84th Shock and Vibration Symposium

Atlanta | November 3-7, 2013

CONFERENCE PROGRAM

SAVE SHOCK & VIBRATION EXCHANGE

HI-TEST Laboratories, Inc.

NTS

PCB PIEZOTRONICS

Team VIBRATION TESTING EQUIPMENT

WEIDLINGER

Introduction

Welcome to Atlanta and the 84th Shock and Vibration Symposium!

Since the first meeting in 1947, the Shock and Vibration Symposium has become the oldest continual forum dealing with the response of structures and materials to vibration and shock. The symposium was created as a mechanism for the exchange of information among government agencies concerned with design, analysis, and testing. It now provides a valuable opportunity for the technical community in government, private industry, and academia to meet and discuss research, practices, developments, and other issues of mutual interest.

The symposium is presented by HI-TEST Laboratories and The Shock and Vibration Exchange. Our special event sponsors are National Technical Systems, PCB Piezotronics, Team Corporation, and Weidlinger Associates.

About the Host and Special Event Sponsors...

At **HI-TEST**, we work 24/7 to provide our customers with complete test program solutions, from pre-test analysis to post-test report generation. We have provided testing and evaluation services to government and industry since 1975. Today, HI-TEST is a single-source solution to your testing programs, offering numerical and analytical engineering tools and expertise alongside our world-class testing capabilities. We offer complete test support with our reputable and experienced team of engineers, instrumentation technicians, craftsmen and support staff, including design, fabrication and installation of test fixtures, as well as equipment repairs and modifications. In 2008, HI-TEST created the Applied Technology (AT) Division allowing us to offer numerical and analytical expertise alongside our testing capabilities.

Founded in 1961, **National Technical Systems (NTS)** is a publicly held company (NASDAQ: NTSC) providing a wide range of product design consulting services, testing and certifications services and supply chain management solutions. Our clients see us an extension of their own engineering teams, filling in their internal gaps and providing the expertise required to build better, stronger, safer, more reliable products and bring those products to market quickly and efficiently. With the largest network of test laboratories in North America and over 50 years of experience to draw from, NTS is prepared to meet any challenge. Because helping you achieve your goals is how we achieve ours!!

PCB Piezotronics was founded in 1967 as a manufacturer of piezoelectric quartz sensors, accelerometers, and associated electronics for the measurement of dynamic pressure, force, and vibration. The unique expertise of the company was the incorporation of microelectronic signal conditioning circuitry within these sensors to make them easier to use and more environmentally compatible. These ICP® sensors gained wide popularity and became the foundation for the company's success. Subsequent growth and steady investment in facilities, machinery, and equipment permitted a constant broadening of the product offering. Measurement capabilities expanded with the addition of piezoceramic, tourmaline, capacitive, piezoresistive, and strain gage sensing technologies. Ensuing products include industrial accelerometers, DC accelerometers, load cells, torque sensors, microphones, pressure transmitters, and calibration equipment.

Team Corporation designs builds and delivers high proformance vibration testing systems and related components. Team Corporation is located in picturesque Skagit Valley, approximately 50 miles north of Seattle, and just 76 miles south of Vancouver, BC, Canada. Well regarded for its mix of agriculture, technology, artistic coastal communities, tourism and world class outdoor activities, Skagit Valley is considered by many to be the jewel of western Washington. If quality of life is important to you, come and experience our, fresh air, action packed winters, lively and colorful spring festivals, adventurous, sun-drenched summers and brisk, colorful autumns for the ultimate in healthy living. For more information on our company location, mission statement and nearby events and adventures, click the appropriate heading.

For more than half a century, **Weidlinger Associates** has been known for its professionalism, innovative solutions, and diversified practice. As a leading structural engineering and applied mechanics consultant, we design and rehabilitate buildings, bridges, and infrastructure and develop advanced analysis software. We also offer special services in vulnerability assessment; risk analysis; forensic, earthquake, wind, and blast engineering; soil/structure interaction; and sustainability. The synergy of applied science research and structural engineering practice sets Weidlinger apart and leads to participation on projects of national and international significance. The scientific achievements and iconic designs that result are milestones for the firm. They are also evidence of a commitment to quality engineering and client-sensitive solutions that extends to every project we undertake and is the driving force of our corporate culture.

84th Shock and Vibration Symposium Committee

Mr. Chris Abate (General Dynamics Electric Boat)
Mr. Ed Alexander (BAE Systems)
Dr. Jonathan Arata (SIMULIA)
Dr. Vesta Bateman (Consultant)
Mr. James Breault (Lansmont Corp.)
Mr. Will Cobb (HI-TEST Labs)
Mr. Frederick Costanzo (NAVSEA Carderock)
Ms. Alicia D'Aurora (HII-NNS)
Mr. Ami Frydman (ARL)
Mr. Bill Gregory (HI-TEST Labs)
Ms. Krista Harris (NAVSEA Carderock)
Mr. Kurt Hartsough (NAVSEA Philadelphia)
Mr. Britton Kreitz (National Technical Systems)
Mr. Herb LeKuch (ShockTech/901D)
Mr. James Letternau (Endevco)
Dr. Tom Moyer (NAVSEA Carderock)
Mr. Sean Murphy (HII-Ingalls)
Mr. Drew Perkins (HI-TEST Labs)
Mr. Mike Poslusny (National Technical Systems)
Mr. Henry Pusey (HI-TEST Labs)
Mrs. Ashley Shumaker (HI-TEST Labs)
Ms. Margaret Tang (Weidlinger Assoc)
Mr. Bill Yancey (HI-TEST Labs)
Ms. Lauren Yancey (HI-TEST Labs)

PROGRAM OVERVIEW / DAILY OUTLINE / TOC

SUNDAY, NOVEMBER 3	TUTORIALS *TUTORIAL DESCRIPTIONS*	12:00PM—7:00PM -	P. 5 *P. 22-27*
MONDAY, NOVEMBER 4	TUTORIALS *TUTORIAL DESCRIPTIONS* IEST COMMITTEE MEETING: DTE-022 (MIMO) LS-DYNA USER GROUP MEETING WELCOME RECEPTION	8:00AM—7:00PM - 1:00PM—3:00PM 5:00PM—7:00PM 7:30PM—9:30PM	P. 6 *P. 22-27* P. 7 P. 7 P. 4
TUESDAY, NOVEMBER 5	OPENING SESSION EXHIBITORS' LUNCHEON TECHNICAL (TRACK) SESSIONS—P.M. IEST WORKING GROUP DTE RP 011, TRANSDUCER SELECTION PYROSHOCK WORKING GROUP XCITEX USER GROUP	8:45AM—11:30AM 11:30AM—1:00PM 1:00PM—5:20PM 1:00PM—2:30PM 5:00PM—7:00PM 5:30PM—6:30PM	P. 7 P. 4, 7 P. 8-11 P. 9 P. 10 P. 11
WEDNESDAY, NOVEMBER 6	TECHNICAL (TRACK) SESSIONS—A.M. SYMPOSIUM AWARDS LUNCHEON EXHIBIT HALL TOUR TIME TECHNICAL (TRACK) SESSIONS—P.M. ABAQUS USER GROUP SYMPOSIUM SOCIAL EVENT/DINNER	8:00AM—12:20PM 12:20PM—1:20PM 1:20PM—2:00PM 2:00PM—4:00PM 4:00PM—6:00PM 7:00PM—10:00PM	P. 12-15 P. 4, 14 P. 4, 15 P. 16-17 P. 16 P. 4, 17
THURSDAY, NOVEMBER 7	TECHNICAL (TRACK) SESSIONS—A.M. S&V COMMITTEE MEETING (*FORMERLY KNOWN AS TAG MEETING)*	8:00AM—Noon 2:00PM—3:30PM	P. 18-21 -

INTERNET CAFE	
Room: San Francisco	
HOSTED BY: WEIDLINGER	
Sunday, Nov 3	12PM—8PM
Monday, Nov 4	7AM—8PM
Tuesday, Nov 5	7AM—8PM
Wednesday, Nov 6	7AM—7PM
Thursday, Nov 7	7AM—12PM

EXHIBIT HALL SCHEDULE (Exhibitors Listed on Page 28-35)		
Monday, Nov 4	*Setup*	*3:00PM—10:00PM*
Tuesday, Nov 5	Exhibit Hall Open	11:00AM—5:00PM
	Exhibitors' Luncheon	11:30AM—1:00PM
	Session Break—PM	3:20PM—4:00PM
Wednesday, Nov 6	Exhibit Hall Open	7:30AM—5:00PM
	Session Break—AM	10:00AM—10:20AM
	Awards Luncheon	12:00PM—1:20PM
	Exhibit Hall Tour	1:20PM—2:00PM
	Dismantle	*5:00PM—10:00PM*
Thursday, Nov 7	*Dismantle (cont.)*	*8:00AM—Noon*

REGISTRATION	
Room: Cascade	
Sunday, Nov 3	9AM—6PM
Monday, Nov 4	7AM—6PM
Tuesday, Nov 5	7AM—6PM
Wednesday, Nov 6	7AM—6PM
Thursday, Nov 7	7AM—12PM

SPECIAL EVENTS

All Symposium Attendees Welcome at All Special Events (Except S&V Committee Meeting).
Guests Welcome at Monday Welcome Reception & Wednesday Evening Social

Monday, November 4th

• Welcome Reception	7:30pm—9:30pm	Azalea Room (Hyatt)

Tuesday, November 5th

• Continental Breakfast	7:00am—8:00am	Grand Ballroom & Foyer
• Exhibitors' Luncheon	11:30am—1:00pm	Grand Ballroom / Exhibit all

Wednesday, November 6th

• Continental Breakfast	7:00am—8:00am	Grand Ballroom & Foyer
• Symposium Awards Luncheon	12:00pm—1:20pm	Grand Ballroom / Exhibit Hall
• Symposium Social Event	7:00pm—10:00pm	Atlanta History Center

Thursday, November 7th

• Continental Breakfast	7:00am—8:00am	Grand Ballroom Foyer
• S&V Committee Meeting (Invt. Only)	2:00pm—3:30pm	Peachtree

Welcome Reception

Monday, Nov. 4 • 7:30pm—9:30pm • Azalea Room (Hyatt)

Sponsored by: National Technical Systems, TEAM, & HI-TEST Laboratories

Exhibitors' Luncheon

Tuesday, Nov. 5 • 11:30am—1:00pm • Grand Ballroom (Exhibit Hall)

Sponsored by: 84th Shock & Vibration Symposium Exhibitors

Symposium Awards Luncheon (followed by Exhibit Hall Tour)

Wednesday, Nov. 6 • 12:00—1:20pm • Grand Ballroom (Exhibit Hall)

Sponsored by: HI-TEST Laboratories

Symposium Social at *Atlanta History Center*

Wednesday, Nov. 6 • 7:00pm—10:00pm

Sponsored by: National Technical Systems, PCB Piezotronics & HI-TEST Laboratories

SUNDAY (NOVEMBER 3)

Tutorial Session 1 (Additional Fees Apply to Attend)

Time	*Tutorial & Presenter(s)*	*Meeting Room*
12:00 - 3:00	**MIL-S-901D Shock Qualification Testing** Mr. Kurt Hartsough & Mr. Domenic Urzillo	*Piedmont*
	Random Vibration Analysis and Specification of Environments Dr. Tom Paez	*Peachtree*
	Introduction to Pseudo-Velocity Data Analysis Dr. Vesta Bateman	*Lenox*
	An Introduction to Dynamics and DDAM Mr. Bart McPheeters	*Buckhead I*
	The Danger of "Sanctification" and Surrender to Social and Managerial Pressures in the Dynamic Environment Simulation Dr. Zeev Sherf	*Buckhead II*

Tutorial Session 2 (Additional Fees Apply to Attend)

Time	*Tutorial & Presenter(s)*	*Meeting Room*
4:00 - 7:00	**MIL-S-901D Shock Qualification Testing Extensions** Mr. Kurt Hartsough & Mr. Domenic Urzillo	*Piedmont*
	Introduction to Vibration Testing Mr. Jon Wilson	*Peachtree*
	Shock Response Spectra and Time History Synthesis Mr. Tom Irvine	*Lenox*
	Analysis for a Floating Shock Platform Test Mr. Bart McPheeters & Mr. Calvin Milam	*Buckhead I*
	Direct Field Acoustic Testing (DFAT) Mr. Paul A. Larkin & Mr. Dann Hayes	*Buckhead II*

MONDAY (NOVEMBER 4)

Tutorial Session 3 (Additional Fees Apply to Attend)

Time	*Tutorial & Presenter(s)*	*Meeting Room*
8:00 - 11:00	**MIL-S-901D Subsidiary Component Shock Testing & Alt. Test Vehicles** Mr. Kurt Hartsough & Mr. Domenic Urzillo	*Piedmont*
	Effective Solutions for Shock & Vibration Control Mr. Alan Klembczyk & Mr. Herb LeKuch	*Peachtree*
	Analysis for a Medium Weight Shock Machine Test Mr. Joshua Gorfain & Mr. Jeff Morris	*Lenox*
	Introduction to Hazard-Based Reliability Analysis Dr. George Lloyd	*Buckhead I*

Tutorial Session 4 (Additional Fees Apply to Attend)

