



# BALLISTICS

30<sup>TH</sup> INTERNATIONAL SYMPOSIUM



INTERNATIONAL  
BALLISTICS SOCIETY

**Connect with  
Industry | Government | Academia**

**September 11-15, 2017**

**Long Beach Convention Center, Long Beach, California, USA**

### PREVIOUS INTERNATIONAL SYMPOSIA ON BALLISTICS

- Orlando, Florida, USA, 1974
- Daytona, Florida, USA, 1976
- Karlsruhe, Germany, 1977
- Monterey, California, USA, 1978
- Toulouse, France, 1980
- Orlando, Florida, USA, 1981
- The Hague, The Netherlands, 1983
- Orlando, Florida, USA, 1984
- Shrivenham, UK, 1986
- San Diego, California, USA, 1987
- Brussels, Belgium, 1989
- San Antonio, Texas, USA, 1990
- Stockholm, Sweden, 1992
- Quebec City, Canada, 1993
- Jerusalem, Israel, 1995
- San Francisco, California, USA, 1996
- Midrand, South Africa, 1998
- San Antonio, Texas, USA, 1999
- Interlaken, Switzerland, 2001
- Orlando, Florida, USA, 2002
- Adelaide, South Australia, 2004
- Vancouver, BC, Canada, 2005
- Tarragona, Spain, 2007
- New Orleans, Louisiana, USA, 2008
- Beijing, China, 2010
- Miami, Florida, USA, 2011
- Freiburg, Germany, 2013
- Atlanta, Georgia, USA, 2014
- Edinburgh, Scotland, UK, 2016

## 30<sup>th</sup> INTERNATIONAL SYMPOSIUM ON BALLISTICS

11-15 September 2017  
Long Beach Convention Center  
Long Beach, California, USA

Welcome to the 30<sup>th</sup> International Symposium on Ballistics! This is an opportunity for ballistics scientists, engineers, and others to report, share, and discuss current research and advances in ballistics and visions of the future.

The International Symposium on Ballistics is jointly organized and supported by the International Ballistics Society (IBS), in conjunction with the National Defense Industrial Association (NDIA).

### WHAT TO EXPECT:

- Exposure to the most current state-of-the-art technology in ballistics. Interact with some of the world's leading experts in the field of ballistics technology.
- Meet other professionals with similar interests and experiences. Opportunity to meet and discuss technology with other professionals in your field of expertise. Cultivate communication, business interests and cooperative development.
- Have an opportunity to present, exhibit, and share your scientific research and development with an international group of professionals. Receive individual feedback and interaction on your work.



### ABOUT THE INTERNATIONAL BALLISTICS SOCIETY:

The IBS promotes the science of ballistics internationally. The IBS provides for technical interchange via the International Symposium on Ballistics and provides professional development for its members by providing opportunities for publication, short courses, student programs, and other activities to promote career development.

Mr. Clive Woodley of QinetiQ serves as President of the Society.



### ABOUT THE NATIONAL DEFENSE INDUSTRIAL ASSOCIATION:

NDIA provides individuals from academia, government, the military services, small businesses, prime contractors, and the international community the opportunity to network effectively with the government-industry team, keeping abreast of the latest in technology developments, and addressing and influencing issues critical to the health of the defense industry and the preservation of U.S. national security.



## LETTER FROM THE PRESIDENT:

It is a great honour and pleasure for me, as President of the International Ballistics Society, to welcome you to the 30th International Symposium on Ballistics (ISB). I hope you enjoy your stay in Long Beach, California. There are many attractions such as Hollywood, Queen Mary and numerous great ocean beaches for you to enjoy.

This is the fifth symposium to be organised by the Society, supported once again by NDIA. I would like to acknowledge the hard work of Britt Sullivan and Kim Williams from NDIA in organizing the symposium and its social program.

I hope you will find the 30th ISB to be a golden opportunity to network with other delegates to expand your knowledge of ballistics, make new contacts and, in particular, to understand the scientific challenges of the future.

The oral papers and posters provide a fascinating insight into recent worldwide research in all areas of ballistics. I very much hope you will enter into an enjoyable debate with the authors and delegates to stimulate new ideas for experiments and research topics to maintain the health of the symposia.

The technical standard of all the papers remains very high and continues to demonstrate the progress being made to develop the theory and experimental methods in all areas of ballistics. The Society continues to encourage a wide range of papers from works in progress through to journal quality papers. I urge all ballisticians to support our younger members and students and encourage them on their chosen research paths.

The Board has as a priority the establishment of educational and training opportunities to allow members to continue their professional development. The Education Committee has succeeded very well in arranging a varied series of tutorials, on Exterior Ballistics, Vulnerability & Survivability, Detonics & Energetic Materials, and Armour Materials, which I hope many of you will have attended.

On behalf of the Board of Directors and the local organizing committee, I wish you a very successful symposium in an exciting and famous part of the USA.

Yours sincerely,  
Clive Woodley  
President, International Ballistics Society  
September 2017

## AUTHORS & PRESENTERS FROM 26 COUNTRIES

- Argentina
- Australia
- Belgium
- Canada
- China
- Czech Republic
- France
- Germany
- Greece
- India
- Israel
- Italy
- Japan
- The Netherlands
- Norway
- Poland
- Russia
- Serbia
- Singapore
- South Africa
- South Korea
- Spain
- Sweden
- Turkey
- United Kingdom
- United States

## AWARD INFORMATION

### **THE ROSALIND AND PEI CHI CHOU AWARD FOR YOUNG AUTHORS**

This NDIA-sponsored award is given to a young author, 35 years of age or younger, at the time of the symposium.

