking and Applications #17017 | *Jason R. Blough–Michigan Technological University*	Acoustic Resonance Crack Identification in Thermoelectric Bi2Te3 Wafers #16882 | *Lindsay Wright–Rice University; Alexandra Murphy–Florida International University; Ruth Hammond–Florida International University; John Greenhall–Los Alamos National Laboratory; Milo Prisbrey–Los Alamos National Laboratory*	A Tutorial on Nonlinear Model Order Reduction #17126 | *Alessandra Vizzaccaro–University of Exeter*
Scanning a Helicopter Engine Casing with a 3D SLDV #16826 | *Matt de Brett–Imperial College London; Andrew Rix–Rolls-Royce Plc; Vaclav Ondra–Rolls-Royce Plc; Sophoclis Patsias–Rolls-Royce Plc; Christoph Schwingshackl–Imperial College London*		Evaluating Damage-sensitive Features for Stiffness Loss Detection in an Aircraft Component using ML Classifiers #17039 | *Nathan R. Doshi–United States Military Academy; Emmett R. Lepp–United States Military Academy; Christopher J. Sowinski–United States Military Academy; Thomas J. Matarazzo–United States Military Academy; Andrew T. Bellocchio–United States Military Academy; Danny L. Parker–United States Army PEO Aviation*	
Panoramic 3D Operating Deflection Shape Measurement of a Cylindrical Structure using a Mirror-Assisted 3D CSLDV System #16721 | *Ke Yuan–University of Maryland Baltimore County; Weidong Zhu–University of Maryland Baltimore County*		Damage Detection in Diffuse and Non-diffuse Acoustic Field #17069 | *Antonio Culla–University of Rome La Sapienza; Francesco Massi–University of Rome La Sapienza; Silvia Milana–University of Rome La Sapienza; Luigi Severa–University of Rome La Sapienza*	
CAE Guided and SLDV Tested FE Model Correlation and Updating for an ICE Radiator Fan #17063 | *Bhaskar Banerjee–ANSYS Inc.; Osama Jameel–Polytec Inc.; David Damiani–Polytec Inc.; Vikrant Palan–Polytec Inc.*	Impact of Periodic Path Imperfections on Dynamic Response of Centrifugal Pendulum Vibration Absorbers #17044 | *Bahadir Sarikaya–University of Massachusetts Lowell; Murat Inalpolat–University of Massachusetts Lowell*	The Effect of Gravity on the Dynamics of Very Slender Structures #16434 | *Lawrence Virgin–Duke University*	Reduced Order Modeling Research Challenge 2023: Nonlinear Dynamic Response Predictions for an Exhaust Cover Plate #16538 | *Kyusic Park–University of Minnesota; Matthew S. Allen–Brigham Young University; Zhenwei Xu–ETH Zurich; George Haller–ETH Zurich; Alexander Saccani–ETH Zurich; Paolo Tiso–ETH Zurich; Amir K. Bagheri–Imperial College London; Yichang Shen–Imperial College London; Ludovic Renson–Imperial College London; Valentin Sonneville–Technical University of Munich; Alessandra Vizzaccaro–University of Exeter; Loic Salles–University of Liege; Hassan Jalali–Northumbria University; Hamed Farokhi–Northumbria University; Alessio Colombo–Politecnico di Milano; Giorgio Gobat–Politecnico di Milano; Attilio Frangi–Politecnico di Milano; Cyril Touze–Institut Polytechnique de Paris; Max de Bono–University of Bristol; Simon Neild–University of Bristol*
	Rotordynamics Continuum Finite Element Formulations from A Structural and Multibody Dynamics Perspective #16660 | *Francesco Trainotti–Technical University of Munich; Andreas Zwölfer–Technical University of Munich; Justin Westphal–Technical University of Munich; Daniel J. Rixen–Technical University of Munich*		Review of Craig-Bampton Internal Mode Selection Techniques for Nonlinear Multibody Analyses #16417 | *Océane Topenot–University of Franche-Comté; Gaël Chevallier–University of Franche-Comté; Christophe Oulerich–SAFRAN Aircraft Engines; Scott Cogan–University of Franche-Comté*
Coffee Break—Exposition			

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		SALON 8	SALON 9	SALON 10
	TRACK	DYNAMIC ENVIRONMENTS TESTING	DATA SCIENCE IN ENGINEERING	FINITE ELEMENT TECHNIQUES
	SESSION	50. FIXTURE DESIGN II	51. APPLICATIONS OF MACHINE LEARNING	52. FINITE ELEMENT TECHNIQUES
	CHAIR(S)	**Troy Skousen**–*Sandia National Laboratories;* **Alexandra Karlicek**–*MIT Lincoln Laboratory*	**Thomas Matarazzo**–*United States Military Academy;* **Francois Hemez**–*Lawrence Livermore National Laboratory*	**Jacquelyn Moore**–*Sandia National Laboratories;* **Aimee Frame**–*University of Cincinnati*
11:30 a.m.	EXPOSITION OPEN	Investigation of Blending Impedance and Modal Fixture Neutralization Methods #16930 | *Troy J. Skousen–Sandia National Laboratories; John M. Matthews–University of Massachusetts Lowell/Sandia National Laboratories; Peter Avitabile–University of Massachusetts Lowell*	Statistical Evaluation of Machine Learning for Vibration Data #16972 | *Samuel Myren–Virginia Tech/Los Alamos National Laboratory; Garrison Flynn–Los Alamos National Laboratory; Nidhi Parikh–Los Alamos National Laboratory; Emily Casleton–Los Alamos National Laboratory; Dave Higdon–Virginia Tech*	Efficient Frequency-based Modelling of Rotating Tire Dynamics for NVH Applications #16805 | *Domenico Minervini–Siemens Digital Industries Software; Marc Brughmans–Siemens Digital Industries Software; Claudio Myrtaj–Università degli Studi di Firenze; Theo Geluk–Siemens Digital Industries Software*
11:50 a.m.		Determining the Required Input Force Set for Fixture Neutralization #16868 | *John M. Matthews–University of Massachusetts Lowell/Sandia National Laboratories; Troy J. Skousen–Sandia National Laboratories; Peter Avitabile–University of Massachusetts Lowell*	Utilization of Bridge Acceleration Response for Indirect Strain Sensing #16732 | *Soheila Sadeghi Eshkevari–Lehigh University; Debarshi Sen–Southern Illinois University; Soheil Sadeghi Eshkevari–Massachusetts Institute of Technology; Iman Dabbaghchian–Lehigh University; Giulia Marasco–Lehigh University; Shamim Pakzad–Lehigh University*	FEA on Silencers Structural Failure Analysis #16891 | *Paul Liang–Durr Universal, Inc.*
12:10 p.m.		Using a Scanning Laser Doppler Vibrometer to Characterize the Full-Field Response of a Dynamic Environment Test Fixture #16608 | *Cora J. Taylor–Michigan Technological University; Jason R. Blough–Michigan Technological University; James P DeClerck–Michigan Technological University; Chuck D. VanKarsen–Michigan Technological University; Raymond Joshua–Honeywell, Kansas City National Security Campus*	Learning Missing Data in Measurements using Meta Modeling Techniques #16919 | *Javier E. Arroyo–University of Nebraska-Lincoln; Thomas Ramsey–University of Nebraska-Lincoln; Cristian Lopez–University of Nebraska-Lincoln; Keegan J. Moore–University of Nebraska-Lincoln*	Propagation of Geometric Uncertainties Through the Analytic Derivative of the System Matrices #17040 | *Abdelhakim Bouras–University of Genova; Luigi Carassale–Università di Genova*
12:30 p.m.		Dynamic Topology Optimization used to Modify Mode Shapes #16623 | *Charles D. Van Karsen–Michigan Technological University; Cora J. Taylor–Michigan Technological University; Jason R. Blough–Michigan Technological University; James P. De Clerck–Michigan Technological University; Raymond Joshua–Honeywell, Kansas City National Security Campus*	On the use of Symbolic Regression for Population-Based Modelling of Structures #16828 | *George Tsialiamanis–University of Sheffield; Nikolaos Dervilis–University of Sheffield; Keith Worden–University of Sheffield*	Time Domain Finite Element Analysis of Viscoelastic Damped Structures Using Fractional Derivative Constitutive Model #17085 | *Jean-François Deü–Conservatoire National des Arts et Métiers; Lucie Rouleau–Conservatoire National des Arts et Métiers*
12:50 p.m.		PDADyE Applied to a 2-attachment Fixture Case #16612 | *Cora Taylor–Michigan Technological University; Jason R. Blough–Michigan Technological University; James P. DeClerck–Michigan Technological University; Chuck D. VanKarsen–Michigan Technological University; Raymond Joshua–Honeywell, Kansas City National Security Campus*		
1:10-2:40 p.m.		**IMAC Awards Luncheon**—Ballroom CD		

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SALON 11	SALON 12	SALON 13	SALON 14
COMPUTER VISION FOR STRUCTURAL DYNAMICS	ROTATING MACHINERY	MODAL ANALYSIS & STRUCTURAL DYNAMICS	NONLINEAR STRUCTURES & SYSTEMS
53. **OPTICAL SYSTEMS FOR ROTATING STRUCTURES**	54. **ROTATING MACHINERY II**	55. **DAMPING**	56. **NONLINEAR MODEL REDUCTION II**
Javad Baqersad–*Kettering University;* **Jayant Sirohi**–*University of Texas at Austin*	**Brian Damiano**–*Oak Ridge National Laboratory;* **Jason Blough**–*Michigan Technological University*	**Jon Furlich**–*ATA Engineering;* **Luke Jurmu**–*Caterpillar Inc.*	**Alessandra Vizzaccaro**–*University of Bristol*
Tutorial: Optical and Vision-Based Systems to Measure the Dynamics of Rotating Structures #16715 | *Javad Baqersad–Kettering Unviersity; Jayant Sirohi–The University of Texas at Austin*	Using a Cell Phone Video and ODS Correlation to Diagnose Unbalance in Rotating Machinery #16426 | *Mark H. Richardson–Vibrant Technology, Inc.; Brian H. Schwarz–Vibrant Technology, Inc.; Shawn H. Richardson–Vibrant Technology, Inc.*	On the Estimation of Modes with High Difference in Frequency-Damping Ratio for Time Domain Methods in OMA #16702 | *Esben Orlowitz–Siemens Gamesa*	Incorporating Implicit Condensation into Data-Driven Reduced-Order Models for Nonlinear Structures #16737 | *Alex J. Elliott–Cranfield University*
	Dynamic Behavior of Turbopump Inducer Submerged in Liquid #16847 | *Yunus E. Ozcelik–Roketsan Inc.; Yunus Tufek–Roketsan Inc.*	Effects of Viscoelastic Damping Treatments on Structural Members #16710 | *Samuel P. Tilmann–Air Force Research Laboratory*	Explanation for Oscillating Backbone Curves based on Fractional Spectral Submanifolds #16711 | *Leonardo Bettini–ETH Zurich; Bálint Kaszás–ETH Zurich; Mattia Cenedese–ETH Zurich; Tobias Brack–ETH Zurich; Jürg Dual–ETH Zurich; George Haller–ETH Zurich*
	Numerical and Experimental Investigations of an on-board Rotor Subject to Multiaxial Excitations #17021 | *Eric Chatelet–INSA Lyon; Yvon BRIEND–ArianeGroup SAS; Regis Dufour–INSA Lyon; Marie-Ange Andrianoely–INSA Lyon; Antoine Naulleau–Avnir Engineering*	Improvement of Bandgap Properties in Finite Metamaterial Beam Structures by Local Damping Measures #16816 | *Hannes Wöhler–Leibniz University Hannover; Sebastian Tatzko–Leibniz University Hannover*	Physics-Informed Model Order Reduction via Generalized Characteristic Value Decomposition #17111 | *Dalton Stein–University of Rhode Island; David Chelidze–University of Rhode Island*
Full-field Modal Parameter Estimation of a Rotating Structure using an Image-based Tracking Continuously Scanning Laser Doppler Vibrometer System #16540 | *Linfeng Lyu–University of Maryland, Baltimore County; Garrett D. Higgins–University of Maryland, Baltimore County; Weidong Zhu–University of Maryland, Baltimore County*		Experimental Modal Analysis of Gears with Particle Damping #17074 | *Mirco Jonkeren–Leibniz University Hannover; Tobias Ehlers–Leibniz University Hannover*	Delay-embedded Modal Analysis for Spectral Submanifold Identification #16456 | *Joar Axås–ETH Zurich; George Haller–ETH Zurich*
Digital Coded Exposure for Physically-Motivated, Event-Based Frame Formation, Interpolation and Motion Blur Control #16734 | *Andre W. Green–Los Alamos National Laboratory; Moises F. Mello da Silva–Los Alamos National Laboratory; Alessandro Cattaneo–Los Alamos National Laboratory; David L. Mascareñas–Los Alamos National Laboratory*			

IMAC Awards Luncheon—Ballroom CD

Full detailed event schedule available on the Whova app.

