



SEPTEMBER 24 - 28, 2023 Atlanta, Georgia www.savecenter.org





#### WELCOME TO ATLANTA AND THE 93RD 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 the **SHOCK AND VIBRATION EXCHANGE**.



# THANK YOU

#### IN ADDITION TO OUR EVENT HOSTS, WE WOULD LIKE TO RECOGNIZE OUR 93ND SHOCK AND VIBRATION SYMPOSIUM COMMITTEE\*:

Jeff Averett, US Army ERDC Thomas Brodrick, NAVSEA Sloan Burns, NSWC Dahlgren Roosevelt Davis, AFRL Dr. Jacob Dodson, AFRL Rebecca Grisso, NSWC Carderock\*\* Adam Hapij, Thornton Tomasetti Kurt Hartsough, 901 Eng. Roger Ilamni, NSWC Indian Head Dr. Bryan Joyce, NSWC Dahlgren Michelle LeBlanc, AFRL Kenneth Lussky, BAE Systems Melissa Maze, PCB Piezotronics Michael Olsen, HII Newport News Drew Perkins, SAVE/HI-TEST John Przybysz, IDA Chris Sensor, Siemens Ashley Shumaker, SAVE/HI-TEST Troy Skousen, Sandia National Laboratories Ernest Staubs, AFRL Mackenzie Wilson, HII Newport News

\*TAG members in attendance at summer meeting for 93<sup>№</sup> S&V program review (held at NSWC Carderock) \*\*NSWC Carderock host



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# Schedule at a Glance

## (WITH DAILY OUTLINE AND HOURS)

DAY/DATE	PROGRAM FEATURE TYPE	TIME	PAGE
SUNDAY (09/24)	REGISTRATION (ROOM 203) BUSINESS CENTER (EXHIBIT HALL FOYER) EXTENDED TUTORIAL SESSION	8:00AM - 5:00PM 9:00AM - 5:00PM 9:00AM - 4:00PM	PG. 7
MONDAY (09/25)	REGISTRATION (ROOM 203) TUTORIALS BUSINESS CENTER (EXHIBIT HALL FOYER) EXHIBIT HALL SETUP (SALON BALLROOM) WELCOME RECEPTION (SALON BALLROOM)	7:00AM - 6:00PM 8:00AM - 7:00PM 7:00AM - 6:00PM NOON - 6:00PM 6:30PM - 8:30PM	PG. 8-13 PG. 14
TUESDAY (09/26)	REGISTRATION (ROOM 203) EXHIBIT HALL OPEN (SALON BALLROOM) BUSINESS CENTER (EXHIBIT HALL FOYER) TUTORIALS GENERAL SESSION I & EXHIBITORS LUNCHEON TECHNICAL PAPER SESSIONS & TRAINING	7:00AM - 6:00PM 7:00AM - 5:00PM 7:00AM - 6:00PM 8:00AM - 11:00AM 11:00AM - 1:00PM 1:00PM - 6:10PM	PG. 16-17 PG. 18 PG. 20-23
WEDNESDAY (09/27)	REGISTRATION (ROOM 203) BUSINESS CENTER (EXHIBIT HALL FOYER) TECHNICAL PAPER SESSIONS & TRAININGS EXHIBIT HALL OPEN (SALON BALLROOM) GENERAL SESSION II & AWARDS LUNCHEON TECHNICAL PAPER SESSIONS & TRAININGS TUTORIALS EXHIBIT HALL DISMANTLE COMMERCIALLY SPONSORED SOCIAL EVENT	7:00AM - 6:00PM 7:00AM - 6:00PM 8:00AM - NOON 9:00AM - 4:00PM NOON - 1:30PM 1:30PM - 3:30PM 3:30PM - 6:30PM 4:15PM - 6:00PM 7:00PM - 10:00PM	PG. 24-27 PG. 28 PG. 30-31 PG. 32-33 PG. 34-35
THURSDAY (09/28)	REGISTRATION (ROOM 203) BUSINESS CENTER (EXHIBIT HALL FOYER) TECHNICAL PAPER SESSIONS & TRAININGS S&V TAG COMMITTEE MEETING (ROOM TBD) EXHIBIT HALL LAYOUT & VENDOR DESCRIPTIONS HOTEL MEETING SPACE FLOOR PLANS	7:00AM - NOON 7:00AM - NOON 8:00AM - 12:05PM 1:00PM - 2:00PM	PG. 36-39 PG. 39 PG. 40-47 PG. 48-49

# FOOD & BEVERAGE EVENTS

## (ALL SYMPOSIUM ATTENDEES ARE WELCOME TO ATTEND EVENTS LISTED BELOW)

MONDAY (09/25)	WELCOME RECEPTION (SALON BALLROOM / EXHIBIT HALL) BEVERAGES & HEAVY HORS D'OEUVRES	6:30PM - 8:30PM
TUESDAY (09/26)	*GUESTS OF SYMPOSIUM ATTENDEES ARE WELCOME. BREAKFAST & NETWORKING (SALON BALLROOM / EXHIBIT HALL)	7:00AM - 8:00AM
	GENERAL SESSION 1: KEYNOTE ADDRESS & EXHIBITORS LUNCHEON (SALON BALLROOM / EXHIBIT HALL)	11:00AM - 1:00PM
	ICE CREAM SOCIAL (SALON BALLROOM / EXHIBIT HALL)	3:00PM - 3:40PM
WEDNESDAY (09/27)	BREAKFAST & NETWORKING (SALON BALLROOM / EXHIBIT HALL)	7:00AM - 8:00AM
	GENERAL SESSION 2: AWARDS PRESENTATION AND LUNCHEON (SALON BALLROOM / EXHIBIT HALL)	NOON - 1:30PM
	AFTERNOON SNACK BREAK & PASSPORT PROGRAM DRAWING (SALON BALLROOM / EXHIBIT HALL)	3:30PM - 4:15PM
	SYMPOSIUM SOCIAL/DINNER AT OFF-SITE LOCATION (HARD ROCK CAFE) COMMERCIALLY SPONSORED BY HI-TEST LABORATORIES & NTS *GUESTS OF SYMPOSIUM ATTENDEES ARE ALSO WELCOME.	7:30PM - 9:30PM
THURSDAY (09/28)	BREAKFAST & NETWORKING (SALON BALLROOM / EXHIBIT HALL)	7:00AM - 8:00AM



## EXTENDED TUTORIAL SESSION 9:00AM - 4:00PM

OPTIONAL SIX-HOUR COURSE WITH ONE-HOUR LUNCH BREAK. ATTENDEES WILL RECEIVE A CERTIFICATE OF COMPLETION AND MAY RECEIVE CEUS/PDHs (VARIES BY STATE). ADDITIONAL FEES APPLY TO ATTEND.

#### MIL-DTL-901E SHOCK QUALIFICATIONS & SHOCK EXTENSIONS

Kurt Hartsough (901 E&T)

#### MIL-DTL-901E SHOCK QUALIFICATIONS

Instructors will be presenting the requirements for shock qualification testing as detailed in MIL-DTL-901E and interpreted by NAVSEA 05P1. Shock testing theory, MIL-DTL-901E shock test devices and facilities, detailed specification requirements, cost avoidance and clarification and MIL-DTL-901E IC#2 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.

#### MIL-DTL-901E SHOCK EXTENSIONS

Instructors will also be presenting the requirements for shock qualification extensions as detailed in MIL-DTL-901E and interpreted by NAVSEA 05P1. Shock extension specification requirements, MIL-DTL-901E design guidelines and shock design lessons learned 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.

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\*If you enroll in this course, the two separate courses of similar names on Monday will be duplicate material.

End Sunday Events



MTG ROOM 204/205



## TUTORIAL SESSION I 8:00 - 11:00AM

OPTIONAL THREE HOUR COURSES. ATTENDEES WILL RECEIVE A CERTIFICATE OF COMPLETION AND MAY RECEIVE CEUS/PDHs (VARIES BY STATE). ADDITIONAL FEES APPLY TO ATTEND.

#### MIL-DTL-901E SHOCK QUALIFICATION TESTING

Kurt Hartsough (901 E&T)

The Naval Surface Warfare Center Carderock Division Philadelphia (NSWCCD-SSES) Code 333 is NAVSEA 05P1's Delegated Approval Authority (DAA) for MIL-DTL-901E Surface Ship Shock. As the DAA, Code 333 engineers are responsible for review and approval of all Government Furnished Equipment (GFE) and heavyweight shock tested equipment. NSWCCD Code 333 will be presenting the requirements for shock qualification testing as detailed in MIL-DTL-901E and interpreted by NAVSEA 05P1. Shock testing theory, MIL-DTL-901E shock test devices and facilities, detailed specification requirements, cost avoidance and clarification and MIL-DTL-901E IC#2 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.

#### **DDAM 101**

George D. (Jerry) Hill (SERCO)

The U.S. Navy Dynamic Design Analysis Method (DDAM) has been in general use since the early 1960s. It is a method of estimating peak shock response of equipment and outfitting on naval combatants using normal mode theory, originally extended from earthquake analysis methods. The DDAM requires linearelastic model behavior and employs a statistical method of modal superposition yet has persisted to today as the U.S. Navy required method for shock qualification by analysis. This, in spite of the rapid advancement of dynamic transient simulation technology and techniques for representing nonlinearities including material plasticity and contact behavior. The tutorial will address: how the method works, how the shock spectral input values are presented in DDS-072-1, what is the role of modal weights and participation factors, why has the method persisted including what are its strengths and also what are its weaknesses. The tutorial will provide a basic understanding of the method, requirements, and procedures to those who expect to be involved in shock analysis and will demystify the procedure for many who are current users.

#### FUNDAMENTALS OF CLASSIC SHOCK AND SRS SHAKER TESTING

Chris Sensor (Siemens) Bob Metz (PCB Piezotronics)

This tutorial will cover the fundamental concepts of shaker shock testing, from field data acquisition to Classic Shock and Shock Response Spectrum (SRS) wavelet synthesis in a vibration controller. Shock data acquisition and analysis, classic shock pulses, SRS concepts, SRS and Pseudo Velocity Shock Spectrum (PVSS) data analysis, Fatigue Damage Spectrum, a review of Classic Shock and SRS test methods in MIL-STD-810H (including the "new" method of Te and TE), shock test tailoring and SRS wavelet synthesis for shaker SRS testing will all be discussed during the tutorial. A segment covering specialty shock sensors and instrumentation will also be presented. Topics will be reinforced with live demonstrations of data acquisition and shaker testing. Attendee interaction, questions and discussion are welcome and encouraged.

[SEE ADDITIONAL TOPICS FOR THIS SESSION ON PAGE 9]

MTG ROOM 204/205

MTG ROOM 202

## TUTORIAL SESSION I 8:00 - 11:00AM (CONTINUED)

#### INTRODUCTION TO PYROSHOCK TESTING

Dr. Vesta Bateman (Mechanical Shock Consulting)

This course discusses the concepts of Near Field, Mid Field Pyroshock and Far Field Pyroshock and their criteria. Instrumentation used for measurement of pyroshock and structural response to pyroshock is described. The development of pyroshock specifications using primarily the Shock Response Spectra is discussed in detail, and various other analysis techniques are presented as well. Simulation techniques for near field, mid field and far field pyroshock are presented and include both pyrotechnic simulations and mechanical simulations. Examples of actual test specifications and the resulting laboratory test configuration and measured results are discussed. In addition, recent problems and issues in the pyroshock community are described and analyzed.

#### OVERVIEW OF UNDERWATER EXPLOSION PHENOMENOLOGY AND BULK CHARGE WEAPON EFFECTS NOTE: LIMITED DISTRIBUTION D (SECURITY PAPERWORK REQUIRED) Greg Harris (Consultant)

This tutorial will provide an overview of underwater explosion (UNDEX) phenomenology relevant to bulk charge underwater warheads. The phenomenology discussion includes UNDEX shock wave propagation, bulk cavitation effects, and UNDEX bubble dynamics. UNDEX testing and analysis procedures for characterizing the shock wave and bubble performance of explosive compositions will be described. Finally, a brief discussion of the damage mechanisms used by bulk charge underwater weapons such as mines and torpedoes will be given using illustrative examples from UNDEX testing programs and recent naval encounters.

This talk contains Controlled Unclassified Information (CUI) / Distribution Statement D: Distribution authorized to DOD agencies and US DOD contractors.



MTG ROOM 304/305

#### MTG ROOM 302/303



## TUTORIAL SESSION II NOON - 3:00PM

OPTIONAL THREE HOUR COURSES. ATTENDEES WILL RECEIVE A CERTIFICATE OF COMPLETION AND MAY RECEIVE CEUS/PDHs (VARIES BY STATE). ADDITIONAL FEES APPLY TO ATTEND.

#### MIL-DTL-901E SHOCK QUALIFICATION TESTING EXTENSIONS

Kurt Hartsough (901 E&T)

The Naval Surface Warfare Center Carderock Division Philadelphia (NSWCCD SSES) Code 333 is NAVSEA 05P1's Delegated Approval Authority (DAA) for MIL-DTL-901E Surface Ship Shock. As the DAA, Code 333 engineers are responsible for review and approval of all Government Furnished Equipment (GFE) and heavyweight shock tested equipment. NSWCCD Codes 333 will be presenting the requirements for shock qualification extensions as detailed in MIL-DTL-901E and interpreted by NAVSEA 05P1. Shock extension specification requirements, MIL-DTL-901E design guidelines and shock design lessons learned 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.

### AN INTRODUCTION TO ALIASING, FFT, FILTERING, SRS & MORE FOR FEA USERS AND TEST ENGINEERS

MTG ROOM 204/205

MTG ROOM 206/207

Dr. Ted Diehl (Bodie Technology)

Working with either physical test data and/or numerical simulations related to severe mechanical shock, impact, failure, etc. is extremely challenging. Some of the biggest challenges in this type of work are 1) properly collecting the initial raw data while avoiding aliasing [especially from numerical simulations], 2) utilizing robust methods to identify and separate the "noise & distortions" from the "true" frequency-rich content in the data, and 3) determining what portion of the "true" frequency-rich content is meaningful and what does it tell you. For a given problem, the initial appearance of raw time-domain data in this class of work may be vastly different between physical testing and data derived from transient simulation codes (LS-Dyna, Abaqus/Explicit, RADIOSS...). While the data might look different, the rules of DSP (Digital Signal Processing) are the same. Most importantly, understand and utilizing DSP properly is a critical requirement to success in BOTH types of approaches, especially to obtain correlation between physical tests and simulation of the same specific problem.