### **THE LOUIS & EDITH ZERNOW AWARD**

This NDIA-sponsored award is given by Louis and Edith Zernow to the author of the paper containing the best advancement made in the fundamental nature of ballistics.

### **THE NEILL GRIFFITHS MEMORIAL AWARD**

The Griffiths Award, sponsored by QinetiQ, is presented to the author(s) of the paper judged to have made the most significant contribution to shaped charge technology at the International Symposium on Ballistics.

### **THE SOUTH AFRICAN BALLISTICS ORGANISATION (SABO) AWARD**

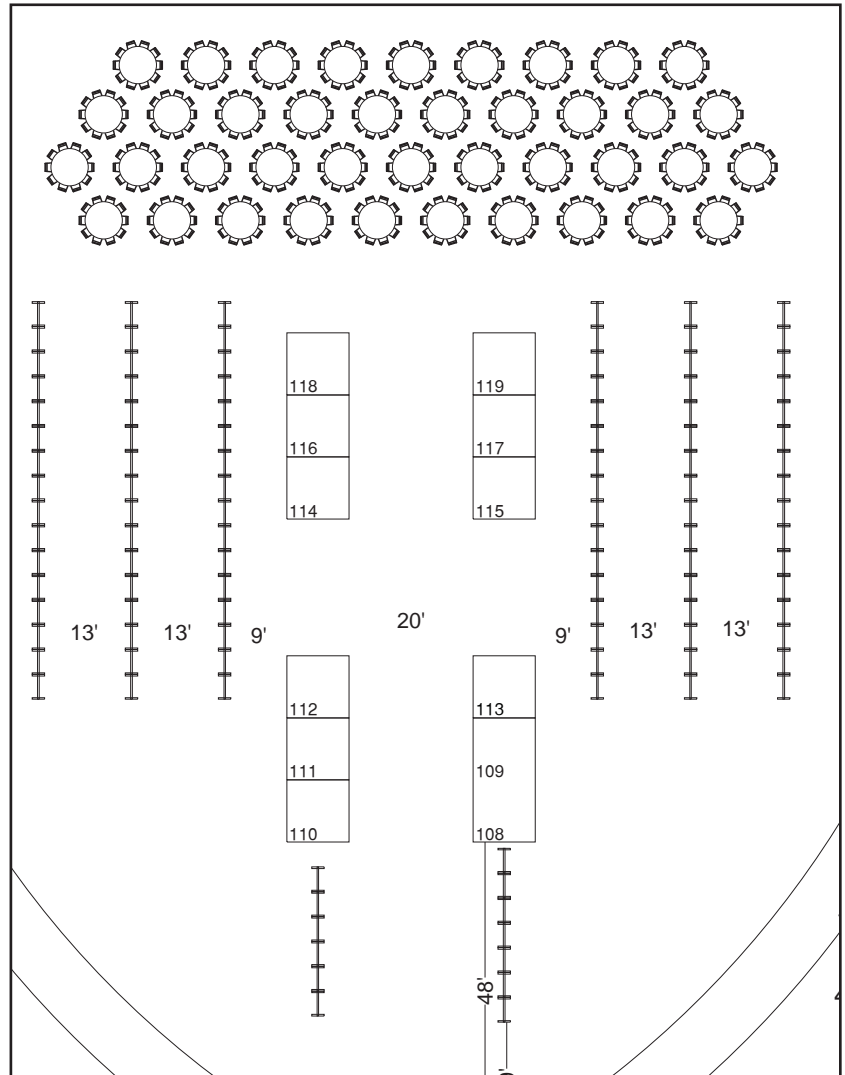
The SABO Award is presented to the author(s) of the best poster as displayed and presented to appointed adjudicators. The presence of the author at the poster during the session is of paramount importance.

The objective of this award is to inspire poster presenters to present their work in creative, legible and professional fashion thus enhancing the poster sessions as a quality medium for the exchange of information during the symposium.

## EXHIBITS HALL INFORMATION

### LIST OF EXHIBITORS

- 108 HADLAND IMAGING
- 109 MSInstruments
- 110 AMOtronics
- 111 New Lenox Ordnance
- 112 Arrow Tech Associates, Inc.
- 113 Weibel Scientific
- 114 PCB Piezotronics, Inc.
- 115 IMPETUS Afea AS
- 116 Specialised Imaging, Inc.
- 117 Frazer-Nash Consultancy
- 118 Photron USA
- 119 Kistler Instrument Corp.



### EXHIBIT HALL HOURS

#### MONDAY

17:00 - 19:00

Networking Reception  
in Exhibit Hall

#### TUESDAY

09:40 - 16:40

Exhibit Hall Open

09:40 - 10:00

Networking Coffee Break in Exhibit Hall

11:40 - 13:00

Networking Luncheon in Exhibit Hall

14:40 - 15:00

Networking Coffee Break in Exhibit Hall

#### WEDNESDAY

08:00 - 16:40

Exhibit Hall Open

09:40 - 10:00

Networking Coffee Break in Exhibit Hall

11:40 - 13:00

Networking Luncheon in Exhibit Hall

14:40 - 15:00

Networking Coffee Break in Exhibit Hall

#### THURSDAY

08:30 - 16:20

Exhibit Hall Open

09:40 - 10:00

Networking Coffee Break in Exhibit Hall

11:40 - 13:00

Networking Luncheon in Exhibit Hall

14:40 - 15:00

Networking Coffee Break in Exhibit Hall

**ENTRANCE**

## TUTORIALS (registration required)

Monday, 11 September 2017

Hyatt Regency Long Beach

## MORNING COURSES

### **Introductory Exterior Ballistics**

This course given by Dr. Uwe Chalupka aims at:

- Providing an insight into the physics, modeling methods, and experimental techniques of non-powered projectiles in flight as well as rockets and missiles;
- Enabling attendees to better follow and utilize papers presented at conference sessions and / or to qualify for participating in advanced courses;
- Giving an overview of exterior ballistic standards within NATO.