		SALON 8	SALON 9	SALON 10
	TRACK	DYNAMIC ENVIRONMENTS TESTING	DATA SCIENCE IN ENGINEERING	SYSTEM IDENTIFICATION
	SESSION	57. MIMO DET I	58. MACHINE LEARNING AND MODELING OF STRUCTURES	59. SYSTEM IDENTIFICATION
	CHAIR(S)	**John Schultze**–*Los Alamos National Laboratory;* **Tyler Schoenherr**–*Sandia National Laboratories*	**Zhu Mao**–*Worcester Polytechnic Institute;* **Amir Gandomi**–*University of Technology Sydney*	**Eric Little**–*St. Cloud State University;* **Cora Taylor**–*Michigan Technological University*
2:40 p.m.	EXPOSITION OPEN	Improving IMMAT Planning Through Shaker Modeling and Modal Filtering #16430 | *Marcus Behling–Brigham Young University; Bradon Thomason–Brigham Young University; Matt Allen–Brigham Young University; Randall Mayes–Mayes Consulting; Washington DeLima–Kansas City National Security Campus; Jonathan Hower–Kansas City National Security Campus*	Quantifying the Value of Information Transfer in Population-based SHM #17020 | *Aidan J. Hughes–University of Sheffield; Jack Poole–University of Sheffield; Nikolaos Dervilis–University of Sheffield; Paul Gardner–Frazer-Nash Consultancy; Keith Worden–University of Sheffield*	A New Impact Localization Method Based on Spatially Sparse FRFs: Evaluation using a FE Beam Model #16552 | *Sa'ed Alajlouni–The Hashemite University; Vijaya VN Sriram Malladi–Michigan Technological University; Pablo Tarazaga–Texas A&M University*
3:00 p.m.		Evaluating Degree of Freedom Selection Methods for MIMO Vibration Modeling #16599 | *Moheimin Khan–Sandia National Laboratories; Tyler Schoenherr–Sandia National Laboratories*	Transfer Learning Across Heterogeneous Structures Through Adversarial Training #16787 | *Mohammad Hesam Soleimani-Babakamali–University of California, Los Angeles; Onur Avci–West Virginia University; Serkan Kiranyaz–Qatar University; Ertugrul Taciroglu–University of California, Los Angeles*	Mitigating Machine-Structure Interaction Issues through Dynamic Properties Assessment and Structural Modifications in a Coal Preparation Plant #16786 | *Alejandro Duarte–Mincka Engineering; Fidel Gonzalez–Mincka Engineering*
3:20 p.m.		Utilizing Under-determined Solutions for MIMO Vibration Control #16625 | *Ryan Schultz–Sandia National Laboratories*	Integrating Digital Twins and Reduced Order Modeling for Enhanced Structural Health Monitoring and Material Characterization of Turbin Blade #17116 | *Seyed Jamaleddin Mostafavi Yazdi–Kettering University; Praveenkumar Muthiah Ramakrishnan–Kettering University*	Parameter Optimization and Comparison of Different Small Scale Elasticity Theories for Carbon Nanotubes #16869 | *Doğuhan N. Kılıçarslan–Middle East Technical University; Ender Cigeroglu–Middle East Technical University*
3:40 p.m.		Development of a Digital Twin for a Multi-Axis Vibration Testing Setup #16884 | *Rúben M. Araújo–Siemens Digital Industries Software; Raul F. Flores Hernandez–Siemens Digital Industries Software/Politecnico di Torino; Alberto Garcia de Miguel–Siemens Digital Industries Software; Mattia Dal Borgo–Siemens Digital Industries Software; Bart Forrier–Siemens Digital Industries Software; Umberto Musella–Siemens Digital Industries Software; Emilio Di Lorenzo–Siemens Digital Industries Software; Alfonso Pagani–Politecnico di Torino; Frank Naets–KU Leuven*	Markov Chain Monte Carlo on Matrix Manifolds for Probabilistic Model Order Reduction #17127 | *Alessandra Vizzaccaro–University of Exeter; Mikkel B. Lykkegaard–digiLab; Tim Dodwell–University of Exeter*	Residual-based Identification of the Input Forces using Gaussian Process Discrepancy Model #17094 | *Antonina Kosikova–Columbia University; Andrew Smyth–Columbia University*
4:00 p.m.		Quantitative Comparison of Vibration Testing Techniques #16917 | *Tharwat Elkabani–New Mexico State University; Celvi Lisy–Massachusetts Institute of Technology; Gerrit Vander Wiel–LeTourneau University; Peter Fickenwirth–Los Alamos National Laboratory; Thomas Thompson–Los Alamos National Laboratory; Sandra Zimmerman–Los Alamos National Laboratory*		
4:20-5:00 p.m.		**Coffee Break**—Exposition		

Full detailed event schedule available on the Whova app.

SALON 11	SALON 12	SALON 13	SALON 14
COMPUTER VISION FOR STRUCTURAL DYNAMICS	BIOMEDICAL APPLICATIONS	BASICS OF MODAL ANALYSIS	NONLINEAR STRUCTURES & SYSTEMS
60. **DIC APPLICATIONS**	61. **BIOMEDICAL APPLICATIONS**	62. **BASICS OF MODAL ANALYSIS: TUTORIALS I**	63. **NONLINEAR MODEL REDUCTION III**
Marc Eitner–*The University of Texas at Austin;* **Bluejay Robinson**–*Correlated Solutions, Inc.*	**Sheyda Davaria**–*Northrop Grumman*	**Michael Mains**–*The Modal Shop*	**Matthew Allen**–*Brigham Young University;* **Drithi Shetty**–*Rice University*
Full Field Stereo DIC and Sensor merging for an FE Model Validation #16850 | *Davide Mastrodicasa–Siemens Industry Software NV; Emilio Di Lorenzo–Siemens Industry Software NV; Bart Peeters–Siemens Industry Software NV; Patrick Guillaume–Vrije Universiteit Brussel*	Modal Gait Analysis: On the use of POD and MAC to Extract the Fundamental Differences between a Human and a Robot Walking #16561 | *Arian Kist–Technical University of Munich; Daniel Rixen–Technical University of Munich*	Understanding the Fourier Transform #17208 | *John Hiatt–Dewesoft*	Dynamic Response of a Structure with Frictional and Geometric Nonlinearity using Reduced Order Model #16588 | *Arati A. Bhattu–Rice University; Matthew RW Brake–Rice University*
Deformation Estimation of a Clamped Plate using a PVDF Sensor Array #16921 | *Marc A. Eitner–The University of Texas at Austin; Jayant Sirohi–The University of Texas at Austin*	3D Printable Analogue Spine Models: Towards Cost and Time Effective Spinal Biomechanical Research #16531 | *Siril Teja Dukkipati–McGill University; Mark Driscoll–McGill University*		Evaluation of Interface Reduction Techniques for Systems with Frictional Contacts within the Scope of the Harmonic Balance Method #16722 | *Tido Kubatschek–Leibniz University Hannover; Alwin Förster–Leibniz University Hannover*
Super-sensitivity Full-field Displacement Measurement with Photogrammetry #16994 | *Shanwu Li–Michigan Technological University; Yongchao Yang–Michigan Technological University*	Effect of Ligaments on Lumbar Spine Stiffness: A Systematic Investigation using Novel 3D-Printed Analogue Spine Models #16532 | *Siril Teja Dukkipati–McGill University; Mark Driscoll–McGill University*		Nonlinear Vibration Analysis of a Two-Blade System with Shroud-To-Shroud Contact by using Response Dependent Nonlinear Normal Modes #16909 | *Tahsin Ahi–The Ohio State University; Ender Cigeroglu–Middle East Technical University; H. Nevzat Özgüven–Middle East Technical University*
Investigation of Internal Illumination as an Optical Method for Digital Image Correlation #17045 | *Vasha Sedlacek–The University of Texas at Austin; Marc Eitner–The University of Texas at Austin*	Finite Element Evaluation of the Contribution of Intra-Abdominal Pressure Toward Dynamic Spine Stability #16955 | *Sean A. Murray–McGill University; Mark Driscoll–McGill University*	Understanding How Filters Affect Data #17209 | *John Hiatt–Dewesoft*	Nonlinear Model Reduction from Experimental Data to Fractional Spectral Submanifolds #16990 | *George Haller–ETH Zurich*
An Abundance of Spatial Points: Implications for Camera-Based Modal Analysis and Beyond #16862 | *Sean Collier–The Pennsylvania State University; Tyler Dare–The Pennsylvania State University*	Dynamic Analysis of a Tactile Device for Mimicking Mechanical Stimuli Responsible of Texture Perception #17000 | *Livia Felicetti–Sapienza University of Rome; Eric Chatelet–Univ Lyon; Francesco Massi–Sapienza University of Rome*		

Coffee Break—Exposition

Full detailed event schedule available on the Whova app.

	SALON 8	SALON 9	SALON 10
TRACK	DYNAMIC ENVIRONMENTS TESTING	DATA SCIENCE IN ENGINEERING	
SESSION	64. MIMO DET II	65. STRUCTURAL MODELLING AND CONDITION ASSESSMENT	
CHAIR(S)	**Umberto Musella**–*Siemens Industry Software;* **Ryan Schultz**–*Sandia National Laboratories*	**Austin Downey**–*University of South Carolina;* **Nikolaos Dervilis**–*University of Sheffield*	
5:00 p.m.	CRI-based IMMAT on a Simplified Commercial Airplane Model #17110 | *Amirhossein Omidi Soroor–Texas A&M University; Lucas Spies–Texas A&M University; Pablo A. Tarazaga–Texas A&M University*	A Multi-Factor Decision Framework for Offshore Wind Turbine Maintenance #17057 | *Anna R. Haensch–Tufts University; Eleonora M. Tronci–Northeastern University; Babak Moaveni–Tufts University; Eric Hines–Tufts University*	
5:20 p.m.	Quantifying Differences Between MIMO and SISO Testing on the BARC Structure #16568 | *Hunter R. Kramer–Duke University; John F. Schultze–Los Alamos National Laboratory; Shannon M. Danforth–Los Alamos National Laboratory; Brian P. Mann–Duke University*	Optimal Modeling of Deep Groove Ball Bearings for Application in Multibody Dynamics Simulations #16693 | *Josef Koutsoupakis–Aristotle University of Thessaloniki; Dimitrios Giagopoulos–Aristotle University of Thessaloniki*	
5:40 p.m.	On the Fatigue Damage Estimation in Multi-axis and Single-axis Vibration Testing #16463 | *Enrico Proner–University of Ferrara; Emiliano Mucchi–University of Ferrara*	Frequency-Based Damage Detection using Drone-deployable Sensor Package with Edge Computing #17035 | *Ryan Yount–University of South Carolina; Joud Satme–University of South Carolina; Austin RJ Downey–University of South Carolina*	
6:00 p.m.	Fatigue Analysis of Solder Joints using Time Domain Reflectometry #16673 | *Lauren Tomanek–The University of Texas at Austin/Sandia National Laboratories; Thomas Brown–Sandia National Laboratories; Thomas Buchheit–Sandia National Laboratories; Kenny Leeson–Sandia National Laboratories*		
7:00-10:00 p.m.	**IMAC Social Event: Howl At The Moon**—(see page 23 for details)		

Full detailed event schedule available on the Whova app.