The 3-hour seminar provides guidance to both simulation analysts and test engineers on how to properly collect and process such data; ultimately uncovering significantly improved results. The course covers highlights of DSP theory in the language of Mechanical Engineering pertinent to simulation analysts and test engineers. This seminar introduces key aspects of working with transient data – specifically, clearly explaining time-domain and frequency domain analysis (DFS, FFT, PSD); data collection (sampling, up-sampling, decimation, and aliasing); filtering (lowpass, highpass, IIR, and FIR), how to avoid aliasing, calculating Shock Response Spectrum (Accel SRS & PVSS) from transient data, and numerous unique aspects related to explicit dynamics FEA data (non-constant time increments, massively over-sampled data, short transient signals with non-zero end conditions, and more). Simplified demonstrations are presented to solidify key DSP aspects, along with many relevant real-world examples. Both FEA users and experimentalists will benefit from this training.

#### DATA INTEGRITY

John Hiatt (DEWESoft)

The data integrity training is designed as an overview of the data acquisition process and how each step in the measurement chain can affect your measured data. Primary focus of this session is on the data acquisition system (DAS). We will learn what happens in each step of the process and how to mitigate common measurement errors. The idea is to get the best possible data first time. Its hard to make good decisions with bad data. We also cover DAS specifications so users can be better prepared to compare system specifications.

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MTG ROOM 302/303

## TUTORIAL SESSION II NOON - 3:00PM (CONTINUED)



## INTRODUCTION TO WEAPONS EFFECTS AND SHIP COMBAT SURVIVABILITY ANALYSIS

Jan Czaban (Zenginworks Limited)

This short course provides a practical understanding of naval ship combat survivability and methods to assess the effects of various weapons. The introduction will review terminology, concepts and current practice involved in setting, achieving and verifying survivability requirements. Naval threats and weapon types will be reviewed and methods for predicting their resultant loads and damage mechanisms explained. Primary weapons effects will include attacks from underwater explosions, above water explosions, internal blast, fragments and ballistic projectiles. Sample problems will be provided to demonstrate how to estimate the extent of damage sustained by ship structures and how to apply and interpret damage using standard terms of capability degradation. Methods for hardening ship systems and structures will be reviewed with an introduction provided to explain dynamic load effects tolerance, armour systems and simplified pass/fail global design assessment techniques. The course material will be entirely based on public domain sources and includes a comprehensive list of references and applicable military standards.

#### **BRIDGING THE GAP - TOOLS MISSING IN THE ACCELERATED VIBRATION TESTING** Zeev Sherf (Consultant)

Description of the Missing tools in the activity of accelerated vibration testing. Presentation of two methods to overcome the problems. One based on fatigue damage accumulation. The load counting Methods required in the application of the Method are presented. The problematic of the fatigue damage models description that makes the method almost un feasable. The description of solving the problem by the Energy Consideration based method. A much more practical and easier to use. Example of application of the both Methods are also presented

#### INTRODUCTION TO DESIGNING SHOCK MOUNTED SYSTEMS USING SIMPLE SOFTWARE Dave Callahan (HII - Newport News Shipbuilding)

This course will introduce a process for designing and assessing shock isolation systems with special emphasis on applications related to the design of shipboard equipment for shock loads produced by underwater explosions utilizing the analytical software tool "Shock Isolation Mount Prediction & Loading Estimates" (SIMPLE). This process is split into two parts: 1) initial analysis using classic Shock Response Spectrum (SRS) and 2) assessment, confirmation, iteration or comparison of isolation system designs using SIMPLE simulation methods. Attendees will learn how to building six Degree of Freedom (DOF) SIMPLE models of isolated systems, select shock mounts and modify mount properties, select shock inputs, evaluate the isolation system performance and iterate designs rapidly. This course is intended for anyone who desires validation and assurance that shock and vibration mounts are properly selected for equipment racks, consoles, cabinets and other structures using SIMPLE software. Examples of SIMPLE users are: engineers, program and project managers, equipment integrators, shock/vibration analysts, mount vendors and shock qualification reviewers/approvers.

MTG ROOM 202

MTG ROOM 304/305

MTG ROOM 301



## TUTORIAL SESSION III 4:00 - 7:00PM

OPTIONAL THREE HOUR COURSES. ATTENDEES WILL RECEIVE A CERTIFICATE OF COMPLETION AND MAY RECEIVE CEUS/PDHs (VARIES BY STATE). ADDITIONAL FEES APPLY TO ATTEND.

#### MIL-DTL-901E SUBSIDIARY COMPONENT SHOCK TESTING & ALTERNATIVE TEST VEHICLES Kurt Hartsough (901 E&T)

The MIL-DTL-901E Subsidiary Component Shock Testing and Alternate Test Vehicles course will cover the following areas: NAVSEA 05P1'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 (MDR) 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-DTL-901E testing and particularly MIL-DTL-901E extensions offered by the same instructors (Urzillo and Kurt Hartsough).

#### DIGITAL SIGNAL PROCESSING - FILTERING AND THE FOURIER TRANSFORM (GOING FROM TIME TO FREQUENCY DOMAIN) John Hiatt (DEWESoft)

Two of the most common Digital Signal Processing (DSP) techniques are filtering and transforming data from the time domain to the frequency domain with the Fourier transform (FFT). Both mathematical processes can create unwanted effects on the data. This session will examine these effects on your data and how they can be mitigated. For the Fourier transform, we will also discuss the assumptions, inputs to the FFT and possible reasons FFT's calculated with two different software packages do not match. This training is designed to help new users understand how these processes and how they work to help prevent data processing mistakes.

## REMOVING THE BOUNDARY CONDITION HOBGOBLINS FOR BASE MOUNTED COMPONENTS IN VIBRATION QUALIFICATION TESTING

Troy Skousen (Sandia National Laboratories) Randy Mayes (Consultant)

How a modal technique provides a simple modification to the base input mitigating the field-to-laboratory impedance mismatch for high confidence component qualification

Random vibration laboratory testing is used to qualify components to survive in-service responses to system environments. Using realistic research hardware and an analytical rocket system, we show that traditional single degree of freedom (SDOF) shaker test specifications guarantees large response uncertainties when compared with the field environment responses due to the difference in laboratory boundary conditions. A brief review is provided showing how fixed-base mode shapes are derived from test data. A model utilizing fixed-base and rigid body modes of the component on its vibration test fixture is used to decompose the component field motion into a few intuitive responses. This model demonstrates why 6DOF laboratory control can eliminate large uncertainties in traditional SDOF testing with a corresponding boost in qualification confidence. In fact, the model leads to modified base inputs for a greatly improved SDOF or 3DOF test.

[SEE ADDITIONAL TOPICS FOR THIS SESSION ON PAGE 13]

MTG ROOM 202

MTG ROOM 206/207

## TUTORIAL SESSION III 4:00 - 7:00PM (CONTINUED)



#### SEA (STATISTICAL ENERGY ANALYSIS) METHOD -PRINCIPLES AND EXAMPLE OF USE

Zeev Sherf (Consultant)

The use of the classical FEM(Finite Element Method) in the domain of high modal density structures (150-200 Hz and above is not feasible. For solving the problem of dynamic analysis of this kind of structures when excited by random vibration or acoustical noise, the SEA method was developed by P. Smith, and R. Lyon,. The tutorial will describe the limitations of the classical FEM method, the principles of the SEA method the ways to determine the parameters required in the Method's application by experiments and by modeling ,the building of the system of Energy equations that describe the dynamics of the system, Methods for evaluation of the excitation power of the system and methods to solve the system of equations. A program written for the Method's Implementation is also described. Finally the application of the Method to the dynamic analysis of an Electronic box exposed to random Vibration and Acoustic Noise, and the Acoustic Fatigue of a panel are also described.

QUANTITATIVE METHODS FOR SURVIVABLE ELECTRONICS PACKAGING FOR COMBINED LOADING OF THERMAL AND HIGH AMPLITUDE MECHANICAL SHOCK NOTE: LIMITED DISTRIBUTION D (SECURITY PAPERWORK REQUIRED)

Dr. Adriane Moura (ARA) Jared Hammerton (ARA)

Fuze electronics intended for hard target defeat must survive both MIL-STD thermal cycle environments and extreme mechanical shock. Fuzes are often potted to prevent printed circuit board (PCB) flexure associated with component failure during impact. Potting techniques, or packaging strategies, may vary significantly by vendor and are often developed through trial and error. In many cases they are proprietary. Some packaging strategies include the application of elastomeric coatings to PCBs and components, or the use of epoxy underfills beneath components. Because most packaging materials are polymers, the disparity in thermal expansion between them and other fuze materials leads to a whole new series of problems during thermal cycling. As such, the DoD and the DOE have devoted considerable effort in the areas of material characterization, model development, and experimental validation, all with the goal of identifying survivable packaging strategies for use in both conventional and nuclear weapon stockpiles. Upon completion of this course, the user should have a basic understanding of the properties of common packaging materials, modeling and simulation tips and tricks, and latest developments in the design and evaluation of survivable packaging strategies for high-g electronics.

MTG ROOM 304/305

MTG ROOM 301

SAVE Awards & Nomination Instructions

Henry C. Pusey Best Paper Award

KEEP A LOOKOUT IN THE PROGRAM FOR THIS QR CODE! SCAN TO NOMINATE ANY PRESENTATION DESERVING OF OUR ANNUAL *HENRY C. PUSEY BEST PAPER AWARD*. FULL AWARD CRITERIA AND NOMINATION FORM AVAILABLE BY SCANNING THE QR CODE.





Award for Excellence in Instruction

NOMINATE ANY THREE-HOUR TUTORIAL DESERVING OF OUR NEW **AWARD FOR TUTORIAL EXCELLENCE.** 2023 IS THE FIRST YEAR TO NOMINATE A TUTORIAL. 2024 WILL BE THE FIRST AWARD PRESENTATION. FULL AWARD CRITERIA AND NOMINATION FORM AVAILABLE BY SCANNING THE QR CODE.

Lifetime Achievement Award

THE LIFETIME ACHIEVEMENT AWARD IS BESTOWED TO A MEMBER OF THE SHOCK AND VIBRATION COMMUNITY WHO HAS MADE SIGNIFICANT TECHNICAL CONTRIBUTIONS TO THE FIELD WITH A LIFETIME OF CAREER DEDICATION.

REACH OUT TO DREW PERKINS OR ASHLEY SHUMAKER FOR ADDITIONAL AWARD CRITERIA AND/OR A NOMINATION PACKAGE FOR THIS PRESTIGIOUS AWARD.







## ALL SYMPOSIUM ATTENDEES AND GUESTS ARE INVITED TO ATTEND.

## 6:30 - 8:30PM FOOD & DRINKS SALON BALLROOM/EXHIBIT HALL

End Monday Events







## 7:00 - 8:00AM SALON BALLROOM/EXHIBIT HALL

AFTER BREAKFAST, ENJOY THE OPPORTUNITY TO NETWORK WITH OTHER ATTENDEES AND INTERACT WITH EXHIBITORS.

## TUTORIAL SESSION IV 8:00 - 11:00AM

OPTIONAL THREE HOUR COURSES. ATTENDEES WILL RECEIVE A CERTIFICATE OF COMPLETION AND MAY RECEIVE CEUS/PDHs (VARIES BY STATE). ADDITIONAL FEES APPLY TO ATTEND.

#### ANALYSIS FOR A MEDIUM WEIGHT SHOCK TEST

Josh Gorfain (Quartus Engineering)

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 high-light 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.

#### MIL-DTL-901E ENGINEERING TOPICS

Domenic Urzillo (NSWC Carderock)

MIL-DTL-901E Engineering topics is a follow-on course to the MIL-DTL-901E 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-DTL-901E testing, digital data filtering, shock response frequency, shock test fixture design fundamentals and FSP deck simulation fixtures.

#### FUNDAMENTALS OF DIGITAL IMAGE CORRELATION (DIC)

Chris Sensor (Siemens)

This tutorial will cover the fundamental concepts of Digital Image Correlation (DIC) for both static and dynamic vibration scenarios. The basic concepts of DIC will be explained, followed by live demonstrations of both static and dynamic DIC data acquisition. An overview of the required test equipment and it's set-up will be presented. Advantages of DIC such as strain measurements, multi-plane response measurement, and contactless measurement will be compared and contrasted to traditional data acquisition methods.

AIR BLAST AND CRATERING: AN INTRODUCTION TO THE ABC'S OF EXPLOSION EFFECTS IN AIR AND ON LAND

Denis Rickman (USACE ERDC)

This three-hour course introduces the effects of explosions in air and on land. Topics covered include airblast, soil/rock/ pavement cratering, and ground shock phenomena produced by explosive detonations. There is a little math, but for the most part, the focus is on aspects and principles that are of practical use to those conducting (and utilizing) blast-related research. Most researchers in the blast arena have some grasp of explosion effects fundamentals, but very few have a good, broad-based understanding of how it all works. The goal is to provide the participants with enough of an understanding that they can appreciate the various explosion phenomena and those parameters that affect blast propagation and blast loading of objects in a terrestrial setting.

## MTG ROOM 202

## MTG ROOM 301



UESDAY SEPTEMBER 26

\_\_\_\_\_\_ МТG ROOM 204/205

MTG ROOM 302/303



## EXHIBITORS LUNCHEON (GENERAL SESSION I) WITH KEYNOTE ADDRESS 11:00AM - 1:00PM

LROOM

11:00AM—11:10AM	CALL TO ORDER       SALON BAL         Mr. Drew Perkins, SAVE / HI-TEST Laboratories       SALON BAL
11:10ам—11:15ам	<b>KEYNOTE INTRODUCTION</b> Mr. John Rhatigan, Marine Machinery Association
11:15am—Noon	<b>KEYNOTE ADDRESS</b> Mr. Matthew Sermon, Executive Director, PEO Strategic Submarines
NOON-1:00PM	LUNCH FOLLOWED BY EXHIBITOR MEET & GREET



Exhibitor Meet & Greet

Enjoy time to peruse the exhibit hall and meet the vendors.