It is composed of the following contents:

- Introduction: course overview and scope, further reading / bibliography
- Exterior ballistics: vacuum ballistics, classical and modified point mass models, atmospheric models, Earth models, reference systems, forces and torques acting on the projectile, stability, numerical integration of equations of motion
- Exterior ballistics implementation within NATO: overview of relevant STANAGs and NATO Armaments Shareable Software Suite (S4)

### **Introduction to Vulnerability and Survivability**

The course taught by Mr. Heinrich Dorsch concentrates on these major learning outcomes:

- Fundamental understanding of subject matter;
- Understanding of weapon target interaction phenomena;
- Overview of data requirements concerning targets, weapons, and encounter situations.

The course is composed of the following topics:

- Fundamentals: definitions, scenario-based capability analysis, targets, threats, engagements, applicable probability theories
- Threat modeling: relevant properties, velocity ranges and physical effects, synergistic effects
- Target Modeling: geometry (CAD tools), physical description, functional description on component-level, functional description on system-level
- Methodologies: Method development (theoretical basis, experimental work, numerical simulation), penetration, blast, component damage, structural damage
- Applications: vulnerability wrt targets (e.g. soft, armored, infrastructure) and weapons (e.g., projectiles, HEF, SC, KE), survivability wrt targets (e.g., soft, armored, infrastructure), weapons (e.g., projectiles, HEF, SC, KE), and active protection systems

## AFTERNOON COURSES

### **Detonics and Energetic Materials**

This course by Dr. Ronald E. Brown provides practical insights into the safety, security and application of explosive devices and specifically aims at:

- Practical applications, e.g., technical evaluation, estimation, bases for inventiveness;
- Shock and detonation physics, i.e., applicable conservation laws and derivations;
- The explosive molecule, energetic materials, and expectations vs. usage potentials.

Theoretically-based arguments will be presented for purposes of developing relationships and trends for the developer, engineer, experimenter and user:

- Potential applications of course topics 'from initiation to detonation' and 'energy release and efficiencies'
- Shock and detonation physics (equations of states)
- The explosive molecule and energetic systems
- Estimation techniques, quantification of effects, and applications

### **The Science of Armour Materials**

The objectives of the course given by Dr. Ian Crouch are as follows:

- To deliver the main message: the science of armour materials is not a codified branch of engineering but a science in its own right. A detailed and broad-ranging introduction will be given to armour materials and penetration mechanics, within the context of terminal ballistics, impact dynamics and armour physics;
- To contextualize the role of numerical modelling and analytical techniques in the design of real armour systems for vehicles and personnel;
- To ensure that attendees gain a better appreciation of the drivers behind armour design and the strong influence that material properties have upon ballistic performance and impact behaviour.

The detailed contents of the course are:

- Traditional monolithic armours like steels and the light alloys, and armour systems like structural, appliqué and integrated. Designing simple and complex systems with precision engineering. The role of numerical modelling and analytical techniques in the design process
- Laminated materials and layered structures: design methodologies and drivers; principles of laminates; interfaces and air gaps; surface coatings; examples of laminated armours and layered systems
- Fibres, textiles and composites: advanced, high-performance fibres, including latest UHMWPE and aramid fabrics; fibre-reinforced polymer composites; protective apparel; soft armour systems; new helmet technologies
- Glasses and Ceramics: Conventional laminated glasses, glass-ceramics, transparent crystalline ceramics, opaque ceramics. Recent process developments, including Viscous Plastic Processing of boron carbide. Applications, including Hard Armour Plates for body armours

## MONDAY, 11 SEPTEMBER 2017

- 09:00 - 16:00 **Tutorial Sessions** (Hyatt Regency Long Beach)  
*\*Additional Registration Fees Apply*
- 09:00 - 12:00 **Morning Tutorial Session**
- 11:00 - 19:00 **Registration Open** (Long Beach Convention Center)
- 12:00 - 13:00 **Working Box Luncheon - Tutorial Attendees Only**
- 13:00 - 16:00 **Afternoon Tutorial Session**
- 11:00 - 16:00 **Exhibitor Move-In & Poster Set-Up** (Long Beach Convention Center Arena)
- 17:00 - 19:00 **Networking Reception in Exhibit Hall** (Long Beach Convention Center Arena)

## TUESDAY, 12 SEPTEMBER 2017

- 07:00 - 16:40 **Registration Open**
- 08:00 **Welcome & Administrative Remarks**  
*Sidney Chocron and James Walker, Symposium Co-Chairs*
- 08:10 **Keynote Address - Juno Mission To Jupiter**  
*Scott Bolton, Southwest Research Institute*
- 08:55 **Keynote Address - The Ultimate Potential Of High Strength Polymeric Fibers To Reduce Armor Weight**  
*Harm van der Werff, DSM*
- 09:40 - 16:40 **Exhibit Hall Open**
- 09:40 - 10:00 **Networking Coffee Break in Exhibit Hall**
- 10:00 - 11:40 **General Oral Session (G1)**  
*Chaired by Y Sreenivas Rao and Clive Woodley*
- 10:00 **1024 - Developments In Additive Manufacturing Of Energetic Materials At TNO**  
*Chris van Driel, TNO*
- 10:20 **1119 - Fast-Running Model Enhancements For Predicting Damage Scenes From Synergistic Effects Of Multiple Penetrator Impact**  
*Daniel Hyams, PeopleTec, Inc.*
- 10:40 **948 - Characterization Of A Linear Shaped Charge With Increased Standoff Capability**  
*Dennis Baum, Lawrence Livermore National Laboratory*
- 11:00 **1033 - Design Of A Muzzle Brake By Computational Fluid Dynamics To Reduce Noise Exposure During Training**  
*Jamie Tolhurst, QinetiQ*