Time	*Tutorial & Presenter(s)*	*Meeting Room*
Noon - 3:00	**MIL-S-901D Engineering Topics** Mr. Domenic Urzillo	*Piedmont*
	The Measurement & Utilization of Valid Shock & Vibration Data Dr. Patrick Walter	*Peachtree*
	Rainflow Cycle Counting for Random Vibration Fatigue Analysis Mr. Tom Irvine	*Lenox*
	Advanced FEMAP Training Mr. Bart McPheeters	*Buckhead I*
	Beyond the Shock Response Spectrum Mr. David Smallwood	*New York*
	MIL-S-901D Cost Avoidance and Clarification Letters - Explained Mr. Kurt Hartsough	*Azalea*

Tutorial Session 5 (Additional Fees Apply to Attend)

Time	*Tutorial & Presenter(s)*	*Meeting Room*
4:00 - 7:00	**Shock Test Failure Modes** Mr. Kurt Hartsough & Mr. Domenic Urzillo	*Piedmont*
	Fundamentals of Multiple-Input/Multiple-Output Vibration Testing Mr. David Smallwood	*Peachtree*
	UNDEX Analysis of Floating Structures Dr. Ray Daddazio & Mr. Fred Costanzo	*Lenox*
	Theoretical and Computational Analysis of Composite Materials and Structures Dr. Tom Moyer & Mr. Bart McPheeters	*Buckhead I*
	Fatigue and Durability: Explained Mr. Erik Ostergaard	*New York*

1:00-3:00	**IEST Committee Meeting DTE-022; MIMO Recommended Practice Committee** Chairs: Mr. Tony Keller & Mr. Russ Ayres (Spectral Dynamics) Using more than one shaker to test large or unusually shaped objects is becoming an accepted part of the vibration testing industry. As interest in simultaneously testing articles in multiple axis increases, the need for guidelines to understand MIMO (multiple input multiple output) testing grows more important. Come get up to speed and contribute to our growing database on multi shaker concepts, fixturing, control, and reporting.	*Meeting Room: Buckhead II*

MONDAY (NOVEMBER 4)

5:00-7:00	**LS-DYNA User Group Meeting** *Meeting Room: Buckhead II* Chair/Organizer: Dr. Len Schwer (Schwer Engineering) LS-DYNA and its predecessor, LLNL DYNA3D, were originally developed for military and defense applications, and are widely used in both the DoD and DoE. LS-DYNA has advanced features for defense applications, including simulating projectile penetration, blast response, explosives modeling, and underwater shock simulation. This discussion group is an opportunity for engineers to meet with Livermore Software Technology Corporation (LSTC) personnel, learn about recent developments in LS-DYNA, LS-PrePost, LS-Opt, discuss applications of LS-DYNA to their problems, share best practices, and make requests for new features. The meeting is supported by Livermore Software and Technology Corporation (LSTC) and moderated by Dr. Len Schwer of Schwer Engineering & Consulting Services. You may contact Len (Len@Schwer.net) for more information, comments, or suggestions. The invited speaker this year is Dr. Nicolas Aquelet, a developer at LSTC for the LS-DYNA Multi-Material Arbitrary Lagrangian Eulerian (MM-ALE) capability. Dr. Aquelet provided the 1D-spherical and 2D-axisymmetric MM-ALE versions, together with the ability to map these solutions onto three dimension models. Most recently he has introduced a capability to adaptivity refine/coarsen MM-ALE models. This technique has been expanded to traditional Lagrange meshes.

Welcome Reception

Monday, Nov. 4 • 7:30pm—9:30pm • Azalea Room (Hyatt)

Sponsored by: National Technical Systems, TEAM, & HI-TEST Laboratories

TUESDAY (NOVEMBER 5)

84TH SHOCK AND VIBRATION SYMPOSIUM
OPENING SESSION
(GRAND BALLROOM)

9:00	Call to Order/Welcome	Mr. Drew Perkins (HI-TEST Laboratories)
9:05	Symposium & SAVE Highlights	Mr. Drew Perkins (HI-TEST Laboratories)
9:15	S&V Committee Remarks	Mr. Fred Costanzo (NAVSEA Carderock / UERD)
9:25	Keynote Introduction	Ms. Margaret Tang (Weidlinger Associates)
9:30	Keynote Lecture	*TBD Title* Dr. Raymond Daddazio (Weidlinger Associates)
10:20	Break	
10:40	Elias Klein Lecture Introduction	Mr. Drew Perkins (HI-TEST Laboratories)
10:45	Elias Klein Lecture	*Excavation of the H.L. Hunley Submarine* Dr. Maria Jacobsen, Senior Archaeologist (Warren Lasch Conservation Ctr.)

EXHIBITORS' LUNCHEON

Tuesday, Nov. 5 • 11:30am—1:00pm • Grand Ballroom (Exhibit Hall)

Sponsored by: 84th Shock & Vibration Symposium Exhibitors

TUESDAY PM (NOVEMBER 5)

	TRACK 1	TRACK 2	TRACK 3
	UNDEX Modeling/Simulation I (1:00-1:40 / Stmt A) Training I (2:20-3:20 / Stmt A) Chair(s): Mr. George Schmeelk (GD Electric Boat)	Modeling & Testing for Shock & Blast (1:00-2:00 / Stmt D) Chair(s): Dr. Jon Arata (SIMULIA) Dr. George Lloyd (ACTA Inc.)	Structural Response in Naval Applications (1:00-1:40 / Stmt A) (2:00-2:20 / Stmt C) Cost Reduction-Naval App. (2:20-2:40 / Stmt C) Chair(s): Mr. Rick Griffen (HII - Newport News) Mr. Jarrod Gilmore (HII - Ingalls)
	All Presenters and Chairs (for Nov. 5th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading		
	Meeting Room: Buckhead I	***Meeting Room: Buckhead II***	***Meeting Room: Piedmont***
1:00	**Automated Ship Shock M&S Software Tool Integration The New Common Structural Model (CSM): Built-Up Stiffeners (10)** Dr. Russ Miller & Mr. Brian Rich (Alion Science and Technology), Mr. Paul Lara, Dr. Thomas Moyer, & Mr. Dan Bruchman (NAVSEA Carderock)	**Innovative Modeling of Buildings and Infrastructure Components for Functional Kill *(Lim. Dis. D+ incl. DOE, FBI, DHS)* (14)** Dr. George Lloyd (ACTA), Ms. Diane Verner & Mr. Randy Anderson (Applied Research Assoc.)	**Improved DDAM Analysis By A Residual Modal Mass Approach (12)** Mr. Rick Griffen (HII - Newport News Shipbuilding)
1:20	**Ship Shock M&S Optimization Using the Common Structural Model (CSM) (10)** Dr. Russ Miller & Mr. Brian Rich (Alion Science and Technology), Mr. Paul Lara, Dr. Thomas Moyer, & Mr. Dan Bruchman (NAVSEA Carderock)	**Evolving Methodologies for Probable Effects Modeling of Infrastructure Components *(Lim. Dis. D+ incl. DOE, FBI, DHS)* (14)** Dr. George Lloyd, Dr. Tim Hasselman, & Mr. Rayn Schnalzer (ACTA)	**Beating in Pipes Subjected to Shock (13)** Prof. Rudy Scavuzzo (Consultant), Mr. Domenic Urzillo (NAVSEA Philadelphia)
1:40		**Measurement and Interpretation of High-G Impact Event Acceleration Data (15)** Mr. Alma Oliphant, Dr. Jeff Simmers, & Dr. J. Scott Furlow (Applied Research Assoc.)	
2:00			**A Peridynamic Formulation of the Mindlin-plate (12)** Mr. Michael Miraglia & Dr. Tom Moyer (NAVSEA Carderock)
2:20	**Training:** **Optimizing Ship Structures to Address Dynamic/Shock Concerns** Mr. Daniel Pusey (Altair Engineering Inc.) *This workshop will teach the attendee how optimization can be incorporated into the design and analysis process to improve structural performance accounting for potential dynamic/shock loads. A demonstration incorporating optimization into the design/ analysis process as well as a discussion of past optimization projects will be provided as part of the presentation.*		**Cost Reduction Measures for Late Stage Outfitting (13)** Mr. Jarrod Gilmore & Mr. Sean Murphy (HII - Ingalls Shipbuilding)
2:40			

SYMBOL KEY: (#) - Correlating Page Number in Abstract Book

TUESDAY PM (NOVEMBER 5)

	OPEN DISCUSSION	TRAINING
	Open Discussion (1:00-2:40 / Stmt A)	Training II (1:00-2:00 / Stmt A) Training III (2:00-3:00 / Stmt A)
	Presenters and Chairs (for Nov. 5th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading	
	Meeting Room: Azalea	***Meeting Room: Library***
1:00		**Introduction to Finite Element Analysis** Mr. Bart McPheeters (NEi Software) This class will focus on the practical aspects of finite element theory and modeling techniques. We will work through a few examples to demonstrate the application of theory and examine some of the implications of using it. We will conclude with a section on practical modeling tips for a diverse array of problems, including choosing elements, modeling approaches. We will discuss some of the issues with stiffened shells, bolts, resilient mounts, and rigid representations and the pros and cons of different approaches. Finally, the tutorial will examine result post processing and some of the common issues that come up in that area.
1:20	**History, Evolution, & Growth of Naval Shock Testing** Mr. Jerry Sullivan (Consultant) Mr. Henry Pusey (Consultant) This forum/talk will begin with a 45-minute presentation of the evolution of Naval shock testing from the post WW-II days to today. Advancements in test operations, testing vehicles, instrumentation, and standards/ specifications will be presented. An open discussion will follow.	
1:40		
2:00		**Introduction to Nonlinear Analysis** Mr. Bart McPheeters (NEi Software) This class will provide an introduction to nonlinear engineering problems. We will identify characteristics of a nonlinear problem and discuss exactly what makes a problem nonlinear. The class will describe the different types of nonlinearities and what distinguishes a nonlinear problem from a linear one. We will discuss strategies for solution of nonlinear problems, and the limits of different solutions methods. Additionally, we will discuss implicit and explicit finite element codes and how each can be best used (either alone or together) to solve a nonlinear problem.
2:20		
2:40		

1:00-2:30	**IEST Working Group DTE RP 011, Transducer Selection** Chair: Mr. Jon Wilson (Wilson Consulting) Continuing discussions on updating the IEST RP on vibration transducer selection. A tentative draft of the updated RP will be available for comment.	***Meeting Room: Veranda***

TUESDAY PM (NOVEMBER 5)

	TRACK 1	TRACK 2	TRACK 3
	Vibration I (4:00-5:20 / Stmt A) Chair(s): Mr. Michael Poslusny (National Technical Sys.) Mr. Jordan Dunn (SAIC - NAVSEA Crane)	Blast Protection (4:00-5:00 / Stmt A) Blast Measurements I (5:00-6:00 / Stmt A) Chair(s): Dr. Ady Aviram (Simpson, Gumpertz, & Heger)	UNDEX Testing I (4:00-4:20 / Stmt D) (4:20-5:40 / Stmt C) (5:40-6:00 / Stmt A) Chair(s): Mr. Fred Costanzo (NAVSEA Carderock) Mr. Chris Abate (GD Electric Boat)
	All Presenters and Chairs (for Nov. 5th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading		
	Meeting Room: Buckhead I	***Meeting Room: Buckhead II***	***Meeting Room: Piedmont***
4:00	**Experimental Characterization of a Nonlinear Joint (15)** Dr. Laura Jacobs-O'Malley (Sandia National Laboratories)	**Recommended Minimum Standoff Distance for Conventional Steel Stud Infill Walls Subject to External Blast Loads (16)** Dr. Bryan Bewick (Protection Engineering Consultants), Mr. Casey O'Laughlin (Jacobs Technology), Dr. Eric Williamson (University of Texas at Austin)	**UNDEX Induced Injury Test Series: Post Test Analysis and Validation Efforts (20)** Ms. Krista Harris, Mr. Thomas Brodrick, Dr. E Thomas Moyer, & Dr. Timothy Walilko (NAVSEA Carderock)
4:20	**Predicting Fatigue Failure of a Circuit Board in Random Vibration: The Reference Model (15)** Mr. Troy Savoie & Mr. Vit Babuska (Sandia National Laboratories)	**Structural Silicone Effect on Window Frames Subjected to Blast Loading (17)** Mr. David Holgado & Mr. Darrell Barker (ABS Consulting), Dr. Manuel Diaz (University of Texas)	**Summary of U.S. Airgun Testing Experiences to Date (20)** Mr. Frederick Costanzo (NAVSEA Carderock/ UERD)
4:40	**Steady-state Exterior Acoustic Simulation of BeTSSi Submarine (16)** Mr. Shantharam Dravida & Mr. Andrzej Bajer (Dassault Systemes Simulia Corp)	**Recent Experimental Validation of Blast Resistant Modules Consisting of Tube Framing and an Innovative Steel Stud Wall System (17)** Dr. Ady Aviram, Dr. Ronald L. Mayes, & Mr. Ronald O. Hamburger (Simpson, Gumpertz, & Heger), Dr. Gilbert A. Hegemier (UCSD), Dr. Lauren K. Stewart (Georgia Tech)	**Brief Overview of FY 12 FSP Test Series (Airguns and UNDEX vs. Equipment) (20)** Mr. Brian Lang, Mr. A.J. Corbishdale, Dr. Bradley Klenow, Mr. Scott Yamada, Mr. Thomas Brodrick, & Frederick Costanzo (NAVSEA Carderock)
5:00	**Development of Active Hybrid Mount for Naval Shipboard Equipment (16)** Dr. Yun-ho Shin & Dr. Seok-jun Moon (Korea Institute of Machinery and Materials), Dr. Woo-jin Jung (Agency for Defence Development)	**Measuring Explosive Blast Loading through the use of Load Cells (18)** Dr. Robert Abernathy, Mr. Leonard C. Garcia, & Mr. Paul Giannuzzi (New Mexico Tech EMRTC)	**Airgun Source Modeling – Development and Validation (20)** Ms. Margaret Tang, Mr. Ryan Anderson, Mr. Adam Hapij, Mr. Joseph Wright, & Dr. Raymond P. Daddazio (Weidlinger Assoc.)
5:20		**Optical Measurement of Airblast Shock Wave Pressures (19)** Dr. Michael Hargather & Ms. Jessica Tobin (New Mexico Tech EMRTC)	**Development of Airgun Source Model Library (21)** Mr. Ryan Anderson, Dr. Kirubel Teferra, Mr. Joseph Wright, Ms. Margaret Tang, Mr. Adam Hapij, & Dr. Raymond Daddazio (Weidlinger Assoc.)
5:40		**Ultra High-speed Fiber Optics Strain Measurements Based on Rapid Edge-filter Monitoring of Fiber Grating Spectra (19)** Mr. Tom Graver, Mr. Brian Soller (MicronOptics)	**Update on Canada's Airgun Program (21)** Mr. Jan Czaban (Royal Canadian Navy)