SALON 11	SALON 12	SALON 13	SALON 14
COMPUTER VISION FOR STRUCTURAL DYNAMICS	NONLINEAR STRUCTURES & SYSTEMS	BASICS OF MODAL ANALYSIS	NONLINEAR STRUCTURES & SYSTEMS
67. **OPTICAL SYSTEM FOR ADDITIVE MANUFACTURING AND DAMAGE DETECTION**	68. **JOINTS II**	69. **BASICS OF MODAL ANALYSIS: TUTORIALS II**	70. **CONTROL OF NONLINEAR SYSTEMS**
Pawel Malinowski–*Polish Academy of Sciences;* **David Mascarenas**–*Los Alamos National Laboratory*	**Matthew Brake**–*Rice University*	**Michael Mains**–*The Modal Shop*	**Ludovic Renson**–*Imperial College London*
Employing Guided Wave-Based Damage Localisation Techniques for Additively Manufactured Plates with Different Infill Densities #16637 | *Pawel H. Malinowski–Polish Academy of Sciences; Mohammad Ali Fakih–Polish Academy of Sciences; Shishir K Singh–Polish Academy of Sciences; Samir Mustapha–American University of Beirut*	In-Situ Measurement of Local Contact Stiffness using Ultrasound #16629 | *Drithi Shetty–Rice University; Jonah Wagner–Rice University; Risto Djishev–Rice University; Matthew Brake–Rice University*	Understanding How Filters Affect Data, Part II #18007 | *John Hiatt–Dewesoft*	Nonlinear Behaviour in Flexible, Large-Scale Space Structures: Dynamics and Control #16738 | *Alex J. Elliott–Cranfield University; Leonard Felicetti–Cranfield University*
Demonstration of Neuromorphic Event-Based Imagers for Optical Measurement of Melt Pools for Additive Manufacturing and Welding Diagnostics #16727 | *David L. Mascarenas–Los Alamos National Laboratory; Andre W. Green–Los Alamos National Laboratory*	Full-Field Diagnostics of Bolted Joints Using High-Speed Optical Techniques #16647 | *Khalid Alkady–University of Nebraska-Lincoln; Javier Arroyo–University of Nebraska-Lincoln; Daniel Rohe–Sandia National Laboratories; Dannelle Aragon–Sandia National Laboratories; Ronald Hopkins–Sandia National Laboratories; Robert J. Kuether–Sandia National Laboratories; Keegan Moore–University of Nebraska-Lincoln*	Using Accelerometer and Cell Phone Data Together for Modal Analysis #17982 | *Mark Richardson–MechaniCom*	Noninvasive Control in the Presence of Model Uncertainties #16526 | *Hamed Rezaee–Imperial College London; Ludovic Renson–Imperial College London*
Investigating Vibrational Characteristics of Novel Lattice Structures Using non-contact Methods and Numerical Analysis #17113 | *Seyed Jamaleddin Mostafavi Yazdi–Kettering University; Javad Baqersad–Kettering University; Jacob Lecluyse–Kettering University*	Phase-Based Motion Magnification: A Comprehensive Study of its Application in Analyzing Nonlinear Structural Dynamics #16935 | *Cengizhan Taslicay–Rice University; Serena Occhipintia–Politecnico di Torino; Victor Clerc–FEMTO-ST; Jessica Herbert–Rolls-Royce; Celso T. do Cabo–Worcester Polytechnic Institute; Zhu Mao–Worcester Polytechnic Institute; Christoph Schwingshackl–Imperial College London; Matthew Brake–Rice University*		Stability Analyses and Detection of Isolated Resonance Curves of Strongly Nonlinear Structures using Fixed Frequency Voltage Control Tests #16572 | *Eric Robbins–University of New Mexico; Robert J. Kuether–Sandia National Laboratories; Benjamin R. Pacini–Sandia National Laboratories; Fernando Moreu–University of New Mexico*
Time-Inferred Sparse Autoencoder for Improved Full-Field Reconstruction from Sparse Measurements #16469 | *Nitin Nagesh Kulkarni–University of Massachusetts Lowell; Alessandro Sabato–University of Massachusetts Lowell*	Multi-Model Uncertainty Quantification and Model Updating for the TMD Research Challenge #16982 | *Jonel A. Ortiz–Sandia National Laboratories; Moheimin Y. Khan–Sandia National Laboratories; David A. Najera–ATA Engineering, Inc; Robert J. Kuether–Sandia National Laboratories; Paul R. Miles–Sandia National Laboratories*		Linearization and Nonlinear Model Reduction for the Model Predictive Control of Nonlinear Structure Vibrations #16541 | *Yichang Shen–Imperial College London; Ludovic Renson–Imperial College London*

IMAC Social Event: Howl At The Moon—(see page 23 for details)

Full detailed event schedule available on the Whova app.

	SALON 8	SALON 9	SALON 10
TRACK	DYNAMIC ENVIRONMENTS TESTING	DATA SCIENCE IN ENGINEERING	EXPERIMENTAL TECHNIQUES
SESSION	71. SHAKER DET	72. PHYSICS INFORMED MACHINE LEARNING	73. CONDITION MONITORING & DAMAGE DETECTION
CHAIR(S)	**Julie Harvie**–*Lilium*	**Austin Downey**–*University of South Carolina;* **Eleonora Maria Tronci**–*Northeastern University*	**Doug Osterholt**–*ATA Engineering*
9:00 a.m.	Evaluating Vibration Controller Performance in Virtual and Hardware Tests #16760 | *Tessa Q. Lytle–Worcester Polytechnic Institute; Wyatt J. Saeger–University of New Mexico; Aiden Tombuelt–Clemson University; Shannon M. Danforth–Los Alamos National Laboratory; James P. DeClerck–Michigan Technological University; Brittany J. Ouellette–Los Alamos National Laboratory; John F. Schultze–Los Alamos National Laboratory*	Physics Informed Machine Learning Part I: Different Strategies to Incorporate Physics into Engineering Problems #16944 | *Eleonora Maria Tronci–Northeastern University; Austin RJ Downey–University of South Carolina; Azin Mehrjoo–Tufts University; Puja Chowdhury–University of South Carolina; Daniel Coble–University of South Carolina*	Development of a Road Condition Monitoring System Based on Vehicle Response and Fuzzy Classification #16620 | *Harry M. Ngwangwa–University of South Africa*
9:20 a.m.	Variable Transient Input Motion Influence on Shake Table Operational Conditions – Electrodynamic Shaker Applications #16794 | *Jaroslav Hruby–Vibration Research Corporation; Igor Neuhold–European Organisation for Nuclear Research; Tomas Drazan–University of Defense Brno; Cherie Stoll–Vibration Research Corporation; Zdenek Joska–University of Defense Brno*	Physics Informed Machine Learning Part II: Applications in Structural Response Forecasting #17081 | *Austin Downey–University of South Carolina; Eleonora Maria Tronci–Maria Tronci; Puja Chowdhury–University of South Carolina; Daniel Coble–University of South Carolina*	On the Influence of Structural Attributes for Transferring Knowledge in Population-Based Structural Health Monitoring #16931 | *Giulia Delo–Politecnico di Torino; Daniel S. Brennan–University of Sheffield; Cecilia Surace–Politecnico di Torino; Keith Worden–University of Sheffield*
9:40 a.m.	Influence of Shaker Dynamics on Base Mounted Test Article #16943 | *John M. Matthews–University of Massachusetts Lowell/Sandia National Laboratories; Troy J. Skousen–Sandia National Laboratories; Peter Avitabile–University of Massachusetts Lowell*	Uncertainty Quantification of a Machine Learning Model for Deviatoric Force Identification with Conformal Prediction #16509 | *David A. Najera-Flores–ATA Engineering, Inc./UCSD; Justin Jacobs–Sandia National Laboratories; D. Dane Quinn–The University of Akron; Michael D. Todd–University of California San Diego; Anthony Garland–Sandia National Laboratories*	Determination of Dynamic Tyre Forces using Artificial Neural Network Simulation #16573 | *Harry M. Ngwangwa–University of South Africa*
10:00 a.m.	Application of Operational Modal Analysis for In-Situ Deflection Shape Analysis during Shaker Tests #16803 | *Andreas Renner–m+p international; Marian Dieh–Leibniz University Hannover; Thomas Hoffmann–m+p international; Dale Schick–m+p international*	Decoupling Nonlinear Normal Modes using Normalising Flows #16820 | *Tina A. Dardeno–The University of Sheffield; Lawrence A. Bull–The University of Cambridge; Nikolaos Dervilis–The University of Sheffield; Keith Worden–The University of Sheffield*	A Machine Learning Based Damage Estimation Model for Monitoring Reinforced Concrete Structures #17100 | *Omair Inderyas–Ege University; Sena Tayfur–Ege University; Ninel Alver–Ege University; Necati Catbas–University of Central Florida*
10:20 a.m.	Multi-axis Vibration Solder Fatigue Analysis VS. Traditional Vibration Testing #16675 | *Thomas Brown–The University of Texas at Austin/Sandia National Laboratories; Lauren Tomanek–Sandia National Laboratories; Thomas Buchheit–Sandia National Laboratories; Kenny Leeson–Sandia National Laboratories; Jelena Paripovic–Sandia National Laboratories; Glen Throneberry–Sandia National Laboratories; Martin Sanchez–Sandia National Laboratories*	Adaptive Radio Frequency Target Localization #16937 | *Anthony A. Petrakian–Texas A&M University; Parker TP Segelhorst–Colorado State University; Abigail R. Smith–Michigan Technological University; Jeffery D. Tippmann–Los Alamos National Laboratory; Zigfried Hampel-Arias–Los Alamos National Laboratory*	
10:40 a.m.	Optical Comparative Analysis of Stress States of a Component Under Multi-Axis and Single-Axis Vibration Testing #16678 | *Thomas Brown–University of Texas at Austin/Sandia National Labs; Glen Throneberry–Sandia National Labs; Jelena Paripovic–Sandia National Labs; Lauren Tomanek–Sandia National Labs; Martin Sanchez–Sandia National Labs; Stephen Aulbach–Sandia National Labs*	Machine-learning based Method for Structural Damage Detection #16687 | *Daniel Irawan–University of New South Wales; Evgeny Morozov–University of New South Wales; Murat Tahtali–University of New South Wales*	
11:00-11:30 a.m.	**Coffee Break**—Ballroom Foyer		

Full detailed event schedule available on the Whova app.