- 11:20            825 - **Effectiveness Of PG-7 Grenade After Passing Through The Net-Armour - Numerical Analysis**  
*Pawel Zochowski, Military Institute of Armament Technology*
- 11:40 - 13:00    **Networking Lunch in Exhibit Hall**
- 13:00 - 15:00    **Interior Ballistics and Launch Dynamics Poster Session (P1)**  
*Chaired by Jon Yagla, Satoru Shoji and John Ritter*
- 13:00 - 14:40    **Terminal Ballistics (TB1) Oral Session**  
*Chaired by Ian Cullis and Ewa Lidén*
- 13:00            720 - **Fast Running Methods For Penetration Processes In Masonry Materials**  
*Heinrich Dorsch, IABG*
- 13:20            940 - **Penetration Mechanisms Of Ultrahigh Molecular Weight Polyethylene Fiber Reinforced Laminates By A Conical Projectile**  
*Wei Zhu, Beijing Institute of Technology*
- 13:40            824 - **Spall And Fracture In Three Dimensional Simulations Of Penetration Tests Into Al-7075 Plates**  
*Leonid Glikin, Rafael*
- 14:00            848 - **Extended Investigation Of The Dwell Effect For An Unconfined Silicon Carbide Ceramic Against Tungsten Heavy Alloy Rods**  
*Thilo Behner, Fraunhofer Institute for High-Speed Dynamics*
- 14:20            1126 - **Numerical Analysis Of Ceramic Composite Armour Subjected To Ballistic Impact**  
*Manouchehr Nejad Ensan, National Research Council Canada*
- 14:40 - 15:00    **Networking Coffee Break in Exhibit Hall**
- 15:00 - 16:40    **Explosion Mechanics Poster Session (P2)**  
*Chaired by Markus Graswald, Ron Brown and Xiangyang Quan*
- 15:00 - 16:40    **Interior Ballistics (IB1) Oral Session**  
*Chaired by Thelma Manning and Nicholas Eches*
- 15:00            725 - **Ignition And Combustion Of Pyrotechnics At Low Pressures And At Temperature Extremes**  
*Clive Woodley, QinetiQ*
- 15:20            731 - **Solid Propellant Burn Rate Measurement In A Mini Closed Bomb**  
*Sebastian Wurster, Fraunhofer Institute for Chemical Technology*
- 15:40            993 - **Obtaining Correlation Between Pressure Test Results Of Small Caliber Ammunition According To Different Test Standards**  
*Riyad Ratrouf*
- 16:00            840 - **The Study Of Abnormal Combustion In Combustion Light Gas Guns**  
*Ning Liu, Nanjing University of Science and Technology*
- 16:20            936 - **Research On The Criterion Of Transition For Electromagnetic Launching**  
*Bo Tang, National Key Laboratory of Transient Physics, Nanjing University*
- 16:40            **Adjourn for the day**

## WEDNESDAY, 13 SEPTEMBER 2017

- 07:00 - 16:40      **Registration Open**
- 08:00 - 16:40      **Exhibit Hall Open**
- 07:55                **Administrative Remarks**  
*Sidney Chocron and James Walker, Symposium Co-Chairs*
- 08:00 - 10:00      **Explosion Mechanics Poster Session (P3)**  
Chaired by Ernie Baker, Sebastian Wurster and Mark French
- 08:00 - 9:40        **Exterior Ballistics (EB1) Oral Session**  
Chaired by Vladimir Cech and David Lambert
- 08:00                1011 - **Numerical Techniques For The Prediction Of The Aerodynamic Behavior Of A Complex Projectile**  
*Sidra Silton, U.S. Army Research Laboratory*
- 08:20                1066 - **Validation Of The NATO Armaments Ballistic Kernel For Use In Small-Arms Fire Control Systems**  
*Daniel Corriveau, Defence R&D Canada*
- 08:40                1057 - **Projected Area And Drag Coefficient Of High Velocity Irregular Fragments That Rotate Or Tumble**  
*John Fredrik Moxnes, Norwegian Defence Research Establishment*
- 09:00                1056 - **Modeling And Simulation Studies For Advanced Towed Artillery Gun System**  
*Padmanabhan M. Sundaram, ARDE, Defence Research & Development, MoD, India*
- 09:20                783 - **External Ballistics And Accuracy Of Lead Free Bullets In 5.56X45mm NATO**  
*Michael Courtney, BTG Research*
- 09:40 - 10:00      **Networking Coffee Break in Exhibit Hall**
- 10:00 - 11:40      **Terminal Ballistics Poster Session (P4)**  
Chaired by Werner Arnold, Nobert Heider, ZhengXiang Huang, Amy Pullen, and Alon Weiss
- 10:00 - 11:40      **Vulnerability, Survivability and Explosion Mechanics (V&S1)**  
Chaired by Debra Carr and Frederik Coghe
- 10:00                727 - **The Influence Of Soil Temperature On Blast Intensity Of Buried Explosive Charges**  
*Zvika Asaf, Plasan, Ltd.*
- 10:20                920 - **Assessment Of Rate Dysfunction Of Statistical Armour Against Rpg-7 Family Threat**  
*Tommy Chevalier, DGA*
- 10:40                1086 - **A Methodology For Structural And Component Damage Assessment Of Building Targets**  
*Ho S. Kim, Agency for Defense Development*

