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SURVIAC is a U.S. Department of Defense Information Analysis Center (IAC) sponsored by the Defense Technical Information Center (DTIC).

SURVIAC

Bulletin

Modeling and Simulation in Ration Systems Development: Optimizing Warfighter Nutrition and Performance

By NSRDEC Combat Feeding Directorate

INTRODUCTION

The individual Warfighter is the single most important weapon system on the battlefield...lethal, agile, decisive and highly adaptive. Every major military conflict, campaign or action in U.S. history has been marked by the critical role of "boots on the ground" by men and women in uniform. Despite technological advances that increase capability and survivability, and weapon platforms that shock and awe, boots on the ground are, and will remain the foundation of successful combat operations and an important instrument of U.S. foreign policy.

Taking care of the needs of Soldiers, Sailors, Airmen, Marines, Coast Guardsmen, and Homeland Defenders is the unique, Joint-Service mission of the Natick Soldier Research, Development and Engineering Center (NSRDEC). The NSRDEC core mission is focused on maximizing survivability, sustainability, mobility, combat effectiveness and field quality of life through technology generation, application, integration and transition to address identified user needs, provide solutions to operational capability gaps, and solve field problems rapidly by treating the Warfighter as a system.

KEY PLAYERS

Fueling the Warfighter to ensure the nutritional sustainment and cognitive and physical performance of today's Warfighter is the primary mission of NSRDEC's Combat Feeding Directorate (CFD). CFD provides the Department of Defense (DoD) with a Joint Service program for the research, development, integration, testing, and engineering of combat rations, food service equipment technology, and combat feeding systems. CFD teams perform the full

life cycle management of rations, food service equipment, and combat feeding systems, from basic science and technology research to advanced system development and demonstration to engineering support. CFD partners with the Product Manager - Force Sustainment Systems (PM-FSS) by transitioning technology for Army managed field food service equipment.

The NSRDEC and U.S. Army Research Institute of Environmental Medicine (USARIEM), co-located at the U.S. Army Soldier Systems Center in Natick, Massachusetts, collaborate on cutting-edge nutrition and performance research, ration acceptability and consumption tests. This work is performed in both laboratory and operational settings that cover the range of environmental conditions in which the rations are expected to function. These vitally important state-of-the-art laboratory facilities, NSRDEC, CFD and USARIEM, Military Nutrition Division (MND), create unique synergistic opportunities for testing operational ration components and field feeding concepts and evaluate their impact on Warfighter performance. USARIEM, MND conducts relevant applied military nutrition research, provides policy recommendations to the Office of the Secretary of Defense



A deployed Warfighter is shown carrying a First Strike Ration® (FSR™).

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We would like to hear from you. Have we helped you in some way? How can we improve? Would you like to author an article for a future issue? What issues would you like to see discussed in upcoming bulletins? Modeling & Simulation? Homeland Defense/Homeland Security? Space Survivability Issues? Unmanned Aerial Systems? Please e-mail your comments to surviac@bah.com.



Mr. Christopher Zember
IAC Program Manager

DTIC-I Director/Information Analysis Centers Program Manager retires, new Program Manager selected

by Christopher Thomas, Administrator, Defense Technical Information Center

Mr. Terry M. Heston, DTIC-I Director and Program Manager of the DoD Information Analysis Centers (IACs), has retired effective 30 December 2012. Terry held this position since February 2006 and was instrumental in developing the IACs into the invaluable science and technology (S&T) resource they are today. He worked closely with the Assistant Secretary of Defense for Research and Engineering (ASD(R&E)), formerly DDR&E, to ensure the IACs best met the ever-changing research and analysis needs of the DoD community. Terry served as the director of DTIC's Information Systems Support Directorate from 2000-2006 where he was responsible for DTIC's telecommunications and ADP support including systems analysis, programming and central design, as well as maintenance and modifications. He was also the Deputy Director for this Directorate as well as for DTIC's Administration and Resource Management Directorate. He also held a number of positions in Aviation Logistics Management at the Naval Air Systems Command.

Mr. Christopher Zember was named the IAC Program Manager in late December 2012. He previously served as the Deputy Program Manager under Mr. Heston. As the new IAC Program Manager, Mr. Zember will be responsible for operational management and policy guidance for technical research and analysis, aligning with the Secretary of Defense's top Science and Technology priorities. Christopher has completed certification requirements as a Defense Acquisition Workforce Improvement Act (DAWIA) Level III Program Manager, and has held several certifications in private industry in the areas of Lean Six Sigma, and Project Management; he earned his Master's in Public Administration from the American University in Washington, D.C. During his career, Christopher has served in the non-profit sector, as a uniformed military service member, and in private industry.

Through these diverse roles, he has gained important insight into the unique capabilities and perspectives of the various organizations supporting our nation's defense. In the non-profit sector, Christopher worked with international organizations to provide transition support for political refugees. While in uniform, he led key initiatives in the intelligence community to expand information sharing and collaboration. And in the private sector, Christopher led the Strategy and Operations practice of a management consulting firm, serving as a member of the executive team responsible for corporate direction and management. Christopher is frequently called upon as an expert advisor and public speaker on a broad range of topics, including national security reform, technology innovation, renewable energy, knowledge management, and acquisition reform. During his nearly 3 years as IAC Deputy PM, Christopher has been instrumental in reshaping the IAC Program structure, developing and implementing a new acquisition strategy and business processes to achieve several important goals: expanding scope and increasing synergy across related technology areas; increasing opportunities for small business; lowering cost and improving quality through enhanced competition; and expanding the industrial base accessible through the IACs. These changes will position the IACs to create and sustain a focus on the Better Buying Power Initiative to improve affordability, productivity, and standardization within defense acquisition programs. Please join me in congratulating Christopher on his selection, and in continuing to offer your support as he leads the transformation of the IAC Program in support of the Department's top S&T priorities.

For further information on DTIC's Information Analysis Centers please visit the IAC website at <http://iac.dtic.mil>

Warfighter Nutrition Modeling continued from page 1.

(Health Affairs) and the Joint Culinary Center of Excellence on nutritional issues impacting the Warfighter, supports the Surgeon General's responsibilities as the DoD Executive Agent for nutrition, and supports the CFD mission to ensure that U.S. Warfighters are the best fed in the world.

The CFD actively leverages leading edge technologies to provide the Warfighter an edge in all aspects of combat feeding. Efforts conducted provide the science and technology base and engineering support to satisfy the feeding requirements of the Warfighter. CFD employs Integrated Product Teams comprised of representatives of the Services, academia, industry, other government agencies, and the Defense Logistics Agency along with CFD staff to optimize cost, delivery schedule and performance of all CFD developmental efforts. All CFD developmental products are continually tested and evaluated with Warfighters so that their needs and desires are considered resulting in a family of combat rations and food service equipment that are *Warfighter Recommended*, *Warfighter Tested*, and *Warfighter Approved*[™].