DON'T FORGET TO GET STARTED ON YOUR PASSPORT PROGRAM ENTRY FORM! DRAWING TO BE HELD DURING WEDNESDAY'S AFTERNOON BREAK IN THE EXHIBIT HALL. PRIZES TO INCLUDE:

SAVE PROGRAM PRIZES \$250 AMAZON GIFT CARD ASUS 14" CHROMEBOOK OUTDOOR BLUETOOTH SPEAKER RING VIDEO DOORBELL AMAZON ECHO SHOW GPS 4K DRONE VENDOR DONATED PRIZES YETI MERCHANDISE VARIOUS GIFT CARDS EARBUDS & MISC. ELECTRONICS EXHIBITOR APPAREL & SWAG



EXHIBITORS LUNCHEON (GENERAL SESSION I) WITH KEYNOTE ADDRESS 11:00AM - 1:00PM



Meet the Speaker

## **MATTHEW SERMON** EXECUTIVE DIRECTOR PEO STRATEGIC SUBMARINES



**MR. MATTHEW SERMON** is the Executive Director of Program Executive Office, Strategic Submarines. Previously, Mr. Sermon served as the Executive Director for Program Executive Office Columbia Class Submarine and as the Executive Director, Amphibious, Auxiliary and Sealift Office, Program Executive Office, Ships. In his current role, he provides executive leadership to the Columbia Class Submarine acquisition program and the In Service SSBN/SSGN program, while also being assigned responsibility for revitalization of the Submarine Industrial Base. In this portfolio, he provides enterprise leadership for more than 250 acquisition personnel and approximately \$130 Billion in acquisition and sustainment programs.

Mr. Sermon entered the Senior Executive Service in February 2019, and has been in federal service for more than 20 years. He has served in a variety of key leadership positions throughout his career, including Deputy Program Manager for the Columbia Class Submarine program (2016-2019), a \$100 billion DoD Major Defense Acquisition Program. During his tenure, he led the program through detail design, construction readiness, and significant sustainment planning activities. Before leading the Columbia Class, he was the Deputy Program Manager for the Zumwalt Class Destroyer (2014-2016) during test, trials, and delivery of the lead ship (DDG 1000). Prior to DDG 1000, he was the Deputy Program Manager for International Fleet Support in the Naval Sea Systems Command's Surface Warfare Directorate (2010- 2014), where was responsible for the management of more than \$5 billion in Foreign Military Sales cases for more than 40 partner nations.

Other previous assignments include Principal Assistant Program Manager in the Support Ships, Boats, and Craft Program Office (PMS 325) in PEO Ships (2007-2010), where he led the \$1.1 billion Egyptian Navy Missile Craft project while providing program management expertise for numerous other boat building projects.

Prior to starting in Navy civilian service, Mr. Sermon was a U.S. Navy Surface Warfare Officer (Nuclear). He received his Surface Warfare Officer qualification aboard USS Ramage (DDG 61). Additionally, Mr. Sermon served as nuclear engineering officer aboard USS Dwight D. Eisenhower (CVN 69) before leaving the uniformed Navy in 2004. He is a veteran of Operations Enduring Freedom and Iraqi Freedom.

Mr. Sermon is a member of the Acquisition Professional Community and has a Level III Certification in Program Management. He holds Defense Acquisition Workforce Improvement Act certifications in Production, Quality, and Manufacturing and Test & Evaluation, and has completed certification as a Project Management Professional (PMP). He received a Bachelor of Science degree in economics from the United States Naval Academy in 1999, and a Master of Science degree in engineering management from The Catholic University of America in 2006. He is a 2012 graduate of the Defense Systems Management College's Program Manager Course. During his distinguished federal service career, Mr. Sermon has received three Navy Civilian Meritorious Service Awards and one Navy Civilian Superior Service Award.

	SESSION 1: SPECIAL SESSION: "THE BEST OF SAVE" HENRY C. PUSEY BEST PAPER AWARD-WINNING PRESENTATIONS 1:00-2:35PM / UNLIMITED DIST. A CHAIR(S): JOHN PRZYBYSZ	SESSION 2: SHOCK TESTING METHODOLOGY I 1:00-3:00PM / UNLIMITED DIST. A CHAIR(S): RACHEL MCINTYRE (NSWC CARDEROCK) SLOAN BURNS (NSWC DAHLGREN)	SESSION 3: BLAST RELATED DAMAGE 1:00-2:10PM / LIMITED DIST. D CHAIR(S): DR. JASON FOLEY (AFRL)
	MEETING ROOM 204/205	MEETING ROOM 202	MEETING ROOM 302/303
	(##) FOLLOWING EACH PAPER	TITLE INDICATES ASSOCIATED PAGE NUMBER IN TH	IE ABSTRACT BOOK APPENDIX.
1:00	A SIMPLIFIED FINITE ELEMENT MODEL FOR DESIGN OF A RESONANT PLATE (1) Angela Patterson, Dr. Vit Babuska, David Soine, & Daniel Lee (Sandia National Laboratories) 2023 Award Recipient	<b>DEVELOPMENT OF A MAST MOUNTED</b> <b>ANTENNA TESTING CAPABILITY, PART I (3)</b> <i>Sloan Burns, Garrett Wiles, Robert Ponder,</i> & Dr. Bryan Joyce (NSWC Dahlgren)	SHAKE & BAKE: INVESTIGATING THE HIGHLY COUPLED AND EXTREME NEAR-FIELD THERMOMECHANICAL ENVIRONMENT OF ROCKET FIRINGS (4) Dr. Jason Foley, Dr. W. Jacob Mozel, Dr. Ming Chen, Dr. Malissa Lightfoot, & Stephen Danczyk (AFRL), Dr. Robert Jensen (Sierra Lobo), Kathryn Rutherford & Dr. Jeroen Deijkers (UES, Inc.)
1:25	DERIVING BEST SDOF SHAKER INPUTS FROM 6 DOF BASE INPUT PAYLOAD MODELS (2) Randall Mayes (Consultant) 2022 Award Recipient	<b>DEVELOPMENT OF A MAST MOUNTED</b> <b>ANTENNA TESTING CAPABILITY, PART II (3)</b> Sloan Burns, Garrett Wiles, Robert Ponder, & Dr. Bryan Joyce (NSWC Dahlgren)	<b>CHARACTERIZATION OF SIMPLIFIED</b> <b>SURROGATE MUNITION (5)</b> Marcus Barksdale, Austin Hopkins, Bradley Foust, & Bowen Woodson (USACE ERDC)
1:50	A TECHNIQUE TO DEVELOP A SPECTRAL DENSITY MATRIX WITH SYNTHESIZED ROTATIONAL DEGREES-OF-FREEDOM (2) Dr. Mike Hale (Trideum Corporation) 2019 Award Recipient	Common Pitfalls in Environmental Testing (3) Roger Bunce & Calvin Milam (NTS Technical Systems)	<b>DYNAMIC BLAST EFFECTS (5)</b> Dr. Brian Taylor (AFRL)
2:15	On THE NATURE OF SPECTRAL DENSITY MATRICES USED TO CHARACTERIZE VIBRATION ENVIRONMENTS (2) Dr. Luke Martin & Shawn Schneider (NSWC Dahlgren) 2017 Award Recipient	DYNAMIC ENVIRONMENT TEST FIXTURE RESPONSE UNDER SHOCK LOADING (4) Cora Taylor, Dr. James DeClerck, Dr. Jason Bough & Charles VanKarsen (Michigan Technological University), Raymond Joshua(DOE Kansas City National Security Camps)	
2:40		<b>TWR PULSE DEVELOPMENT FROM MULTIPLE</b> <b>TEST RECORDS (4)</b> <i>Sloan Burns &amp; Dr. Bryan Joyce (NSWC Dahlgren)</i>	

3:00 -



**ENIDINE** 

Ice Cream Social Salon Ballroom (EXHIBIT HALL)

S P E C T R A L D Y N A M I C S

20

## TUESDAY (SEPTEMBER 26)

SESSION 4:	VENDOR SESSION A:	TRAINING I:
DYSMAS I 1:00-3:00PM / LIMITED DIST. D CHAIR(S): DR. ALAN LUTON (NSWC INDIAN HEAD) DR. T. NEIL WILLIAMS (USACE ERDC)	EXHIBITOR PRESENTATIONS INCLUDING CASE STUDIES, NEW DEVELOPMENTS, TESTING & PRODUCTS 1:00-3:00PM / UNLIMITED DIST. A CHAIR(S): BOB METZ (PCB PIEZOTRONICS)	SHOCK RESPONSE SPECTRUM PRIMER 1:00-3:00PM / UNLIMITED DIST. A
MEETING ROOM 304/305	MEETING ROOM 301	MEETING ROOM 206/207
(##) FOLLOWING EACH PAPER	TITLE INDICATES ASSOCIATED PAGE NUMBER IN TH	IE ABSTRACT BOOK APPENDIX.
<b>PARADYN PARTICLE COUPLING FOR</b> <b>FRAGMENTATION APPLICATIONS (6)</b> <i>Dr. Jeff St. Clair, Jim Warner, &amp; Dr. Tom</i> <i>McGrath (NSWC Indian Head)</i>	<b>PRESSURE SENSOR THERMAL SHOCK</b> <b>MITIGATION (7)</b> <i>Bob Metz (PCB Piezotronics)</i>	SHOCK RESPONSE SPECTRUM PRIMER (9) Dr. Carl Sisemore (ShockMec Engineering LLC) 1:00-3:00PM
HIGH SPEED FUZE IMPACT TESTING AND EVALUATION (6) Horacio Nochetto, Erin Ruiz, Noah Schaeffer, Kevin Cochran, Dr. Jeff St. Clair, Chris Cao, & Ryan Barretta (NSWC Indian Head)	SENSORS WITH BUILT-IN ESD PROTECTION (8) Jennifer MacDonell (Endevco)	
DYSMAS-BASED AUTOMATION FOR MACHINE LEARNING OF LETHALITY EFFECTS (6) Dr. Frank VanGessel & Dr. Cameron Stewart (NSWC Indian Head)	IEPE SHOCK SENSORS FOR HIGH-G MEASUREMENTS (8) Kevin Westhora (Dytran Instruments)	
<b>ARCTIC ICE MODELING IN GEMINI (7)</b> Dr. Brad Klenow & Anna Czerepak (NSWC Indian Head)	HIGH SPEED TRANSIENT EVENT CAPTURE – RECENT ADVANCES IN SMALL FORM FACTOR, HIGH FIDELITY BROADBAND MEASUREMENT SYSTEMS (9) Mark Remelman & Rob Eaton (MECALC)	
WATER ENTRY MODELING FOR AIR- DELIVERED, UNDERWATER WEAPONS (7) Horacio Nochetto, Dr. Jeff St. Clair, & Dr. Alan Luton (NSWC Indian Head)	Controlled Long Duration 100 G Testing Module for High Intensity Visible Spectrum LED Lighting (9) Dr. Josh Loukus (REL Inc.)	
	DYSMAS I         1:00-3:00PM / LIMITED DIST. D         CHAIR(S):         DR. ALAN LUTON (NSWC INDIAN HEAD)         DR. T. NEIL WILLIAMS (USACE ERDC)         MEETING ROOM 304/305         (##) FOLLOWING EACH PAPER         PARADYN PARTICLE COUPLING FOR         FRAGMENTATION APPLICATIONS (6)         Dr. Jeff St. Clair, Jim Warner, & Dr. Tom         McGrath (NSWC Indian Head)         HIGH SPEED FUZE IMPACT TESTING AND         EVALUATION (6)         Horacio Nochetto, Erin Ruiz, Noah         Schaeffer, Kevin Cochran, Dr. Jeff St. Clair,         Chris Cao, & Ryan Barretta (NSWC Indian Head)         DYSMAS-BASED AUTOMATION FOR         MACHINE LEARNING OF LETHALITY EFFECTS         (6)         Dr. Frank VanGessel & Dr. Cameron Stewart         (NSWC Indian Head)         ARCTIC ICE MODELING IN GEMINI (7)         Dr. Brad Klenow & Anna Czerepak (NSWC Indian Head)         WATER ENTRY MODELING FOR AIR-         DELIVERED, UNDERWATER WEAPONS (7)         Horacio Nochetto, Dr. Jeff St. Clair, & Dr.         Alan Luton (NSWC Indian Head)	DysMAS 1EXHIBITOR PRESENTATIONS INCLUDING CASE STUDIES, NEW DEVELOPMENTS, TESTING & PRODUCTS1:00-3:00PM / LIMITED DIST. D CHAIR(S): DR. ALAN LUTON (NSWC INDIAN HEAD) DR. T. NEIL WILLIAMS (USACE ERDC)1:00-3:00PM / UNLIMITED DIST. A CHAIR(S): BOB METZ (PCB PIEZOTRONICS)MEETING ROOM 304/305MEETING ROOM 301(##) FOLLOWING EACH PAPER TITLE INDICATES ASSOCIATED PAGE NUMBER IN TH PARADYN PARTICLE COUPLING FOR FRAGMENTATION APPLICATIONS (6) Dr. Jeff St. Clair, Jim Warner, & Dr. Tom McGrath (NSWC Indian Head)PRESSURE SENSOR THERMAL SHOCK MITIGATION (7) Bob Metz (PCB Piezotronics)HIGH SPEED FUZE IMPACT TESTING AND EVALUATION (6)SENSORS WITH BUILT-IN ESD PROTECTION (8) Jennifer MacDonell (Endevco)DYSMAS-BASED AUTOMATION FOR MACHINE LEARNING OF LETHALITY EFFECTS (6) Dr. Frank VanGessel & Dr. Cameron Stewart (NSWC Indian Head)IEPE SHOCK SENSORS FOR HIGH-G MEASUREMENTS (8) Kevin Westhora (Dytran Instruments) Dr. Frank Klanow & Anna Czerepak (NSWC Indian Head)HIGH SPEED TRANSIENT EVENT CAPTURE - RECENT ADVANCES IN SMALL FORM FACTOR, HIGH FIDELITY BROADBAND MEASUREMENT SYSTEMS (9) Mark Remelman & Rob Eaton (MECALC)WATER ENTRY MODELING FOR AIR- DEVERED, UNDERWATER WEAPONS (7) Horacio Nachetto, D. Jeff St. Clair, & Dr. Alan Luton (NSWC Indian Head)CONTROLLED LONG DURATION 100 G TESTING MODULE FOR HIGH INTENSITY VISIBLE SPECTURU LED LIGHTING (9) Dr. Josh Loukus (REL Inc.)