- 11:00 947 - **Comparison Of 3D Simulations With Data For The Interaction Of An Array Of Linear Shaped Charges Against A Complex Target**  
*Kristen Howley, Lawrence Livermore National Laboratory*
- 11:20 1008 - **Modeling Of Thermal Reactions And Associated Events**  
*Markus Graswald, TDW GmbH*
- 11:40 - 13:00 **Networking Luncheon in Exhibit Hall**
- 13:00 - 16:40 **Vulnerability and Survivability Poster Session (P5)**  
Chaired by Zvi Asaf
- 13:00 - 14:40 **Explosion Mechanics (EM1) Oral Session**  
Chaired by Paul Locking and Jon Toreheim
- 13:00 785 - **Quantification Of Mechanisms For Blast Mitigation With Water-Filled Containers**  
*Huon Bornstein, Defence Science and Technology Group*
- 13:20 803 - **Study On Penetration Performance And Distribution Characters Of Multi-Explosively Formed Projectiles**  
*Jinxiang Wang*
- 13:40 875 - **Laboratory Setback Activator Tests For Gun Launch Explosive Suitability**  
*Ernest Baker, NATO MSIAC*
- 14:00 934 - **Measurement Of The Spatial Specific Impulse Distribution Due To Buried High Explosive Charge Detonation**  
*Vincent Denefeld, Fraunhofer EMI*
- 14:20 1087 - **Exploring The V2d Initiation Criterion Within The Lee-Tarver Model**  
*Roy Ceder, RAFAEL*
- 14:40 - 15:00 **Networking Coffee Break in Exhibit Hall**
- 15:00 - 16:40 **Interior Ballistics and Launch Dynamics Poster Session (P6)**  
Chaired by Xiaobing Zhang, Linfang Qian, Xiao Zhenggang and Ove Dullum
- 15:00 - 16:40 **Teminal Ballistics Oral Session (TB2)**  
Chaired by Jack Riegel and William Flis
- 15:00 841 - **Experimental High Velocity Impacts Through Float Glass Plates**  
*Fabrice Gillot, CEA*
- 15:20 722 - **An Investigation Of Armor Bolt Failure Due To Ballistic Events**  
*Shawn Klann, U.S. Army TARDEC*
- 15:40 865 - **Experimental And Numerical Results Of A New Helmet Concept Against Rifle Ammunition**  
*Ana Azevedo, Royal Military Academy (Belgium)*
- 16:00 956 - **Mesoscale And Continuum Modeling Of Ballistic Impact On S-2 Glass/ Sc-15 Epoxy Composite Panels**  
*Alexander Carpenter, Southwest Research Institute*

- 16:20 831 - **Application Of The RHT Concrete Model For Predictive Simulations Of The Penetration Into Adobe Targets**  
*Christoph Sauer, Fraunhofer EMI*
- 16:40 Adjourn

## **THURSDAY, 14 SEPTEMBER 2017**

- 08:00 - 16:20 Registration Open
- 08:30 - 16:20 Exhibit Hall Open
- 07:55 Welcome and Administrative Remarks  
*Sidney Chocron and James Walker, Symposium Co-Chairs*
- 08:00 - 10:00 **Exterior Ballistics Poster Session (P7)**  
Chaired by Marie Albisser, Don Carlucci, and Amy Courtney
- 08:00 - 9:40 **Oral Session Internal Ballistics and Launch Dynamics (IBLD2)**  
Chaired by Baoming Li and Ryan Hill
- 08:00 971 - **A Series Of BKNO<sup>3</sup> Nitrocellulose Based Low Sensitivity Igniters With Varying Ignition Characteristics**  
*Eugene Rozumov, U.S. Army ARDEC*
- 08:20 1003 - **Modifying Small Caliber Interior Ballistics By Employing A Flash Tube**  
*John Ritter, U.S. Army Research Laboratory*
- 08:40 1084 - **Enhanced Propellant Performance Via Environmentally Friendly Curable Surface Coating**  
*Thelma Manning, U.S. ARMY RDECOM ARDEC*
- 09:00 990 - **Influence Of The Obturator Breakage On The Sabot Separation Of An Apfsds Round**  
*Nicolas Eches, Nexter Munitions*
- 09:20 932 - **The Uncertainty Propagation Analysis Of The Projectile-Barrel Coupling Problem**  
*Linfang Qian, Nanjing University of Science and Technology*
- 09:40 - 10:00 **Networking Coffee Break in Exhibit Hall**
- 10:00 - 11:40 **Terminal Ballistics Poster Session (P8)**  
Chaired by Shannon Ryan, Alex Carpenter, Daniel Corriveau, and Vladislav Veldanov
- 10:00 - 11:40 **Exterior Ballistics (EB2) Oral Session**  
Chaired by Zhongyuan Wang and Marcelo Martinez
- 10:00 925 - **Improved Theory Of Projectile Trajectory Reference Heights As Characteristics Of Meteo-Ballistic Sensitivity Functions**  
*Vladimir Cech, Oprox, Inc.*
- 10:20 946 - **Aerodynamic Characterization of a New Concept of Long Range Projectiles from Free Flight Data**  
*Marie Albisser, French-German Research Institute*