MODELING AND SIMULATION FACILITIES

CFD's unique and comprehensive laboratory facilities support a broad range of capabilities enabling critical research, innovative product development, testing and analysis. These facilities include an Advanced Food Processing Laboratory and Food Pilot Plant for production and testing of food to facilitate state-of-the-art ration development. The Analytical Microbiology and Food Analysis Laboratories contain equipment that perform microbiological analyses for pathogenic and spoilage microorganisms. The Flexible Food Packaging Laboratory is used to fabricate and test many types of prototype packages (e.g., bags, pouches, trays, cartons, etc.) and evaluate performance under environmental extremes (such as desert, arctic, or tropical conditions). Cutting edge material R&D is conducted in the Food Packaging, Polymer Processing, and Characterization Laboratory as part of the Polymer Film Center of Excellence. Sensory Consumer and Technical Testing Laboratories support studies to characterize the consumer responses to foods, beverages, and other consumer products using sensory panels, , and focus groups. Equipment labs evaluate 200 to 200,000 BTU/ hr JP-8 and diesel-fired combustion systems, including burners, military kitchen appliances, stoves, water heaters, shelter heaters, and generators for combustion efficiency and heat transfer. Other unique facilities include the Refrigeration Calorimeter Test Chamber for testing refrigeration systems and shipboard ice-making equipment, and the Navy Test Laboratory, complete with the capability for simulating 15° pitch and rolls and process control monitoring, which is used for test and evaluation of equipment items.

USARIEM possesses unique laboratories that can mimic any environment in the world. Environmentally controlled rooms, a hypobaric chamber, and a water immersion laboratory enable researchers to more closely examine the impact of environmental stress on the physiological and cognitive functions of the Warfighter. USARIEM researchers study the impact of nutrition from the sub-cellular to whole body level. Biological samples are analyzed using state-of-the-art equipment in the Protein Analysis and Nutrition Laboratories that provide capabilities including stable isotope methodology, muscle biopsies, and other molecular techniques to examine muscle protein turnover and micro-qualitative computed tomography (QCT) for studying bone structure, and specialized instrumentation for conducting analytical biochemistry. USARIEM is also home to a Bone Health/Body Composition Laboratory, where research is aimed to better understand adaptations that occur in healthy bone as the result of strenuous physical training, and a Warfighter Cognitive Performance Laboratory, designed to conduct cognitive and behavioral evaluations of Warfighter performance by simulating exposure to operational stressors. These unique facilities enable collaborative research to sustain and improve Warfighter health and performance under all conditions.

OPTIMIZATION MODEL PROJECTS

The joint efforts of NSRDEC and USARIEM resulted in the development of the nutritionally-optimized First Strike Ration® (FSR[™]). The FSR[™] was designed to improve tactical mobility by reducing the weight joint Warfighters carry during combat operations. This compact, eat-on-the-move assault ration designed for high intensity operations is substantially lighter and more compact than a day's supply of the standard military ration, the Meal, Ready-to-Eat[™]. The FSR[™] utilizes advancements in food processing, preservation, nutrient delivery, delivery through nutrient dense food components (appropriate nutrient ratios), and packaging technologies, including intermediate moisture formulations, glucose optimization, and novel packaging materials and configurations. This collaborative effort resulted in increased Warfighter consumption, nutritional intake, and mobility along with notable recognition as recipient of the prestigious Army Research and Development Laboratory of the Year Collaboration Team Award.

FUTURE DIRECTION

Collaborative efforts will continue to push the envelope in state-of-the-art ration and nutrition research, product development, performance optimization and innovative systems integration. One such effort by CFD is the potential use of a range of omega-3 fat-enhanced ration components for

improved Warfighter physical and mental health and nutritional strategies to mitigate effects/injuries related to soldier load. MND is actively investigating the potential benefit of dietary proteins to lessen the damaging effects of sustained/repeated combat missions on musculoskeletal health in Warfighters. MND researchers will examine muscle protein turnover in response to dietary manipulation and make recommendations for ration improvement.

Together CFD and MND are working toward a web-based, comprehensive operational ration data base. The vision is an easy to use database that Warfighters, military food service officers, dietitians and leaders can access for up-to-date and detailed macronutrient information on all individual and group combat ration components. It will also be a tool for continued ration improvement, menu diversity and product development. Additional CFD efforts include the development of an integrated database of Unitized Group

Ration™ (UGR™) and field kitchen equipment. These tools will facilitate CFD's effort to improve UGR™ menus, field kitchen efficiency and waste management. Collectively, our common goal is to provide the "nutritional armor" to help ensure our Warfighters will outlast any adversary, any place, and at any time.■

Did you know, if you are U.S. military or U.S. Government civilian personnel you can receive the textbooks below FREE from SURVIAC?

The Fundamentals of Aircraft Combat Survivability Analysis and Design, Second Edition by Robert E. Ball, Ph.D.

This textbook presents the fundamentals of the aircraft combat survivability design discipline as defined by the DoD military standards and acquisition processes. It provides the history of, the concepts for, the assessment methodology, and the design technology for combat survivability analysis and design of fixed- and rotary-wing aircraft, UAVs, and missiles.

Fundamentals of Ground Combat System Ballistic Vulnerability/Lethality by Paul H. Deitz, Harry L. Reed, Jr., J. Terrence Klopac, James N. Walbert.

With contributions from more than 50 vulnerability/lethality (V/L) professionals in Government and industry, this 300-page text provides a comprehensive look at the basic history, terminology, processes, tools, and applications associated with the V/L discipline. It's intended to serve as both a foundational textbook for new V/L analysts, testers, developers, researchers, and scientists as well as a ready-reference for those practitioners already working in the field.

These books are limited to one copy per government personnel. For more information please contact SURVIAC, (937) 255-3828, or by e-mail: surviac@bah.com.