3:00 -

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3:40

**Ice Cream Social** Salon ballroom (exhibit hall)

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S P E C T R A L D Y N A M I C S

G

## TUESDAY (SEPTEMBER 26)

	SESSION 5: INSTRUMENTATION DEVELOPMENTS & SELECTION TECHNIQUES 3:45-5:45PM / UNLIMITED DIST. A	SESSION 6: RANDOM VIBRATION TEST DESIGN 3:45-4:05PM / LIMITED DIST. D 4:10-5:20PM / UNLIMITED DIST. A	SESSION 7: GROUND SHOCK AND CRATERS FROM DETONATIONS 3:45-5:45PM / LIMITED DIST. D
	CHAIR(S): Dr. Vesta Bateman (Consultant) Lauren Yancey (HI-TEST Laboratories)	CHAIR(S): Troy Skousen (Sandia National Labs) Dr. Bryan Joyce (NSWC Dahlgren)	CHAIR(S): Dr. Jay Ehrgott (USACE ERDC) Stephen Turner (USACE ERDC)
	MEETING ROOM 204/205	MEETING ROOM 202	MEETING ROOM 302/303
5	COMPARING PHOTON DOPPLER VELOCIMETRY (PDV) SYSTEMS DEVELOPMENT COST WITH AN OPEN PLATFORM AND MODULAR BASED APPROACH (10) Ren Hong (Quantifi Photonics)	MULTI-AXIS VIBRATION TESTING OF A HIGH ENERGY LASER FOR AIRBORNE APPLICATION (12) Matthew Forman, Dr. Luke Martin, & Dr. Bryan Joyce (NSWC Dahlgren)	EXPLOSIVE REMOVAL OF DAMAGED PAVEMENT FOR AIRFIELD DAMAGE REPAIR (14) Stephen Turner (USACE ERDC)
0	TOWARDS A NOVEL MICROSYSTEM SHOCK ACCELEROMETER UTILIZING A LIQUID PROOF MASS (10) Dr. Paul Galambos, Josh Dye, Alex Chen, & Cayden Boll (Sandia National Laboratories)	<b>RECOMMENDED GUIDANCE FOR SUBSIDIARY</b> <b>SHIPBOARD VIBRATION TESTING (13)</b> <i>Garrett Wiles, Shawn Schneider, &amp; Dr.</i> <i>Bryan Joyce (NSWC Dahlgren)</i>	RESULTS AND ANALYSIS OF CRATERS FROM ABOVEGROUND DETONATIONS ON AN ASPHALT ROADWAY (14) Daniel Vaughan, Joshua Payne, Dr. Jay Ehrgott (USACE ERDC)
5	<b>ELECTROSTATIC DISCHARGE (ESD)</b> <b>CONSIDERATIONS IN SHOCK TESTING (11)</b> James Nelson (PCB Piezotronics) & Dr. Ted Diehl (Magic Leap)	WHY DO WE NEED TO DESIGN DYNAMIC ENVIRONMENT TEST FIXTURES? (13) Dr. James DeClerck, Cora Taylor, Dr. Jason Blough, & Charles VanKarsen (Michigan Technological University), Raymond Joshua (DOE Kansas City National Security Campus)	INFLUENCE OF PAVEMENT ON GROUND SHOCK AND ABOVEGROUND OVERPRESSUR FROM BURIED DETONATIONS (15) Will Myers & Dr. Jay Q. Ehrgott, Jr. (USACE ERDC)
D	SIGNAL CONDITIONER SELF NOISE: CHARACTERIZATION AND SPECIFICATION (11) Douglas Firth, Dr. Thomas Gerber, & Alan Szary (Precision Filters)	<b>PROCEDURE FOR GENERATING IMPULSE-ON-</b> <b>RANDOM SHAKER TESTS (13)</b> <i>Ryan Quellet (Vibration Research Corp.)</i>	DEVELOPMENT OF THE GENERIC MUNITION CRATER ASSESSMENT TOOL (GMCAT) (15) Daniel Vaughan, Joshua Payne, Dr. Jay Q. Ehrgott, Jr. (USACE ERDC)
5	MINIMUM REQUIREMENTS FOR MECHANICAL SHOCK DATA ACQUISITION (12) David Soine (Sandia National Laboratories)		THE EFFECT OF SOIL COVER ON EARTH- COVERED MAGAZINE LOADING (16) Joshua Payne (USACE ERDC)

	SESSION 8: DYSMAS II 3:45-4:55PM / LIMITED DIST. D 5:00-5:20PM / UNLIMITED DIST. A CHAIR(S): ROGER ILAMNI (INDIAN HEAD) TIMOTHY MCGEE (NSWC CARDEROCK)	VENDOR SESSION B: EXHIBITOR PRESENTATIONS INCLUDING CASE STUDIES, NEW DEVELOPMENTS, TESTING & PRODUCTS 3:45-6:10PM / UNLIMITED DIST. A CHAIR(S): BLUEJAY ROBINSON (CORRELATED SOLUTIONS)	TRAINING II: CLEAR GUIDELINES FOR IMPROVING SPACECRAFT SHOCK ANALYSIS AND TESTING 3:45-5:45PM
	MEETING ROOM 304/305	MEETING ROOM 301	MEETING ROOM 206/207
3:45	MULTI-COMPONENT STRENGTH IMPLEMENTATION FOR SEA-BED MODELING (16) Dr. Brad Klenow & Dr. Tom McGrath (NSWC Indian Head)	<b>INDUCTION RING SHAKERS IN AEROSPACE</b> <b>APPLICATIONS (17)</b> <i>Luis Infante (ETS Solutions)</i>	CLEAR GUIDELINES FOR IMPROVING SPACECRAFT SHOCK ANALYSIS AND TESTING (19) Monty Kennedy (MK Engineering)
4:10	INFLUENCE OF SEA-BED PROPERTIES ON UNDEX EFFECTS (16) Rachael Busby, Dr. Brad Klenow, Otto Quinones-Melendez, & Dr. Tom McGrath (NSWC Indian Head)	Advanced Technologies For Single and Multi Degree of Freedom Shock and Vibration Testing (18) Thomas Reilly (NVT Group)	Dr. Jason Blough (Michigan Technological University) 3:45 - 5:45рм       
4:35	UNDEX TESTING AND M&S OF COMBAT RUBBER RAIDING CRAFT (17) Otto Quinones-Melendez, Ron Zitzman, & Roger Ilamni (NSWC Indian Head), Kent Rye & Bill Lewis (NSWC Carderock)	IMPROVEMENTS IN VISUALIZING DIC FFT RESULTS AND IN DATA PROCESSING SPEEDS (18) Bluejay Robinson (Correlated Solutions)	
5:00	SIMULATING THE UNDERWATER SHOCK RESPONSE OF HUMAN LUNG SIMULANTS (17) Dr. Emily Guzas, Brandon Casper, M. Babina, & Dr. Eugenia Stanisauskis Weiss (NUWC Newport)	HIGH SPEED IMAGING WITH SENSOR DATA IN SMALL SPACES (18) William Spinelli (Photron)	
5:25		<b>PROANALYST 2023 BY XCITEX</b> <b>THE NEXT GENERATION OF MARKERLESS</b> <b>MOTION ANALYSIS SOFTWARE (18)</b> <i>Shane Fitzgerald (Xcitex)</i>	

Visit our staff in Room 203 with any questions!

End Tuesday Events



#### **BREAKFAST WITH THE EXHIBITORS**

SALON BALLROOM | 7:00-8:00AM

	SESSION 9: SIGNAL AND DATA ANALYSIS 8:00-9:10AM / UNLIMITED DIST. A CHAIR(S): DR. TED DIEHL (BODIE TECHNOLOGY)	SESSION 10: BLAST 8:00-9:35AM / UNLIMITED DIST. A CHAIR(S): DR. PETER VO (RAYTHEON) ROB BYRNE (RAYTHEON)	SESSION 11: PROJECTILE PENETRATION TOOL DEVELOPMENT 8:00-9:35AM / LIMITED DIST. D CHAIR(S): JEFF AVERETT (USACE ERDC) ERNIE STAUBS (AFRL)
	MEETING ROOM 204/205	MEETING ROOM 202	MEETING ROOM 302/303
8:00	A ROBUST METHOD FOR ESTIMATING THE TRANSIENT DURATION OF COMPLEX SHOCKS (19) Dr. Carl Sisemore (ShockMec Engineering)	METHODOLOGY FOR NATO AEP-55 STANAG- COMPLIANT MINE EXPLOSION SIMULATIONS (PART I) (21) Giri Prasanna (Altair Engineering)	JOINT AFLCMC/AFRL/DTR HIGH-VELOCITY ROCK PENETRATION EXPERIMENTS (22) Mark Green (Geomechanics Research & Analysis), Dr. James Cargile (J. Donald Cargile Consultancy), Ernie Staubs & Dr. Brian Plunkett (AFRL), Keri Bailey (USACE ERDC), Dr. Danny Frew (DSF), Dr. Bradley Martin (US Air Force Life Cycle Management Center), Koby Kennison (ISS)
8:25	ENHANCING SIGNAL ACCURACY AND BANDWIDTH EXTENSION IN TRANSIENT SHOCK MEASUREMENTS USING TRANSFER FUNCTION COMPENSATION (20) Strether Smith (Strether Smith Consulting), Dr. Ted Diehl (Bodie Technology)	METHODOLOGY FOR NATO AEP-55 STANAG- COMPLIANT MINE EXPLOSION SIMULATIONS (PART II) (21) Giri Prasanna (Altair Engineering)	UPDATE OF CAPABILITIES OF PENCURV+ COMPUTATIONAL SOFTWARE FOR ANALYSIS OF PROJECTILE PENETRATION EFFECTS (22) Logan Rice, Ernesto Cruz, & Dr. Mark Adley (USACE ERDC)
8:50	<b>THE EFFECTS OF DROPOUT IN TELEMETERED</b> <b>DATA ON SHOCK RESPONSE SPECTRA (20)</b> <i>Dr. Vit Babuska, Angela Patterson, David</i> <i>Soine, &amp; Daniel Lee (Sandia National</i> <i>Laboratories)</i>	SMALL SCALE AIRBLAST TESTING FOR THE ASSESSMENT OF MULTIPLE BARRIERS ON SHOCK WAVE PROPAGATION (21) Kellan Sullivan, John Hoemann, & Dr. Genevieve Pezzola (USACE ERDC), Dr. Hussam Mahmoud (Colorado State University)	ADVANCING RUNWAY DAMAGE ASSESSMENT: A COMPREHENSIVE OVERVIEW OF RW- CRATER+ HYBRID TOOL (23) Ernesto Cruz (USACE ERDC)
9:15		NUMERICAL MODELING OF FULL-SCALE RC SLABS TO CLOSE IN BLAST, COMPARISON BETWEEN SPH - LSDYNA & VIPER::BLAST - OPENRADIOSS (22) Dr. Peter McDonald (Viper Applied Science)	MULTI-SURFACE SPLASH RING (MSSR) ANALYSIS AND PREDICTION TOOL DEVELOPMENT FOR HIGH EXPLOSIVE ANTI- TANK (HEAT) MUNITION (23) Jasiel Ramos-Delgado & Keila Estevez-Cruz (USACE ERDC)

9:35

10:00

COFFEE BREAK with the Schibitors

EXHIBIT HALL / SALON BALLROOM



## BREAKFAST WITH THE EXHIBITORS

SALON BALLROOM | 7:00-8:00AM

## WEDNESDAY (SEPTEMBER 27)

	SESSION 12: INNOVATIVE SHOCK TEST ANALYSES 8:00-9:10AM / LIMITED DIST. D 9:15-9:35AM / LIMITED DIST. C CHAIR(S): DR. RUSS MILLER (IDA) ADAM HAPIJ (THORNTON TOMASETTI)	VENDOR SESSION C: EXHIBITOR PRESENTATIONS INCLUDING CASE STUDIES, NEW DEVELOPMENTS, TESTING & PRODUCTS 8:00-9:35AM / UNLIMITED DIST. A CHAIR(S): JEFF MORRIS (HI-TEST LABORATORIES)	TRAINING III: BLAST SCALING 8:00-9:00AM / UNLIMITED DIST. A
	MEETING ROOM 304/305	MEETING ROOM 301	MEETING ROOM 206/207
8:00	A METRIC FOR COMPARING PSEUDO- VELOCITY SHOCK RESPONSE SPECTRA (23) Matthew Stevens (NSWC Carderock)	DESIGN, INSTALLATION, AND COMMISSIONING OF LARGE MIMO SYSTEM TESTING (25) Deepak Jariwala (Spectral Dynamics)	BLAST SCALING (26) Denis Rickman (USACE ERDC) 8:00 - 9:00AM
8:25	DATA DRIVEN METHODS TO PREDICT CONFINED IMPLOSION (24) Caleb Penner, Dr. Abilash Nair, Gregory Norman, & Adam Hapij (Thornton Tomasetti), Benjamin Medina (NSWC Carderock), Dr. Joseph Ambrico & Dr. Emily Guzas (NUWC Newport)	DIGITAL TWIN: BACK TO THE FUTURE (25) Ray Deldin (Altair)	
8:50	ENABLING QUICK GENERATION OF PREDICTIVE MODELS USING THE IMPLOSION DATABASE UTILITY (IDU) (24) Dr. Abilash Nair, Gregory Gorman, Caleb Penner, & Adam Hapij (Thornton Tomasetti), Benjamin Medina (NSWC Carderock), Dr. Joseph Ambrico & Dr. Emily Guzas (NUWC Newport)	<b>RESONANT PLATE TESTING: ROUND OR SQUARE PLATES (25)</b> Dr. Carl Sisemore (ShockMec Engineering)	
9:15	INCORPORATION OF VALIDATION-DERIVED ERROR TO IMPROVE SURVIVABILITY PREDICTIONS (25) Dr. Russel Miller & John Przybysz (IDA)	CHARACTERIZING SHOCKWAVE PROPAGATION & MECHANICAL VIBRATIONS USING HIGH- SPEED DIGITAL IMAGES (26) Dr. Kyle Gilroy (Vision Research)	