- 10:40 953 - **A Technique To Create Repeatable Yaw In Long-Rod Penetrators**  
*Brett Sorensen, U.S. Army Research Laboratory*
- 11:00 972 - **The Effect Of Humidity On Small Arms Trajectory**  
*Gregory Oberlin, U.S. Army Research Laboratory*
- 11:20 868 - **Nonlinear Dynamic Analysis of Supercavitating Vehicles based on Two-Dimensional Bifurcation**  
*Jintao Wu, China*
- 11:40 - 13:00 **Networking Luncheon in Exhibit Hall**
- 13:00 - 14:40 **Exterior Ballistics Poster Session (P9)**  
Chaired by L. Koene and William Ng
- 13:00 - 14:40 **Oral Session Terminal Ballistics (TB3)**  
Chaired by Adam Wisniewski and Matthias Wickert
- 13:00 989 - **Numerical Investigations on Ricochet of a Spin-Stabilised Projectile on Differently Shaped Target Surfaces**  
*Marina Seidl, ISL - French-German Research Institute of Saint-Louis*
- 13:20 997 - **Development And Application Of Model For Adobe To Penetration Into Adobe Targets**  
*Barry Stewart, QinetiQ*
- 13:40 996 - **The Influence Of Edge Effects On The Ballistic Performance Of Transparent Armor**  
*Eldad Shemer, OSG*
- 14:00 1016 - **Protection Capabilities Of HHA And UHA Steels Against Long-Rod Kinetic Energy Penetrators**  
*Patrick Frueh, Fraunhofer EMI*
- 14:20 1100 - **Deriving Constitutive Model Parameters From Taylor Rod-On-Anvil Impact Experiments**  
*Shannon Ryan, Defence Science and Technology Group*
- 14:40 - 15:00 **Networking Coffee Break in Exhibit Hall**
- 15:00 - 16:20 **Oral Session Explosion Mechanics (EM2)**  
Chaired by Dennis Baum and K.D. Dhote
- 15:00 959 - **Tubular And Reconstituted Jets Using Annular Shaped Charge Liners**  
*Fred Grace, Enig Associates, Inc.*
- 15:20 1001 - **Integration Of An Over-Fly Top Attack Shaped Charge Jet Within A Kinetic Energy Penetrator For Enhanced Multiple-Effects**  
*Barry Stewart, QinetiQ*
- 15:40 1041 - **Statistical Variations In Blast Loads From Buried Explosives**  
*James Walker, Southwest Research Institute*
- 16:00 1023 - **Scaled Demonstration Of A Momentum Cancelling Active Blast Mitigation Concept**  
*Elsmari Wium, CSIR*
- 18:30 - 21:30 **Symposium Banquet at the Aquarium of the Pacific**  
\*Dress code is business

## **FRIDAY, 15 SEPTEMBER 2017**

- 07:55 Welcome and Administrative Remarks
- 08:00 - 09:40 **Oral Session General (G2)**  
Chaired by Frederick Rickert and Meir Mayseless
- 08:00 862 - **Research On The Damage Diagnosis For Rails With A New 3D Scanning Method**  
*Zhaoxin Wang, Nanjing University of Science and Technology*
- 08:20 1082 - **Coupling Vibration Model Of In-Bore Balloting**  
*Satoru Shoji*
- 08:40 1114 - **A Design Of Pulsed Solid Divert And Attitude Control System (DACs) For An Interceptor**  
*P. Sunitha, RCI/DRDO*
- 09:00 963 - **A Novel Electromagnetic Launching Assisted Bore Ram Accelerator And Its Potential Applications**  
*Baoming Li*
- 09:20 881 - **Ballistic Performance Prediction For Sc Jets**  
*Thomas Hartmann, NUMERICS GmbH*
- 09:40 - 10:00 **Networking Coffee Break**
- 10:00 **Presentation of Awards**
- Louis and Edith Zernow Award
  - Rosalind & Pei Chi Chou Award for Best Young Author
  - Neill Griffiths Award for Best Shaped Charge Warhead Paper
  - SABO Award for Best Poster Paper
- 11:15 **Invitation to the 31<sup>st</sup> International Symposium on Ballistics**
- 11:20 **Symposium Adjourned**
- 11:20 - 12:00 **Society Business Meeting**

## POSTER SESSIONS

### INTERIOR BALLISTICS AND LAUNCH DYNAMICS POSTER SESSION (P1)

TUESDAY 13:00 - 15:00

724 - Experimental Investigation On Ignition And Combustion Characteristics Of NEPE Propellant

*Li Lianbo, China*

728 - Headspace Effect on Aluminum Cartridge Case Behavior

*Song Cai, China*

744 - Preparation And Study Of Ultrafine Flake-Aluminum With High Reactivity

*Xiao Lei, China*

761 - Research On The Deformation Of Die Pins During Propellant's Extrusion Process

*Dandan Ji, China*

799 - Experiments And Numerical Simulation On The Expanding Processes Of High Pressure Hot Gas Jet In Bulk-Loaded Liquid

*Shanshan Mang, China*

801 - Simulation Of Two-Dimensional Interior Ballistics Model Of Solid Propellant Electrothermal-Chemical

*Launch Yanjie Ni, China*

806 - Preparation And Performance Of Insensitive Spherical Nano-Nitrocellulose

*Xiangjun Meng, China*

820 - Factors Determining Nature Of Dynamic Vivacity Curve During Closed Vessel Investigations

*Zbigniew Leciejewski, Poland*

832 - Response of Nitramine and Non-Nitramine based Composite Propellant to Pulse Triggered Combustion Instability

*Jayesh Upadhyay, India*

843 - Effects Of Sound Suppressors On Muzzle Velocity, Bullet Yaw, And Drag

*Michael Courtney, USA*

845 - Studies On Composite Solid Propellant With Tri-Modal Ammonium Perchlorate Containing An Ultrafine Fraction

*Venkata Suresh Babu Konanki, India*

858 - Dynamic Of Tubes Crossed By High Speed Projectiles, Influence Of Tube And Weapon Geometry On Accuracy And Dispersion