SALON 11	SALON 12	SALON 13	SALON 14
COMPUTER VISION FOR STRUCTURAL DYNAMICS	NONLINEAR STRUCTURES & SYSTEMS	BASICS OF MODAL ANALYSIS	NONLINEAR STRUCTURES & SYSTEMS
74. **IN MEMORY OF DAVID EWINS II**	75. **EXPERIMENTAL TECHNIQUES FOR NONLINEAR SYSTEMS**	76. **BASICS OF MODAL ANALYSIS: TUTORIALS III**	77. **INDUSTRIAL APPLICATIONS**
Dario Di Maio–*University of Twente;* **Weidong Zhu**–*University of Maryland, Baltimore County*	**Richard Wiebe**–*University of Washington;* **Ludovic Renson**–*Imperial College London*	**Michael Mains**–*The Modal Shop*	**Benjamin Pacini**–*Sandia National Laboratories;* **Deborah Fowler**–*Sandia National Laboratories*
Continuously Scanning Laser Doppler Vibrometry for Vibration Measurement: A Tutorial on Principles, Recent Developments, and Applications #16718 | *Weidong Zhu–University of Maryland Baltimore County*	Experimental Bifurcation Forecasting using the Transient Response of an Airfoil in a Wind Tunnel #16455 | *Jesús García Pérez–University of Michigan; Amin Ghadami–University of Southern California; Leonardo Sanches–Universit´e de Toulouse; Guilhem Michon–Universit´e de Toulouse; Bogdan Epureanu–University of Michigan*	ABCs of LDVs: Beginner Level Introduction to Laser Doppler Vibrometry #17314 | *Vikrant Palan–Polytec, Inc.; Joerg Sauer–Polytec GmbH; David Damiani–Polytec, Inc.*	Challenges in Simulating the Forced Vibration Response of Assembled Space Structures #16530 | *Jip van Tiggelen–University of Twente; Marcel Ellenbroek–University of Twente/Airbus Netherlands; Sjoerd de Bekker–Airbus Netherlands; Mark Bakker–Airbus Netherlands; Dario Di Maio–University of Twente*
	Experimental Development of Nonlinear Transfer Function Measurements #17097 | *Caleb Bengs–University of Texas A&M; Dan Roettgen–Sandia National Labs*		Comparative Experimental Studies on the Dynamical Responses of Additively Manufactured Complex Structures #16669 | *Jonah Madrid–New Mexico State University; Kyle Girven–New Mexico State University; Ezekiel Granillo–New Mexico State University; Sevren Jackson–New Mexico State University; Trey Swan–New Mexico State University; Abdessattar Abdelkefi–New Mexico State University*
	Smart Automatic Modal Hammer for Studying Nonlinear Dynamical Systems #16915 | *Mohammad Nasr–University of Nebraska-Lincoln; Aryan Singh–University of Nebraska-Lincoln; Keegan Moore–University of Nebraska-Lincoln*		Crack Detection in Train Wheelset Axles Based on Nonlinear Higher Order Harmonics of Breathing Crack #16824 | *Ehsan Naghizadeh–ETH Zurich; Paolo Tiso–ETH Zurich; Eleni Chatzi–ETH Zurich*
Investigation of the Dynamic Influences of a Two-Disc Tribometer on Wear Via High-End Cameras and Vibrometers #16825 | *A. Mario Puhwein–AC2T Research GmbH; Markus J. Hochrainer–University of Applied Sciences, Wiener Neustadt; Balazs Jakab–AC2T Research GmbH*	Dynamic Response of Damping Estimation of Layered Plate Systems Under Shock Loading #17099 | *Alexandria R. Thomas–University of Oklahoma; David Soine–Sandia National Labs*	Measuring Operational Deflections Shapes with Digital Image Correlation #17802 | *Bluejay Robinson–Correlated Solutions, Inc.*	Mooring System Analysis for a 15 MW Semi-submersible Floating Offshore Wind Turbine in Deep-sea Deployment #16907 | *Ibrahim Engin Taze–University of New Hampshire*
Understanding High Frequency Modes in Electromechanical Impedance Measurement Using Non-contact Vibration Testing #16605 | *Sourabh Sangle–Texas A&M University; William C. Rogers–Texas A&M University; Mohammad I. Albakri–Texas A&M University at Qatar; Pablo A. Tarazaga–Texas A&M University*			Fundamental Analysis of Dynamic Response in the Presence of Bilinear Stiffness #16516 | *Brennen Clark–Brigham Young University; Matthew S. Allen–Brigham Young University; Benjamin R. Pacini–Sandia National Laboratories*
Image-based Estimation of Real-time Angular Positions and Angular Velocities of Rotating Structures #17051 | *Garrett D. Higgins–University of Maryland, Baltimore County; Weidong Zhu–University of Maryland, Baltimore County*			Additive Manufacturing of Resonant Vibration Absorbers for Turbomachinery Blisks #16529 | *Mihai Cimpuieru–University of Michigan, Ann Arbor; Alexander D. Kripfgans–University of Michigan, Ann Arbor; Sean T. Kelly–University of Michigan, Ann Arbor; Bogdan I. Epureanu–University of Michigan, Ann Arbor*

Coffee Break—Ballroom Foyer

Full detailed event schedule available on the Whova app.

	SALON 8	SALON 9	SALON 10
TRACK	DYNAMIC ENVIRONMENTS TESTING		EXPERIMENTAL TECHNIQUES
SESSION	78. TRANSIENT DET		80. QUALIFICATION AND DURABILITY TESTING
CHAIR(S)	**David Soine**–*Sandia National Laboratories;* **Tyler Schoenherr**–*Sandia National Laboratories*		**Tina Dardeno**–*University of Sheffield;* **Kaitlin Spak**–*Exponent*
11:30 a.m.	Improvements are Needed by the Customer and Launch Vehicle Provider on Spacecraft Shock Loads, Required Analysis, and Required Testing #16633 | *Monty R. Kennedy–Michigan Technological University/MK Engineering; Jason Blough–Michigan Technological University*		A Hybrid Numerical-experimental Method for Long-term Durability Prediction in a Random Vibration Environment #16464 | *Enrico Proner–University of Ferrara; Emiliano Mucchi–University of Ferrara*
11:50 a.m.	Spacecraft Impact and Shock Testing is Needed to Reduce the Significant Uncertainty in Shock Analysis and Shock Subsystem Testing #16630 | *Monty R. Kennedy–Michigan Technological University/MK Engineering; Jason R. Blough–Michigan Technological University*		Vibration Quantification for Kawasaki Engines in F1000 Racing Vehicles #16521 | *Kaitlin S. Spak–Exponent; Shane C. Kennett–Exponent*
12:10 p.m.	Multi-Axis Resonant Plate Angled Fixture #16602 | *Trevor Turner–Texas A&M University; Pablo Tarazaga–Texas A&M University; William Zenk–Honeywell Federal Manufacturing & Technologies; Chase Zion–Honeywell Federal Manufacturing & Technologies; Washington DeLima–Honeywell Federal Manufacturing & Technologies*		Development and Modal Characterization of a Scaled Underwater Kite Wing #16753 | *Carson M. McGuire–North Carolina State University; Matthew Bryant–North Carolina State University*
12:30 p.m.	Resonant Bar Shock Test Equipment Under Offset Loading #16766 | *David E. Soine–Sandia National Laboratories; Tyler F. Schoenherr–Sandia National Laboratories; Adam J. Bouma–Sandia National Laboratories*		
12:50 p.m.	Shear Wave Velocity Measurement for Seismic Site Characterization Using Ambient Vibration Tests #16389 | *Mehrtash Motamedi–University of British Columbia; Carlos E. Ventura–University of British Columbia; Leila Katebi–University of British Columbia; Alexander Mendler–Helmut-Schmidt-University*		

Full detailed event schedule available on the Whova app.

SALON 11	SALON 12	SALON 13	SALON 14
COMPUTER VISION FOR STRUCTURAL DYNAMICS	NONLINEAR STRUCTURES & SYSTEMS		NONLINEAR STRUCTURES & SYSTEMS
81. COMPUTER VISION FOR CIVIL APPLICATIONS AND SHM	82. NUMERICAL METHODS		84. APPLICATIONS
Tengjiao Jiang–*Norwegian University of Science and Technology;* **Necati Catbas**–*University of Central Florida*	**Robert Kuether**–*Sandia National Laboratories;* **D. Dane Quinn**–*The University of Akron*		**Keegan Moore**–*University of Nebraska-Lincoln;* **Andrea Cammarano**–*University of Glasgow*
Full-field Displacement of Mode Shapes by Time-Average Holography with Applications #16744 | *Matthew Luceadams–New Mexico State University; Michael Steinzig–Los Alamos National Laboratory; Abdessattar Abdelkefi–New Mexico State University; David Mascarenas–Los Alamos National Laboratory*	A Harmonic Balance-Based Tracking Procedure for Amplitude Resonances #16842 | *Ghislain Raze–University of Liège; Martin Volvert–University of Liège; Gaëtan Kerschen–University of Liège*		Dynamical Characterization of Additively-Manufactured Beams with the Presence of Stoppers #16677 | *Micah Cheng-Guajardo–New Mexico State University; Nicholas Hall–New Mexico State University; Trey Swan–New Mexico State University; Abdessattar Abdelkefi–New Mexico State University*
Multi-level Bridge Corrosion Detection Methods Based on Super-Resolution Reconstruction and Segmentation Network #16814 | *Ziyue Lu–Norwegian University of Science and Technology; Tengjiao Jiang–Norwegian University of Science and Technology; Gunnstein T. Frøseth–Norwegian University of Science and Technology*	Analyzing Nonlinear Structures with Random Excitation using Integral Quadratic Constraints #16774 | *Sze Kwan Cheah–University of Minnesota Twin Cities; Ryan J. Caverly–University of Minnesota Twin Cities*		Mathematical Modeling and Experimental Validation of a Kiiking Swing #16517 | *Ben Davis–University of Georgia; Cody M. Langston–University of Georgia; Mark W. Jackson–University of Georgia; Johannes Erm–University of Georgia*
Photogrammetry-based Damage Detection for Plate-like Structures #16896 | *Karthik Ramesh–University of Cincinnati; Alireza Tadibi–University of Cincinnati; Yongfeng Xu–University of Cincinnati*	Nonlinear Normal Modes of Highly Flexible Beam Structures Modelled Under the SE(2) Lie Group Framework #16559 | *Amir Kamyar Bagheri–Imperial College London; Valentin Sonneville–Technical University of Munich; Ludovic Renson–Imperial College London*		Transient Behavior with Three Degrees of Freedom #16606 | *Lawrence Virgin–Duke University; Yue Guan–University of Memphis*
Object Detection Model for Ultrasound Applications on Concrete #17059 | *Inad Alqurashi–University of Central Florida; Mahta Zakaria–University of Central Florida; Ninel Alver–Ege University; Necati Catbas–University of Central Florida*	On the use of the Generating Series for the Impulse Response of Duffing's Equation #16991 | *Tristan Gowdridge–University of Sheffield; Graeme Manson–University of Sheffield; Nikolaos Dervilis–University of Sheffield; Keith Worden–University of Sheffield*		Numerical Investigation of a Reluctance Force Shunt Damping System #16851 | *Martin Jahn–Leibniz University Hannover; Sebastian Tatzko–Leibniz University Hannover*
			The Effects of Mass and Loading Conditions on Energy Flows in Coupled Nonlinear Oscillators #16899 | *Manal Mustafa–University of Nebraska-Lincoln; Keegan J. Moore–University of Nebraska-Lincoln*

WE HOPE YOU ENJOYED IMAC-XLII!