Tip

	SESSION 13: SHOCK & VIBRATION ISOLATION DESIGN AND ANALYSES 10:00-NOON / UNLIMITED DIST. A CHAIR(S): ROBERT SHARP (HUTCHINSON) SHAWN CZERNIAK (HUTCHINSON)	SESSION 14: RANDOM VIBRATION CHARACTERIZATION AND SPECIFICATION DEVELOPMENT 10:00-11:10AM / UNLIMITED DIST. A CHAIR(S): ASHLEY RENDELL (SANDIA NATIONAL LABS) CHRIS SENSOR (SIEMENS)	SESSION 15: PROJECTILE IMPACT AND CRATERING 10:00-NOON / LIMITED DIST. D CHAIR(S): DR. KYLE CROSBY (USACE ERDC) DR. JAY EHRGOTT (USACE ERDC)
	MEETING ROOM 204/205	MEETING ROOM 202	MEETING ROOM 302/303
10:00	<b>INTERPRETATION OF ELASTOMERIC FINITE ELEMENT ANALYSIS (26)</b> <i>Robert Sharp (Hutchinson)</i>	A PROPOSED UPDATE TO THE COMMON CARRIER VIBRATION SPECIFICATION (29) Dr. Michael Hale (Trideum Corp.), William Barber & Jesse Porter (Redstone Test Center), Dr. Bryan Joyce, Dr. Luke Martin, & Shawn Schneider (NSWC Dahlgren)	An Overview of Soil Cratering Data and Models for Buried Detonations and Kinetic Energy Impact (30) Dr. Kyle Crosby, Denis Rickman, & Logan Callahan (USACE ERDC)
10:25	THE USE OF HIGH DAMPING WIRE ROPE ISOLATORS AND SYMOS SOFTWARE FOR UNDEX APPLICATIONS (27) Ali Shehadeh, Osadolo Irowa, & Cyril Coquet (Socitec)	<b>DEFINING MULTI-AXIS VIBRATION TEST</b> <b>CONTROL MATRIX (29)</b> Barak Deutscher, Zachi Katzir, & Gal Rubinstein (RAFAEL)	Soil CRATERING FROM PROJECTILES IMPACTING AT HIGH VELOCITIES (30) Logan Callahan, Dr. Zane Roberts, Reid Bond, Dr. Kyle Crosby, Dr. Jay Q. Ehrgott (USACE ERDC)
10:50	WIRE ROPE ISOLATORS FOR TRANSPORT CONTAINERS (27) Robert Filec & Liron Fridman (Socitec)	ARTIFICIAL INTELLIGENCE FOR ANOMALY DETECTION IN VIBRATION TESTING AND SCREENING (30) Dr. Charles Hull (Lockheed Martin)	HIGH VELOCITY PERFORATION OF STEEL AND REINFORCED CONCRETE TARGETS WITH A MULTI-COMPONENT PROJECTILE (31) Dr. Zane Roberts, Dr. Kyle Crosby, Reid Bond, Logan Callahan, & Dr. Jay Q. Ehrgott, Jr. (USACE ERDC)
11:15	EXPECTED TRENDS IN MODAL RESPONSE SENSITIVITY OF A VIBRATION ISOLATED RIGID BODY SUBJECTED TO SINUSOIDAL BASE EXCITATION IN 3 ORTHOGONAL AXIS UNDER TWO VARYING CONDITIONS (28) Dr. Christopher Merrill (CM&A Engineering)		<b>PERFORATION AND PENETRATION OF 3MR</b> <b>ULTRA HIGH PERFORMANCE CONCRETE (31)</b> <i>Reid Bond, Dr. Kyle Crosby, &amp; Dr. Bill Heard</i> <i>(USACE ERDC)</i>
11:40	EXPECTED TRENDS IN TRANSIENT RESPONSE SENSITIVITY OF A VIBRATION ISOLATED RIGID BODY SUBJECTED TO TRANSIENT SHOCK BASE EXCITATION IN 3 ORTHOGONAL AXIS UNDER TWO VARYING CONDITIONS (28) Dr. Christopher Merrill (CM&A Engineering)		EVALUATION OF PENETRATION RESISTANCE OF CONVENTIONAL CONCRETE SLABS REPAIRED WITH SPRAYABLE ULTRA-HIGH- PERFORMANCE CONCRETE (31) Cameron Thomas (USACE ERDC)

DON'T FORGET TO VISIT THE EXHIBIT HALL AND COMPLETE YOUR "PASSPORT" FOR A CHANCE TO WIN GIFT CARDS, GADGETS, & MORE!

	SESSION 16: MECHANICAL SHOCK: TEST CHARACTERIZATION, ANALYSIS, & SOLUTIONS 10:00-11:35AM / LIMITED DIST. D 11:40-NOON / UNLIMITED DIST. A	VENDOR SESSION D: EXHIBITOR PRESENTATIONS INCLUDING CASE STUDIES, NEW DEVELOPMENTS, TESTING & PRODUCTS 10:00AM-NOON / UNLIMITED DIST. A	TRAINING IV: SHIP SHOCK INSPECTIONS 10:00-11:00AM / LIMITED DIST. D DISCUSSION GROUP:
	CHAIR(S): Mackenzie Wilson (HII)	CHAIR(S): Alan Klembczyk (Taylor Devices)	QUALIFICATION WORKING GROUP 11:15AM-NOON / UNLIMITED DIST. A
	MEETING ROOM 304/305	MEETING ROOM 301	MEETING ROOM 206/207
10:00	VALIDATION OF THE DYNAMIC FEA MODELING OF AN ARMAMENT SYSTEM TO EMPIRICAL TEST RESULTS USING ACCELEROMETERS AND STRAIN GAUGES (32) Blace Jacobus, Dr. Catherine Florio, David Geissler, Ryan Hanc, Russell Jones, Steven Manole, & Thomas Ziegler (US Army)	DESIGN, CHARACTERIZATION, AND REFINEMENT OF A MULTIBODY SHOCK ISOLATION SYSTEM (34) Alan Klembczyk (Taylor Devices)	TRAINING
10:25	SUPPORTING PIPE FOUNDATION FLANGE SHOCK ANALYSIS TOOL FOR SIMULTANEOUS LARGE QUANTITY FLANGE ANALYSIS - IMPROVEMENTS (33) Mackenzie Wilson & Chris Campbell (HII Newport News Shipbuilding)	<b>COMPOUNDING CUSTOM ELASTOMERIC</b> <b>FORMULATIONS TO INCREASE SERVICE LIFE</b> (34) <i>Neil Donovan &amp; Adam Meyer (Hutchinson)</i>	SHIP SHOCK INSPECTIONS (35) Michael Poslusny (Gibbs & Cox) 10:00 - 11:00AM
10:50	INVESTIGATION OF SHIPBOARD FIRE DETECTOR RESPONSE TO NON-MIL-DTL-901 SHOCK (33) Daniel Provenzano & Brian Moore (NSWC Philadelphia)	<b>IDC AND THE JES GROUP – YOUR RESOURCE</b> <b>FOR SHOCK AND VIBRATION SOLUTIONS (35)</b> <i>Eric Jansson (Isolation Dynamics Corp.)</i>	
11:15	PRINTED HYBRID ELECTRONIC (PHE) ASSEMBLIES ON HEMISPHERICAL DOMES SUBJECT TO EXTREME (100,000 G) ACCELERATION LEVELS: MECHANICAL PERFORMANCE AND OPERATIONAL APPLICATIONS (33) Mjr. Hayden Richards & Dr. Abhijit Dasgupta (Univ. of Maryland), Andres Bujanda, Dr. Harvey Tsang, & Dr. Jian Yu	BENEFITS OF USING BAND-LIMITED DAMPING IN EXPLICIT DYNAMICS FEA SIMULATIONS (35) Dr. Ted Diehl (Bodie Technology)	Dynamic Environments Qualification Working Group Moderators: Troy Skousen (Sandia National Labs) David Soing (Sandia National Labs)
11:40	How to Fail a Shock Test (34) Dan Moran (NSWC Philadelphia)	MOTION AMPLIFICATION MEETS MODAL ANALYSIS: WHAT'S SO "SHOCKING" ABOUT THAT? (35) Jeff Hay (RDI Technologies)	Lavia Soine (Sanaia National Labs) 11:15AM - Noon         

SEE A PRESENTATION WORTHY OF OUR HENRY C. PUSEY AWARD? REMEMBER TO NOMINATE THAT PAPER USING THE PROVIDED QR CODE!

27

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## AWARDS LUNCHEON (GENERAL SESSION II) NOON - 1:30PM



NOON—12:05pm	<b>CALL TO ORDER</b> Mr. Drew Perkins (S	SAVE / HI-TEST Laboratories)	M
12:05рм—12:15рм	IN MEMORIAM		
12:15рм—12:25рм	HENRY PUSEY BES Presented to:	ST PAPER AWARD Angela Patterson, Dr. Vit Babuska, David Soine, Daniel Lee Sandia National Laboratories	
12:25рм—12:35рм	<b>DISTINGUISHED S</b> Presented to: Presented to:	ERVICE AWARD Rebecca Grisso, NSWC Carderock Ashley Shumaker, SAVE/HI-TEST	

Henry Pusey Best Paper Award

PRESENTED TO: "A SIMPLIFIED FINITE ELEMENT MODEL FOR DESIGN OF A RESONANT PLATE" Angela Patterson, Dr. Vit Babuska, David Soine, Daniel Lee (Sandia National Laboratories)

Accurate finite element models are often very complex and can take a long time to develop. The goal of the work described in this paper was to create a model for design that is as simple as it can be and no more complicated than it must be. This paper focuses on the creation of a simplified model for a resonant plate. Resonant plates are used in mid-field pyroshock testing environments. During these tests, components are mounted to one side of the plate, and the other side of the plate is struck by a projectile or hammer. Damping bars are mounted along the plate's edges to damp the response of the plate and avoid problematically long ring down times.

The 1kHz resonant plate was selected to be modeled because an abundance of test data was available and because a more complex model of this plate had already been developed and validated. The simplified model was created using Ansys Mechanical. Ansys was chosen as the modeling software because it is a trusted, widely available, commercial product.

The 1kHz plate has a thickness to length ratio of approximately 1:10, so the first simplification made was to model the plate using two-dimensional plate elements. The accuracy of Ansys plate elements was assessed by comparing the results of modal analyses of models using two-dimensional and three-dimensional elements for plates of varying thicknesses. Plates with thickness to length ratios from 1:40 to 1:2 were modeled. It was found that Ansys plate elements are very robust and can provide results within 1.5% of three-dimensional solid elements even for plates whose thickness is approximately half of its length – well beyond normal plate assumptions. A similar comparison between plate and solid elements was conducted in Sierra SD, but the results were not as promising.

Since Ansys plate elements provided such accurate results, a model consisting purely of plate elements and point masses was produced. These point masses were needed to represent the mounting blocks along the edge of the plate and the impact block in the middle of the plate. The model of the plate with point masses produced natural frequencies within 3.5% of the test data. Next, a simplified model of the plate with damping bars was created. This model consisted of the bare plate model connected to four bars that were modeled using plate elements. Two rows of beam elements were used to connect each bar to the plate within 5% of the frequencies found during a modal test of the plate with damping bars. Modal assurance criteria (MAC) were computed to compare the mode shapes of the models to the test data and identify matching modes for frequency comparison.



## AWARDS LUNCHEON (GENERAL SESSION II) NOON - 1:30PM



Distinguished Service Award

#### **PRESENTED TO:**

Rebecca Grisso, NSWC Carderock

Rebecca Grisso is recognized for her commitment and dedication to the Shock and Vibration Symposium and to the S&V community. In association with Becky's organization, NAVSEA Carderock, the Technical Advisory Group's annual summer meeting has been welcomed on the campus of NAVSEA Carderock since 2012. She has consistently served as the host of the meeting assisting with its planning, access, and operation. In addition, she has been a strong champion of the forum through her contributions of technical presentations, sessions, and chairmanship.

#### PRESENTED TO:

#### Ashley Shumaker, SAVE/HI-TEST

Ashley Shumaker is recognized for her commitment and dedication to the Shock and Vibration Symposium and to the operations of SAVE. Since becoming the Manager of Operations in 2007, Ashley has served as the "go to" person for all things SAVE. Her dedication to serving the Shock and Vibration Community, through tireless devotion to professionalism and efficiency, is evident each and every time a symposium is held. Ashley's contemporary enhancements to the symposium, along with her welcoming nature, have made the conference experience better for all attendees.

	SESSION 17: SHOCK TESTING METHODOLOGY II 1:30-3:05PM / UNLIMITED DIST. A CHAIR(S): JEFF MORRIS (HI-TEST LABORATORIES)	SESSION 18: BALLISTICS 1:30-2:15PM / UNLIMITED DIST. A ELECTRONICS PACKAGING FOR SHOCK SURVIVABILITY 2:45-3:30PM / UNLIMITED DIST. A CHAIR(S): DR. JACOB DODSON (AFRL)	SESSION 19: WEAPONS EFFECTS MODELING & SIMULATION 1:30-3:30PM / LIMITED DIST. D CHAIR(S): DR. T. NEIL WILLIAMS (USACE ERDC)
	MEETING ROOM 204/205	MEETING ROOM 301	MEETING ROOM 302/303
1:30	A COMPARISON OF THE NON-LINEAR DYNAMIC FORCE-DISPLACEMENT CHARACTERISTICS OF SHOCK MOUNTS WITH BOTH STATIC MEASUREMENTS AND VENDOR PROVIDED CHARACTERISTICS (36) Dr. Bernhard Heinemann & Dr. Delf Sachau (Univ. of the Federal Armed Forces Hamburg), Jan Dreesen (Bundeswehr Tech. Ctr. for Ships and Naval Weapons)	SIMULATING AIR BURST THREATS AND Assessing Survivability (38) Giri Prasanna (Altair Engineering)	MODELING FRAGMENTING MUNITIONS AND THEIR EFFECT ON STRUCTURES (39) Dr. T. Neil Williams, William Furr, Christopher Shackelford, & Dr. Jay Ehrgott, Jr. (USACE ERDC)
1:55	IMPROVED DIGITAL CONTROL OF SHOCK WAVEFORMS WITH SHAKERS (36) Dr. Mattia Dal Borgo, Umberto Musella, Eddy Faignet, Dr. Bart Peeters (Siemens)	<b>RESISTANCE OF FEBR GLAZING AGAINST</b> <b>INDIRECT FIRE THREATS (38)</b> <i>David Senior (USACE ERDC) &amp; Craig</i> <i>Ackerman (US Dept. of State)</i>	FRAGMENTATION AND BLAST EFFECTS LIBRARY (FABEL) (40) William Furr, Christopher Shackelford, Dr. T. Neil Williams, & Dr. Jay Ehrgott, Jr. (USACE ERDC)
2:20	GENERATION OF SYNTHETIC SHOCK DATA USING GAN'S (37) Victor Nevarez & Jingyu Chen (Sandia National Laboratories)		STRUCTURAL RESPONSE PREDICTIONS OF STEEL AND CONCRETE TARGETS USING THE FRAGMENTATION AND BLAST EFFECTS LIBRARY (40) Christopher Shackelford, William M. Furr, Dr. T. Neil Williams and Dr. Jay Ehrgott, Jr. (USACE ERDC)
2:45	A NEW APPROACH FOR SYNTHETIZING MULTI-AXIS SHOCKS FROM SRS SPECIFICATIONS (37) Umberto Musella, Dr. Mattia Dal Borgo, Dr. Alberto Garcia De Miguel, Dr. Bart Peeters, & Eddy Faignet (Siemens)	ELECTRONIC SURVIVABILITY AND RESPONSE OF MICROBEADED ENCAPSULANTS UNDER SHOCK (38) Alex Chen, Cayden Boll,& Dr. Dan Stefan (Sandia National Laboratories), Dr. Robert Andrew (Buraque de Mexico), Dr. Jeff Hill (Brigham Young University)	MODELING AND SIMULATION OF DEFORMABLE PROJECTILES INTO CONCRETE TARGETS USING EPIC (41) David Lichlyter, Dr. T. Neil Williams, Dr. Kyle Crosby, Dr. Jay Ehrgott Jr. (USACE ERDC)
3:10		SHOCK MITIGATION EXPERIMENTS WITH A SIX-INCH DIAMETER GAS GUN (39) Joshua Nowlin, Dr. Nancy Winfree, Chad Heitman (Sandia National Laboratories)	PRE-DAMAGED HIGH-PERFORMANCE CONCRETE TARGETS SUBJECTED TO PENETRATION TESTING TO OBSERVE RESIDUAL VELOCITIES (41) Justin Gilliland, Andreas Frank, & M. Jason Roth (USACE ERDC)

3:30

4:15

**Afternoon Cookie Brenk** É **Passport Program Drawing** SALON BALLROOM (EXHIBIT HALL)

HI-TEST Laboratories, Inc.