**DoD Joint Aircraft Survivability Program (JASP)
Aircraft Combat Survivability Short Course**

14-15 August 2013 · Ft. Eustis, VA

Topics to be covered include:

- Introduction to survivability
- Historical and current survivability combat loss data
- Survivability methodology – assessment/enhancement
- Modeling and simulations for survivability
- Mission and campaign survivability analysis
- IR, Radar, and EW fundamentals
- Current Susceptibility Reduction technology
- Current Vulnerability Reduction technology
- Joint Live Fire and Live Fire Test programs
- Personnel casualties and safety
- Current survivability initiatives

For more information, please contact Mr. Paul Jeng at SURVIAC (937) 255-3828, E-mail: jeng_paul@bah.com

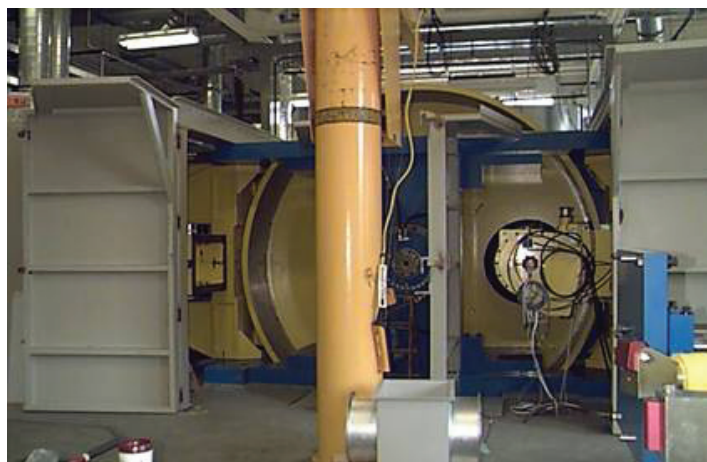


External Problems, Internal Solutions

by Mr. John Kemp and Dr. Michael Bohun, 96 Test Group

The United States Air Force (USAF) spends over a seven figure dollar amount on the research, development, test, repair, sustainment, and replacement of aircraft wheels, brakes, tires, and landing gear components. A key element in the Test and Evaluation effort is the 96th Test Group, Aerospace Survivability and Safety Operating Location (96 TG/OL-AC) Landing Gear Test Facility (LGTF), located at Wright-Patterson AFB. This world class facility has a combination of drop towers, fatigue test equipment, a tire force machine, laser inspection tools, and many different sized dynamometers under one roof. The facility is dedicated to assessing, evaluating, and improving the safety of aircraft wheels, brakes, tires, and landing gear assemblies at the component and full-scale levels. LGTF is also committed, through testing, to reduce the monetary encumbrance of wheels, brakes, tires, and landing gear at every stage in the operating life cycle by performing full-scale aircraft component tests on new enhanced component designs.

For example, aircraft tire testing is conducted on high-speed dynamometers which typically test a tire's performance on the outer diameter of the dynamometer's inertia wheel. This inertia wheel is a smooth steel surface that allows the tire to be tested at various landing, take-off and ground speed and load conditions. These standard dynamometer tests provide important information to engineers that answer a wide range of performance questions needed to qualify an aircraft tire before it is placed in service on an aircraft. However, with only a smooth dynamometer surface, you cannot measure tire friction or wear due to aircraft runway operations (i.e., landing, take-off and ground maneuvers). However, LGTF has a world unique dynamometer in which the dynamometer surface can be altered to simulate the friction of an actual aircraft runway. This dynamometer, called the 168i Internal Drum Dynamometer, is unique in that a tire is placed on the "inside" of the internal dynamometer's drum, which is lined with high strength "textured" ductal concrete tiles to simulate the actual friction an aircraft tire would experience on a runway. This ductal tile concept took a team of Air Force LGTF engineers, led by Dr. Michael Bohun, over two years to develop and implement; this innovative textured tile concept, is currently being used to evaluate the safe operating envelope of aircraft tires under both dry and wet runway operating conditions. In addition, a detailed life-cycle wear analysis of the tire can be performed to help understand the cost impact of a new tire design under various runway operational conditions. The advantages of this internal dynamometer are many



168i Internal Drum Dynamometer

and subtle. The top speed of the 168i is 350 MPH. Its maximum acceleration is 16 feet/second². Integral to its name, 168 inches equates to its 13 foot diameter internal drum. Because the diameter is big enough, it alleviates the need for a tire air pressure correction, based on the flywheel diameter. This causes a more accurate tire footprint through a more realistic pressure distribution as well as better traction forces. Thus, the internal drum configuration more realistically simulates a tire operating on flat runway conditions. The 168i has two carriages, east and west, four running wheels, tires and brakes. The maximum sustainable load is 150,000 lbs with which Yaw and Camber of the tire can be varied. The Yaw can be changed up to ± 20 degrees, while the Camber can be changed ± 10 degrees. These potential variations add to the flexibility of the internal dynamometer simulating actual dynamic aircraft landing or ground handling conditions. Both carriages have active computer control which allows the Load, Yaw and Camber to be changed during testing. A profile is programmed to run the wheel/tire through specific combinations of load, Yaw, Camber and speed. The control system is also capable of measuring the 6 components of force while executing testing. Many test programs have run on the 168i in the past few years. Life Cycle Cost Wear Testing was a program to determine which tire would last the longest when running on a specific wear surface. Tire Failure Analysis was a detailed program that examined why a particular tire design was failing prematurely on given runway texture. Tire Endurance Testing examined how many hours a tire could run on a textured surface before failing. Countless practical examples of testing on the 168i dynamometer and its benefits exist. The opportunities for use are limited only by the imagination of the original equipment manufacturers.

External Problems continued on page 7

Model Spotlight: BLUEMAX 6

SURVIAC is distributing the newest version of BlueMax 6 (Aircraft Flight Dynamics, Flight Path Generator, Mission and Aero-Performance Evaluation Model). This program and its upgrades were funded by the Joint Aircraft Survivability Program Office (JASPO) and were developed by AFLCMC/EZJA.

The new version of BlueMax 6 model is an upgrade of the BLUEMAX 5 v1.0.2 developed in the Microsoft C++ environment. BlueMax 6 is a pseudo Six-DOF Point Mass Aircraft Flight Dynamics Model. BlueMax 6 utilizes installed propulsion data, trimmed aerodynamic data, flight control laws/limiters and structural limit data. BlueMax 6 is used to construct realistic air-vehicle TSPI data for input into other models, analysis tools and simulation environments for the purpose of conducting Aircraft Susceptibility, Survivability and Vulnerability Analysis. BlueMax 6 is also useful as a standalone tool for determining aircraft aerodynamic performance characteristics. BlueMax 6 has been integrated with non-real-time constructive/virtual and real-time virtual simulation environments.

BlueMax 6 utilizes National Geospatial – Intelligence Agency (NGA) Level 0, Level 1 or Level 2 Digital Terrain Elevation Data (DTED) to generate realistic terrain below the aircraft flight path, generate terrain following flight paths and determine line of sight to ground threats. This provides the user the capability to perform exposure studies and quick survivability estimates, as well as mission planning. BlueMax 6 also incorporates the World Magnetic Model (WMM) and the WGS84 Spheroid to generate geospecific flight path data real world geodetic/geocentric coordinates. BlueMax 6 outputs aircraft position in Flat-Earth North-East-Down (NED), Geodetic Latitude/Longitude, Earth-Centered-Earth-Fixed (ECEF) and Universal Transverse Mercator (UTM) coordinates.