5:00-7:00	**Pyroshock Working Group** Chair: Dr. Vesta Bateman (Mechanical Shock Consulting)	***Meeting Room: New York***
	The changes to MIL-STD-810G, Change 1, for Method 516 for Shock (SME Mike Hale), Method 517 for Pyroshock (SME Vesta Bateman), and Method 522 (SME Scott Walton) will be presented and discussed including the new requirements for data acquisition and an Appendix about data analysis in Method 517. Anyone can join this group, so please come and provide your knowledge and expertise! Significant changes have been made based on comments from last year's group meeting.	

TUESDAY PM (NOVEMBER 5)

	TRACK 4	TRACK 5	TRAINING
	DS: Modeling, Simulation, & Validation of High Shock Events (4:00-6:00 / Stmt D) Chair(s): Dr. Janet Wolfson (AFRL)	DS: Recent Developments in Progressive Collapse Research (4:00-5:40 / Stmt A) Chair(s): Dr. Mohammed Ettouney (Weidlinger Assoc.) Ms. Margaret Tang (Weidlinger Assoc.)	Training IV (4:00-5:00 / Stmt A)
	All Presenters and Chairs (for Nov. 5th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading		
	Meeting Room: Lenox	***Meeting Room: Azalea***	***Meeting Room: Library***
4:00	**Grand Challenge: Prediction of Models under Shock Loading (21)** Dr. Janet Wolfson (AFRL)	**An Analytical Tool for the Identification of the Type of Progressive Collapse Mode of Steel Moment Frames Subjected to Corner Column Removal (23)** Dr. Simos Gerasimidis, Ms. Athina Spyridaki, & Dr. George Deodatis (Columbia University), Dr. Mohammed Ettouney (Weidlinger Assoc.)	**Performing UNDEX Analysis with Abaqus/Explicit** Dr. Jonathan Arata (Dassault Systemes SIMULIA) In this UNCLASSIFIED training session, attendees will learn how to simulate UNDEX problems using Abaqus/Explicit, a general purpose multi-physics tool from Dassault Systèmes Simulia Corp. During this training, we will demonstrate how Abaqus/Explicit can be used to set up and effectively solve the UNDEX problem, with a principal focus on employing the Coupled Eulerian-Lagrangian (CEL) method for simulating near-field attacks. We will also discuss the use of Smoothed Particle Hydrodynamics (SPH) techniques for the near-field problem, as well as the incident-wave acoustic approach to far-field attacks.
4:20	**Characterization of a Reverse Ballistics Test (22)** Dr. Jason Foley, Dr. Ryan Lowe, Ms. Erin Silva, & Dr. Brian Plunkett (AFRL), Mr. Chris Mougeotte & Dr. Jennifer Cordes (U.S. Army ARDEC)	**Progressive Collapse of 3D Steel Moment Frames Due to Loss-of-Stability Phenomena (24)** Dr. Simos Gerasimidis, Ms. Thaleia Kontoroupi, & Dr. George Deodatis (Columbia University), Dr. Mohammed Ettouney (Weidlinger Assoc.)	
4:40	**SRS of a Blast Simulator (22)** Dr. Lauren Stewart, Mr. Brad Durant, & Dr. Gilbert Hegemier (UCSD), Dr. Janet Wolfson (AFRL)	**A Global Loss of Stability Study for Progressive Collapse of Tall Steel Moment Frames (24)** Dr. Simos Gerasimidis, Mr. Yan Yan, & Dr. George Deodatis (Columbia University), Dr. Mohammed Ettouney (Weidlinger Assoc.)	
5:00	**Characterization of the Local Dynamics in Polymeric Composites (23)** Dr. Jacob Dodson & Dr. Janet Wolfson (AFRL), Dr. Alain Beliveau (ARA)	**Retrofit of Existing Buildings to Prevent Progressive Collapse (25)** Dr. Macarena Schachter Adaros & Dr. Robert Smilowitz (Weidlinger Assoc.)	
5:20	**Effects of Boundary Confinement on Wave Propagation (23)** Dr. Janet Wolfson, Dr. Jacob Dodson, & Dr. Jason Foley (AFRL)	**Progressive Collapse Considerations for Bridges (25)** Dr. Mohammed Ettouney (Weidlinger Assoc.), Dr. Sreenivas Alampalli (New York State Department of Transportation)	
5:40			

5:30-6:30	**Xcitex's ProAnalyst User Group Meeting** Chair: Mr. Peter Carellas (Xcitex)	***Meeting Room: Library***
	The Xcitex's ProAnalyst User Group Meeting is where we gather our current and future users of ProAnalyst motion analysis software to discuss features, applications and usage techniques. Xcitex engineers will be on-hand, in an informal interactive setting, to review and present new developments in ProAnalyst. Feel free to bring your videos for review.	

WEDNESDAY AM (NOVEMBER 6)

	TRACK 1 DS: Dr. Howard Gaberson Memorial Session (8:00-10:00 / Stmt A) Chair(s): Dr. Vesta Bateman (Mechanical Shock Conslt.) Mr. Ed Alexander (BAE Systems)	TRACK 2 Modeling of Blast Resistant Structures (8:20-9:20 / Stmt A) Chair(s): Mr. John Rehard (National Technical Systems)	TRACK 3 DS: DYSMAS Enhancements and Applications for UNDEX, AIREX & Buried Blast (8:00-10:00 / Stmt C) Chair(s): Mr. Roger Ilamni (NAVSEA Indian Head) Mr. Jeffrey St. Clair (NAVSEA Indian Head)
	All Presenters and Chairs (for Nov. 6th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading		
	Meeting Room: Buckhead I	***Meeting Room: Buckhead II***	***Meeting Room: Piedmont***
8:00	**Remembering Dr. Howard Gaberson (25)** Mr. Henry Pusey (HI-TEST Laboratories)		**Recent Improvements to Modeling Afterburn in DYSMAS/FD (29)** Mr. Jeffrey St. Clair & Dr. Thomas McGrath (NAVSEA Indian Head)
8:20	**Overview of the New American National Standard for Shock Testing Equipment (25)** Mr. Brian Lang (NAVSEA Carderock), *presented by:* Mr. Fred Costanzo (NAVSEA Carderock)	**Combined Axial and Blast Resistance Characterization of Steel Stud Walls (27)** Dr. Ady Aviram & Dr. Ronald Mayes (Simpson, Gumpertz, & Heger), Mr. Casey O'Laughlin (Jacobs Technology)	**Use of DYSMAS to Model Airblast Loading Effects (30)** Mr. Roger Ilamni & Dr. Thomas McGrath (NAVSEA Indian Head)
8:40	**A COTS Shock Failure SRS Based on Testing (26)** Mr. Russ Miller (Alion Science and Technology), Mr. Fred Costanzo & Dr. Thomas Moyer (NAVSEA Carderock)	**Beyond Biggs – Review, Implementation and Comparison of Modern SDOF Analysis (28)** Mr. Roope Kotiranta & Mr. Henri Lotvonen (Surma Ltd)	**Underwater Explosion Testing & Analysis of a 12:1 Ammonium Nitrate / Aluminum Explosive (30)** Mr. Thomas Griffin, Dr. Thomas McGrath, & Mr. Greg Harris (NAVSEA Indian Head), Mr. William Lewis & Mr. Kent Rye (NAVSEA Carderock)
9:00	**Pseudo Velocity and its Application to Space Structures (26)** Dr. Ali Kolaini (Jet Propulsion Lab), *presented by:* Dr. Vesta Bateman (Mechanical Shock Consulting)	**Finite Element and Single-Degree-of-Freedom Simulations of Steel Stud Walls under Impulsive Blast Pressures (29)** Dr. Ady Aviram, Dr. Ronald Mayes, & Mr. Ronald Hamburger (Simpson, Gumpertz, & Heger)	**Computational Modeling of a 12:1 Ammonium Nitrate / Aluminum Explosive in Underwater Explosion Scenarios (30)** Dr. Thomas McGrath & Mr. James Warner (NAVSEA Indian Head)
9:20	**Update 2DOF Model of the MWSM to Include Damping and Matlab Function (27)** Mr. Ed Alexander (BAE Systems)		**An Improved HBX-1 EOS for Underwater Explosion Simulations (31)** Mr. Brian Howell (NAVSEA Indian Head), *presented* by: Mr. Jeffrey St. Clair (NAVSEA Indian Head)
9:40	**Update 2DOF Model of the MWSM to Include Damping and Matlab Function (cont.)** Mr. Ed Alexander (BAE Systems)		**An Initial Implementation of Eulerian Material Strength in DYSMAS (31)** Dr. Thomas McGrath & Mr. Jeffrey St. Clair (NAVSEA Indian Head)

SYMBOL KEY: (#) - Correlating Page Number in Abstract Book

WEDNESDAY AM (NOVEMBER 6)

	TRACK 4	TRAINING
	DS: Objective Methods in Resilience Management (8:00-9:40 / Stmt A) Chair(s): Dr. Mohammed Ettouney (Weidlinger Assoc.) Ms. Margaret Tang (Weidlinger Assoc.)	Training V (8:00-9:00 / Stmt A) Training VI (9:00-10:00 / Stmt A)
	All Presenters and Chairs (for Nov. 6th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading	
	Meeting Room: Lenox	***Meeting Room: Library***
8:00	**Resilience Managements and Engineering Mechanics (31)** Dr. Mohammed Ettouney (Weidlinger Assoc.)	**Survey of Structural-acoustic Simulations with Abaqus Unified FEA** Mr. Shantharam Dravida & Dr. Jonathan Arata (Dassault Systemes SIMULIA) In this UNCLASSIFIED training session, attendees will learn how to perform structural-acoustic simulations using the steady-state dynamics methodology available in Abaqus/Standard, a general purpose multi-physics tool from Dassault Systèmes Simulia Corp. During this training, we will demonstrate how setup and run Steady-state dynamic analyses in Abaqus/Standard, using Benchmark Target Strength Simulation (BeTSSi) submarine example model. Two distinct approaches: the direct-solution and the mode-based solution, that are available in Abaqus/Standard will be discussed along with their mutual benefits/limitations will also be discussed.
8:20	**Resiliency as Part of the Bigger Goal of High Performance (31)** Mr. Martin Denholm (SmithGroup)	
8:40	**Sustainability and Resilience in Infrastructure (31)** Ms. Margaret Tang & Ms. Colleen Kirk (Weidlinger Assoc.)	
9:00	**Measuring and Managing Resilience in Existing Facilities (32)** Mr. Roger Grant (National Institute of Building Sciences)	**A Deterministic Methodology for Designing a Measurement System for a Given SRS Error Allowance** Mr. Doug Firth & Mr. Alan Szary (Precision Filters) In this training, we develop a systematic approach to determine how to use any low-pass filter to make valid shock measurements for a subsequent Shock Response Spectrum computation. We propose a quantitative method for describing the error in the SRS caused by the characteristics of the accelerometer and the low-pass filter. We develop a methodology for setting the filter cutoff for a given SRS error budget that includes errors from the accelerometer transfer function. We discuss how to set the sampling frequency to avoid aliasing. Finally we give practical examples of using the methodology to design measurement systems for commonly used PE and PR accelerometers.
9:20	**Planning Resilient Buildings (32)** Mr. Roger Grant (National Institute of Building Sciences)	
9:40		

WEDNESDAY AM (NOVEMBER 6)