	SESSION 20: UNDEX 1:30-3:30PM / LIMITED DIST. D CHAIR(S): REBECCA GRISSO (NSWC CARDEROCK) TOM BRODRICK (NSWC CARDEROCK)	PANEL: MULTI-DEGREE-OF-FREEDOM VIBRATION TESTING CURRENT CAPABILITIES, HURDLES, & PATH FORWARD FOR WIDESPREAD ADOPTION 1:30PM-3:30PM / UNLIMITED DIST. A	TRAINING V: INTRODUCTION TO HEAVYWEIGHT SHOCK TESTING 1:30-3:30PM / UNLIMITED DIST. A
	MEETING ROOM 304/305	MEETING ROOM 206/207	MEETING ROOM 202
1:30	UNDERWATER EXPLOSION RESPONSE OF CANTILEVERED BEAMS AT VARIED SPACING (41) Rebecca Grisso, Sara Fisher, & Matthew Stevens (NSWC Carderock)	MULTI-DEGREE-OF-FREEDOM VIBRATION TESTING CURRENT CAPABILITIES, HURDLES, AND PATH FORWARD FOR WIDESPREAD ADOPTION (43) This panel discussion will brief out cur- rent lab technologies used to accomplish multi-degree-of-freedom (MDOF) tests and survey the audience to gather perspective	INTRODUCTION TO HEAVYWEIGHT SHOCK TESTING (43) Travis Kerr (HI-TEST Laboratories) 1:30 - 3:30PM
1:55	SHOCK QUALIFIED STOWAGE SOLUTIONS FOR SUBMARINE APPLICATIONS (42) Teresa Gangi & Monica Blanchard (NUWC Newport)	on obstacles which have held up the com- munity from more widespread adoption. Feedback will be incorporated to assist in development of a "MDOF Roadmap" to continue adoption efforts.	
2:20	DEVELOPMENT OF A MIL-DTL-901 SUBSIDIARY COMPONENT SHOCK TEST INFORMED BY 6 DOF SIMULATIONS (42) LeeYung Chang (NSWC Carderock)	PANELISTS: Matt Forman (NSWC Dahlgren) Troy Skousen (Sandia National Labs) Dr. Bryan Joyce (NSWC Dahlgren) Dr. Chris Roberts (UK MOD) William Barber (Redstone Test Center) Dr. Pablo Tarazaga (Texas A&M)	
2:45	Hybrid-Scaled Whipping Model Tests: Overview (42) Dr. Ken Nahshon, Alexander Burr, Matthew Strawbridge, & D. Umansky (NSWC Carderock)	1:30-3:30PM	
3:10	HyBRID-SCALED WHIPPING MODEL TESTS: DATA PROCESSING (42) David Umansky & Dr. Ken Nahshon (NSWC Carderock)		

3:30

4:15

Afternoon Cookie Brenk & Passport Program Drawing salon ballroom (exhibit hall)



## TUTORIAL SESSION V 3:30 - 6:30PM

OPTIONAL THREE HOUR COURSES. ATTENDEES WILL RECEIVE A CERTIFICATE OF COMPLETION AND MAY RECEIVE CEUS/PDHs (VARIES BY STATE). ADDITIONAL FEES APPLY TO ATTEND.

**SHOCK TEST FAILURE MODES** Kurt Hartsough (901 E&T)

This tutorial will cover examples of shock test failures typically experienced by equipment exposed to MIL-DTL-901E shock levels. MIL-DTL-901E provides guidance for designers responsible for meeting the requirements of MIL-DTL-901E. 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.

#### PEAK RESPONSE OF LINEAR STRUCTURES IN RANDOM VIBRATION

Dr. Thomas Paez (Thomas Paez Consulting)

The main focus of fundamental studies in random vibration of linear structures is the characterization of the distribution of mean square signal content in the frequency domain. A basic development of random vibration theory starts with probability and random process theory (The latter requires an understanding of Fourier analysis.), the theory of deterministic structural dynamics, and then proceeds to establish the fundamentals of random vibration. Most important in random vibration are the concepts of the spectral density of stationary excitation and response random processes, and the fundamental relation of random vibration, i.e., the equation that expresses the spectral density of a linear response in terms of the spectral density of an excitation and a structural property. Most of the important experimental and analytical activities in random vibration are supported by the fundamental activities described here. However, there are many other more advanced facets to random vibration, and some of those can be developed directly. For example, the problems of low- and high-cycle fatigue, and the peak response of structures in random vibration are important. This tutorial develops the latter subject, peak response. The first half of the tutorial is a review of the basic ideas of linear random vibration. The spectral density and the fundamental relation of random vibration are developed. The second half of the tutorial deals with development of the probability distribution, mean and variance of peak response. These results are first obtained for a narrow-band random response and then generalized to the realistic case of wide-band response. Examples are included. MATLAB scripts and functions for establishing the probabilistic measures of peak response are provided to attendees. An electronic copy of the color slides is provided as well.

## INTRODUCTION TO MIL-STD-461G- THE ELECTROMAGNETIC INTERFERENCE CONTROL REQUIREMENTS FOR DOD SUBSYSTEMS AND EQUIPMENT

Jeff Viel (NTS Technical Systems)

This 3 hour tutorial provides a detailed technical overview of MIL-STD-461G addressing the electromagnetic interference (EMI) emission and susceptibility test methods and control requirements for subsystems and equipment and subsystems designed or procured for the Department of Defense (DoD). This tutorial starts from the very beginning discussing the basis for EMI control testing, including a historical case study, to the progressive development of test methods and requirements adapted to modern day technologies and electromagnetic environments. While the standard is broadly designed to address all DOD platforms, this tutorial is focused to specifically address shipboard and submarine application requirements.

[SEE ADDITIONAL TOPICS FOR THIS SESSION ON PAGE 33]



MTG ROOM 204/205

MTG ROOM 302/303



## TUTORIAL SESSION V 3:30 - 6:30PM (CONTINUED)



#### EFFECTIVE SOLUTIONS FOR SHOCK AND VIBRATION CONTROL

MTG ROOM 304/305

Alan Klembczyk (Taylor Devices) Ken Lussky (BAE Systems)

Part 1 of this Tutorial 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.

Part 2 of this Tutorial addresses characterization of shock and vibration environments and finite element analysis (FEA) of shock and vibration isolation performance. Methods used to characterize shock and vibration responses and their application are defined. For shock these include spectral definitions (SRS shock response spectrum and PVSS pseudo velocity shock spectrum) and time-history definitions (peak velocity, peak acceleration, average acceleration and displacement). These are discussed with respect to their application to shock input severity, and equipment fragility and damage potential. Shock test qualification methods, their input definitions, and how they are represented in FEA are discussed. Also addressed are the value of damping in shock isolation and how shock and vibration isolation systems are represented in FEA. For vibration the spectral definition of Acceleration Spectral Density (ASD) is discussed. Other topics addressed are the application of UERD Tools for shock characterization, and when to engage with the appropriate shock and vibration Technical Warrant Holders (TWH).

#### GENERAL CRADLE TO GRAVE QUALITY CONTROL TECHNIQUES FOR MAXIMIZING ACCURACY AND MINIMIZING DISCRETE OR BASIC ERRORS IN MIL-DTL-901E SHOCK AND MIL-STD-167 VIBRATION CLASSICAL AND NUMERICAL DYNAMIC ANALYSIS

MTG ROOM 301

Dr. Christopher Merrill (CM&A Engineering)

This training provides general simple techniques for use in parallel with long term Classical and Numerical Dynamic Analysis of Systems subjected to US Navy shock and vibration requirements to maximize accuracy and minimize errors in Dynamic Analysis of systems. The interaction of the US Navy shock and vibration requirements is a major driver of the efficacy of long-term Dynamic Analysis from the start. Apart from major issues that occur on any major long-term developmental programs, simple, seemingly minor, errors present in the analysis from the beginning can lead to huge cost and schedule impacts generally at the worst time for the program (FAT). Fortunately, there are procedural long-term Dynamic Analysis to mitigate the risk of such errors. This training will provide examples of types and genesis of such errors, as well as, a process to perform at the beginning and in parallel with the long-term dynamic analysis in order to perform quality control comparisons with it. Finally, the importance of comparison of FAT dynamic test results to dynamic analysis including failure and use of prototyping will be included. The training will end with an exercise where the trainer will attempt to stump the trainee with balky computer model results. The trainee will leave the training with a list of types of and genesis of discrete and basic errors, a process chart and algorithm for applying these Quality Control Techniques at the start and in parallel with the long-term dynamic analysis when they return.



## Join us for a social event at the



# 7:00 - 10:00PM

All symposium attendees & guests are invited for dinner, beverages, & entertainment.



Venue is 1/3 mile walk from the Hilton Atlanta. Bring your conference badge for entry.

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#### BREAKFAST SALON BALLROOM | 7:00-8:00AM

	SESSION 21: EXPERIMENTAL METHODS FOR SRS 8:00-10:00AM / UNLIMITED DIST. A CHAIR(S): DAVID SOINE (SANDIA NATIONAL LABS) DR. PABLO TARAZAGA (TEXAS A&M)	SESSION 22: NUMERICAL METHODS 8:00-9:35AM / UNLIMITED DIST. A CHAIR(S): DR. WASHINGTON DELIMA (KANSAS CITY NSC)	SESSION 23: MODELING, TESTING, AND ANALYSIS OF FUZE TECHNOLOGY FOR EXTREME ENVIRONMENTS 8:00-9:35AM / LIMITED DIST. D CHAIR(S): DR. ALAIN BELIVEAU (ARA) DR. JACOB DODSON (AFRL)
	MEETING ROOM 204/205	MEETING ROOM 206/207	MEETING ROOM 302/303
8:00	Experimental Determination OF Resonant Plate Modes Under High SHOCK LOADS (43) Dr. Carl Sisemore (ShockMec Engineering)	A COMPREHENSIVE DIGITAL TWIN SOLUTION: REVOLUTIONIZING DEFENSE OPERATIONS (46) Kory Soukup (Altair Engineering)	DESIGN OF ADDITIVELY MANUFACTURED INTERPENETRATING LATTICE FOR INTEGRATED SENSING (48) Richard Clayson, Joshua Dye, & Benjamin White (Sandia National Laboratories)
8:25	RESPONSE LIMITING & OPTIMIZING SHAKER SHOCKS - ALGORITHMS (44) Dr. Vit Babuska & Jerome Cap (Sandia National Laboratories)	STREAMLINING THE DESIGN CYCLE WITH A MESH-FREE APPROACH TO STRUCTURAL ANALYSIS (47) Kory Soukup (Altair Engineering)	M&S EVALUATION OF FUZE PACKAGING STRATEGIES UNDER THERMAL AND MECHANICAL SHOCK ENVIRONMENTS (48) Jared Hammerton (Applied Research Associates)
8:50	RESPONSE LIMITING & OPTIMIZING SHAKER SHOCKS - EXPERIMENTS (45) Dr. Vit Babuska & Jerome Cap (Sandia National Laboratories)	PARAMETERIZED FRICTION MODEL WITH OPTIMIZED USER CONSTRUCTS (47) Robert Duong (Sandia National Laboratories), Andrew Slezak (Texas Tech. Univ.), Chris Jawetz (Georgia Inst. of Tech.)	<b>EXPERIMENTAL EVALUATION OF ELECTRONIC</b> <b>PACKAGING STRATEGIES (48)</b> Zachary Jowers (Applied Research Associates)
9:15	SHOCK RESPONSE OF RESONANT BARS FOR COMPONENT TESTING (45) David Soine, Tyler Schoenherr, & Adam Bouma (Sandia National Laboratories)	SEMI-ANALYTICAL METHOD FOR PREDICTING ELASTO-PLASTIC WAVE PROPAGATION IN ONE-DIMENSIONAL PERIODIC MEDIA (47) Greg Dorgant & Dr. Michael Leamy (Georgia Inst. of Tech.), Dr. Washington DeLima (Kansas City National Security Campus)	<b>TESTING HARDENED FORWARD ASSEMBLIES</b> <b>FOR FUNCTIONAL VALIDATION (48)</b> <i>Dustin Landers (Applied Research</i> <i>Associates)</i>
9:40	MULTI-AXIS RESONANT PLATE ANGLED FIXTURE (46) Trevor Turner & Dr. Pablo Tarazaga (Texas A&M Univ.), William Zenk, Chase Zion, & Dr. Washington DeLima (Honeywell Federal Manufacturing & Technologies)		



	DISCUSSION GROUP: MODELING AND SIMULATION OF BOLTED CONNECTIONS 8:00-9:00AM / LIMITED DIST. D	TRAINING VI: INTRODUCTION TO MULTI SHAKER TESTING 8:00-10:00AM / UNLIMITED DIST. A	TRAINING VII: BLAST DATA PROCESSING & DATA ANALYSIS 8:00-9:00AM / UNLIMITED DIST. A TYPE I VIBRATION QUALIFICATION IN ACCORDANCE WITH MIL-STD-167-1A, COMMON ERRORS & BEST PRACTICES 9:15-10:00AM / UNLIMITED DIST. A
	MEETING ROOM 304/305	MEETING ROOM 301	MEETING ROOM 202
8:00	Discussion on the Modeling and Simulation of Bolted Connections When Subjected to Dynamic Loading (49)	INTRODUCTION TO MULTI SHAKER TESTING (49) Raman Sridharan	Blast Data Processing and Analysis (50)
	Moderator:	(Data Physics/NVT Group)	Denis Rickman (USACE ERDC)
8:25	Joshua Yates (NSWC Carderock) 8:00-9:00AM	8:00-10:00AM	8:00-9:00AM
8:50	Discussion will focus on modeling & simulation of bolted connections under dynamic loading. Bolted connections are integral to US Navy equipment and structures; accordingly it is critical that they are designed and assessed properly. Due to the wide variety of bolted connections, different M&S techniques should be used depending on the specific intended use of the analysis. Selecting the proper approach for representing a bolted connection in a dynamic analysis has a meaningful impact on results; however, there are not generally accepted best practices for what modeling constructs should be used in different applications. The objective of this group is to understand the different M&S approaches used across the shock and vibration community and to discuss the effect that different M&S techniques have on analysis results.		
5.15			Type I Vibration Qualification in Accordance with MIL-STD-167-1A, Common Errors and Best Practices (50)
9:40			(NSWC Philadelphia) 9:15-10:00AM