External Problems continued from page 6

Besides tire qualification testing; several unique tests of tire “failing” or “shredding” can be conducted and can be considered a survivability related issue. Pieces of tire spinning at high speed can separate from a tire and have the potential to penetrate critical flight control systems or puncture fuel tanks leading to safety of flight conditions (i.e., July 2000 Concorde Air France Flight 4590 crash after take-off due to tire cut and rupture). The LGTF is capable of accommodating a wide variety of customers ranging from

BlueMax 6 has a large array of commands to construct aircraft flight paths from Takeoff to Landing. BlueMax 6 has a newly developed cross-platform Graphical User Interface (GUI) and interfaced with the latest version of the Hybrid Integration and Visualization Engine (HIVE) for Real-Time and Faster Virtual Display and HOTAS Control (Hands-On-Throttle-And-Stick) USB Interface.

Major enhancements new to this version include:

- Re-written in C++
- New Cross-Platform Graphical User Interface (GUI) with enhanced editing and data plotting
- GUI “Guided Mode” option to guide the User through the flight path construction
- Integrated with latest version of the Hybrid Integration and Visualization Engine (HIVE)
- Enhanced Aircraft Equations Of Motion (EOM)
- Expanded Aircraft Aerodynamic Modeling and Optional Data Tables
- Updated Aircraft Input Data File Format
- Enhanced DTED model to utilize best available data (Level 0, Level 1 or Level 2)
- Enhanced Aircraft Aero-Performance Evaluation Module
- Enhanced User-Defined Output for customized output file
- Run-Time Log file
- Enhanced Output Options
- Post Processing Tools
- HOTAS Control and Virtual Display Interface via HIVE for Pilot-In-Loop control

Supported Platforms: 1) PC , 2) Linux

*You can obtain BLUEMAX 6 from SURVIAC,
(937) 255-3828 (DSN: 785-3828).*

military, government, commercial, domestic and foreign entities. The LGTF can work with test requirements on small budgets, as well as ones with robust resources. With unique pieces of equipment like the 168i dynamometer, a customer’s testing needs and problems can be handled professionally at the LGTF. For more information, please contact, John S. Kemp at 937-255-5740 for additional information concerning potential testing solutions.■

Improving Ballistic Vulnerability Analyses through Geometry Simplification *by Rodney Stewart, SURVIAC*

INTRODUCTION

In this era of advancing technological progress, the growth and evolution of computing capabilities have made the jobs of vulnerability analysts and engineers increasingly easier. Analyses that were once conducted using extensive hand calculations are now performed with computers in a fraction of the time, and the technologies supporting this process are ever improving.

While much progress has been made, the state-of-the-art for handling geometry in vulnerability software has not yet progressed to the point where it can effectively handle the complex geometries often generated in Computer-Aided Design (CAD) applications. Due to the assumptions behind our penetration methodologies and runtime-related issues when dealing with highly facetized geometry, a gap must be bridged to prepare CAD-generated geometry for use in a vulnerability assessment. Bridging this gap is essential for ensuring that the results of these evaluations, often used to determine that the systems in question meet their survivability requirements, are accurate and best reflect the aircraft's response to threats.

There are two ways in which the gap between CAD and vulnerability software can be bridged: 1) enhance existing vulnerability tools to effectively handle complex geometries or 2) simplify CAD-type geometries to fit within the domain of vulnerability software. While work is underway to undertake the first approach, these capabilities will not likely be available in the near future. So the only recourse to take in the meantime is to simplify geometry to fit the current tools.

GEOMETRY SIMPLIFICATION

The idea of simplifying CAD geometry for use with vulnerability tools is not new. CAD has been around for several years, and over the past two decades or so, more and more members of the vulnerability community have been looking to use CAD-generated geometries in their analyses. The general belief behind this trend is that it costs less to prepare existing CAD geometry for vulnerability purposes than to build a new model for the analysis from scratch. Due to the proliferation of CAD tools, it is likely that each analysis shop researching survivability/vulnerability questions has some process in place to prepare CAD geometry for these analyses. Regardless of the specifics employed, every process looking to simplify geometry has the following three elements:

- Conversion
- Optimization
- Verification

CONVERSION

Out of the three elements involved in geometry simplification, conversion is almost unavoidable. The goal in conversion is to translate a CAD-derived geometry description into the input format (typically FASTGEN or BRL-CAD) required by vulnerability software. Unless aircraft designers are using BRL-CAD as their CAD application of choice, every simplification process will likely have to perform a conversion of some kind.

The conversion process is typically composed of two steps. In the first, the CAD representation is exported into some accessible, non-proprietary format. Common formats used in the community include the stereolithography (STL), standard for the exchange of product model data (STEP), virtual reality modeling language (VRML), initial graphics exchange specification (IGES), and Wavefront Technologies .OBJ formats. With the geometry in this intermediate format, the second step is to convert it into the geometry input format expected by the vulnerability tools. Several tools exist to perform this second step. Some are openly available, like the conversion tools available with BRL-CAD, while others are proprietary utilities developed within each analysis shop.

OPTIMIZATION

The second and most important element in a geometry simplification process is optimization. Activities focused on optimization remove extraneous features from CAD-derived geometry, redefine part surfaces to reduce primitive counts, and replace groups of primitives with more efficient geometric descriptions. The goal in this process is to reduce the geometry so that it can be processed more quickly by vulnerability tools and better fit within the assumptions governing the penetration models. Optimization can be broken down into three key activities: feature removal, mesh redefinition, and element replacement.

Feature removal focuses on the elimination of geometry or segments of geometry that do not fit within the conceptual domain of the penetration models employed in vulnerability software. In general, this activity looks to remove small

features like rivet holes, fillets, bevels, ribbing, grooves, and other details that may lead to incorrect penetration assessments. An example of feature removal can be found in Figure 1, in which a CAD representation of a car pinion gear has had its grooves, holes, and threading removed. Besides improving penetration assessments, performing feature removal reduces the amount of information required to define the system of interest, allowing the vulnerability tools to perform the analysis more quickly. In the figure, the part on the left would require a large number of triangles to represent it within the FASTGEN tool while the part on the right may be represented with a much smaller number of cylinders and truncated cones.