	TRACK 1	TRACK 2	TRACK 3
	Modeling for Shock Response (10:20-11:20 / Stmt A) Modeling for Structural Response (11:20-12:00 / Stmt A) Chair(s): Mr. Ed Alexander (BAE Systems) Mr. Bart McPheeters (NEi Software)	Ballistic Testing, Simulation, & Performance (10:20-Noon / Stmt A) Chair(s): Mr. Chris Key (HI-TEST Laboratories) Mr. Rob Sharp (Hutchinson N.A.)	Isolation I - DS: U.K. Navy Mount Program (10:40-Noon / Stmt A) Chair(s): Dr. David Russell (BAE Systems)
	All Presenters and Chairs (for Nov. 6th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading		
	Meeting Room: Buckhead I	***Meeting Room: Buckhead II***	***Meeting Room: Piedmont***
10:20	**Efficient Generation of Analysis Models for Ship Structures (32)** Mr. Daniel Pusey, Mr. Len Covian, & Dr. Dhiren Marjadi (Altair Engineering)	**A Scaled Model Describing the Rate-Dependent Strength of Brittle Materials (35)** Dr. Jamie Kimberley (New Mexico Institute of Mining and Technology), Prof. Nitin P. Daphalapurkar & Prof. K.T. Ramesh (Johns Hopkins University)	
10:40	**Optimization Driven Design Process for Foundations (33)** Dr. Dhiren Marjadi & Mr. Daniel Pusey (Altair Engineering)	**Liner Collapse and Jetting Process of Linear Shaped Charges (35)** Dr. Seokbin Lim (New Mexico Tech / EMRTC)	**UK Navy Mount Shock Characterisation Programme Overview (37)** Mr. Thomas Priestley & Mr. Matthew Brownlow (BAE Systems)
11:00	**Time-Domain Analysis and Empirical Modeling of Shock Responses (33)** Mr. Robert Martinez (C.S. Draper Laboratory)	**Analysis of Multiple-Impact Ballistic Performance of a Tempered Glass Laminate with a Strike Face Film (35)** Mr. Michael Magrini (Jacobs Technology)	**Testing of UK Navy Mount and Snubbers to Obtain Shock Characterisation Data (37)** Mr. Thomas Priestley & Mr. Matthew Brownlow (BAE Systems)
11:20	**Failure Analysis of Aluminum Structures Subjected to Fire (33)** Dr. Pawel Woelke, Mr. Badri Hiriyur, Mr. Brett Benowitz, Mr. Ryan Anderson, & Dr. Najib Abboud (Weidlinger Assoc.)	**Plastic Deformation of Steel Plates under High Impact Loading (36)** Mr. S. Roy, Dr. M. Trabia, Dr. B. O'Toole, Dr. J. Thota, Mr. R. Jennings, Mr. D. Somasundarum, & Ms. M. Matthes (University of Nevada, Las Vegas), Mr. S. Becker, Mr. E. Daykin, Dr. R.Hixson, Mr. E. Machorro, Mr. T. Meehan, Mr. M. Pena, Mr. C. Perez, Mr. N. Snipe, Ms. K. Crawford, & Mr. S. Gardner (National Security Technologies, LLC)	**Development of UK Navy Mount and Snubber Shock Characterisations (38)** Mr. Matthew Brownlow & Mr. Thomas Priestley (BAE Systems)
11:40	**Ductile Fracture Simulation for Large-Scale Structures (34)** Dr. Pawel Woelke & Mr. Badri Hiriyur (Weidlinger Assoc.), Mr. John Hutchinson (Harvard University)	**Dynamic Finite Element Analysis of a Cradle System (37)** Mr. Bulent Acar & Mr. Ali Yetgin (Roketsan Missile Ind. Inc.), Dr. Suat Kadioglu (Middle East Technical University)	**Implementation of UK Navy Mount and Snubber Shock Characterisations as User Elements for Shock Analysis (38)** Mr. Matthew Brownlow & Mr. Thomas Priestley (BAE Systems)

AWARDS LUNCHEON

Wednesday, Nov. 6 • Noon-1:20PM • Grand Ballroom (Exhibit Hall)

12:40PM - Henry Pusey "Best Paper" Award Presentation
1:00PM - Lifetime Innovation Award Presentation

WEDNESDAY AM (NOVEMBER 6)

	TRACK 4	TRACK 5	TRAINING
	Numerical Methods of Structural Responses (10:20-10:40 / Stmt C) Advancements in Instrumentation (11:00-11:40 / Stmt C) (11:40-12:00 / Stmt A) Chair(s): Mr. Randy Martin (Meggitt)	UNDEX Modeling/Simulation II (10:20-11:40 / Stmt A) Chair(s): Mr. Bob Krezel (HII - Newport News)	Training VII (10:20-12:20 / Stmt A)
	All Presenters and Chairs (for Nov. 6th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading		
	Meeting Room: Lenox	***Meeting Room: Azalea***	***Meeting Room: Library***
10:20	**Near Miss Lethality (NML) LS-DYNA Modeling of Buried Weapons (39—"Untitled")** Dr. Alexander Paleocrassas, Mr. Bob Frank, & Dr. James Pearson (Applied Research Assoc.), Mr. Nick Leon (DTRA)	**An Innovative Numerical Spectral Method to Model Sonar Antennas and Transducers Against UNDEX Loading (40)** Dr. Gerard Vanderborck (Thales Underwater Systems - France), Ms. Margaux Masclef (ISEN - France)	**Introduction to Heavyweight Shock Testing** Mr. Travis Kerr (HI-TEST Laboratories) This training will cover the necessary background information relative to heavyweight shock testing. This session is intended for engineers and product developers who are unfamiliar with the heavyweight shock testing process. Subjects covered include pre-test planning, procedure preparation, fixture design, test set-up, test operations, instrumentation interpretation, and reporting. Construction and use of the floating shock platforms (FSP, IFSP, and LFSP) will be covered. MIL-S-901D test requirements applicable to heavyweight shock testing will be discussed.
10:40		**Study for Shock Response of Shipboard Equipment According to Analysis Method Against Non-contact Underwater Explosion (41)** Dr. Jeong Il Kwon & Dr. Jung Hoon Chung (Korea Institute of Machinery & Materials), Mr. Won Ki Kang (Daewoo Shipbuilding & Marine Engineering Co.)	
11:00	**Design Features of the New Generation of High-shock MEMS Accelerometer Die with Extreme Survivability Performance (39)** Mr. Tom Kwa (Meggitt Sensing Systems)	**Feature-Based Model Validation (41)** Dr. David Manko (Sandia National Laboratories)	
11:20	**Preliminary Test Results of the New High-g Shock SMT Triaxial Accelerometers (39)** Mr. Randy Martin & Mr. James Letterneau (Meggitt Sensing Systems)	**3D Finite Element Modeling of Bolted Connections (41)** Dr. Emily Guzas, Mr. Kevin Behan, Mr. John Davis, & Mr. Jeffrey Milburn (NUWC Newport)	
11:40	**Building a Legacy for the New Endevco® Family of Damped Accelerometers through Laboratory and Field Testing (12)** Mr. James Letterneau (Meggitt Sensing Systems), Dr. Vesta Bateman (Mechanical Shock Consulting)		

EXHIBIT HALL TOUR

Wednesday, Nov. 6 • 1:20PM-2:00PM • Grand Ballroom (Exhibit Hall)

Enjoy your dessert as your tour the exhibit hall. This 40-minute touring time offers attendees the chance to tour the exhibits with no other conflicts in the program.

WEDNESDAY PM (NOVEMBER 6)

	TRACK 1	TRACK 2	TRACK 3
	DS: Acceleration Sensing Technologies for Severe Mechanical Shock (2:00-3:40 / Stmt A) Chair(s): Dr. Patrick Walter (TCU/PCB)	Blast - Modeling/Simulation I (2:00-3:40 / Stmt A) Chair(s): Dr. Len Schwer (Schwer Engineering)	UNDEX Testing II (2:00-3:20 / Stmt C) UNDEX Simulation (3:20-4:00 / Stmt C) Chair(s): Ms. Alicia D'Aurora (HII - Newport News Shp.) Mr. Rick Griffen (HII - Newport News Shp.)
	All Presenters and Chairs (for Nov. 6th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading		
	Meeting Room: Buckhead I	***Meeting Room: Buckhead II***	***Meeting Room: Piedmont***
2:00	**Challenges Among Sensing Technologies for Severe Mechanical Shock (42)** Dr. Patrick Walter (TCU Engineering Dept. / PCB Piezotronics)	**Advancements in Blast Simulator Analysis (43)** Mr. Aaron Freidenberg (UCSD)	**Comparison of Deck Simulating Shock Machine (DSSM) Test Response to FSP Shock Tests on Class II Enclosures (46)** Mr. John R. Krezel, Ms. Jennifer M. Arney, & Dr. Michael A. Talley (HII - NNS)
2:20	**Design Considerations for Isolated Piezoelectric Accelerometers in Severe Mechanical Shock (42)** Mr. Anthony Agnello (PCB Piezotronics)	**Scalable Fidelity Shock Propagation Simulations with a Meshless Solver (43)** Mr. Bryan Susi & Mr. Evan McCorkle (Applied Research Assoc.)	**Development Of A Component-Level Shock Test Environment From FSP Principal Unit Testing (46)** Mr. Rick Griffen & Mr. Matt Davis (HII-Newport News Shipbuilding)
2:40	**Design Considerations for Isolated and Non-Isolated MEMS Accelerometers in Severe Mechanical Shock (42)** Mr. Robert Sill (PCB Piezotronics)	**Applied Energy Calculation for Predicting Breach of Steel Plates by Close-in Detonation (44)** Dr. Eric Williamson & Mr. Rob Hendryx (University of Texas at Austin), Mr. John Puryear (Protection Engineering Consultants)	**Design And Implementation Of A Type B Component Shock Test Using A Nonstandard Medium Weight Shock Machine Arrangement (47)** Mr. Matt Davis & Mr. Rick Griffen (HII-Newport News Shipbuilding)
3:00	**Laboratory Evaluations of Accelerometer Technologies Employed in Severe Mechanical Shock (42)** Mr. Jeffrey Dosch (PCB Piezotronics)	**A Simplified Dynamic Response Model for Reinforced Concrete Bridge Columns Subjected to Small-Standoff Detonations (45)** Dr. Eric Williamson & Mr. Eric Sammarco (University of Texas at Austin), Mr. John Puryear (Protection Engineering Consultants)	**Test Design And Execution Of A Type B Component Shock Test Using A Nonstandard Medium Weight Shock Machine Arrangement (47)** Mr. Matthew Conley & Mr. Rick Griffen (HII - Newport News Shipbuilding)
3:20	**Field Performance of Acceleration Sensing Technologies (Case Studies) (43)** Mr. Bob Metz (PCB Piezotronics)	**Mach Stem Pressures: Comparison of Experiments with Empirical and Numerical Models (45)** Dr. Len Schwer (Schwer Engineering)	**Navy Enhanced Sierra Mechanics: Full Physics Simulation Of Ship Shock Response & Damage (47)** Dr. Thomas Moyer, Mr. Raymond DeFrese, & Mr. Jonathan Stergiou (NAVSEA Carderock)
3:40			**An Underwater Shock Simulator for Composite Laminates (47)** Dr. David Hufner & Mr. Matthew Augustine (General Dynamics Electric Boat)

4:00-6:00	**Abaqus Users Group Meeting** Chair: Mr. Peter Nannucci (Dassault Systemes SIMULIA)	***Meeting Room: Veranda***

SIMULIA is the Dassault Systèmes brand that delivers a portfolio of Realistic Simulation solutions including the Abaqus product suite for Unified Finite Element Analysis, multiphysics solutions for insight into challenging engineering problems, and product lifecycle management solutions for managing simulation data, processes, and intellectual property. The Abaqus Unified FEA product suite is widely used in the Defense, Shipbuilding and Energy industries across the globe and offers powerful and complete solutions for both routine and sophisticated engineering problems covering a vast spectrum of industrial applications. Mike Sasdelli and Peter Nannucci will moderate this discussion and give an update presentation covering some of the newer features in Abaqus and other SIMULIA products that are of interest to the Shock and Vibration community. An open discussion focused on the use of the Abaqus product suite in these key industries will follow.