	SESSION 24: SRS ANALYSIS METHODS 10:00-10:20AM / UNLIMITED DIST. A UNDEX 10:50-NOON / UNLIMITED DIST. A CHAIR(S): MICHAEL POSLUSNY (GIBBS & COX)	SESSION 25: SPACECRAFT SHOCK TESTING 10:00-NOON / UNLIMITED DIST. A CHAIR(S): Monty Kennedy (MK Engineering) DR. JASON BLOUGH (MTU)	SESSION 26: STRUCTURAL RESPONSE & MATERIALS 10:00-10:20AM / LIMITED DIST. D 10:25-10:45 / UNLIMITED DIST. A CHAIR(S): MINA HABASHY (US ARMY DEVCOM)
	MEETING ROOM 204/205	MEETING ROOM 206/207	MEETING ROOM 302/303
10:00	SHOCK RESPONSE SPECTRUM ANALYSIS AND DATA VALIDATION TOOL (51) Seth Siddle-Mitchell & Dr. Logan McLeod (NTS Technical Systems)	<b>IT IS ESSENTIAL TO PERFORM SPACECRAFT</b> <b>LEVEL SHOCK TESTING (53)</b> Monty Kennedy (MK Engineering), Dr. Jason Blough (MTU)	Soil Response to Impact Loads (56) Mina Habashy & Dr. Mike Macri (US Army DEVCOM Armaments Center)
10:25		NASA SPACECRAFT MOCKUP USED TO PERFORM SPACECRAFT LEVEL SHOCK TESTING (54) Monty Kennedy (MK Engineering), Dr. Jason Blough (MTU)	SEISMIC TESTING OF A CROSS-LAMINATED TIMBER SHELTER CONSTRUCTED WITH THERMALLY MODIFIED COASTAL WESTERN HEMLOCK AND CARBON FIBER JOINTS (56) James Wilcoski & Peter Stynoski (USACE ERDC), Mark O'Brien & Erik Poulin (Composites Recycling Tech. Center)
10:50	THE RESPONSE OF WELDED STEEL PLATES WITH RESIDUAL STRESS TO CLOSE-PROXIMITY UNDEX LOADING (51) Dr. Rasmus Wedberg & Niklas Alin (Swedish Defence Research Agency)	NASA SHOCKSAT UTU SHOCK TEST RESULTS AND RECOMMENDATIONS TO IMPROVE SHOCK ANALYSIS AND TESTING (55) Monty Kennedy (MK Engineering), Dr. Jason Blough (MTU)	
11:15	JASSO: A FURTHER YEAR OF TESTING AND DEVELOPMENT (52) Gavin Colliar, Phillip Thompson, Nick Misselbrook, Brian Ferguson, & Alex Whatley (Thornton Tomasetti Defence)	SHOCK TEST AND ANALYSIS LESSONS LEARNED PART I (56) Alexander Hardt (Northrop Grumman Space Systems)	
11:40	<b>EXPERIMENT AND NUMERICAL SIMULATION</b> <b>STUDY ON THE NEAR-FIELD UNDERWATER</b> <b>EXPLOSION OF ALUMINIZED EXPLOSIVE (52)</b> <i>Dr. Yuanxiang Sun (Beijing Institute of</i> <i>Technology)</i>	SHOCK TEST AND ANALYSIS LESSONS LEARNED PART II (56) Alexander Hardt (Northrop Grumman Space Systems)	

1:00 -



### SAVE TECHNICAL ADVISORY GROUP (TAG) MEETING

ROOM 206/207

The annual meeting of the members of the SAVE Technical Advisory Group (TAG) will convene to review the 93rd Shock & Vibration Symposium and discuss plans for 2024.

	SESSION 27: UPDATES TO BLASTX 10:00-11:35AM / LIMITED DIST. D	<i>TRAINING VIII:</i> INTRODUCTION TO UERDTOOLS 10:00AM - NOON / LIMITED DIST. C	TRAINING IX: INTRODUCTION TO MEDIUM WEIGHT SHOCK TESTING 10:00AM - NOON / UNLIMITED DIST. A
	CHAIR(S): Gustavo Emmanuelli (USACE ERDC) Michelle LeBlanc (AFRL)	TRAINING	TRAINING
	MEETING ROOM 304/305	MEETING ROOM 301	MEETING ROOM 202
10:00	IMPROVEMENTS TO ALUMINIZED EXPLOSIVE MODELS IN BLASTX (57) Gustavo Emmanuelli (USACE ERDC)	INTRODUCTION TO UERDTOOLS (59)	INTRODUCTION TO MEDIUM WEIGHT SHOCK TESTING (59)
		Brian Lang (NSWC Carderock)	Jeff Morris (HI-TEST Laboratories)
10:25	IMPLEMENTATION OF THE ERDC CASED MUNITION MODEL (ECMM) INTO BLASTX (57) Krystal Rodriguez-Soto & Dr. Gregory Bessette (USACE ERDC)	10:00AM - NOON         	10:00AM - NOON         
10:50	MODELING TIME-DEPENDENT BREACH IN BLASTX (58) Zoran Nadzakovic & Dr. Gregory Bessette (USACE ERDC)		
11:15	VALIDATION OF THE BLASTX CODE FOR CASED AND UNCASED ALUMINIZED EXPLOSIVES (58) DeBorah Luckett & Gustavo Emmanuelli (USACE ERDC), Roosevelt Davis (AFRL Munitions Directorate)		
11:40			

1:00 -



#### SAVE TECHNICAL ADVISORY GROUP (TAG) MEETING

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ROOM 206/207

The annual meeting of the members of the SAVE Technical Advisory Group (TAG) will convene to review the 93rd Shock & Vibration Symposium and discuss plans for 2024.

Exhibitor List

EVENT SPONSOR HI-TEST Laboratories (F1)

<u>GOLD LEVEL CORPORATE SUPPORTERS</u> Hutchinson/Mide (005/006) PCB Piezotronics (201/202)

SILVER LEVEL CORPORATE SUPPORTERS Huntington Ingalls (504) ITT Enidine (401) Thornton Tomasetti (501)

BRONZE LEVEL CORPORATE SUPPORTERS

Bodie Technology (103) The Boeing Company (105) Dayton T. Brown (402/403) E-Labs (002) National Technical Systems (204) Spectral Dynamics (101/102) Taylor Devices (601) Societec US (104)

#### ADDITIONAL EXHIBITING COMPANIES

Advanced Test Equipment Rentals (303) Altair Engineering (009) Applied Technical Services (604) Correlated Solutions (205) Crystal Instruments (106) Data Physics/Team Corp. (602) DEWESoft (304) Dytran Instruments (406) ETS Solution (F6) Experior Laboratories (404) HEAD Acoustics (F2) Hi-Techniques (001) Instrumented Sensor Technology (605) Isolation Dynamics Corp. (302) iX Cameras (603) m+p International (204)

MECALC (F3/F4) Performance Controls Inc (F5) Photron (003) Precision Filters (206) RDI Technologies (606) REL, Inc. (502) ShockMec Engineering (607) Siemens (203) Society for Experimental Mechanics (608) Specialised Imaging (405) USACE ERDC (007) Vibration Research Corporation (301) Viper Applied Science (010) Vision Research (503) Xcitex (008)

#### **ANCILLARY SPONSORSHIP RECOGNITION**

LANYARD SPONSOR Spectral Dynamics (101/102)

<u>NOTEPAD & PEN SPONSOR</u> Isolation Dynamics Corp. (302)

WIFI SPONSOR IN EXHIBIT HALL Hi-Techniques (001) CHARGING STATION SPONSORS E-Labs (002) m+p International (204)

ICE CREAM SOCIAL SPONSORS ITT Enidine (401) Spectral Dynamics (101/102)

Exhibit Hall Layout



Exhibitor Descriptions



**ADVANCED TEST EQUIPMENT RENTALS** primary focus is providing a complete rental solution of measurement and test equipment to industries such as Aerospace, Defense, Communications, EMC, and more. Our wide inventory, custom solutions, flexible terms, and quality support differentiates us from competitors as a complete solution for all test and measurement needs. Our inventory covers most electronic test applications and we are always expanding to remain the leading rental provider.



**ALTAIR** is a global leader in computational science and artificial intelligence (AI) that provides software and cloud solutions in simulation, high-performance computing (HPC), data analytics, and AI. Altair enables organizations across all industries to compete more effectively and drive smarter decisions in an increasingly connected world – all while creating a greener, more sustainable future.



**APPLIED TECHNICAL SERVICES, LLC (ATS)** is a premier provider of high quality consulting engineering, testing, and inspection services. Since our founding in 1967, ATS has established an excellent reputation with business, industry, and the legal profession. Notably, ATS is known for successfully uncovering facts in metallurgy, materials testing, chemical analysis, non-destructive testing, calibrations, fires and explosions. ATS can take a closer look for you to help find the technical answers and solutions you need.



**BODIE TECHNOLOGY** provides engineers with excellent software, training, and consulting resources to help analyze complex nonlinear mechanics problems, especially those involving problematic or noisy transient data. Bodie offers guidance on how to tackle a nonlinear mechanics problem, including best practices for utilizing FEA and physical testing methods.



**BOEING** is the world's largest aerospace company and leading manufacturer of commercial jetliners and defense, space and security systems. A top U.S. exporter, the company supports airlines and U.S. and allied government customers in 150 countries. Boeing products and tailored services include commercial and military aircraft, satellites, weapons, electronic and defense systems, launch systems, advanced information and communication systems, and performance-based logistics and training.



**CORRELATED SOLUTIONS, INC.** develops and manufactures turn-key Digital Image Correlation (DIC) measurement systems for non-contact full-field analysis of shape, motion, deformation, strain, and vibration applications. The VIC-3D HS FFT system is capable of measuring ODS's with frequencies up to 50 kHz with nanometer resolution and has a large dynamic range. Visit the booth to see new windowing function options and how they can be used to see distinct amplitude peaks in the frequency domain.



**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. Cl's products are used across a wide range of industries, including aerospace, defense, and medical device manufacturing.



**DATA PHYSICS** has been pioneering high-performance vibration testing and signal analysis in the aerospace, defense and automotive industries since 1984. We design and manufacture a range of air and water-cooled electrodynamic shakers, vibration controllers, and dynamic signal analyzers. The modern 900 Series analyzer and controller enables simultaneous dynamic signal analysis and shaker vibration control, leveraging a compact hardware form factor with exceptional dynamic range, phase accuracy, and intuitive software which auto-aggregates your data into an easily searchable relational database. Data Physics controllers lead the industry in multi-shaker vibration control, and our MIMO controllers are trusted to control the world's most advanced multi-shaker vibration tables including multi-shaker single axis, 3-DOF, 6-DOF, 6+DOF, over-actuated systems, IMMAT/modal control, and more. Our unique soft-shutdown technology – engineered to protect high-value test articles – proved to be an invaluable feature, critical to the successful testing of the recently launched James Webb Space Telescope.

Exhibitor Descriptions



**DAYTON T. BROWN's** tenured engineers provide experience in adapting our test equipment to meet the most challenging customer requirements. Our extensive test facility includes several shakers, anechoic EMI/EMC rooms, multiple chambers to perform a myriad of environmental tests and our newly expanded structural testing area with its 40ft ceiling. DTB is an A2LA and NVLAP accredited laboratory in accordance with ISO/IEC 17025 requirements and is ISO 9001:2008 and AS9100C registered.













**DEWESOFT**, a privately held company, is a World leading provider of data acquisition software and hardware serving all. The DEWESoft software and hardware synchronizes Analog, Digital, Video, GPS, CAN, ARINC 429/1553, PCM and Chapter 10 support. The instruments have wide temperate and shock ranges and are available in many configurations.

Founded in 1980, **DYTRAN INSTRUMENTS, INC**. is a leading manufacturer and designer of piezoelectric and DC MEMS sensors. Dytran offers a complete range of impulse hammers, piezoelectric force and pressure sensors, electronics, cables, and accessories for dynamic measurements, with full in-house customization capabilities.

**E-LABS** is a full-service testing laboratory featuring state of the art facilities, knowledgeable personnel, and simulation services such as test planning and fixture design. We perform climatic and dynamic testing, offer full EMI and EMC testing, and conduct specialized testing such as explosive atmosphere, high pressure, and helium leak detection.

**ENDEVCO** provides a complete range of dynamic test and measurement sensor solutions, including piezoelectric, piezoresistive, MEMS, and variable capacitance accelerometers, as well as angular rate, shock, and 6 DoF sensors, miniature pressure sensors, signal conditioners, cables and accessories. Our brand is recognized for highly reliability products with a wide range of testing applications, including automotive design and crash testing, aircraft and space vehicle testing, weapons and munition testing, and general lab testing. Endevco is an assumed name of PCB Piezotronics of North Carolina, Inc., which is a wholly-owned subsidiary of PCB Piezotronics, Inc. More info www.endevco.com

**ETS SOLUTION** is a world leader in High performance shakers, designed to enable the better test. We are discussing our IPA series amp, designed to never fail a fuse, and our Extreme Acceleration Solid armature Y-connection "EASY" Ring, designed for up to 220 g sine and 180 g RMS Random. ETS Solutions offers affordable, high quality vibration test equipment. Utilizing extensive and innovative technical expertise ETS delivers a reliable long term solution to meet your test requirements. All systems comply with the European CE standards with full testing and certification from TUV-SUD Product Service GmbH.

**EXPERIOR LABORATORIES, INC** is a Southern California based, third-party test laboratory providing independent design verification and qualification testing services to component and system manufacturers, military contractors, integrators and system providers within the Telecommunication, Military, Aerospace, Space, Industrial, Medical and many other industries. Recognized throughout the industry for superior customer service, consistent on-time delivery, project management by experts and end-to-end accountability, Experior Labs offers customers cost-effective, highly qualified testing services that add value to any organization, regardless of size.