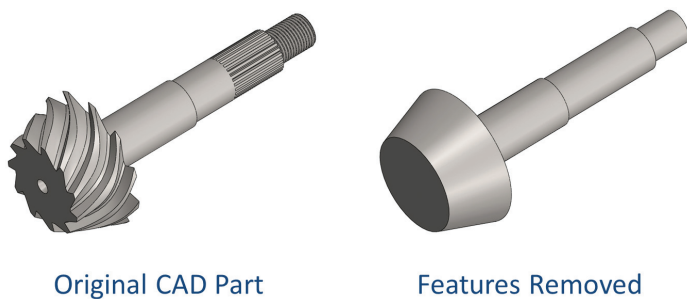
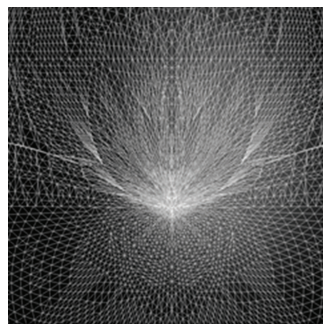


Figure 1: Feature Removal

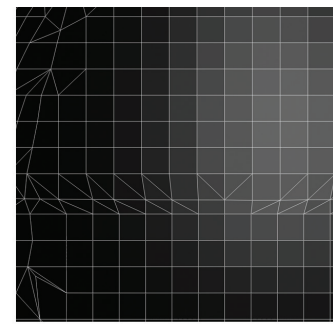
The second optimization activity, mesh redefinition, attempts to reduce the number of elements required to define the surfaces of a part. The goal here, like in feature removal, is to reduce the amount of information needed to define the geometry so that it can be processed faster.

The need to perform mesh redefinition stems from the process utilized by most of the community to convert CAD geometry into vulnerability software inputs. This process, commonly called the “bag of triangles” (BoTs) approach, seeks to represent the surfaces of a part with a mesh of triangles. Most CAD packages allow analysts to control the size of the triangles in the initial mesh overlaid on the geometry; however, if a mesh does not come with its original CAD geometry (as is frequently the case for third-party analyses), other tools must be employed to redefine the mesh.

Several software packages exist that can perform mesh redefinition. Some of these packages, like Rhinoceros 3D, are proprietary and require the purchase of a license to use. Others, like the US Army TACOM’s Eclectic package, can be obtained from the government. Finally, still others, like MeshLab, are open source and can be obtained free of charge. An example of mesh redefinition using the Eclectic package can be found in Figure 2.



Initial Mesh



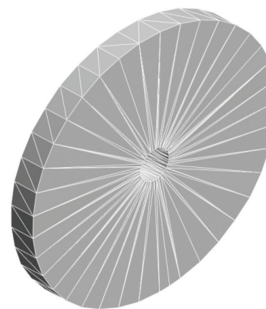
Redefined Mesh

Figure 2: Mesh Redefinition

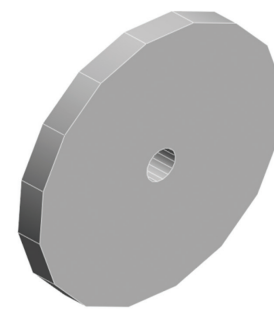
The third optimization activity, element replacement, seeks to substitute more efficient geometry descriptions in situations where a number of triangles are being used to represent another simple geometric shape. The goal in this activity, again, is to reduce the amount of information required to define surfaces so that the vulnerability tools can process them more quickly.

The BoTs approach, discussed earlier, transforms parts into meshes of triangles. While triangles are the lowest common denominator for geometry definition, they are far from being the most efficient way to define geometry.

Vulnerability tools often allow for the use of primitives other than triangles in input geometry descriptions, shapes such as quadrilaterals, boxes, spheres, and cylinders. As a result, the element replacement process identifies areas where groups of triangles are being used to represent these other primitives and replaces them with a description suitable for the shape represented. Performing this activity can greatly reduce the number of primitives required to define parts like fuel lines, hydraulic components, and avionics boxes. An example of element replacement performed on a representative flight control pulley in the FASTGEN format can be found in Figure 3.



Faceted Pulley
• 203 Nodes
• 406 Triangles



Element Replacement
• 2 Nodes
• 1 Cylinder

Figure 3: Element Replacement

Improving Vulnerability Analysis continued from page 9

When taken in total, the combination of these three optimization activities (feature removal, mesh redefinition, and element replacement) can have a substantial positive impact on an analysis. For example, SURVIAC (Ref. 1) recently optimized the geometry comprising an older model of an existing transport aircraft. The starting point for this undertaking was a geometry description in the FASTGEN format that initially contained over seven million triangular elements. By performing mesh redefinition and element replacement activities, SURVIAC reduced the model's size by about 24%, which then led to a 25% reduction in the time required for FASTGEN to process the model.

VERIFICATION

The final and most overlooked element in geometry simplification process is the verification that the resulting geometry, after conversion and optimization activities, reflect the original description. As a result, the verification process seeks to compare the final geometry to the original and evaluate its effectiveness as a representation of the original geometry.

Out of the three elements discussed, processes to handle verification are still in their infancy. Most verification activities, when they are actually performed, consist of visually inspecting the similarities between the geometries before and after conversion or optimization. This process is analyst-intensive, time-consuming (depending on the amount of geometry to inspect,) and prone to error. In an effort to make verification more automated, SURVIAC has developed a tool, FG_GCHECK, which runs FASTGEN on two geometries and assesses the similarities of several key metrics (presented areas, calculated volumes, etc.) with the assumption that more acceptable recreations of the geometry will have similar metrics. Other tools of this type may be available within the community, but these are likely proprietary to the shops using them.

FUTURE OF GEOMETRIC SIMPLIFICATION

As long as the community continues using CAD-derived geometry in vulnerability analyses, the need for geometry simplification will remain. Not only is the process necessary to make analyses run faster, but it also ensures that geometry inputs to vulnerability tools lie within the conceptual domain of the penetration models employed. While efforts are underway to improve the ability of these models to handle complex geometries, simplification for the purposes of vulnerability assessment will likely be around for many years to come.

REFERENCES

1. Smith, Jonathan & Rodney Stewart, HC/MC-130J Vulnerability Analysis, Volume I: Analysis Overview, September 2011, SURVIAC TR-11-2465.

ABOUT THE AUTHOR

Rodney Stewart

Mr. Stewart is an Associate with Booz Allen Hamilton and serves as a modeler and vulnerability analyst for SURVIAC at Wright-Patterson AFB. He has over 10 years of experience in the realm of target vulnerability and weapons lethality modeling. He has extensive experience with the Computation of Vulnerable Area Tool (COVART) and the Fast Shotline Generator (FASTGEN), being a developer of these codes in the past, which he now uses to support vulnerability analyses and the training classes provided by SURVIAC. Mr. Stewart earned his B.S. in Mechanical Engineering from the University of Colorado at Colorado Springs. He may be contacted at stewart_rodney@bah.com

RADGUNS Version 2.4.2

SURVIAC is distributing the Enhanced Radar-Directed Gun System Simulation RADGUNS 2.4.2. This program and its upgrades were funded by the Joint Aircraft Survivability Program Office (JASPO) and were developed by SURVIAC.