MARK YOUR CALENDARS FOR IMAC-XLIII

FEB 10-13, 2025

Session Organizers

We would like to thank the following individuals for their efforts in organizing the sessions below:

05. Structural Health Monitoring I
Kirk Grimmelsman–FDH Infrastructure Services

06. Modal Analysis for the New/Young Engineer I
Timothy Marinone–ATA Engineering;
Brandon Dilworth–MIT Lincoln Laboratory;
Jason Blough–Michigan Technological University;
Michael Mains–The Modal Shop

09. Uncertainty Quantification in Dynamics
Babak Moaveni–Tufts University;
Costas Papadimitriou–University of Thessaly

11. Sensors
Chad Walber–Michigan Technological University

13. Modal Analysis for the New/Young Engineer II
Timothy Marinone–ATA Engineering;
Brandon Dilworth–MIT Lincoln Laboratory;
Jason Blough–Michigan Technological University;
Michael Mains–The Modal Shop

14. Nonlinear System Identification I
Gaetan Kerschen–University of Liege;
Nevzat Özgüven–Middle East Technical University

16. Fusion of Test and Analysis
Ibrahim Sever–Rolls-Royce;
Scott Ouellette–Los Alamos National Laboratory

17. Open-source Scientific Computing in Structural Dynamics
Janko Slavič–University of Ljubljana

18. Instrumentation
Chad Walber–Michigan Technological University

19. Dynamics of Buildings
Milad Roohi–University of Nebraska-Lincoln

20. Modal Analysis for the New/Young Engineer III
Timothy Marinone–ATA Engineering;
Brandon Dilworth–MIT Lincoln Laboratory;
Jason Blough–Michigan Technological University;
Michael Mains–The Modal Shop

21. Nonlinear System Identification II
Gaetan Kerschen–University of Liege;
Nevzat Özgüven–Middle East Technical University

23. Model Form Uncertainty incl. Round Robin Challenge
Roland Platz–Deggendorf Institute of Technology;
Alana Lund–University of Waterloo

26. Dynamics of Bridges and Rail
Bjorn Svendsen–NTNU

30. Recursive Bayesian System Identification
Yashar Eftekhar Azam–University of New Hampshire;
Eleni Chatzi–ETH Zurich;
Nikolaos Dervilis–University of Sheffield

32. High-speed Camera Based EMA I
Janko Slavič–University of Ljubljana

33. Human Structure Interaction
Hae Young Noh–Stanford University;
Fernando Moreu–University of New Mexico

37. Virtual Sensing & Realtime Monitoring
Scott Cogan–CNRS;
Garrison Flynn–Los Alamos National Laboratory

39. High-speed Camera Based EMA II
Janko Slavič–University of Ljubljana

40. Structural Vibration Mitigation and Control
Scott Harvey–University of Oklahoma;
Nicholas Wierschem–University of Tennessee

44. Surrogate Modeling and Reduced Order Models
Zhen Hu–University of Michigan-Dearborn;
Kyle Neal–Sandia National Laboratories

46. In Memory of David Ewins I
Dario Di Maio–University of Twente

53. Optical Systems for Rotating Structures
Javad Baqersad–Kettering University

60. DIC Applications
Javad Baqersad–Kettering University

62. Basics of Modal Analysis: Tutorials I
Timothy Marinone–ATA Engineering;
Brandon Dilworth–MIT Lincoln Laboratory;
Jason Blough–Michigan Technological University;
Michael Mains–The Modal Shop

67. Optical System for Additive Manufacturing and Damage Detection
Pawel Malinowski–Polish Academy of Sciences

69. Basics of Modal Analysis: Tutorials II
Timothy Marinone–ATA Engineering;
Brandon Dilworth–MIT Lincoln Laboratory;
Jason Blough–Michigan Technological University;
Michael Mains–The Modal Shop

72. Physics Informed Machine Learning
Austin Downey–University of South Carolina;
Eleonora Maria Tronci–Northeastern University

74. In Memory of David Ewins II
Dario Di Maio–University of Twente

76. Basics of Modal Analysis: Tutorials III
Timothy Marinone–ATA Engineering;
Brandon Dilworth–MIT Lincoln Laboratory;
Jason Blough–Michigan Technological University;
Michael Mains–The Modal Shop

81. Computer Vision for Civil Applications and SHM
Tengjiao Jiang–Norwegian University of Science and Technology;
Alessandro Sabato–University of Massachusetts Lowell

Computer Vision and Laser Vibrometry

Organized by:

Technical Division on Computer Vision and Laser Vibrometry

The Technical Division on Computer Vision and Laser Vibrometry aims to share knowledge on advances in the area of optical measurement techniques that are applied to the area of vibrations, structural dynamics, structural health monitoring, and dynamic measurement. This group covers presentations including, but not limited to, operating data measurement, modal parameter estimation, model updating, full field dynamic strain extraction, damage detection, and high-speed deformation measurement.

Tutorial: Optical and Vision-Based Systems to Measure the Dynamics of Rotating Structures #16715

Javad Baqersad - Kettering University
Jayant Sirohi - The University of Texas at Austin
Wednesday, January 31, 2024 | 11:30 a.m. | Session 53

Dynamic modeling of rotating structures is challenging due to their complex structures and loading conditions. Measurement data can be used for developing and validating dynamic models and for monitoring these structures. Optical techniques have recently received considerable attention due to their ability to achieve full-field measurement and their robustness to work in testing environments where other measurement techniques may not be practical. These techniques have many advantages over conventional measurement approaches to measure the dynamics of rotating structures (e.g., challenges in wiring and mass loading). The presentation reviews a technical background on the structural dynamics of rotating blades. The tutorial also presents the most current trends in optical methods, such as digital image correlation, and highlights their novel structural dynamic measurement concepts and applications in rotating structures. The talk also discusses the future directions for applications of non-contact optical methods in structural dynamics.

Tutorial: Continuously Scanning Laser Doppler Vibrometry for Vibration Measurement: A Tutorial on Principles, Recent Developments, and Applications #16718

Weidong Zhu - University of Maryland Baltimore County
Thursday, Feb 1, 2024 | 9:30 a.m. | Session 74

A laser Doppler vibrometer can measure the surface velocity of a point on a structure. A continuously scanning laser Doppler vibrometer (CSLDV) was developed to significantly improve efficiency and spatial resolution of vibration measurement of the structure. As a non-contact system, it can avoid the mass-loading problem in vibration measurement using accelerometers. The CSLDV was made by adding two orthogonal scan mirrors in front of a single-point laser Doppler vibrometer. Two scan mirrors can be referred to as X and Y mirrors based on their rotation axes, respectively. During CSLDV measurement, two scan mirrors can be controlled to continuously rotate about their rotation axes, and the laser spot of the CSLDV can continuously move along a pre-designed scan trajectory on the structure, which is a major difference compared to a conventional scanning laser Doppler vibrometer (SLDV) system that has a point-by-point scanning capability. This tutorial first overviews principles in vibration measurement using a CSDLV, such as signal processing methods for structures under various excitations such as sinusoidal, impact, and random excitations, and scan trajectory design methods for structures with various shapes. Recent developments on (1) a novel general-purpose three-dimensional (3D) CSLDV system for measuring 3D full-field vibration of a structure with arbitrarily curved surfaces, and (2) a novel zero-contact image-based tracking CSLDV system for measuring vibration of a rotating structure are presented. The general-purpose 3D CSLDV system can measure vibrations of difficult to access areas of structures with the assistance of reflective mirrors and obtain their 3D panoramic modal parameters through a novel vibration stitching method. The image-based tracking CSLDV system can track and scan a rotating structure such as a rotating wind turbine blade through a novel edge detection method and estimate its modal parameters through an improved lifting method and an improved demodulation method. Applications of continuous scanning laser vibrometry to structural damage detection will be discussed.

Computer Vision and Laser Vibrometry *(continued)*

Computer Vision & LDV Best Paper Award by Polytec

The Optical Techniques & Computer Vision Best Paper Award was established in 2018 to attract high-quality publications and presentations of interest to the DIC, Computer Vision, and Optical Techniques community at IMAC. Three best papers are recognized with a certificate and a monetary award, funded by Polytec and Correlated Solutions. The awards will be presented at the Awards Luncheon on Wednesday of the conference.

Sessions:

32. High-Speed Camera Based EMA I
39. High-Speed Camera Based EMA II
46. In Memory of David Ewins I
53. Optical Systems for Rotating Structures
60. DIC Applications
67. Optical System for Additive Manufacturing and Damage Detection
74. In Memory of David Ewins II
81. Computer Vision for Civil Applications and SHM ■

Data Science Applications

Organized by:

Data Science Technical Division

The Data Science Technical Division promotes the application of data analytics in structural and mechanical engineering. Machine learning, deep learning, neural networks, big data, statistics, Gaussian processes, and related methods define the analytical toolset, referred to as Data Science, to process vast volumes of measurements and predictions, analyze complex phenomena, identify trends and relationships, and guide predictive models through empirical data. Progress in smart systems (sensors with integrated signal processing) and sensing technologies (high-speed video, laser sensing, unmanned aerial vehicles, etc.) increasingly requires data management strategies and frameworks. High-performance computing and cloud systems are becoming unavoidable to store, classify, interpret, and visualize these data. Statistical and machine learning methods provide fast, resilient, adaptive, scalable engines for the online monitoring of structures and mechanical systems, and to support decision-making and risk analysis. The TD proposes technical sessions on Wednesday and Thursday that present applications of Data Science to structural monitoring and damage detection, advanced manufacturing, and optimization. Consider attending to learn recent developments, share points-of-view, and contribute to moving Data Science forward.

Sessions:

51. Applications of Machine Learning
58. Machine Learning and Modeling of Structures
65. Structural Modelling and Condition Assessment
72. Physics Informed Machine Learning ■

Dynamic Environments Testing

Organized by:

Dynamic Environments Testing Technical Division

The Dynamic Environments Testing Technical Division was recently established to assess and improve upon laboratory tests that are conducted in order to deem products as fit for service in their operational environments. This testing is often referred to as endurance, qualification, acceptance, or certification testing. The standards for performing these tests has remained largely unchanged for the past 50 years, however research in the field has accelerated significantly in the past decade.

The primary components of this type of testing include: characterization and specification of the service environment, determination of appropriate laboratory test excitation techniques, and design of a test fixture (adapter) to attach the product to the laboratory test equipment. This year's sessions and papers will showcase a variety of research spanning all of these focus areas. The topics covered within this technical division overlap notably with those of other technical divisions, and we invite all IMAC attendees to participate in our diverse sessions. ■

Dynamic Substructures

Organized by:

Dynamic Substructures Technical Division

Substructuring is a general paradigm in engineering dynamics where a complicated system is analyzed based on the dynamics of each subcomponent and the interactions between subcomponents. In numerical simulations, substructuring allows one to reduce the size of the model for a subcomponent of the system and reduce the computational burden by discarding those dynamics that are not important to the assembly/environment of interest. In other applications, a subcomponent model is derived experimentally from hardware, which can be beneficial when the substructure is difficult to model or when there is not enough information to create an accurate finite element model. Substructuring can also be used to couple numerical simulation with real-time testing of components. Such approaches are known as hardware-in-the-loop or hybrid testing.

Whether experimental or numerical, all substructuring approaches have a common basis, namely the equilibrium of the substructures under the action of the applied and interface forces and the compatibility of displacements at the interfaces of the subcomponents. Experimental substructuring requires special care in the way the measurements are obtained to establish acceptable equilibrium and compatibility in the presence of noise and a relatively small number of sensor degrees of freedom. In numerical approaches, the fundamental quest is the efficient computation of reduced order models describing the substructure's dynamic motion. For hardware-in-the-loop applications difficulties include the fast computation of the numerical components and the proper sensing and actuation of the hardware component. Recent advances in experimental techniques, sensor/actuator technologies, novel numerical methods, and parallel computing have rekindled interest in substructuring. The program this year contains several sessions focusing on different aspects of dynamic substructuring. ■

Dynamics of Civil Structures

Organized by:

Dynamics of Civil Structures Technical Division

The Dynamics of Civil Structures TD serves as a primary focal point within the SEM umbrella for technical activities devoted to civil structures analysis, testing, monitoring, and assessment. This TD covers all types of civil engineering structures such as buildings, bridges, rails, stadiums, dams, wind turbines, and so on. Please note that the TD holds its annual meeting during IMAC (IMAC-XLII: Tuesday, Jan. 30, 12:30 PM). The Dynamics of Civil Structures TD welcomes members and guests to attend our annual meeting.