Since foundation in 1986, **HEAD ACOUSTICS** has been a reliable partner wherever acoustics, vibrations, or speech, audio and sound quality play an important role. We are not only one of the world's leading companies in the comprehensive analysis of sound and vibration; our expertise and pioneering role in measurement and optimization of speech and audio quality in communications technology are recognized worldwide. Our customers value the combination of cutting-edge measurement technology with decades of experience. With our hardware and software, we offer scalable solutions for specific problems posed by a variety of applications. As a service, our experts develop acoustic optimization approaches – in close cooperation with our customers and tailored to their individual needs.



Exhibitor Descriptions



**HII** is America's largest military shipbuilder. HII specializes in providing shock and vibration qualification and support through recognized expertise in testing and advanced shock analysis. HII is also the creator of the patented Deck Simulating Shock Machine (DSSM), the newest Navy approved test method in MIL-DTL-901E.



**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 in data acquisition.



**HI-TEST LABORATORIES, INC.** is an unparalleled facility that has provided engineering, testing, and evaluation services to government and industry since 1975. HI-TEST is the undisputed leader in MIL-DTL-901E shock testing, housing all approved platforms at one convenient location. From pre-test analysis to post-test report generation, we offer our analytical engineering tools and expertise alongside our testing and design capabilities to make your test run as smoothly and efficiently as possible.



**HUTCHINSON** Defense and Mobility products have proven performance in all major modern conflicts from the first Gulf War to the Balkans, Iraq, Afghanistan and Syria. Hutchinson is trusted worldwide by soldiers to ensure their mobility and protection in all terrains and combat situations. Hutchinson provides innovative products and proactive support that exceeds customers' expectations and meets the demands of tomorrow's lighter and more survivable vehicles.

Headquartered in Long Island, NY, **IDC** is a leader in the design, engineering, and manufacture of Shock & Vibration Isolation systems for both military and commercial applications. Specializing in rugged, allmetallic wire rope isolators. IDC has amassed an impressive list of shock qualified systems for the US Navy and all branches of the military. IDC's unsurpassed experience and knowledge in the field of shock and vibration isolation, makes it possible for us to engineer a solution from early concept to final product. All of IDC's products are proudly made in the USA using only the highest quality domestic materials.



**IST** offers a full line of acceleration 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).



**ITT ENIDINE DEFENSE** designs and manufactures energy absorption, vibration isolation and shock systems for defense applications. These engineered products support applications in weapon systems, naval, transportation, and aviation. Products include elastomeric, hydraulic, mechanical shock isolation, as well as standard off the shelf products such as HERMS and Wire Rope Products.



**IX CAMERAS** is a world-leading technology and product company specializing in the field of high-speed (slow motion) imaging. Based on proprietary innovative technologies, we design, build and sell cuttingedge ultra-fast cameras and software for a wide range of advanced scientific research applications. Our commitment to innovate and push the boundaries of high-speed video science is the reason we develop technically superior and easy-to-use products that our customers need to attain the highest scientific achievements and creativity. iX Cameras introduced the revolutionary i-SPEED Series, the fastest high-speed, high-resolution camera in the market.



**M+P INTERNATIONAL** is a worldwide provider of high-quality test and measurement solutions for vibration control, noise & vibration analysis and general data acquisition. By working closely with our customers, we understand their applications from an engineer's point of view and this is apparent in our products. A policy of continuous research and development, which has led to many pioneering solutions, ensures that our products demonstrate superior performance and quality.



Exhibitor Descriptions



endva



MECALC is announcing the release of its newest Module for shock data acquisition. This Module is the

industry's first 5 MSa/s 24-bit digitizer for PyroShock with a flat frequency response to 2.1 MHz. Not

**MIDE** / ENDAQ is a Hutchinson Company with brands that include: enDAQ shock, vibration & environmental sensors & software; Piezo.com Offering high-value piezoelectric products and expert solutions; and Mide's HydroActive Seal Products. Midé is a leading provider of advanced engineering products and services. Midé is committed to providing customers with high-quality deliverables that are on-time, on budget, and meet their expectations through the use of a quality management system focused on continual improvement. Midé uses industry best practices in both execution and cost effectiveness.



For over a half-century, **NTS** has helped manage your toughest environmental test requirements. Leveraging our national network of laboratories, we are uniquely qualified to guide clients through MIL-Standard requirements. Our engineers are experts in shock and vibration, possessing extensive knowledge of ship design and dynamic structural analysis. Trusted by the U.S. government and top defense contractors, NTS offers the most sophisticated MIL-STD testing on the planet.



PERFORMANCE CONTROLS, INC.

Photron

**PCB** manufactures vibration, pressure, force and strain, shock, and acoustic sensors used by design engineers and predictive maintenance professionals worldwide for test, measurement, monitoring, and control requirements. Our sensors support testing in aerospace and defense, automotive, transportation, civil engineering, and general R&D industries. Primary sensing technologies include piezoelectric (ICP®), piezoresistive, and capacitive MEMS. With a worldwide customer support team, 24-hour SensorLine, and a global distribution network, PCB is committed to Total Customer Satisfaction. PCB Piezotronics is a wholly-owned subsidiary of Amphenol Corporation.

**PERFORMANCE CONTROLS, INC. (PCI)** designs and manufactures power amplifiers for demanding applications. PCI supports many industries, including electric vehicles, test and measurement, high speed rotational tools, military positioning systems and MRIs – any equipment that requires reliable, high-performance power control. We offer a range of standard products and we customize solutions for specific needs.

**PHOTRON** has continually expanded their product line to aid in the advancement of photo optics and electronic technologies furthering research and development in the areas of digital imaging and slow motion analysis. Markets include microfluidics, military testing, aerospace engineering, automotive, broadcast, particle image velocimetry (PIV), digital image correlation (DIC), ballistics testing, and more.



**PRECISION FILTERS, INC.** is a global provider of instrumentation for test measurements. You can rely on a single source for signal conditioning and switching—a complete range of instrumentation— products optimized to work together to provide high performance at reasonable cost. PFI designs and manufactures precision solutions that include a family of analog signal conditioning, filtering and switching systems. The 28000 Signal Conditioning System provides a complete range of transducer conditioning with up to 256 channels per chassis. Precision's solid-state switch provides up to 256x256 cross-point switching and replaces tedious manual patch panels. The PF-1U provides 8 or 16 channels of high performance filter/amplifiers in a compact package with Ethernet control.



**RDI TECHNOLOGIES, INC.** was founded in 2013 to commercialize video-based sensing technologies created in the lab at the University of Louisville. Since the beginning, our commitment has been to innovate using relatable video technology and easy-to-use software. In 2015 RDI Technologies invented and began the development of the first-to-market Motion Amplification<sup>®</sup> platform technology for motion and vibration detection and analysis using video. This product was released to the market in 2016 with rapid market adoption. With the release of the Iris M<sup>™</sup>, RDI created a new category of motion and vibration detection and revolutionized the way the Predictive Maintenance industry saw motion. We are poised to do the same in the Test and Measurements market over the next few years.



Exhibitor Descriptions





SIEMENS

**REL, INC.** is a World Class Original Equipment Manufacturer for LED Lighting and High Strain Rate Testing Solutions. REL provides solutions that are used in world class research and development institutions worldwide for bleeding edge product development. LED spectral output with spectral intensities higher than thermobaric explosions and testing timescales measured in microseconds are common environments for tested, tough REL products. Call us to discuss your specific Dynamic Testing Challenge.

**SHOCKMEC ENGINEERING** is a small startup research and development company focused on shock testing and analysis. We have designed and produced our own resonant plate shock test system that is sized for convenient installation in almost any laboratory space. Resonant plate shock testing is intended to be representative of pyroshock and other similar high-energy, low-displacement shock events. Our company also performs shock design and analysis work as well as acoustics testing and design.

Simcenter is the **SIEMENS** software brand for addressing Predictive Engineering Analytics. The Simcenter portfolio consists of solutions that span 3D simulation, 1D simulation, and testing solutions. It is comprised of a number of well-known products such as Simcenter Test.Lab, NX Nastran, STAR-CCM+, Simcenter Imagine.Lab and Simcenter 3D. Simcenter Test Solutions specializes in testing for Acoustics, Structural Dynamics, Rotating Machinery, Durability/Fatigue and Vibration Control and are the market leader for high-end data acquisition and test results visualization and post processing.

The SOCIETY FOR EXPERIMENTAL MECHANICS is composed of members from academia, government,

and industry who are committed to application, research and development, education, and promotion

of experimental methods to: (a) increase knowledge of physical phenomena; (b) further understanding

of the behavior of materials, structures and systems; and (c) provide the necessary physical basis and verification for analytical and computational approaches to the development of engineering solutions.

SPECIALISED IMAGING is an internationally renowned company that designs and manufactures

ultra-high-speed imaging cameras for industrial, scientific & defence research applications. Specialised

Imaging has successfully launched many new and innovative ultra-high speed imaging systems. The company is at the forefront of world-wide innovation in the high-speed imaging field, having been awarded BEEA's Small Company of the year (2009) and the Queen's Award for Enterprise (2011 & 2016).

SEEN Society for Experimental Mechanics





**SPECTRAL DYNAMICS (SD)** is a technically innovative company that has served the Shock and Vibration community for 56 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.



**Team** 

**TAYLOR DEVICES** has provided innovative solutions for shock and vibration control since 1955. Our customers include all branches of the US Military and NASA Space Programs. Products include precise positioning shock isolators, fluid, elastomer and hydropneumatic spring-dampers, high capacity fluid dampers, and modular machined springs. Made 100% in the USA.

**TEAM CORPORATION** continues to define the future of advanced, high-performance vibration test systems and solutions that advance the aerospace, defense and automotive industries. Pioneering the world of multi-axis test systems has led to the introduction of many state-of-the-art high frequency hydraulic and electrodynamic multi-axis test solutions, such as the CUBE and Tensor test systems. Utilizing advanced hydrostatic bearing technology that has been refined over the past 65 years, Team Corporation implements leading hydraulics engineering to solve unique problems that others cannot.

## Thornton Tomasetti

**THORNTON TOMASETTI** provides engineering design, investigation and analysis services to clients worldwide on projects of every size and complexity. We have 70 years of experience in research, testing and software development for the U.S. Navy and Department of Defense in the fields of blast, underwater shock, impact and vibration effects.



Exhibitor Descriptions



**VIBRATION RESEARCH (VR)** has been the innovator in vibration control, data acquisition, and dynamic signal analysis since 1995. VR builds reliable and user-friendly software and hardware at its headquarters in Michigan, USA. It is attentive to emerging technologies and changes to the industries it serves. With every software release, the customer can expect new and relevant features meticulously tested before they reach them. Testing labs worldwide trust VR for the industry's best testing systems and support that delivers unrivaled value. Visit the VR booth to discuss your testing and analysis requirements with industry experts.

VIBRO/DYNAMICS a Socitec group company **VIBRO/DYNAMICS**, a Socitec Group Company, is a leader and pioneer in the field of shock and vibration control solutions specializing in engineering services for the design, simulation and development of shock protected equipment. Vibro/Dynamics offers full lines of wire rope isolators, elastomer mounts, leaf springs, custom isolators and assemblies for protection of equipment against shock and vibration. Markets we serve include: Defense, Aerospace, Transportation, Energy and Construction. Resources we offer our customers include advanced simulation capabilities via SDNL1, SYMOS (proprietary n-DOF simulation software) and ANSYS<sup>®</sup>, SOLIDWORKS<sup>®</sup>, FEA and MATLAB<sup>®</sup>, supported by physical and simulated testing.







**VIPER APPLIED SCIENCE** has over three decades of experience between them in the fields of Blast, Shock & Vibration, Structural Dynamics, Computational Physics & Numerical Methods. All our team have a background in Engineering Consultancy, and the software we write and services we offer our clients reflect this. We pride ourselves in developing practical, usable, real world solutions that don't cost the earth.

VISION RESEARCH designs and manufactures high-speed digital imaging systems that are used in military, industrial, academic, machine vision, and entertainment sectors. Phantom cameras allow you to analyze physical phenomena when it's too fast to see, and too important not toTM. Vision Research prides itself in the high resolution of its images, the power of its software, the reliability of its products and its high level of attentiveness and dedication to its customers. The company's innovative approach to high speed electronic "digital" imaging was recognized by the US Patent Office and was granted US Patent #5,625,412.

**XCITEX** is an industry leader in video-based motion capture and motion analysis. Our engineers introduced the first synchronized high-speed video/data system -- MiDAS 1.0 -- in 1998 to take advantage of the first high-speed computer-based camera systems. We followed in 2005 with the introduction of ProAnalyst software that revolutionized the auto-tracking and motion analysis industry. The ProAnalyst line of software products has since expanded to include numerous innovative, award-winning editions for tracking various types of objects and for accurately tracking projectiles in flight.

Hitton Meeting Space Layout

## **SECOND FLOOR**

SALON BALLROOM: MEETING ROOM 202: MEETING ROOM 203: MEETING ROOM 204/205: MEETING ROOM 206/207: EXHIBITS/GENERAL SESSION/MEALS TECHNICAL SESSIONS/TRAININGS REGISTRATION TECHNICAL SESSIONS/TRAININGS TECHNICAL SESSIONS/TRAININGS



Hitton Meeting Space Layout

## **THIRD FLOOR**

MEETING ROOM 301: Meeting Room 302/303: Meeting Room 304/305:

TECHNICAL SESSIONS/TRAININGS TECHNICAL SESSIONS/TRAININGS TECHNICAL SESSIONS/TRAININGS



Exhibitor Passport Program



**HOW IT WORKS:** 

- EACH SYMPOSIUM ATTENDEE IS GIVEN A "PASSPORT" WITH A LISTING OF PARTICIPATING EXHIBITORS.
- PARTICIPATING EXHIBITORS ARE PROVIDED A CUSTOM STAMP/STICKER.
- AS THE ATTENDEES VISIT THE PARTICIPATING EXHIBITORS, EXHIBITORS "STAMP" THE PASSPORT OF THE ATTENDEE.
- ATTENDEES WHO COLLECT THE STAMP OF AT LEAST 23 PARTICIPATING VENDORS ARE ENTERED INTO THE DRAWING.
- PRIZES RANGE FROM GIFT CARDS TO GADGETS TO NEW EXHIBITOR PRODUCTS!
- DRAWING TO BE HELD DURING THE WEDNESDAY AFTERNOON BREAK (3:30 4:15PM).

THANK YOU TO THE EXHIBITORS PARTICIPATING IN THE PASSPORT PROGRAM:





# SHOCK & VIBRATION SYMPOSIUM

## NOVEMBER 3 - 7, 2024

## SUBMIT ABSTRACTS BY JUNE 30, 2024! EVENT PROGRAM AVAILABLE JULY 2024.

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