The new version of RADGUNS 2.4.2 model is an upgrade of RADGUNS 2.4.1. RADGUNS is used to evaluate the effectiveness of Air Defense Artillery (ADA) gun systems against penetrating aerial targets and to evaluate the effectiveness of different airborne target characteristics (radar cross section (RCS), maneuvers, use of electronic countermeasures, etc.) against a specific ADA system.

Major enhancements new to this version include:

- Implemented 11 Software Change Requests (SCRs)
- Fixed issues in the calculation of pitch and yaw for Nap of the Earth flight paths.
- Fixed issues with vulnerable areas being overestimated due to rotation of the target.
- Increased the number of optional outputs in the optional file from 11 to 99.

SUPPORTED PLATFORMS:

- 1) PC – Intel Visual FORTRAN Compiler
- 2) Linux – Portland Compiler

The Future of SURVIAC

by Kevin Crosthwaite

You may have heard some rumors or misinformation about substantial changes pending for SURVIAC. If you are concerned about the timing and impact of changes to this, your favorite, institution, then this article will help to allay your fears.

SURVIAC has existed as government owned, company operated center of excellence for survivability, lethality and homeland security since 1984. The IAC program has been managed as a part of the Defense Technical Information Center, DTIC. SURVIAC has been operated under four separate competitively awarded contracts, all the while with the core located at Wright-Patterson AFB, Ohio and operated by Booz Allen Hamilton. A feature of the SURVIAC contract from the beginning has been the ability to add sole source delivery orders for technical area tasks, TATs, in our area of excellence. Over the years this part of the institution has grown tremendously to \$654M in funding in GFY12. Due to the size of the contracts and in the interest of fostering more competition, DTIC has determined that some change is necessary.

The basic philosophical shift will be to separate the contract into two parts. One contract will be for the Basic Core Operation, BCO. The new singular BCO contractor will run the new center for excellence— managing the libraries, collecting and analyzing data and responding to inquiries from throughout the DoD community. The second contract will be for a Multiple Award Contract, MAC. The MAC will be a collection of prime contractors, who will competitively bid on new delivery order TATs. Thus both key parts of the SURVIAC contract with which you are familiar, will continue.

Additionally across the IAC program, DTIC has decided to group the ten current separate IACs into three consolidated BCOs and MACs. Similar technical areas are to be aligned for greater efficiency. This process has already begun with the combination of DACS, MSIAC and IATAC into the new Cyber Security Information Analysis Center (CSIAC). In the future SURVIAC is to be combined with the Reliability IAC (RIAC), the Weapon System Technology IAC (WSTIAC), the Sensors IAC (SENSIAC), the Advanced Materials, Manufacturing & Testing IAC (AMMTIAC) and the Chemical Propulsion IAC (CPIAC) into a new Defense Systems IAC (DSIAC.) DSIAC will also have both a BCO contract and a MAC contract.



The latest procurement schedule for the DSIAC contracts projects awards of the DSIAC BCO in October 2013 and the DSIAC MAC in January of 2014. The DSIAC BCO to operate the center will be a small business set aside (so the familiar Booz Allen Hamilton will no longer be the prime contractor). The DSIAC MAC to compete for TATs will be fully open to a number of both small and large businesses (and Booz Allen Hamilton does intend to compete for one of these awards.) To maintain the continuity of service to the DoD community during this procurement, the current SURVIAC contract has been extended. With the new extension, SURVIAC runs until 8 July 2014 with some options to run as long as 8 July 2015, if the procurement is delayed. Thus Booz Allen Hamilton will continue to operate SURVIAC for the near term.

SURVIAC has always provided tailored technical analyses and services to the JASP, the JTTCG/ME and DOT&E as well as for the larger DoD survivability and lethality communities. The growth and success of SURVIAC has been testament to the value of this service and the strong support of the community. It is DTIC's intention that this relationship evolve, but continue in a different form. The faces providing the service may change, but the ability to maintain the center of excellence and provide the key technical expertise behind the IAC will be a crucial evaluation factor in determining the new contractor. Booz Allen is committed to working with the successor contractor for a smooth transition in the future.

For the latest official information and to track progress on the procurement for these new DSIAC contracts, please visit the DTIC web site at <http://iac.dtic.mil>.

In closing, I want to assure everyone that SURVIAC is not dying, it is simply passing on to contract heaven.

For more information on the future of SURVIAC, please call (937) 255-3828 or email surviac@bah.com.

SURVIAC Change in Leadership



Kevin Crosthwaite

On January 31, 2013, Kevin Crosthwaite, SURVIAC Director, retired after more than 28 years of serving the survivability community. As an employee of Booz Allen Hamilton, Kevin joined the SURVIAC in its infant stages in 1985 when it was less than a year old. He began this stage of his career as SURVIAC's primary model analyst and has been the major proponent

to making the survivability/vulnerability modeling program what is today. Kevin also brought experience in operations analysis, focusing on operations analysis of tactical antiarmor and air defense missile systems and combat analysis for fixed wing aircraft, helicopters, unmanned aerial vehicles (UAV), and ground systems. In these areas, he has led survivability and effectiveness analyses to support requirements definition for development and production weapon systems and to evaluate cost effectiveness of various system options. He coordinated SURVIAC model support efforts and major tasks on reducing aircraft vulnerability to the Man Portable Air Defense System threat and has led analysis of C-130 vulnerability to a variety of threats. Since Kevin has been at the helm, SURVIAC has grown to over 500 delivery orders. Inquiries since 1993 have numbered in excess of 20,000. These facts and figures have made SURVIAC the largest and most successful of the Defense Technical Information Center Information Analysis Centers. He has worked closely with the Joint Aircraft Survivability Program Office (JASPO) and Joint Technical Coordinating Group Munitions Effectiveness (JTTCG/ME), and currently serves as the secretary of the Combat Survivability Division of the National Defense Industrial Association (NDIA). He has participated in JASPO Methodology Subgroups and provided recommendations of the needs of the survivability community for numerous JASPO projects. Kevin supported the JASPO and JTTCG/ME methodology groups to enhance the survivability discipline and coordinate the growth of SURVIAC throughout the DoD. Kevin was recently honored by the JASP for his Excellence in Survivability contributions to the JASP, the survivability community and the warfighter.