Special sessions focusing on civil engineering research and applications are scheduled during the conference. This year's sessions and papers discuss a variety of topics including structural vibrations and dynamic analysis of buildings, bridges, and other civil structures, damage identification, structural health monitoring, vibration mitigation and structural control, localization and characterization techniques for human occupants, vibration serviceability, human-structure interaction, experimental modal analysis and experimental testing of in service structures, and innovative measurement techniques among many other topics. In addition, many of the technical sessions present new and innovative analytical and experimental methods applicable to a variety of civil structures. Many other topics of interest are also presented throughout the conference. The Dynamics of Civil Structures TD has also organized a competition this year for the Best Student Paper which will be awarded during the conference from student authored and presented papers that are included in several of the technical sessions. The Dynamics of Civil Structures TD welcomes all attendees to enjoy a very full and diverse technical program organized in the multi-disciplinary style unique to IMAC and SEM. ■

Modal Analysis and Dynamic Systems

Organized by:

SEM/IMAC Modal Analysis/Dynamic Systems Technical Division

The Modal Analysis and Dynamic Systems Technical Division serves as a primary focal point within SEM for technical activities devoted to general Modal Analysis and Structural Dynamics. ■

Basics of Modal Analysis for the New/Young Engineer Program

Organized by:

Modal Analysis /Dynamic Systems Technical Division

The field of Modal Analysis continues to evolve and mature. In order to allow new or young engineers in the modal field to extract deeper insight from paper presentations at the IMAC Conference, a program has been developed to familiarize the new/ young engineer with some of the basic material related to modal analysis. Held on the first day of the conference, the Basics of Modal Analysis lecture sessions are geared towards those individuals who have limited or no experience in the modal field or are interested in a refresher on some of the basic modal nomenclature. The material is centered on the topics of single degree of freedom theory, multiple degree of freedom theory, modal measurements, excitation techniques, and parameter estimation. The intent is to familiarize the new/young modal engineer with the nomenclature and basic techniques involved in modal analysis; the most basic fundamental equations will be explained in an overview sense rather than developed from a theoretical standpoint. These tutorial sessions should not be considered a training seminar but rather an overview of basic definitions that are inherent in most of the presentations at the conference. By attending these sessions, the new or young engineer should be able to better appreciate and comprehend more of the material that is presented in the technical paper presentations. Topics will include: SDOF and MDOF Theory, Measurements for Modal Analysis, Impact Testing, Shaker Testing, and Modal Parameter Estimation.

In addition, this year the TD is happy to present a series of tutorials offered by vendors on Thursday. The goal of these tutorials are to further bring to light the technical information that the new/ young engineers learned about on the 1st day of the conference by demonstrations through hardware and software. ■

Model Validation and Uncertainty Quantification

Organized by:

SEM/IMAC Model Validation and Uncertainty Quantification (MVUQ) Technical Division

Mathematical models and numerical simulations in structural dynamics are approximate representations of the actual systems they represent. Model verification and validation (MV) along with uncertainty quantification (UQ) activities provide a means to establish model credibility in a quantitative and objective manner. Model verification ensures that the mathematical model is being solved correctly while model validation ensures that model is a sufficient credible representation of reality. Uncertainty quantification seeks to evaluate the effects of uncertainties that originate from numerous sources and track the propagation of those uncertainties to the final prediction(s) of the model. MVUQ processes are necessary to ensure that advanced numerical models may be relied upon with confidence. The MVUQ sessions at IMAC-XLI are intended to be of interest to both newcomers and experienced hands in this field and should appeal to all conference attendees whose work makes use of model predictions.

The full program of talks over the four days will cover a broad span of recent work in this field, from the development of new tools for uncertainty quantification through to industrial applications of validation procedures. Highlights include the MVUQ Best Paper Award session, plus special sessions on topics as diverse as fusing the outcomes of test and analysis; recursive Bayesian system identification, virtual sensing and realtime monitoring, surrogate modeling and reduced order models. As a novelty in 2023, we started a round-robin challenge in the MVUQ Technical Division working on uncertainty quantification for different modeling approaches of a vibration isolation example with exclusive experimental test data. We invite the participants to join and present their results at the following IMAC conferences and in joint journal publications. ■

Nonlinear Structures and Systems

Organized by:

Nonlinear Structures and Systems Technical Division

Most real engineering structures behave nonlinearly. Therefore, it is necessary to address the presence of nonlinearity in all the steps of the engineering design process: in the experimental testing (to collect the most informative data), in the data analysis (to estimate nonlinear parameters correctly), in the mathematical modelling (to obtain accurate models of the structure) and in the numerical methods (to simulate and study the response effectively). In doing so, it will be possible to create a model that is more representative of reality and that can be used for better predictions once validated.

The nonlinear sessions address theoretical and numerical aspects of nonlinear dynamics as well as experimental techniques and analysis methods. Several sessions are also dedicated to joints and interfaces due to their omnipresence in structures. To introduce the participants to the fundamentals of nonlinear dynamics and provide an overview of some active research areas in the field, the nonlinear sessions also comprise three tutorials: one on the fundamentals of nonlinear oscillations by Prof. Paolo Tiso (ETH Zürich), one on model order reduction by Dr. Alessandra Vizzaccaro (University of Exeter) and one on data-driven methods in nonlinear dynamics by Prof. Keith Worden (University of Sheffield).

Meeting: International Committee on Joint Mechanics

Monday, January 29, 2024 | 6:15 – 7:00 p.m. | Salon 7

All interested people are welcome to join the International Committee on Joint Mechanics for our annual committee meeting. The agenda will focus on a debrief from the Fifth International Workshop (held in September 2023), updates on the action items for the committee, organization of the mini-workshops throughout the spring, dissemination of information for the summer research camps, and opportunities to become involved.

Tutorial: Fundamentals of Nonlinear Oscillations

Prof. P. Tiso, ETH Zürich

Monday, January 29, 2024 | 9:00 a.m. | Session 7

Linear systems enjoy a set of properties that make their design relatively straightforward. Linear superposition, independence of natural frequencies to the response amplitude, single harmonic response to harmonic excitation, independence of the steady-state response to the initial conditions: all these "linear trademarks" allow the development of rather straightforward analytical techniques for the analysis of the response. However, linearity is in most cases an idealization, valid only in a (too) small neighborhood of the equilibrium, [1,2]. When the excitation and/or the initial energy provided to the system is large enough, a plethora of dynamic responses strongly deviating from the linear counterpart can arise. In several cases, the impact of nonlinearities needs to be understood to assure that the system indeed operates in the intended linear regime. In other cases, nonlinear responses can be exploited to enable new sensing and actuation functionalities. In both cases, it is important to tackle the analysis of the nonlinear system with the right analytical or computational tool. The purpose of this introductory tutorial is twofold. First, we overview the main types of nonlinearities that can affect a mechanical system. In doing this, we sketch the main features of the solutions, namely softening/hardening/mixed response, limit cycles, modal interaction, isolated responses. We illustrate some of these aspects with relevant engineering examples. Second, we overview the main analytical and numerical techniques available for the solution of nonlinear mechanical systems.

Nonlinear Structures and Systems *(continued)*

Tutorial: A Tutorial on Data-Driven Methods in Nonlinear Dynamics

Prof. K. Worden, University of Sheffield

Tuesday, January 30, 2024 | 9:00 a.m. | Session 28

The purpose of this tutorial is to give an overview of where 'data-driven' methods have been applied in nonlinear dynamics. Of course, the whole idea of learning from data has been enshrined in the field of system identification for decades; however, recent developments in Machine Learning have introduced new tools and viewpoints which bear examination. Apart from looking at how new ideas like Bayesian machine learning have transformed system identification, the applications of data-driven methods in the broader field of nonlinear dynamics will be considered.

Tutorial: A Tutorial on Nonlinear Model Order Reduction

Dr. A. Vizzaccaro, University of Exeter

Wednesday, January 31, 2024 | 9:00 a.m. | Session 49

This tutorial introduces nonlinear methods for model order reduction of structures discretised with finite elements, with a particular emphasis on the case of geometric nonlinear structures. The aim of model order reduction (MOR) is to reduce the dimensionality of a large system of nonlinear ordinary differential equations by performing a change of coordinates from the original ones to new reduced ones. The two main ingredients of each (MOR) method are (i) the change of coordinates and (ii) the reduced dynamics in the new coordinate system. Specifically, nonlinear methods differ from linear based techniques, as they rely on a nonlinear change of coordinates rather than the addition of new vectors to enlarge the linear projection basis. ■

Sensors and Instrumentation

Organized by:

J. F. Lally Sensors & Instrumentation Technical Division

The SEM Sensors and Instrumentation Technical Division mission is to promote and encourage the exchange of non-proprietary information relating to transducers, data and control systems, and related components used to test and measure structural dynamic behavior. We continuously organize a series of IMAC tutorial sessions for those who are interested in improving their knowledge and skill in the use of sensors and instrumentation. This technical division sponsors annual sessions for OEMs to demonstrate their new technology and provide roadmap of their future efforts. We encourage sessions for unique instrumentation use cases of challenging tests and measurements of novel uses of traditional instrumentation. We sponsor "best practices" sessions ranging from instrumentation selection, installation techniques, data acquisition selection, cabling, and proper grounding techniques. The Sensors and Instrumentation Technical Division provides benefits from students to seasoned engineers across multiple engineering disciplines.

Technology Applications

Tuesday, February 14, 2023 | Sessions 31 & 38

Due to the great interest in this session over the past few years, we are pleased to be able to offer it again at IMAC-XLI. Several IMAC Exhibitors will provide brief presentations highlighting their hardware and software applications and services. Come visit this extremely timely session and then you will have the opportunity to obtain additional information from the exhibitors during the IMAC-XLI Exposition Hours. ■

Exposition Directory

Exposition Hours:

Monday, January 29	**7:00 p.m.–8:30 p.m.** ***(Welcome Reception)***
Tuesday, January 30	**10:00 a.m.–5:00 p.m.**
Wednesday, January 31	**10:00 a.m.–1:00 p.m. / 2:00 p.m.–5:00 p.m.**

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5800 Granite Parkway, Suite 600
Plano, TX 75024 USA
albert.prosuk@siemens.com
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Specialised Imaging is a manufacture of ultra high-speed imaging solutions for scientific research and military applications. These solutions include the award winning projectile trajectory tracking system, framing and ballistic range cameras, image intensifiers, illumination and triggering systems. Service and software. Specialised Imaging also offer streak cameras and long record duration video camera systems.

Spectral Dynamics, Inc.

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www.spectraldynamics.com

Spectral Dynamics, Inc. specializes in manufacturing environmental testing equipment with market leading data acquisition and control. SD is the only company where the quality of the data measured and recorded is the top priority. Spectral Dynamics manufactures vibration shaker systems with the unique ability to combine any size shaker, in all configurations from single degree of freedom (DOF) to multi degree of freedom systems. SD builds multi shaker single DOF, multi shaker 3DOF and multi shaker 6DOF systems up to 20 shakers. All shakers are simultaneously controlled in amplitude, phase and coherence in real time. Spectral Dynamics's patented vibration controller has the unique ability to control complex configurations as well as safety record all data - processed and raw. What you see on the screen is what you see on the shaker. Period.