WEDNESDAY PM (NOVEMBER 6)

	TRACK 4	TRACK 5	OPEN DISCUSSION
	Blast Measurements II (2:00-2:20 / Stmt C) Training VIII (3:00-4:00 / Stmt A) Chair(s): Mr. Josh Gorfain (HI-TEST Laboratories)	Vibration II (2:00-3:40 / Stmt A) Chair(s): Dr. Peter Vo (Raytheon)	Open Discussion (2:40-4:00 / Stmt A)
	All Presenters and Chairs (for Nov. 6th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading		
	Meeting Room: Lenox	***Meeting Room: Azalea***	***Meeting Room: Library***
2:00	**Effects of Large Airborne Particles on Blast Propagation in a Pipe (48)** Dr. James Gran (SRI International)	**Comparative Evaluation of Stationary and Non Stationary Vibration Spectral Content, Identification Methods (48)** Dr. Zeev Sherf, Dr. Arie Elka, & Mr. Philip Hopstone (RAFAEL)	
2:20		**Using Energy Considerations in the Laboratory Simulation Planning of the Vibration Regime During Buffet Exercises along the Flight Life of an Airborne Store (49)** Dr. Zeev Sherf, Dr. Arie Elka, & Mr. Philip Hopstone (RAFAEL)	
2:40		**Parametric Models of Vibration Testing Set-ups for use in the Study of Scenarios that cannot be Implemented Physically (49)** Dr. Zeev Sherf, Dr. Arie Elka, & Mr. Philip Hopstone (RAFAEL)	**MIL-S-901D Cost Avoidance and Clarification Letters** **Open Discussion Group** Mr. Kurt Hartsough (NAVSEA Philadelphia) In November of 2012, NAVSEA 05P1, the Shock Technical Warrant issued three MIL-S-901D Cost Avoidance and Clarification letters. The intent of these letters is to clarify areas of MIL-S-901D that were not clear, reduce the occurrence of repeat testing and normalize the amount of testing required for Lightweight and Medium Weight and Floating Shock Platform testing. This Q&A discussion group will allow those involved with MIL-S-901D shock testing the opportunity to receive explanations, gain understanding, and ask questions pertaining to the cost avoidance and clarification letters.
3:00	**Damage Boundary Theory** Mr. James Breault (Lansmont) An introduction to analytically defining any system's susceptibility to shock, knows as shock fragility, first introduced by the Navy and commercially utilized today.	**Life Estimation Model of a Cantilevered Beam Subject to Complex Random Vibration (50)** Dr. Mark Paulus & Mr. Aaron Darnton (NUWC Keyport)	
3:20		**2013 Direct Field Acoustic Testing Developments (50)** Mr. Dann Hayes & Mr. Paul Larkin (Maryland Sound International)	
3:40			

Symposium Social at *Atlanta History Center*

Wednesday, Nov. 6 • 7:00pm—10:00pm

Sponsored by: National Technical Systems, PCB Piezotronics, & HI-TEST Laboratories

THURSDAY AM (NOVEMBER 7)

	TRACK 1 UNDEX Testing III (8:20-10:00 / Stmt A) Chair(s): Mr. Kurt Hartsough (NAVSEA Philadelphia) Mr. Travis Kerr (HI-TEST Laboratories)	TRACK 2 Inertial Impact - Reduction & Modeling (8:00-8:40 / Stmt A) Pyroshock (9:00-9:40 /Stmt A) Chair(s): Mr. Skip Kahane (Kellet Ent.)	TRACK 3 Vibration III: Test System Design (8:00-9:40 / Stmt A) Accelerometer Calibration (9:40-10:00 / Stmt A) Chair(s): Mr. Tony Keller (Spectral Dynamics) Mr. Will Freeman (HII—Newport News)
	All Presenters and Chairs (for Nov. 7th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading		
	Meeting Room: Buckhead I	*Meeting Room: Buckhead II*	*Meeting Room: Piedmont*
8:00		**Successful Impact Reduction to Test Base Impact Pit of the 120 mm Blast Simulation Machine @ Watervliet Federal Arsenal using KELLETT Isolation Material (52)** Mr. Charles G. "Skip" Kahane (Kellett Ent.)	
8:20	**Failure of a Stiffened Panel Subjected to an Underwater Contact Explosive (51)** Dr. Julian Lee & Mr. Malcolm Smith (DRDC), Mr. James Huang (DND Canada)	**Elasto-Plastic Impact of a Free Link with a Massive Surface with SolidWorks (53)** Professor Dan Marghitu & Mr. Hamed Ghaednia (Auburn University)	**The Derivation of System Responses for a Mil -Standard Road (54)** Mr. Jerome Cap & Ms. Melissa C' de Baca (Sandia National Laboratories)
8:40	**Polyurea Coating Effects on the UNDEX Response of Curved Composite Panels (51)** Dr. James LeBlanc (NUWC Newport), Dr. Arun Shukla (University of Rhode Island)		**The Derivation of Maximum Predicted Environments for Externally Carried Stores using a Small Number of Flight Tests (55)** Mr. Jerome Cap, Ms. Melissa C' de Baca, & Mr. Troy Skousen (Sandia National Laboratories)
9:00	**Investigation of the Low-Band Response Spectra of the Standard Floating Shock Platform to UNDEX (51)** Dr. Jianhu Liu, Mr. Bing He, &, Mr. Guozheng Liu (China Ship Scientific Research Center)	**Characterizing the Response of Composite Panels to a Pyroshock Induced Environment using Design of Experiments Methodology (53)** Mr. David Parsons, Mr. David Ordway, & Mr. Kenneth Johnson (NASA: Marshall Space Flight Center)	**Effects of Multi-Axis Excitation on Structural Response (55)** Dr. Laura Jacobs-O'Malley, Ms. Shantisa Norman, & Mr. John Hofer (Sandia National Laboratories)
9:20	**Planning of & Construction of a Large Capacity Deck Simulator Fixture for MIL-S-901D Heavyweight Shock Testing of Heavy Equipment at Low Frequencies (52)** Mr. William Wood (HI-TEST Laboratories)	**A Deterministic Methodology for Designing a Measurement System for a Given SRS Error Allowance (54)** Mr. Doug Firth & Mr. Alan Szary (Precision Filters)	**Structural Developments Improve High-Frequency Vibration Testing on a CUBE Multi -Axis System (55)** Mr. Joel Hoksbergen (Team Corporation)
9:40	**Design & Analysis of a Large Capacity Deck Simulator Fixture for MIL-S-901D Heavyweight Shock Testing of Heavy Equipment at Low Frequencies (52)** Mr. Travis Kerr (HI-TEST Laboratories)		**Calibration of Accelerometers at Extended Frequencies Utilizing Piezoelectric Shakers (56)** Mr. Bev Payne & Mr. David Evans (National Institute of Standards and Technology—NIST)

SYMBOL KEY: (#) - Correlating Page Number in Abstract Book

THURSDAY AM (NOVEMBER 7)

	TRACK 4	TRACK 5
	Instrumentation for Shock Testing (8:00-8:40 / Stmt A) Data Acquisition (8:40-10:00 / Stmt A) Chair(s): Dr. Tom Kwa (Meggitt)	*No Session Scheduled*
	All Presenters and Chairs (for Nov. 7th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading	
	Meeting Room: Lenox	***Meeting Room: Azalea***
8:00	**A History of Endevco's 7270 Shock Accelerometer (56)** Mr. Bruce Wilner (Meggitt Sensing Systems)	
8:20	**Primary Calibration of Shock Transducers - Influence of the Laser Spot Position (56)** Dr. Martin Brucke, Mr. Philipp Begoff, & Mr. Michael Mende (SPEKTRA Schwingungstechnik und Akustik GmbH Dresden)	
8:40	**Advanced Test Data Management Practices at a Missile System Company (57)** Mr. Robert Eaton (ASTRIUM Americas / EADS North America)	
9:00	**It's All About Sync: Improving Synchronization in Computer Based Measurements (57)** Mr. Kurt Veggeberg (National Instruments)	
9:20	**Considerations for Computer Based Measurements in High Shock and Vibration Environments (58)** Mr. Kurt Veggeberg (National Instruments)	
9:40	**Vibration Analysis and Solutions for High Speed Camera Rigs Used for Digital Image Correlation in Air Blast Test Environments (58)** Mr. Samuel R Misko (AFCEC/Jacobs Technology)	

THURSDAY AM (NOVEMBER 7)

	TRACK 1 Isolation II (10:00-11:40 / Stmt A) Chair(s): Mr. Alan Klembczyk (Taylor Devices) Mr. Herb LeKuch (Consultant)	TRACK 2 *No Session Scheduled*	TRACK 3 Blast: Modeling & Simulation II (10:00-11:40 / Stmt D+) (11:00-11:40 / Stmt C) Chair(s): Dr. Wije Wathugala (ACTA) Mr. Joseph Abraham (Karagozian and Case)
	All Presenters and Chairs (for Nov. 7th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading		
	Meeting Room: Buckhead I	***Meeting Room: Buckhead II***	***Meeting Room: Piedmont***
10:00	**Novel Vibration and Shock Control Solutions (58)** Mr. Jarkko Keinänen & Mr. Kalle Vehviläinen (VTT)		**Development of an HFPB based FRM for the Characteristics of the Breach Area Created in Urban RC Walls by Small Munitions, Part 1: HFPB Simulations (*Lim. Dis. D+ incl. DOE, FBI, DHS*) (62)** Mr. Joseph Abraham & Mr. Ken Morrill (Karagozian and Case), Dr. Wije Wathugala & Dr. George M. Lloyd (ACTA)
10:20	**Modifying Vibration Isolation Systems for Optical Tables/Workstations (59)** Dr. Viktor Glodov (Glodov Assoc.), Mr. Herb LeKuch (Consultant)		**Development of an HFPB based FRM for the Characteristics of the Breach Area Created in Urban RC Walls by Small Munitions, Part 2: FRM Development (*Lim. Dis. D+ incl. DOE, FBI, DHS*) (62)** Dr. Wije Wathugala & Dr. George M. Lloyd (ACTA), Mr. Joseph Abraham & Mr. Ken Morrill (Karagozian and Case)
10:40	**Description of a Compact, Partially Internally Isolated Enclosure and I-mount Suspension for the Shock and Vibration Protection of Equipment (59)** Mr. Kevork Kayayan (Shock Tech), Mr. Aldric Seguin (901D)		**Numerical Prediction of Secondary Debris due to Underground Explosions (*Lim. Dis. D+ incl. DOE, FBI, DHS*) (63)** Dr. Wije Wathugala & Dr. Wenshui Gan (ACTA)
11:00	**Evaluation of Isolated Rack Assemblies in Recent Navy Barge Shock Tests (60)** Mr. Herb LeKuch (Consultant), Mr. Neil Donovan (Shock Tech)		**Large Venue Analysis In VAPO (63)** Mr. Kyle Foley (Applied Research Assoc.)
11:20	**Description of a Compact, Partially Internally Isolated Enclosure and I-mount Suspension for the Shock and Vibration Protection of Equipment (60)** Mr. Aldric Seguin (901D), Mr. Kevork Kayayan (Shock Tech)		**Improved Shock Characterization Using Tabular Source Files in VAPO (63)** Mr. Andrew Sasak & Mr. Scott Frank (Applied Research Assoc.), Mr. James Robert Britt (U.S. Army Engineer Research and Development Center)

THURSDAY AM (NOVEMBER 7)

	TRACK 4 Implosion (10:00-11:00 / Stmt D) (11:00-11:20 / Stmt A) Chair(s): Mr. Richard Coffman (Northrop Grumman) Dr. Joseph Ambrico (NUWC Newport)	TRAINING Training IX (10:00-Noon / Stmt A)
	All Presenters and Chairs (for Nov. 7th) are Required to Meet at 7:00AM in Buckhead II for Presentation Loading	
	Meeting Room: Lenox	***Meeting Room: Azalea***
10:00	**UNDEX Initiated Implosion of Simple Cylinders (64)** Dr. Joseph Ambrico, Dr. Emily Guzas, & Dr. Ryan Chamberlin (NUWC Division Newport)	
10:20	**Validation Results of the Implosion Physics-Based Tool (64)** Dr. Joseph Ambrico & Dr. Emily Guzas (NUWC Division Newport)	
10:40	**A Fast Running Implosion Evaluation Tool (65)** Dr. Najib Abboud, Dr. Pawel Woelke, Dr. Michael Shields, Mr. Kenneth Stultz, Mr. Adam Hapij, and Mr. David Rubin (Weidlinger Assoc.)	**Introduction to Medium Weight Shock Testing** Mr. Braden O'Meara (HI-TEST Laboratories) This training will cover the necessary background information relative to medium weight shock testing. This session is intended for engineers and product developers who are unfamiliar with the medium weight shock testing process. Subjects covered include pre-test planning, fixture selection, test set-up, test operations, and reporting. Some aspects of medium weight shock machine operation will be covered.MIL-S-901D test requirements applicable to medium weight shock testing will be discussed.
11:00	**Implosion of a Tube Occurring Within a Confining Tube: Experimental and Computational Results (65)** Dr. James LeBlanc (NUWC Division Newport), Mr. Sachin Gupta & Dr. Arun Shukl (University of Rhode Island)	
11:20		

Tutorial Session 1

MIL-S-901D Shock Qualification Testing **November 3rd / 12:00-3:00**
Mr. Kurt Hartsough & Mr. Domenic Urzillo

The Naval Surface Warfare Center Carderock Division Philadelphia (NSWCCD SSES) Code 623 is NAVSEA 05P3's Delegated Approval Authority (DAA) for MIL-S-901D Surface Ship Shock. As the DAA, Code 623 is responsible for review and approval of all Government Furnished Equipment and all Heavyweight tested equipment. In addition, NSWCCD SSES Code 6202 is the NAVSEA 05P3 DAA for all analysis and DDAM approvals. NSWCCD Codes 623 and 6202 will be presenting the requirements for Shock Qualification Testing and Analysis as detailed in NAVSEAINST 9072.1A, MIL-S-901D and NAVSEA 0908-LP-000-3010 Rev 1. This course will concentrate on MIL-S-901D test requirements and how the DDAM requirements in NAVSEA 0908-LP-000-3010 fit into the shock qualification process of equipment. This course will include a detailed explanation of the test requirements as stated in MIL-S-901D and as interpreted by NAVSEA 05P3. Shock qualification testing of principal units, shock qualification by extension of principal units and shock testing of subsidiary components will be covered. Attendees should include anyone involved in the acquisition, specification, review and approval of Navy shipboard equipment including PARMs and LCMs and contracting officers, contractors having to deal with the Navy and wishing to supply shock qualified equipment to the Navy, Ship Program Managers and Ship Logistic Managers responsible for the acquisition & maintenance of shock hardened Navy ships and shock qualification test facilities.