Replacing Kevin as SURVIAC Director is Mr. Barry Vincent. Barry has been with Booz Allen and SURVIAC for 17 years. He has over 19 years of experience in survivability, modeling



Barry Vincent

& simulation and Live Fire Testing. He most recently served as SURVIAC's Program Manager working side-by-side with the SURVIAC Director and Deputy Director, Donna Egner. In this position Barry, along with Kevin and Donna, managed over 190 open delivery orders. Before becoming Program Manager, Barry served as SURVIAC's

model point-of-contact. He was responsible for modeling support for the Joint Aircraft Survivability Program (JASP) models in SURVIAC by providing an interface between the users and the model software. Barry was also the administrator of many of SURVIAC's model user meetings including the Joint Model Users' Meeting (JMUM) which is held twice per year. He also served as the task manager and lead programmer to support the Simulation and Analysis Facility (SIMAF). For the Joint Strike Fighter (JSF) Program Office he integrated code into MIL AASPEM for improved agile missile capability in order to model missiles with high off-boresight guidance. Once completed, he validated the new missile capabilities. Mr. Vincent also provided configuration management support for MIL AASPEM which includes correcting model deficiencies and testing baseline versions of the code.

Previously, Barry supported the Joint Live Fire (JLF) C-130 Wing Hydrodynamic Ram Evaluation Program with ballistic test planning, test site support, data archiving and analysis and test reporting. This program evaluated the vulnerability of C-130 aircraft to threat-induced hydrodynamic ram in wing fuel tanks. He also provided support for the C-130 Vulnerability Reduction Program Wing Dry Bay Fire Extinguishing Agent Evaluation Program with ballistic test planning, test site support, data archiving and analysis and test reporting. Mr. Vincent created several databases to help manage and analyze the data collected from this ballistic test program.

With an experienced staff of SURVIAC professionals, the transition to a new SURVIAC Director will be seamless. We offer our congratulations to Kevin on his retirement and welcome Barry as our new SURVIAC Director. ■

Models Distributed by SURVIAC

The Survivability/Vulnerability Information Analysis Center (SURVIAC) is a U.S. Department of Defense Information Analysis Center (IAC) sponsored by the Defense Technical Information Center (DTIC)

Acronym	Model Name	Version No.
AIRADE	Airborne Radar Detection Model	7.4
ALARM	Advanced Low Altitude Radar Model (Includes EARCE 3.4)	5.4
BLUEMAX 6	Variable Airspeed Flight Path Generator	1.0
BRAWLER	Air-to-Air Combat Simulation	7.5
ESAMS	Enhanced Surface-to-Air Missile Simulation	4.5
FPM	Fire Prediction Model	3.8.2
IVIEW 2000	Graphical User Interface for Output Simulation	1.0E
JSEM	Joint Service Endgame Model	1
LELAWS	Low Energy Laser Weapons Simulation	3.0
RADGUNS	Radar-Directed Gun System Simulation	2.4.2
Vulnerability Tool Kit	Contains: BRL-CAD 7.12.4 (Ballistic Research Laboratory Computer-Aided Design Package), COVART 6.3.1 (Computation of Vulnerable Area Tool), FASTGEN 6.1.1 (Fast Shotline Generator), and FATEPEN 3.3.8 (Fast Air Target Encounter Penetration Program)	

For further information on how to obtain these models and how to establish need-to-know certification, please contact SURVIAC at (937) 255-3828 or DSN 785-3828. **Requests from non-U.S. Agencies must be forwarded to their country's Embassy in Washington, DC, Attention: Air Attache's Office.**

Brawler v7.5

SURVIAC has begun distributing the newest classified and unclassified version of BRAWLER v7.5. These programs and their upgrades are funded by HQ USAF/A9 with administrative support provided by the Joint Aircraft Survivability Program Office (JASPO).

The new version of BRAWLER v7.5 model is an update from BRAWLER v7.4. Major enhancements new to this version include:

- FrankenWEZ Integration
- Revival of Deck-Launched Intercept model
- Scenario inputs in Latitude/Longitude
- DRFM Modeling Enhancements
- DataLink Device for Directed Energy Weapon Cueing
- Directed Energy Weapon Fixes
- Net Enabled Weapon Updates
- TMAP Missile Updates

BRAWLER simulates air-to-air combat between multiple flights of aircraft in both the visual and beyond-visual-range (BVR) arenas. This simulation of flight-versus-flight air combat is considered to render realistic behaviors of military fighter pilots. BRAWLER incorporates value-driven and

information oriented principles in its structure to provide a Monte Carlo, event-driven simulation of air combat between multiple flights of aircraft with real-world stochastic features. The user decides the pilot's decision process including:

- Missions and tactical doctrines
- Aggressiveness
- Perceived capability of the enemy
- Reaction time
- Quality of the decisions made

Supported Platform: Linux

You can obtain BRAWLER v7.5 from SURVIAC, (937) 255-3828.

Aircraft Survivability Symposium 2013
5-7 November 2013, Monterey, CA

<http://www.ndia.org/meetings/4940/Pages/default.aspx>

Products Distributed by SURVIAC

The Survivability/Vulnerability Information Analysis Center (SURVIAC) is a U.S. Department of Defense Information Analysis Center (IAC)
sponsored by the Defense Technical Information Center (DTIC)

Product	Cost
A Critical Review of Graphite Epoxy Laser Damage Studies	Free
A Summary of Aerospace Vehicle Computerized Geometric Descriptions for Vulnerability Analyses	Free
Advanced Materials for Enhanced Survivability	Free
Aircraft Combat Occupant Casualty Assessment State-of-the-Art Report (SOAR)	\$ 50.00
Aircraft Combat Survivability Self Study Program (SSSP) CD (or download from SURVIAC website)	Free
Aircraft Fuel System Fire and Explosion Suppression Design Guide	Free
"Aircraft Survivability" Video	Free
Alternatives for Halon 1301 in Ground Vehicle Firefighting Systems	\$ 50.00
An Overview of Laser Technology and Applications	Free
An Overview of Laser-Induced Eye Effects	Free
Aircraft Asymmetric Threat Survivability Workshop Summary Report	Free
Aircraft Asymmetric Threat Survivability Workshop Report (Full Report)	\$ 50.00
"Battle Damage Repair of Composite Structures" Video	Free
Collection of Vulnerability Test Results for Typical Aircraft Systems and Components	\$ 75.00
Comparative Close Air Support Vulnerability Assessment Study - Executive Summary	Free
Component Vulnerability Workshop Component Pd/h Handbook	\$200.00 (Free to Gov't)
Component Vulnerability Database Development	Free
Computerized Geometric Information to Support Vulnerability Assessments State-of-the-Art Report	\$ 75.00
Continuity of Operations (COOP) State-of-the-Art Report (SOAR)	\$ 50.00
Countermeasures Handbook for Aircraft Survivability	Free
Critical Review and Technology Assessment (CRTA) for Soldier Survivability (Ssv)	Free
"Designing for Survivability" Video	Free
Directed Energy Effectiveness Modeling State-of-the-Art Report (SOAR)	\$ 50.00
DREAM Sensitivity Study	\$ 50.00
"Fundamentals of Ground Combat System Ballistic Vulnerability/Lethality" by Dr. Paul Deitz	Free to Gov't*
Gas Explosion Suppression Agent Investigation	\$200.00
Joint Aircraft Survivability Program (JASP) Promotional Video	Free
Lessons Learned from Live Fire Testing	\$ 50.00 (Free to Gov't)
MANPADS Threats to Aircraft: A Vulnerability Perspective, February 2000, Final Report	\$200.00
Missile Warhead Bomb and Propellant Response State-of-the-Art Report (SOAR)	\$ 50.00
MOSAIC Sensitivity Study	\$ 50.00
Munition Response State-of-the-Art Report (SOAR)	\$ 50.00
National MANPADS Workshop: A Vulnerability Perspective, Proceedings - 2 volumes	\$200.00
Night Vision Goggle (NVG) Rocket Propelled Grenade (RPG) Quick Look Report (QLR) CD	\$ 50.00 (Free to Gov't)
Penetration Characteristics for Advanced Engine Materials	Free
Proceedings of the Eighth DoD Conference on DEW Vulnerability, Survivability, and Effects - 2 Volumes	\$100.00 / per set
RADGUNS 1.8 Parametric Study	\$100.00 (Free to Gov't)
Ship Survivability Overview	Free
State-of-the-Art (SOAR) for Non-Lethal Weapon (NLW) Assessment Methodologies	\$ 50.00
"SURVIAC - A Capabilities Overview" Video	Free
SURVIAC Model Guide	Free
Survivability Analysis Workshop Notebook 2005	\$100.00
"The Fundamentals of Aircraft Combat Survivability Analysis and Design" second edition, by Robert E. Ball	Free to Gov't*
"Threat Effects in Aircraft Combat Survivability" Video (2006)	\$ 50.00 (Free to Gov't)
UAV Survivability Enhancement Workshop Summary Report	Free
UAV Survivability Enhancement Workshop Report	\$ 50.00
Vulnerability Reduction Workshop Summary Report	Free