*Ophélie Chevalier, France*

867 - Effects Of Baffle Plate On Flow Field And Performance Of Two-Phase Pulse Detonation Engines

*Yang Kang, China*

870 - Research On The 3D Reconstruction For Railgun Bore Scanning Based On Combined Binocular Vision And Laser Marking

*Yuan Gao, China*

874 - Optimization Design Of Integration Of Interior And Exterior Ballistics Of Cased Telescoped Ammunition Gun

*Yong-jie Cao, China*

882 - Study On The Effect Of Obstructed Motion Of Projectile On Pressure Distribution In Bore

*Kui Nie, China*

883 - Combustion Performance Of The Multi-Perforated Gun Propellants And Influence On The Interior Ballistic Performance

*Rui Li, China*

884 - A New Launch Principle Gun With Single Chamber And Multiple Barrels

*Ying-hua Guo, China*

893 - Dynamic Model Of Rifle Bullets In Muzzle Flow

*Chuanlin Chen, China*

954 - Variant Buttress Groove Geometry And Its Effect On Sabot Groove Stress

*Michael Minnicino, USA*

961 - Sabot Petal Dynamics: Modeling Effect of Scoop Shape

*Sukratu Barve, India*

962 - Gun Barrel Wall Thickness Optimization

*Onur GÜNGÖR, Turkey*

981 - Developmental Challenges During Realization Of High Progressivity Rocket Motor

*Shrikant Ghogale, India*

988 - Numerical Simulation Of The Muzzle Flowfield Of Embedded Aircraft Gun

*Zeqing Guo, China*

1006 - Investigation Of The In-Bore Structural Integrity Of A Kinetic Energy Projectile

*Sekharan Harikrishnan*

1017 - Ballistic Properties Of Nitrocellulose Based Propellants After Artificial Aiging

*Agata Kamieska Duda, Poland*

1018 - Optimizing Interior Ballistics Performance By Form Function

*Sten Andreasson, Sweden*

1055 - Study On The Performance Of A New Propellant

*Bo Liu, China*

1122 - Performance Evaluation Of Rocket Motor End Dish Using Computed Tomography (Ct)

*C. Muralidhar*

1064 - CFD Study Of Seal Groove During The Mortar Interior Ballistic Process

*Cheng Cheng, China*

1094 - Performance Predictions Of Liquid Fuel Ramjet Combustor

*Srinivasa Rao, India*

1112 - Influence Of Altitude On Explosive Shock Damage Of The Target

*Yi Dong Jing, China*

### EXPLOSION MECHANICS POSTER SESSION (P2)

TUESDAY 15:00 - 16:40

718 - Computer Simulations Of Shaped Charge Jet Driven By Electromagnetic Force

*Chris Quan, US*

755 - Effect Of An Explosive Charge With A Shell Closed To A Metallic Plate

*Denis Leriche, France*

756 - The JWL Coefficients Of The Hexomax (B2269A) Explosive

*Denis Leriche, France*

774 - Effects Of Multi-Point Initiation Control Parameters On Mach Wave Overpressure

*Rui Li, China*

795 - Accuracy Of Empirical Gurney Velocity Prediction Models

*Paul Locking, United Kingdom*

829 - Study On Interference Of Explosive Reaction Armor To EFPS With Different Caliber

*Yuan Nie, China*

839 - Determination Of JWL Equation Of State Parameters Of Explosives Using Cylinder Expansion Test

*Tuğberk İncekürk, Turkey*



## 30th International Symposium on Ballistics

860 - Experimental Research On The Influence Of The Equivalence Ratio And Operating Frequency On The APDE  
*Yan-bin Hu, China*

906 - Effect Of Initiation Configurations On Blast Performance Of Cylindrical Explosive Charge - An Experimental Investigation  
*Sekharan Harikrishnan, India*

979 - Experimental And Numerical Study Of The Fragmentation Of Warhead Casings  
*Aleksandra Górska, Poland*

985 - Role Of Dispersion Model In Predicting Spatial Distribution Of Fragmentation Warhead  
*Kusumkant Dhote, India*

1002 - Analysis Of Several Numerical Schemes For The Characterization Of Solid Propellant Combustion  
*Carmen Lopez-Munoz, Spain*

1009 - Investigation Of Interior Ballistic Initial Conditions In ALE3D For Blast Overpressure Analyses  
*Robert Carson, USA*

1014 - Projectile Formation Of Tantalum EFP Liner Fabricated By Thermo-Mechanical Processes  
*Seong Lee, South Korea*

1034 - Modeling Fragmentation Performance Of Large L/D (Length Over Diameter) Explosively Driven Metal Shells  
*Vladimir Gold, USA*

1071 - Air Blast From A Moving Charge On A Moving Target  
*Meir Maysel, Israel*

1074 - A Computational Framework For The Design And Optimization Of Explosives  
*Logan Beaver, USA*

### EXPLOSION MECHANICS POSTER SESSION (P3)

**WEDNESDAY 0800 - 10:00**

745 - Research On Sectional Type Horizontal Cutting Interception Munitions  
*Li Yin-liang, China*

769 - Numerical Simulation And Experimental Investigation Of Two Types Of Shaped Charge Comprised Of Reactive Material Liner  
*Yu Shan, China*

776 - Analysis Of The Influence Of The Embedded Structure On The Formation Of The Compact Terminal Sensitive Projectile  
*Boyang Xing, China*

780 - Study Of Bonded Flake Structure In Explosively Formed Projectile With Fins  
*Liwei Zang, China*

802 - Numerical Simulation On Forming Of Triple-Layer Tandem EFP  
*Jianping Yin, China*