Structural Vibration Solutions A/S

Novi Science Park
Niels Jernes Vej 10 Aalborg
DK-9220 Denmark
45 9635 4422
info@svibs.com
www.svibs.com

Structural Vibration Solutions A/S is the developer of ARTeMIS Modal software platform. ARTeMIS Modal is an open, and user-friendly platform for modal testing, modal analysis and modal problem solving. If you can measure the vibrations, ARTeMIS Modal can give you the modes in terms of mode shapes, natural frequencies, and damping ratios. For two decades ARTeMIS Modal has been the preferred software for Operational Modal Analysis (OMA). The modal analysis technology for the vast number of cases where it is preferred not to control or measure the loading. Now ARTeMIS Modal also includes polyreference methods for Experimental Modal Analysis (EMA), and tools for long term Structural Health Monitoring (SHM).

The Modal Shop

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The Modal Shop delivers innovative structural vibration and acoustic sensing systems and services to test laboratories and manufacturing facilities around the globe. We offer a world-leading sound and vibration rental program, precision calibration systems, modal shakers, non-destructive test systems, and digital sensors, which are all designed to simplify testing for our customers.

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Since 1995, Vibration Research (VR) has been the innovator in vibration control, data acquisition, and signal analysis. It builds reliable and user-friendly software and hardware at its headquarters in Michigan, USA. Testing labs worldwide trust Vibration Research for the industry's best systems and support that delivers unrivaled value.

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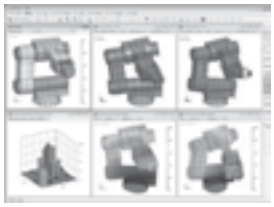

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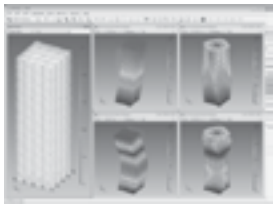

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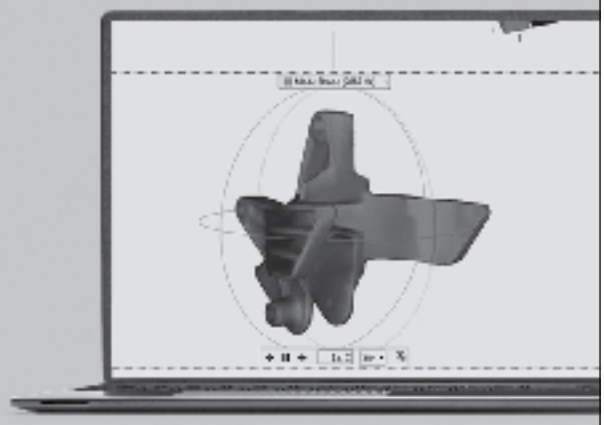

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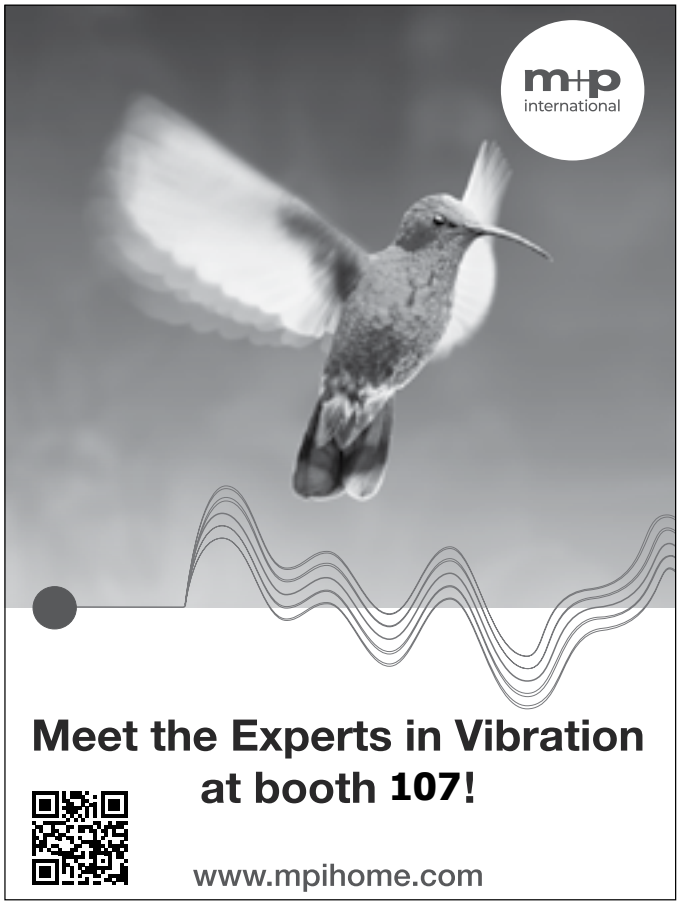

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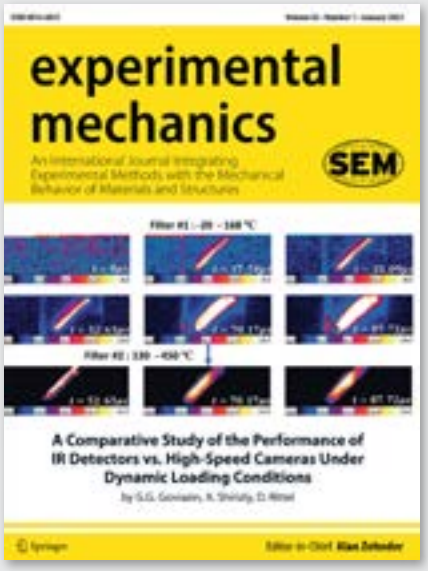

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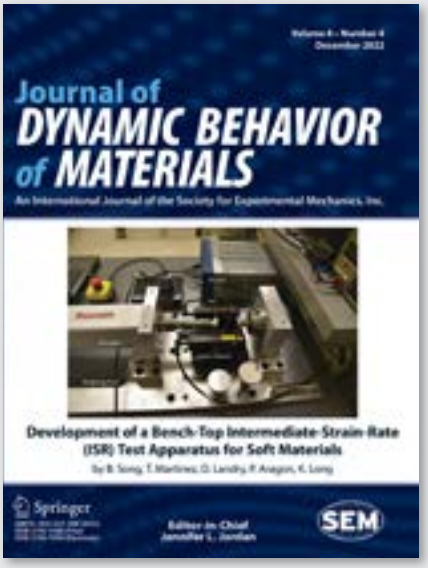

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SEM Membership

Membership in SEM is open to any individual who supports the mission of the society. The members of SEM encompass a unique group of experimentalists, development engineers, design engineers, test engineers and technicians, students, and research and development scientists from industry and educational institutions. Prices listed (except Individual Life Membership) are for one year of membership.

Individual Membership $100

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SEM Membership has its benefits! Among those benefits is free electronic access to a number of journals. To sign up for any of the above options, select them upon registration.

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Registration Information

Conference:
January 29 - February 1, 2024

Pre-Conference Courses
January 28, 2024

Course fee includes lunch each day of the course, course handout materials, and refreshment breaks. Lodging and additional food or materials are not included.

Cancellation Policy
If the course or conference is canceled for any reason, the Society for Experimental Mechanics' liability is limited to the return of the registration fees.

We understand that circumstances may arise that require you to cancel. If you need to cancel, your conference fee, less a $75.00 nonrefundable cancellation fee, will be refunded when the cancellation is made in writing and received by December 29, 2023. No refunds will be given for cancellations received after December 29, 2023. Cancellation notification should be faxed or emailed to Shari Matthews: Fax: 203-790-4472; shari@sem.org

† Payments made with PO must be submitted no later than December 29, 2023. After December 29, 2023 PO will not be accepted as a form of payment. + Payment Net 30 days.

Registration Rates

	Early Bird	Regular	Late
Member	$925	$1025	$1100
Non-Member	$1050	$1225	$1300
Student Member*	$300	$350	$375
Student Non-Member*	$360	$435	$460

Early Bird Rates effective 10/3/23 UNTIL 12/19/23 @4:59 PM EST
Regular Rates effective 12/19/23 at 5:00 PM UNTIL - 1/16/24 at 4:59 PM EST
Late Rates effective as of 1/16/24 at 5:00 PM EST

**** please see Student Membership requirements under at www.sem.org/faqs#bb***

Conference Registration
Registration fee entitles the registrant to 350+ 20-minute technical presentations, free downloadable conference submissions (available for 30 days after the conference), full access to the Whova App, and includes the following: Welcome Reception on Monday, January 29, Exposition, Awards Luncheon on Wednesday, January 31, and IMAC-XLII Social Event on Wednesday evening.

Conference participants, including authors, coauthors, students, and session chairs, should preregister online at sem.org. Your badge and other conference materials will be ready for you when you arrive at the registration desk.

All those who registered by the December 19, 2023 deadline are eligible to win one of many door prizes being offered by IMAC Exhibitors.

Students
To qualify for student rates, you must be a full-time engineering or science student at the time of the conference. This includes Graduate and/or Undergraduate students. Post-Doctoral do not qualify and must pay regular rate. An unofficial transcript showing proof of enrollment MUST be emailed to Shari Matthews (shari@sem.org).
**** please see Student Membership requirements under at www.sem.org/faqs#bb***

Conference Registration Hours
Course Only Registration:
Sunday, January 28, 2024 ..... 8:00 AM –10:00 AM

Conference Registration:
Sunday, January 28, 2024 ..... 4:00 PM–6:00 PM
Monday, January 29, 2024 ..... 7:00 AM–4:00 PM
Tuesday, January 30, 2024 ..... 7:30 AM–4:00 PM
Wednesday, January 31, 2024 ..... 7:30 AM–4:00 PM
Thursday, February 1, 2024 ..... 8:00 AM–1:00 PM

SEM/IMAC Code of Conduct

The Society for Experimental Mechanics, Inc. is committed to making its SEM/IMAC Conferences inclusive spaces for sharing ideas and knowledge by providing a safe and productive meeting environment that fosters open dialogue and the exchange of scientific ideas, promotes equal opportunities and treatment for all participants, and is free of harassment and discrimination. All participants are expected to treat others with respect and consideration, follow venue rules, and alert staff or security of any dangerous situations or anyone in distress. Speakers are expected to uphold standards of scientific integrity and professional ethics. The policies herein apply to all attendees, speakers, exhibitors, staff, contractors, volunteers, and guests at SEM/IMAC Conferences and related events.

SEM/IMAC prohibits any form of harassment, sexual or otherwise. Harassment should be reported immediately to SEM/IMAC Conference staff and via email: director@sem.org or (203) 790-6373 extension 100.

What is Harassment?

Harassment includes speech or behavior that is not welcome or is personally offensive, whether it is based on ethnicity, gender, religion, age, body size, disability, veteran status, marital status, sexual orientation, gender identity, or any other reason not related to scientific merit. It includes stalking, unnecessary touching and unwelcome attention.

Behavior that is acceptable to one person may not be acceptable to another, so use discretion to be sure that respect is communicated. Harassment intended in a joking manner still constitutes unacceptable behavior. Retaliation for reporting harassment is also a violation of this policy, as is reporting an incident in bad faith.

Reporting Harassment

SEM/IMAC is committed to supporting a productive and safe working environment for everyone at our conferences. If an individual experiences, or witnesses, harassment, they should contact SEM/IMAC Conference staff and via email: director@sem.org or (203) 790-6373 extension 100, or, if during a conference, by using a venue phone and ask for security if they feel unsafe. All complaints will be treated seriously and responded to promptly.

If an individual experiences harassment, it is recommended that, in addition to notifying SEM/IMAC Conference staff, they write down the details, as they may be asked to fill out a report. They are not expected to discuss the incident with the offending party. Their confidentiality will be maintained to the extent that it does not compromise the rights of others.