*These products are free to US Government, military and civilian, employees. Contractors and other requesters please visit the AIAA website, www.aiaa.org for information on purchasing these books.

For further information on how to obtain these products and how to establish need-to-know certification, please contact SURVIAC at (937) 255-3828 or DSN 785-3828.

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Calendar of Events

AUGUST 2013

AIAA Aviation 2013

12-14 Aug 2013
Los Angeles, CA
POC: AIAA, (800) 639-2422
E-mail: custserv@aiaa.org
<https://www.aiaa.org/Aviation2013>

A Short Course in Live Fire Testing: Building Survivable Systems and More Effective Weapons

20-22 Aug 2013
Belcamp, MD
POC: Jim O'Bryon, (443) 528-2711
<http://www.survice.com/news/upcoming-event/building-survivable-systems>

Directed Energy Systems Symposium

26-30 Aug 2013
Monterey, CA
POC: DEPS, Tiffany Bjelke, (505) 998-4910
E-mail: tiffany@deps.org
<http://www.deps.org/DEPSpages/DESystems-Symp13.html>

SEPTEMBER 2013

AIAA Space 2013 Conference & Exposition

10-12 Sep 2013
San Diego, CA
POC: AIAA, (800) 639-2422, E-mail: custserv@aiaa.org
<https://www.aiaa.org/SPACE2013>

AFA Annual Air & Space Conference and Technology Exposition 2013

16-18 Sep 2013
National Harbor, MD
POC: <http://www.afa.org/AirSpaceConf/Home>

2013 Biometric Consortium Conference and Technology Expo

17-19 Sep 2013
Tampa, FL
POC: AFCEA/NIST/NSA, (703) 449-6418
E-mail: biometricsregistration@jspargo.com
<http://events.jspargo.com/biometrics13/public/enter.aspx>

OCTOBER 2013

Insensitive Munitions and Energetic Materials Technology Symposium

7-10 Oct 2013
San Diego, CA
POC: NDIA, Julie Veldkamp, (703) 247-2577
E-mail: jveldkamp@ndia.org
<http://www.ndia.org/meetings/4550/Pages/default.aspx>

Homeland Security 2013

15-18 Oct 2013
Washington, DC
POC: IDGA (800) 882-8684
E-mail: info@idga.org
<http://www.homelandsecurityexpo.com/>

AUSA 2013 Annual Meeting & Exposition

21-23 Oct 2013
Washington, DC
POC: AUSA, (800) 336-4570
<http://www.ausa.org/meetings/2013/AnnualMeeting/Pages/AnnualMeeting2013.aspx>

50th Annual AOC International Symposium and Convention

27-30 Oct 2013
Washington, DC
POC: AOC, (703) 549-1600
<http://www.crows.org/conventions/50th-annual-aoc-international-symposium-and-convention.html>

18th Annual Expeditionary Warfare Conference

29-31 Oct 2013
Portsmouth, VA
POC: NDIA, Brant Murray, (703) 247-2572
E-mail: bmurray@ndia.org
<http://www.ndia.org/meetings/4700/Pages/default.aspx>

NOVEMBER 2013

Aircraft Survivability Symposium 2013

5-7 November 2013
Monterey, CA
POC: NDIA, Laura Yuska, (703) 247-2596
E-mail: lyuska@ndia.org
<http://www.ndia.org/meetings/4940/Pages/default.aspx>

2013 Homeland Security Symposium

7-8 Nov 2013
Washington, DC
POC: NDIA, Tia Pitt, (703) 247-9467
E-mail: tpitt@ndia.org
<http://www.ndia.org/meetings/4490/Pages/default.aspx>

30th Annual International Test and Evaluation Symposium

12-15 Nov 2013
Crystal City, VA
POC: ITEA, (703) 631-6220, E-mail: info@itea.org
<http://www.itea.org>

DECEMBER 2013

The Seventh Triennial International Fire & Cabin Safety Research Conference

2-5 Dec 2013
Philadelphia, PA
<http://www.fire.tc.faa.gov/2013Conference/conference.asp>

I/ITSEC 2013 (Interservice/Industry Training, Simulation & Education Conference)

2-5 Dec 2013
Orlando, FL
POC: <http://www.iitsec.org/Pages/default.aspx>

2013 Land EW Conference

10-11 Dec 2013
Quantico, VA
POC: AOC, (703) 549-1600
<http://www.crows.org/details/223-landew.html>

JANUARY 2014

AIAA Modeling and Simulation Technologies Conference

13 - 17 Jan 2014
National Harbor, Maryland
POC: AIAA, (800) 639-2422, E-mail: custserv@aiaa.org
<http://www.aiaa.org/EventDetail.aspx?id=18409>

43rd Annual Collaborative Electronic Warfare Symposium

28-30 Jan 2014
Point Mugu, CA
POC: AOC, (703) 549-1600, events@crowds.org
<http://www.crows.org>

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