Random Vibration Analysis and Specification of Environments **November 3rd / 12:00-3:00**
Dr. Tom Paez

Mechanical tests are performed on structures for a number of reasons. Among these are exploration of structural characteristics, attempts to prove that structures and their components will survive specific environments, efforts to understand how structures and their components perform in certain environments, etc. The practice of mechanical testing usually subjects structures to random vibration environments or shock environments, and more rarely, swept sine or sine dwell environments. An attempt is usually made to match the test environment specification to the purpose of a test. When the environment is random vibration and the purpose of the test is to understand how a structure performs in an environment or whether or not the structure and its components will survive the environment, it is critical to specify the environment accurately. This tutorial starts by discussing some background ideas in random vibration; it then proceeds to describe the approach used to estimate the spectral density of a random process. A procedure for estimating confidence intervals on the spectral density is presented, next, and some rationales for selecting confidence levels are discussed. Finally, the effect of random process non-Gaussianity on the confidence intervals of random processes is briefly discussed, along with an accurate method for analyzing non-Gaussian random processes. The entire presentation uses an ensemble of measured random process realizations to demonstrate the operations presented.

Introduction to Pseudo-Velocity Data Analysis **November 3rd / 12:00-3:00**
Dr. Vesta Bateman

This tutorial introduces PVSS on four coordinate paper (4CP) and how it defines shock severity level and the severe shock frequency range. This tutorial presents the basic concepts of the relationship between maximum modal stress and PVSS, PVSS calculation ramp invariant filter theory, shock polarity measurement with the damped PVSS, the conversion of SRS plots to approximate PVSS for severity evaluation, and PVSS analysis of all simple shocks that shows them all equally severe. The tutorial also covers the new ANSI standard based on PVSS, and the new adoption of PVSS guidelines by the aerospace industry.

An Introduction to Dynamics and DDAM **November 3rd / 12:00-3:00**
Mr. Bart McPheeters

Basic dynamic analysis is the foundation behind most analytical shock and vibration techniques. This tutorial will provide a brief introduction to the highlights of dynamic analysis with a slant towards shock and vibration. We will cover basic modal analysis techniques and the interpretation of modal results. We will move on to the two major dynamic analysis types, forced vibration or frequency response and transient analysis or time dependent analysis. We will examine the direct and modal approaches to these analysis and the advantages of both. The tutorial will cover the various kinds of damping available to the analyst and the ramifications of using the different types. We will finish up with a short talk on Random analysis and a longer discussion of response spectrum analysis and DDAM.

The Danger of "Sanctification" and Surrender to Social and Managerial Pressures in the Dynamic Environment Simulation **November 3rd / 12:00-3:00**
Dr. Zeev Sherf

Human activities and endeavors are performed according to well established patterns that assure order, efficiency and effectiveness in day to day human life. While regular patterns change according to differing life circumstances, religious patterns have a much higher inertia and in many cases act to slow down or to prevent changes, advance and progress. The technological professions that represent a specific group of human activities have their own characteristic patterns. This means a specific language, a professional discipline, specific tools and methods of use. While in general, the pattern of exercising a technical profession is of much higher uniformity among professionals, still one can observe behavior characterized by "beliefs", "sanctification", surrender to professional and managerial authority and the effect of being swept away by traditions and rituals. These elements can be encountered also in the technological activity aimed at a definition of in-laboratory simulation of dynamic environments (vibration, mechanical shock and acoustic noise). The main goal of this activity is to "bring the field into the laboratory", with a maximal realism.

The paper discusses several aspects of this activity, in which a psychological element predominates, one with all its negative effects of conservatism, preservation of methods based on incorrect physics, avoidance of simulation realism improvement, paying "lip service" to "social" pressures, etc. *(cont. next page)*

Tutorial Session 1 (cont.)

(cont.) The tailoring philosophy introduced in the early eighties of the 20th century is an important conceptual frame in the improvement of laboratory simulation realism. While the "what to dos" required for realism improvement are well defined, criteria of equivalence between service and laboratory evaluation are not developed sufficiently. And directly related to this, amazingly the term of "realism" is also not clear-cut. Amongst others, the above mentioned psychological elements affect negatively the progress towards settlement of these issues. The main aspects brought up are as follows:

It will be shown that during vibration testing of an airborne store replication of the PSDs at stiff forward and rear locations is insufficient to achieve equivalence between flight and laboratory conditions. The limitations in vibration testing of airborne store subsections will be discussed, as compared to the flight and acoustic testing (over-testing at low frequencies and lack of excitation in the high frequency range). The non-realism of using the SRS (Shock Response Spectrum) in shock simulations will be discussed. Use of classical shock shapes in simulation of the shock environment, with their lack of realism will be elucidated. The need to reconsider accelerated testing planning when using a power fatigue model of the GRMS will be discussed. It will also be shown how important it is to understand and to preserve the excitation transmission path during the simulation, in order to avoid unrealistic testing. The need for reconsidering the requirements of naval vibration simulation will be stressed. A comparison between FFT and parametric modeling analysis methods used during characterization of the environment will be presented also. Advantages of parametric modeling methods will be highlighted. And finally, the importance will be stressed of tailoring a simulation environment that will enable designing for service and not for the testing facilities.

Tutorial Session 2

MIL-S-901D Shock Qualification Testing Extensions **November 3rd / 4:00-7:00**
Mr. Kurt Hartsough & Mr. Domenic Urzillo

The Naval Surface Warfare Center Carderock Division Philadelphia (NSWCCD SSES) Code 623 is NAVSEA 05P3's Delegated Approval Authority (DAA) for MIL-S-901D Surface Ship Shock. As the DAA, Code 623 is responsible for review and approval of all Government Furnished Equipment and all Heavyweight tested equipment. In addition, NSWCCD SSES Code 6202 is the NAVSEA 05P3 DAA for all analysis and DDAM approvals. NSWCCD Codes 623 and 6202 will be presenting the requirements for Shock Qualification Testing and Analysis as detailed in NAVSEAINST 9072.1A, MIL-S-901D and NAVSEA 0908-LP-000-3010 Rev 1. This course will concentrate on MIL-S-901D test requirements and how the DDAM requirements in NAVSEA 0908-LP-000-3010 fit into the shock qualification process of equipment. This course will include a detailed explanation of the test requirements as stated in MIL-S-901D and as interpreted by NAVSEA 05P3. Shock qualification testing of principal units, shock qualification by extension of principal units and shock testing of subsidiary components will be covered. Who should attend? Attendees should include anyone involved in the acquisition, specification, review and approval of Navy shipboard equipment including PARMs and LCMs and contracting officers, contractors having to deal with the Navy and wishing to supply shock qualified equipment to the Navy, Ship Program Managers and Ship Logistic Managers responsible for the acquisition & maintenance of shock hardened Navy ships and shock qualification test facilities.

Introduction to Vibration Testing **November 3rd / 4:00-7:00**
Mr. Jon Wilson

This tutorial introduces the novice to vibration testing and provides a comprehensive review for the experienced practitioner. It concentrates on conceptual understanding and minimizes mathematics. It is recommended for technicians, engineers, program managers, and others who need a basic understanding of the fundamentals of vibration testing.

Topics covered include the definition and nature of vibration; fundamental structural dynamics; sine, complex and random vibration; spectra; vibration measurement and different measurement systems; shakers and shaker system characteristics; and fundamental fixture design and analysis.

Student participation and questions are encouraged. Numerous references are cited.

Shock Response Spectra and Time History Synthesis **November 3rd / 4:00-7:00**
Mr. Tom Irvine

Students will receive basic instruction in calculating shock response spectra for time histories and for synthesizing time histories to meet shock response spectra specifications. The synthesis is performed using wavelets and damped sine functions. Students will receive software programs in both C/C++ & Matlab for making these calculations, as well as accompanying pdf files with formulas.

Tutorial Session 2 (cont.)

Analysis for a Floating Shock Platform Test **November 3rd / 4:00-7:00**
Mr. Bart McPheeters & Mr. Calvin Milam

While FSP tests are essentially the bottom line for a shock qualification, a lot of analysis often goes into the mix before the test. The reasons for this are many: The equipment manufacturer wants his/her equipment to pass and will often commission some kind of pre-test prediction to assure success or highlight design problems. Tested equipment usually requires some kind of interface foundation or test fixture to attach it to the FSP, and this structure is designed to simulate the shipboard installation. Finally, items on the deck simulator fixture (DSF) must be examined to assure that the tested environment is correct. This tutorial will describe the types of analysis that can be preformed pre-test to assure a successful test, including discussions of when each is appropriate, necessary or unneeded. Examples will be presented that illustrate different types of analyses that have been done and how the test compared to the pre-test analysis.

Direct Field Acoustic Testing (DFAT) **November 3rd / 4:00-7:00**
Mr. Paul A. Larkin & Mr. Dann Hayes

This course will present methodology and concepts necessary for the successful development and execution of a Direct Field Acoustic Test (DFAT). Material covered will include a review of the environmental characteristics, DFAT terms and definitions and some background and history of the development of the process and the current state of the art. Details on preparation and execution will include facility logistics and handling, configuration and layout, sound generation equipment, control and data processing procedures and a review of the results to be expected from a successful test. The session will conclude with a summary of recommendations and discussion of some special topics relating direct and reverberant testing as well as a hands-on demonstration.

Tutorial Session 3

MIL-S-901D Subsidiary Component Shock Testing & Alt. Test Vehicles **November 4th / 8:00-11:00**
Mr. Kurt Hartsough & Mr. Domenic Urzillo

The MIL-S-901D Subsidiary Component Shock Testing and Alternate Test Vehicles course will cover the following areas; NAVSEA 05P3's current policy for testing subsidiary components, Description of test environment requirements, Examples of recent successful test programs, Alternate Test vehicle descriptions, Alternate Test Vehicle limitations, Discussions on Shock Spectra, Multi-Variable Data Reduction and Various Shock Isolation Systems. This course is intended to give the necessary information to equipment designers and program managers who intend to shock qualify COTS equipment that will require frequent upgrades due to obsolescence, equipment upgrades, change in mission, etc. Although not required, it is recommended that those attending this course also attend courses on Shock Policy, MIL-S-901D Testing and particularly MIL-S-901D Extensions offered by the same instructors (Domenic Urzillo and Kurt Hartsough).

Effective Solutions for Shock and Vibration Control **November 4th / 8:00-11:00**
Mr. Alan Klembczyk & Mr. Herb LeKuch

This presentation provides an outline of various applications and methods for implementing isolation control of dynamic loads and damping within a wide array of dynamic systems and structures. Photos, videos, and graphical results are presented of solutions that have been proven effective and reliable in the past. Design examples are given and typical applications are reviewed Additionally, key definitions and useful formulae are presented that will provide the analyst or systems engineer with the methods for solving isolation problems within the commercial, military, and aerospace sectors.

A wide range of isolation mounts and systems are covered including liquid dampers, elastomer and wire rope isolators, tuned mass dampers, and engineered enclosures. Engineering guidelines are presented for the selection and evaluation of isolation control products. Protection of COTS electronic equipment and probable damage levels are reviewed for the preparation of design and test specifications. Applications involve shipboard, off-road vehicles and airborne projects. Included also are industrial equipment and seismic control of structures and secondary equipment. Field and test data such as Mil-S-901D barge test measurements are presented. The use of Shock Response Spectra (SRS) for equipment assessment as well as isolator analysis is discussed. Details and examples of shock and vibration analyses are presented including case studies with step by step description of engineering calculations.

Finite Element Analyses in Support of Medium Weight Shock Testing **November 4th / 8:00-11:00**
Mr. Joshua Gorfain & Mr. Jeff Morris

While a shock test is essentially the bottom line for a shock qualification, a lot of analysis often goes into the mix before the test. The reasons for this are many: The equipment manufacturer wants his equipment to pass and will often commission some kind of pre-test prediction to maximize the likelihood of success or to highlight design problems. Since the weight and frequency of the tested equipment can affect the response of the test significantly, the system may need to be examined to assure that the tested environment is correct. This tutorial will first review the Medium Weight Shock Machine (MWSM) and its use in shock qualification testing, followed by presentation of the test environment. Next, the types of analysis that can be performed to estimate the test environment experienced by a given piece of equipment will be described. The intention of these analyses is to provide an assessment of equipment response subject to a MWSM test in an effort to assure a successful test. Additionally, the merits and limits of these methods are discussed so the most appropriate method may be rationally selected for a given application. Examples will be presented that illustrate the different types of analyses and how they may be applied.

Tutorial Session 3 (cont.)