Filing a Formal Complaint of Harassment

If an individual wishes to file a formal complaint of harassment:

- Notify SEM/IMAC Conference staff and via email: director@sem.org or (203) 790-6373 extension 100
- SEM/IMAC staff will discuss the details first with the individual filing the complaint, then with the alleged offender; seek counsel if the appropriate course of action is unclear; and report findings as needed to the SEM Executive Board
- SEM/IMAC will consult with the individual filing the complaint prior to taking any action

SEM/IMAC reserves the right to request the removal of any individual engaging in harassment type behavior from its Conferences. All conference fees shall not be refunded, the individual(s) will be prohibited from attending future SEM/IMAC Conferences and their employer or institution will be notified.

For any questions about this policy, please contact Nuno Lopes, Executive Director at director@sem.org or (203) 790-6373 extension 100. ■

Terms and Conditions

The following Terms and Conditions apply to the Society for Experimental Mechanics (SEM) website and to SEM Events, both online and in-person. As a condition of registration, you will be required to acknowledge and accept the SEM Terms and Conditions contained herein.

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Using our website indicates your acceptance of our terms and conditions. Your continued visits to our website after changes are posted to these terms and conditions will signify your acceptance of those changes.

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Event participants grant SEM the absolute right to take photographs and/or make audio and visual recordings of an event for any purpose in SEM-related publications, promotion or website, at its sole discretion.

Recording Policy

Conferences, courses, and sessions: Recordings of any kind are strictly prohibited without prior written consent of both SEM and the session presenter(s) or instructor. Attendees may not capture or use materials presented in any session/course room without written permission. Individuals not complying with this policy will be asked to leave a given session and/or asked to surrender their recording media. Refusal to comply with such requests is grounds for expulsion from the event.

Exposition: Recordings of any kind are prohibited without explicit permission from on-site company representatives. Individuals not complying with this policy will be asked to surrender their recording media and to leave the exhibition hall. Refusal to comply with such requests is grounds for expulsion from the event.

Event Access

Conference Events: All conference technical and networking events require a badge for admission. Registered attendees may bring a guest if they have been issued a badge. Registration badges for guests are available at the SEM registration desk onsite.

Exposition: Everyone who attends the exposition must be registered and have a badge. Only company representatives allowed in the exposition area during move-in and move-out

Payment Policy

SEM accepts VISA, MasterCard, American Express, checks and wire transfers as payment. For onsite registrations, only cash or credit card payments will be accepted. All registrations must be paid in full to access a conference. Invoice options are not available for credit card payments, only a system-generated receipt. All invoices must be requested more than 30 days before a conference start date.

Presentation Policy

One paid Conference registration is limited to no more than two presentations per registered individual. Author(s)/presenter(s) wishing to present more than 2 presentations must pay for two registrations or have a co-author/presenter register for the Conference.

Event Cancellation Policy

If for some unforeseen reason SEM should have to cancel an event, processed registration fees will be refunded to registrants. Registrants will be responsible for cancellation of travel arrangements or housing reservations and the applicable fees.

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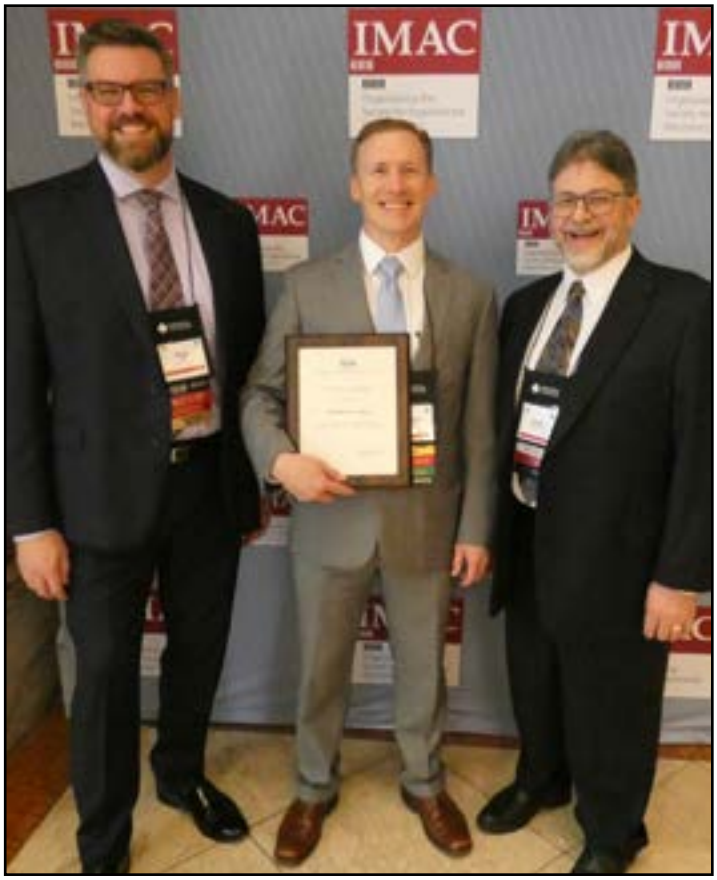

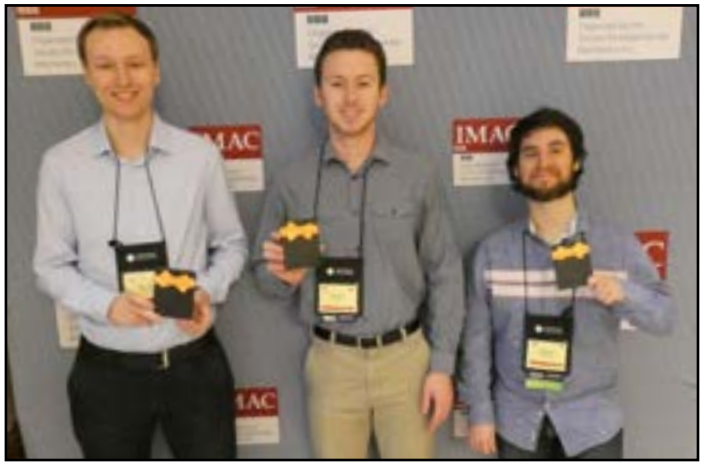

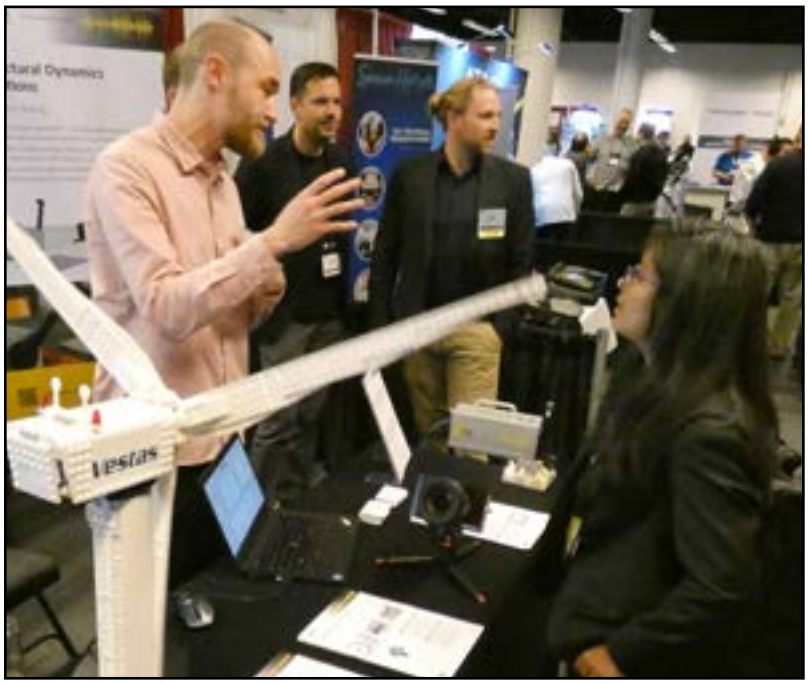

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- Or, visit www.whova.com/portal/imacx_202402/ in your web browser.

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1. Sign on to Whova with the same email as registered for the Conference on sem.org
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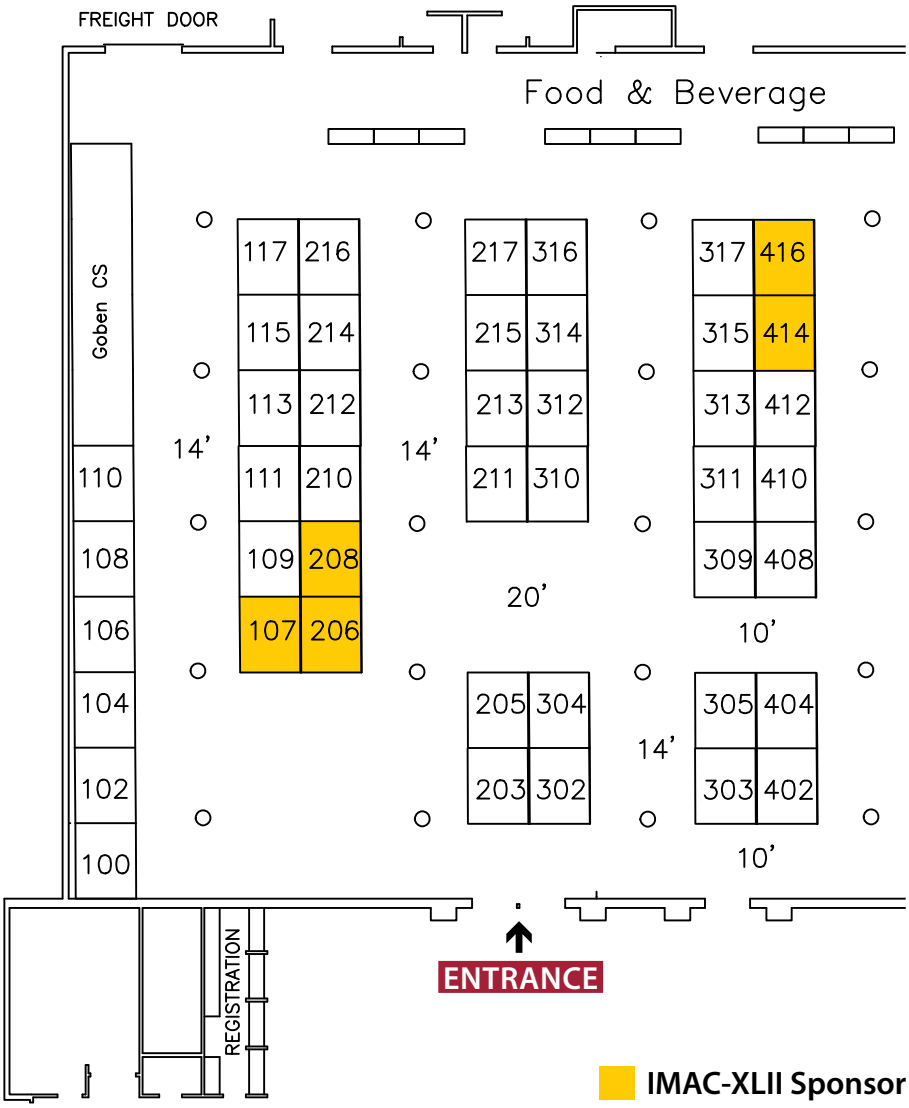
Rosen Plaza Floor Plan

Exposition Floor Plan



EXHIBITOR	BOOTH #
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ATA Engineering, Inc.	309
Correlated Solutions, Inc.	211
Crystal Instruments	**208**
Dantec Dynamics	315
Data Physics (NVT Group/Data Physics)	106
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ETS Solution NA LLC	214
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m+p international	**107**
MECALC Technologies, Inc.	216
Modal Shop, The	303-305-402-404
NV-Tech-Design	212
OmiSensing Photonics LLC	215
PCB Piezotronics, Inc.	303-305-402-404
Polytec, Inc.	310
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