Introduction to Hazard-Based Reliability Analysis **November 4th / 8:00-11:00**
Dr. George Lloyd

It is increasingly important to quantify the expected reliability of long-lived complex systems which are subjected to very non-stationary environments, arising for example from system relocations to disparate environments and the consequent exposure to shock and vibration. Quantifying reliability and the uncertainty of its estimate under these scenarios is difficult using classical empirically-based approaches or strictly computational damage-based modeling schemes. In this tutorial we introduce attendees to the fundamentals of a hazard-based technique which provides a framework for advanced methodologies for accomplishing reliability estimates with quantified uncertainty. The ultimate goal of the method is to leverage existing empirical data to construct surrogate populations and hazard estimates along desired covariate trajectories for reliability analysis.

The scope of the tutorial will be confined to an overview of several topics which lie at the core of this ultimate strategy. The topics consist of the selection of reliability variables and a survey of empirical reliability estimators for censored reliability data, selection of covariates (factors which influence reliability) and quantification of continuous and intermittent covariates as stochastic processes, and descriptions of the empirical hazard associated with observed covariate histories in a parametric reliability framework suitable for more advanced work.

Tutorial Session 4

MIL-S-901D Engineering Topics **November 4th / 12:00-3:00**
Mr. Domenic Urzillo

MIL-S-901D Engineering topics is a follow-on course to the MIL-S-901D Test and Extension training courses and is aimed at providing the NAVSEA acquisition and engineering communities with a more in-depth review of engineering mathematics routinely used in equipment shock qualification. Topics covered include shock spectrum as it relates to MIL-S-901D testing, digital data filtering, shock response frequency, shock test fixture design fundamentals and FSP deck simulation fixtures. Multi-variable Data Reduction (MDR) will be covered, time permitting.

The Measurement & Utilization of Valid Shock and Vibration Data **November 4th / 12:00-3:00**
Dr. Patrick Walter

Significant focus is often provided to applying sophisticated analysis techniques to data resulting from shock and vibration tests. However, inadequate focus is often provided to assuring that valid shock and vibration data are acquired in the first place. This tutorial attempts to correct this deficiency. For the instrumentation novice it will provide an introduction to shock and vibration measurements, the physics of piezoelectric and silicon based accelerometers, and motion characterization. For the experienced test technician or engineer it will provide additional insight into topics such as optimized measurement system design, accelerometer and measurement system calibration, accelerometer mounting effects, analog filtering, data validation, data utilization, and more. For the analyst or designer it will provide a series of simple observations and back of the envelope calculations that he/she can make on data to validate its credibility before using it in product design.

Rainflow Cycle Counting for Random Vibration Fatigue Analysis **November 4th / 12:00-3:00**
Mr. Tom Irvine

Students will learn the basics of the rainflow cycle counting method. The rainflow results can be fed into Miner's cumulative damage index (CDI). Examples will be given for a metallic structure and an electronics circuit board, where each system is subjected to a random vibration base input. Students will also receive software written in C/C++ & Matlab for making the rainflow calculation.

Advanced FEMAP Training **November 4th / 12:00-3:00**
Mr. Bart McPheeters

This class will be an introduction to some of the new and lesser known capabilities of FEMAP not covered in a basic training class. These include Output processing, Data Tables, Data Surfaces, Meshing Concepts using the Toolbox and the New Charting application. We will discuss using Macros and the FEMAP API and how these capabilities allow a user to customize and facilitate many commonly performed functions. Rather than providing a comprehensive training class on a single subject, we will endeavor to familiarize everyone with these capabilities, how to access them, and how their use can make modeling within FEMAP more productive.

Tutorial Session 4 (cont.)

Beyond the Shock Response Spectrum **November 4th / 12:00-3:00**
Mr. David Smallwood

In practice shocks are often quite complicated oscillatory time histories with a large random component. By far the most common method for the characterization of shocks is the shock response spectrum (SRS). The SRS was developed to reduce the complexity to a simple measure, that is, the peak response of a single-degree-of-freedom system to the shock. One of the serious limitations of the SRS is that all temporal information is lost. Several attempts have been make to reduce this limitation by specifying the duration of the shock. However the definition of the "duration" for a complicated shock has not been consistent. Temporal moments provide a consistent framework to define the duration and other moments. Fourier spectra can also be used to characterize shock, but again all temporal information is lost. The most general way to characterize a shock with a large random component is with a time varying spectral density. However, we frequently have insufficient information to estimate this spectrum. Bandlimited temporal moments can help bridge this gap.

The tutorial will introduce the temporal moments and discuss the theoretical implications. The uncertainty theorem will be discussed, and it will be shown how this theorem limits the available information about a shock. Using the product model, a connection between the uncertainty parameter and the variance in the energy estimates will be established. For a shock with a given rms duration, defined by the temporal moments, the uncertainty theorem limits the frequency resolution, as defined by the rms bandwidth. The tutorial will show how the first few bandlimited temporal moments can be used to characterize shock. This information can be used independently of the SRS, or used to supplement the SRS of a shock.

It will be shown how the product model can be used to synthesize realizations of a shock, which match the temporal moments. Examples will be shown that suggest, that if the bandlimited temporal moments are matched, the SRS will also be matched. The realizations can be used for some tests (for example, shaker shock) or can be used as inputs to analytical models to estimate response. Wavelet transforms can also be used to characterize shocks. These techniques will be introduced as a method to decompose a transient into component parts that are approximately bandlimited. The product of the bandwidth and duration is held approximately constant for each component. Thus higher frequencies are resolved with good time resolution giving up frequency resolution while the lower frequencies are resolved with good frequency resolution giving up time resolution. It is shown how the wavelet transform can correct some flawed shock data. The Harmonic Wavelet Transform is introduced as an excellent tool for visualizing shocks in a time-frequency framework. The Karhunen-Loeve Expansion is introduced as a way to characterize and simulate ensembles of shocks that can be modeled as nonstationary random events. A new method of characterizing shocks in an energy framework is introduced. The method has several advantages over the SRS. It is shown that there is a close relationship between the Energy Input, the Fourier Energy Spectrum, and the pseudo velocity SRS. The energy methods can handle non-linear systems, and multiple degree of freedom systems in a rigorous mathematical framework.

MIL-S-901D Cost Avoidance and Clarification Letters - Explained **November 4th / 12:00-3:00**
Mr. Kurt Hartsough

In November of 2012, NAVSEA 05P1, the Shock Technical Warrant, issues three MIL-S-901D Cost Avoidance and Clarification letters. The intent of these letters is to clarify areas of MIL-S-901D that were not clear, reduce the occurrence of repeat testing and normalize the amount of testing required for Lightweight and Medium Weight and Floating Shock Platform testing. This tutorial will provide an opportunity to discuss specific situations related to shock qualification testing with NAVSEA 05P1's Delegated Approval Authorities for Surface Ships and Submarines. Areas covered include: Updated and New Definitions, Reduce Shock Test Schedules, Shock Isolation, use of Standard and Non-Standard Fixtures, Reduced Hammer Blows, Reduced Multiple Operating Mode requirements, Reduced Retesting, Shock Response Frequency (SRF)and more.

Tutorial Session 5

Shock Test Failure Modes **November 4th / 4:00-7:00**
Mr. Kurt Hartsough & Mr. Domenic Urzillo

This tutorial will cover examples of shock test failures typically experienced by equipment exposed to MIL-S-901D shock levels. MIL-S-901D provides guidance for designers responsible for meeting the requirements of MIL-S-901D. This tutorial will show how and why equipment failures occur and show how minor design changes can prevent shock failures. Hands on demonstrations, real time high speed video and analysis will be used to demonstrate both failures and corrective actions.

Fundamentals of Multiple-Input/Multiple-Output Vibration Testing **November 4th / 4:00-7:00**
Mr. David Smallwood

The fundamentals of multiple-input/multiple-output (MIMO) vibration random testing will be described. Various forms of the testing will be illustrated including multiple inputs in a single axis into a large test item and multiple inputs in several axes. The basic matrix algebra needed to define the test and the results will be developed. A short discussion of waveform replication and sine testing will be presented. The basic formulation of the control of a MIMO test will be discussed. Random test specifications must now be presented in terms of a spectral density matrix at the control points. The diagonal terms are the auto (power) spectra at the control points. The off diagonal terms are the cross spectra between pairs of control points. The cross spectra are often presented in terms of phase and coherence. The problems in developing specification for these tests will be discussed. Then methods and suggestions for the development of specifications for a MIMO test will be discussed and illustrated.

Tutorial Session 5 (cont.)

UNDEX Analysis of Floating Structures **November 4th / 4:00-7:00**
Dr. Ray Daddazio & Mr. Fred Costanzo

This tutorial starts off with an introduction of why the analysis of floating structures to underwater explosions (UNDEX) loadings is of interest. This is followed by a brief discussion of free-field UNDEX phenomena, followed by a more detailed description of physics-based UNDEX simulation. Both coupled and decoupled fluid-structure interaction (FSI) problems will be discussed. Next, a discussion of strategies employed in simulating structural responses to UNDEX will be presented, starting with simple analytical tools, and progressing to more detailed finite element analysis strategies. Issues associated with energy dissipation, frequency ranges of interest, and validation through comparison with existing test data will be addressed. Finally, the highlights of this tutorial will be summarized, and where appropriate throughout each of the sections, example problems and lessons learned will be presented.

Theoretical and Computational Analysis of Composite Materials and Structures **November 4th / 4:00-7:00**
Dr. Tom Moyer & Mr. Bart McPheeters

This tutorial is designed for engineers who are using composite materials, or are considering using them. The tutorial will cover theories used to predict the behavior of composite materials and its limitations. We will cover the current state of composite analysis technology and illustrate some successful implementations. the tutorial will then have a section devoted to the implementation of composite analysis in finite elements, its strengths and its limitations. Various modeling strategies will be considered to handle common issues in composites, such as sandwich materials, delamination and progressive and partial failure. Finally, we well close with a discussion of the limitations of current technology and a summary of best practices for considering the analysis of composite materials.

Fatigue and Durability: Explained **November 4th / 4:00-7:00**
Mr. Erik Ostergaard

Fatigue & Durability: Explained provides a technical introduction to the theory and background of fatigue and durability analysis. The content emphasizes on practical engineering considerations for ensuring product performance whilst covering topics that include:

- Introduction to fatigue and durability
- The factors affecting fatigue life
- Common fatigue analysis methods, including Stress-Life (SN), Strain-life (EN), and crack growth
- Physics of fatigue and the development of analysis methods
- Application of fatigue analysis to both measured strain gauge data and simulation results from finite element analysis (FEA)
- Advanced technology for vibration, welds, short-fibre composites, multi-axial, thermo-mechanical fatigue…

The course is relevant to test engineers, CAE analysts, product design engineers, and even engineering managers. Prior knowledge of material behavior and general structural mechanics is helpful but not required.

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EXHIBITOR DESCRIPTIONS

Ray DelDin
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Altair, using our simulation-driven design process, an extensive suite of technology products and services, coupled with our expansive list of "best-in-class" technology partners, continues to help the Navy and Navy Shipbuilders aggressively address Total Ownership Cost, Design Cycle Times, Energy Efficiency, and Survivability. Altair provides our customers with the proper level of technology, expertise, and support from concept to launch via our flexible engagement model. Altair proudly serves the US Navy as a an Engineering Prime Contractor. We stand ready to assist you in the achievement of your mission critical goals.

Kevin Rees
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ATK Aerospace is the world's top producer of solid rocket propulsion systems and a leading supplier of military and commercial aircraft structures. It also specializes in small and micro-satellites; satellite components and subsystems; lightweight space deployables and solar arrays; low-cost, quick-to-market launch solutions; flares and decoys; and energetic materials and related technologies. The group also has extensive experience supporting human and space payload missions.

Steve Tanaka
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Boeing is the world's leading aerospace company and largest and most versatile manufacturer of commercial and military aircraft. Boeing designs, manufactures, and supports aircraft, unmanned vehicles, electronic and defense systems, missiles, satellites and advanced communication systems. Boeing also is a major service provider to NASA for the space shuttle and International Space Station.

Richard Mack
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Brüel & Kjær will be highlighting the latest PULSE hardware and software for data acquisition including PULSE Reflex Shock response spectrum (SRS) synthesis and control that provides a valuable tool to evaluate the shock-worthiness of equipment. In addition, we will also be showcasing VC-LAN which is the latest generation of vibration controllers, offering LAN-based connectivity alongside advanced testing capabilities such as kurtosis control and environmental chamber integration. Brüel & Kjær offers a full range of accelerometers, force transducers, impact hammers, impedance heads, non-contact transducers, conditioning amplifiers, cables and accessories.

Bluejay Robinson
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Correlated Solutions offers non-contact shape and deformation measurement solutions for materials and product testing. These measurements can be made on length scales ranging from microns to meters and time scales as small as nanoseconds. Our scientists and engineers have specialized in deformation measurements for over 20 years and are recognized as world leaders and the inventors of Digital Image Correlation. In addition to our powerful Digital Image Correlation systems, Correlated Solutions also offers a range of measurement solutions for Laser Shearography and Vibration analysis.

Gina Kim
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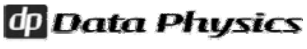
Crystal Instruments (CI) is a leading worldwide supplier of vibration controllers, portable dynamic signal analyzers, and dynamic measurement systems for product testing, machine monitoring, and vibration and acoustic analysis. CI's products are used across a wide range of industries, including aerospace, defense, and medical device manufacturing.



Russell Zuppo
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Established in 1984, **Data Physics** is a worldwide leader in high performance solutions for noise and vibration testing. Data Physics manufactures hardware and software with its full line of SignalCalc Dynamic Signal Analyzers, SignalStar Vibration Control Systems, SignalSound High Intensity and Underwater Acoustic Systems and SignalForce Electrodynamic Shakers.

EXHIBITOR DESCRIPTIONS (CONT.)

Joe Deo
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Ask about our new 3 inch displacement UD T5500 shaker! **Dayton T. Brown, Inc.** is an A2LA / NVLAP accredited*, independent engineering and testing lab. Our facility stands apart from the rest by providing a full spectrum of engineering and testing services. For over 60 years, our goal has been to provide our customers with competitive pricing, low project cost and impeccable services. At DTB, we are committed to helping you successfully meet all of your goals. Our lab's low set-up costs and reduced time-to-test will satisfy your most demanding and complex test objectives. No other testing lab can offer the host of testing services that we can provide to you in one location with a 24/7 schedule.
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As a leading supplier and industrial partner in defense and homeland security, commercial aviation, helicopters, telecommunications and services, **EADS North America** – together with its parent company, EADS – contribute more than $14 billion to the U.S. economy annually, supporting over 225,000 American jobs. EADS is proud to be a valued corporate citizen of the United States. Its business units, operating companies and divisions are found in 29 locations across 15 states, offering a broad array of advanced solutions to customers in the commercial, homeland security, aerospace and defense markets.

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At **E-Labs**, we offer the ability for our customers to access state of the art facilities and personnel. E-Labs personnel have over 40 years of hands on laboratory testing experience within all testing disciplines for the aerospace, automotive, military, commercial and the IT industries. We're a Full Service Testing Laboratory for Industrial, Commercial and Utility Testing, offering Climatic Testing for issues such as Salt Fog, Sand and Dust, Immersion Testing and more. We also offer full EMI and EMC Testing, and Dynamics Testing such as Mechanical Shock, Lightweight Hammer Shock, and Vibration Testing.

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Experior Laboratories is a third party, independent test service provider and test laboratory. Specializing in environmental testing, Experior provides services to component manufacturers, military contractors, integrators and system providers within the space, aerospace, industrial, telecom, and defense markets. Experior Labs' extensive test facility has the capability to conduct a wide-range of services, from structural and subassembly assessment to material evaluation, utilizing environmental and mechanical tests such as vibration, shock, temperature/humidity, altitude, corrosion, and many more. Experior's provided testing services are in accordance with IEEE, MIL, SAE, AS, RTCA and other standard bodies.

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HBM nCode has over 30 years' experience focusing solely on fatigue and durability solutions which span both test and analysis. nCode software enables vibration engineers to ensure product durability with a powerful range of capabilities from defining appropriate shaker profiles equivalent to customer usage to accelerated vibration testing.

Tony Crook
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Hi-Techniques has been a leader in High Performance Data Acquisition Systems for nearly 30 years. Initially founded as a spin off of Norland Corporation, Hi-Techniques has specialized in transient recorders, data acquisition systems and high resolution Digital Oscilloscope products for a variety of applications and markets. Our latest product range, the Synergy, is Hi-Techniques' 7th Generation of Data Acquisition Products. Designed from the ground up, Synergy offers unparalleled performance and flexibility in data acquisition.

EXHIBITOR DESCRIPTIONS (CONT.)

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HI-TEST Laboratories, Inc. is a world-class provider of single-source test program solutions for industry and government, including research, design, testing and evaluation. The company's testing facility is based in Arvonia, VA and offers a full spectrum of testing including standard MIL-S-901D lightweight, medium weight, and heavyweight testing, MIL-STD-167 Types I and II vibration testing, MIL-STD-740 noise and MIL-1399 inclination testing. HI-TEST's Applied Technologies Division offers numerical and analytical testing expertise including response to underwater shock, survivability/vulnerability analysis, advanced composite materials design, progressive failure/survivability of composite structures, fracture mechanics and ballistic modeling and simulation. HI-TEST is a certified HUBZone Small Business.

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Huntington Ingalls Industries (HII) designs, builds and maintains nuclear and non-nuclear ships for the U.S. Navy and Coast Guard and provides after-market services for military ships around the globe. For more than a century, HII has built more ships in more ship classes than any other U.S. naval shipbuilder. Employing nearly 38,000 in Virginia, Mississippi, Louisiana and California, its primary business divisions are Newport News Shipbuilding and Ingalls Shipbuilding.

Tomoko Komuro
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IMV Corporation engages in the design, production, and sale of dynamic simulation systems and measuring systems. The company also provides test house, measuring analysis, and other consulting services for vibration tests. It offers vibration test systems that include energy-saving type, single and multi axis basic, compact type, and temperature, humidity, and vibration combined type systems, as well as vibration controllers. IMV Corporation was founded in 1957 and is headquartered in Osaka, Japan.

Greg Hoshal
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IST offers a full line of instruments from low cost shock detectors and shock & vibration loggers to full-featured shock & vibration waveform recorders and high speed/large memory units for demanding airborne measurements. We offer systems for applications ranging from low level seismic (milli-g range) to high g shock applications up to several thousand (2,000+ gs). We also offer specialized instruments for 6-axis measurement including roll, pitch and yaw as well as high speed atmospheric pressure recorders for specialized air drop & rate of descent testing. We even offer a miniaturized unit for in-situ helmet testing during sporting events or military or industrial training.

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ITT is a diversified leading manufacturer of highly engineered critical components and customized technology solutions for growing industrial end-markets in energy infrastructure, electronics, aerospace and transportation. Building on its heritage of innovation, ITT partners with its customers to deliver enduring solutions to the key industries that underpin our modern way of life. Founded in 1920, ITT is headquartered in White Plains, NY, with employees in more than 15 countries and sales in more than 125 countries.

Terry Mauldin
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Kellett Enterprises, Inc - When vibration and sound reduction is essential to the success of your next project, do you have the reliability and experience of an organization providing solutions to these problems for over 50 years? By laminating composites utilizing mass damping and vibration reducing substrates, Kellett can manufacture products to your specifications. Our products are custom cut—never custom priced.

Rich Cadille
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Kistler Instrument Corporation will exhibit dynamic pressure and force sensors, along with accelerometers used in many shock and vibration applications. New this year is our 8315 single and 8395 triax K-Beam accelerometers that offer 0…1000 Hz response and 0…+/- 2 up to 0…+/-200 g of measuring range. Application engineering support available at our booth.

EXHIBITOR DESCRIPTIONS (CONT.)

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Lansmont Corporation provides specialized engineering and manufacturing services, delivering field instruments (portable data recorders) and dynamic test equipment (shock, vibration, drop, compression) used to improve quality, reduce costs and fulfill regulatory compliances associated with robust product and efficient transport packaging. Over the last 40 years Lansmont has developed distinct expertise in mechanical and electrical design, as well as software control and data analysis. Engineers around the world have relied on Lansmont equipment and our Field-to-Lab™ Methodology to discover the limits and eliminate the unknowns associated with robust design of their products.

Jessica Koble
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Meggitt Sensing Systems is the Meggitt division specializing in sensing and monitoring systems. We measure physical parameters in the extreme environments of aircraft, space vehicles, power generators, nuclear, oil and gas installations and test laboratories. Meggitt Sensing Systems has operated through its antecedents since 1927 under the names of Ferroperm Piezoceramics, Lodge Ignition, Endevco, Sensorex, ECET, Vibro-Meter and Wilcoxon Research. Today, their capabilities and facilities have been integrated under one Meggitt division to provide complete systems from a single supply base.

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Product designers and test engineers throughout the world trust **m+p international** for reliable noise and vibration analysis, structural dynamics, vibration and acoustic control. On display will be m+p's Smart Office Analyzer and Vibco with VibPilot 24, VXI, LXI and USB measurement hardware along with the new data acquisition and control system hardware, VibRunner. Additionally, m+p's Coda, Continous On-line, Data Acquisition system will be demonstrated.

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Since 1976, **National Instruments** has equipped engineers and scientists with tools that accelerate productivity, innovation, and discovery. NI's graphical system design approach provides an integrated software and hardware platform that simplifies development of any system that needs measurement and control. Engineers and scientists use this platform from design to production in multiple industries, advanced research, and academia. The company's long-term vision and focus on improving society through its technology has led to strong, consistent company growth and success of its customers, employees, suppliers, and shareholders

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National Technical Systems (NTS) offers a full range of engineering solutions; from product design, development and testing to systems integration, project management and managed services at laboratories located across the US. Our testing capabilities include MIL-S-901D, MIL-STD-167, MIL-STD-810, MIL-STD-461/461, RS 105, DO-160, MIL-STD 202, and MIL-STD 883.

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NEi Software is the developer of NEi Nastran, NEi Explicit, and global provider of Femap with a portfolio of FEA and CFD software that interfaces with codes like CATIA, AutoCAD, SolidWorks, and MAESTRO for ship modeling and analysis of structural dynamics, DDAM, shock and vibration, impacts, penetration, weapons effects, and virtual explosions.

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PCB Piezotronics has over 40-years of history in the design and manufacture of piezoelectric, piezoresistive, strain gage, MEMS and capacitive sensors and instrumentation for aerospace applications. PCB specializes in high shock and MEMS accelerometers.

EXHIBITOR DESCRIPTIONS (CONT.)

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Precision Filters, Inc specializes in a broad range of high performance instrumentation for test measurements including signal conditioning for bridge, strain, dynamic strain, charge/IEPE w/ LD-TEDS, thermocouple, frequency and others. The all new PF-1U System provides 16 channels of fully programmable filter/amps in a compact 1U (1.75") package complete with Ethernet interface.

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SIMULIA is the Dassault Systèmes brand that makes realistic simulation an integral business practice improving product performance, reducing physical prototypes, and driving innovation. SIMULIA solutions include Abaqus Unified Finite Element Analysis solutions, multiphysics solutions for insight into challenging engineering problems, and SIMULIA SLM for managing simulation data, processes, and intellectual property.

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Spectral Dynamics (SD) is a technically innovative company that has served the Shock and Vibration community continuously for 48 years. Whether it's Sine control of challenging tests, innovative MIMO control of multiple shakers, Shock data capture at 5 Msample/s/channel or accurate Phase-locked acquisition of hundreds of channels of data, Spectral Dynamics uses mathematics effectively to reduce the total costs of dynamic testing. Call Spectral Dynamics for a customized solution to your needs in Vibration, Shock or Acoustic Test Control; Multi-Channel Data Acquisition; Modal Analysis or PIND Testing.

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The *Shock and Vibration Literature/Information Table* is sponsored by **Taylor Devices, Inc.**, designers and manufacturers of components and systems for the control of shock and vibration. Founded in 1955, Taylor Devices' products are used world-wide for energy absorption and control, damping, weapons effects, MIL-S901D, vibration control, and seismic protection.

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As the knowledged leader in multi-axis test system design, **Team Corporation** has developed a number of 6 DoF test systems used commercially and in support of DoD programs. The newest addition to Team's line up of high performance multi-axis systems is the TE6-9000, a 4,000 lbf 6 DoF system with unmatched frequency response and controllability. Please stop by Booth 32 to learn how hydrostatic bearings and electrodynamic shakers can be combined to allow reproduction of your toughest test parameters.

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The mission of the **Vibration Institute** is to disseminate practical information on evaluating machinery behavior and condition without commercial interest. The Institute offers programs including education, training, certification, opportunities for exchanging technical knowledge, information, procedures, and data that are offered through meetings, publications, formal training and networking.

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Vibration Research Corporation will be exhibiting its 5th generation vibration control system hardware (VR9500 Revolution) with Version 10 software for electro-dynamic & servo-hydraulic shakers. Advanced hardware capabilities combined with powerful user friendly software make Vibration Research controllers the premier choice of testing labs around the globe.

EXHIBITOR DESCRIPTIONS (CONT.)

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VTI Instruments provides unmatched hardware performance for your most demanding NVH applications. Step up to VTI Instruments new Sentinel EX platform for unmatched capability. Scalable onboard signal processing, multi-channel independent 24 bit digitizers, highest sample rates, and comprehensive signal conditioning ensure the accurate capture of your analog signals. High-speed, gap-free data throughput guarantees that your mission critical data is secure. Unique playback features and multi-vendor analysis tools simplify data processing and analysis tasks, while maximizing your investment dollars.

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Weidlinger Associates has been one of the world's leading structural engineering and applied mechanics consultants since its founding in 1949. With a staff of more than 300, the firm has seven U.S. offices and an office in the United Kingdom. Weidlinger investigates, designs, rehabilitates, and protects buildings and infrastructure and performs advanced computational analyses for many complex and award-winning projects. The firm is committed to the principles of sustainable design and energy efficiency

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Xcitex is an innovator in the industries of motion analysis and video-based motion capture. ProAnalyst® is the world's leading software for extracting ("tracking"), analyzing, and presenting motion from pre-recorded video. MiDAS DA software combines and synchronizes data from a variety of sensors with your high-speed video.

EXHIBIT HALL LAYOUT