825 - Effectiveness Of PG-7 Grenade After Passing Through The Net-Armour - Numerical Analysis  
*Pawel Zochowski, Poland*

830 - Study On Shock Initiation Of Cylindrical-Shell Charge Impacted By Spherical Fragment  
*Xin Wang, China*

837 - Study On Penetration Of High-Polymer Shaped Charge Jets  
*Jianya Yi, China*

855 - Flight And Penetration Characteristics Of Explosively Formed Penetrators  
*Youngsun Yi, Republic of Korea*

894 - Three-Dimensional Numerical Research On The External Flow Field Of Three-Tube Pulse Detonation Engines  
*Fang Wang, China*

929 - Investigation On The Formation Mechanism Of Natural Fragmentation Of Improvised Explosive Device  
*Nan Zhou, China*

960 - Study On Formation And Penetration Of Shaped Charge With Liner Vertex Initiation  
*Chen Shuai*

998 - Micro Disruption Device  
*Fabien Rondot, France*

1000 - Viscoelastic Constitutive Model With Damages Of Polymer-Bonded Explosives  
*Xinyu Zhang, China*

1110 - The Mechanism Of Variable Thickness Conical Shell Fragments' Characteristics And Fracture Modes  
*Zhibiao Zhang, China*

1037 - Shock Compression Properties Theoretical Calculation Of Mesms With The Effect Of Thermal Motion Of Elections  
*He Yuan, China*

1048 - Numerical Simulation Research On The Effect Of Radial Rotation On The Formation Of Explosive Forming Projectile  
*Pan Xuchao, China*

1075 - Nickel-Tungsten Alloy Evaluation For MEFP Warhead Applications  
*LaMar Thompson, USA*

### TERMINAL BALLISTICS POSTER SESSION (P4)

**WEDNESDAY 10:00 - 11:40**

722 - An Investigation Of Armor Bolt Failure Due To Ballistic Events  
*Shawn Klann, USA*

723 - Numerical Analysis Of Rifle Bullet Impact Armor Covered Human Torso  
*Li Ma, China*

740 - Numerical Analysis Of Penetration Reduction Of A Long Rod Penetrator Impacted By A Linear Explosive Formed Penetrator  
*Jaehyun Joo, Republic of Korea*

742 - Bullet Penetration Into Wooden Targets  
*L. Koene, Netherlands*

757 - On Temperatures In Shaped-Charge Jet Penetration  
*William Flis, USA*

767 - Analysis Of Temperature Rise On The Projectiles' Surface Including The Mass Abrasion Effect  
*Lei Guo, China*

771 - Impact Failure Of Soft Body Armors  
*Wayne Chen, USA*

773 - Study Of High-Speed Aluminum Rod Non-Destructive Recovery Device  
*Qing Fang, China*

790 - Comparison Of Numerical Modeling Of Penetration Of A Capped, Hooded Projectile Into Special Treatment Steel  
*Donald Carlucci, USA*



815 - Investigating Of Mechanical Properties Of Rheological Materials For Flexible Body Armour

*Dawid Pacek, Poland*

817 - Comparison Of Backing Materials Used In The Testing Of Ballistic Body Armour

*Chris Malbon, United Kingdom*

818 - Comparison Of The DM11A1B2 9mm Luger FMJ Bullet From Two Different Manufacturers

*Chris Malbon, United Kingdom*

822 - Measurement Of Bullet Impact Conditions Using Automated In-Flight Photography System

*Ryan Decker, USA*

836 - High Strain Rate Deformation Of W-Ni-Fe Alloys

*Hakan Hafizoglu, Turkey*

847 - Reliability Analysis Of Long-Rod Penetration Using The Walker-Anderson Penetration Model

*In-Han Ga, Republic of Korea*

857 - Effects Of Lateral Edges In Bare And Confined Ceramic On The Ballistic Performance Against Tungsten Alloy Projectile

*Changwook Kim, Republic of Korea*

888 - Simulation Study On The Effect Of Cap On The Nose-Cone-Head Projectile Penetrating Multi-Interval-Layer Steel Targets

*Niu Gongjie, China*

902 - The Design Of Composite Armour System Using Mg Alloy, Ceramic, And Composite Material For Minimum Weight Gun

*In Kim, Republic of Korea*

938 - An Accurate Eulerian Simulation Of Shaper-Charger And Explosively Formed Projectile

*Yo-Han Yoo, Korea*

941 - Experimental Study On The Penetration Effect Of Ceramics Composite Projectile On Ceramic / A3 Steel Compound Targets

*Hu Diqi, China*

983 - The Development Of A Bullet Simulating Projectile For Body Armor Testing

*Georgios Kechagiadakis, Belgium*

999 - Estimation Of The Bullet Depth Of Penetration Based On The Numerical Integration Of Stochastic Differential Equation

*Tahenti Beya, Tunisia*

1013 - Penetration Performance Of Ultrafine-Grained Copper Shaped Charge Liner

*Sung Ho Lee, South Korea*

1089 - Modeling The Effect Of Initial Disturbances When A Bullet Impact In Gelatin

*Thomas Eriksson, Sweden*

1093 - A Potential Methodology For Evaluating Ceramic Quality

*Matthew Burkins, USA*

1097 - Influence Of Numerical Parameters On Impact Simulations

*Benjamin Erzar, France*

1101 - Damage Effect And Parametric Sensitivity Research Of Different Aggregate Composite Target Subjected To Projectile Penetration

*Bin Liang, China*

1102 - An Artificial Neural Network Based Constitutive Model for Predicting The Response Of A High-Strength Steel And Aluminium

*Mark Edgerton, Australia*

1118 - Ballistic Impact Of 5.56mm Small Arms Projectiles On Steel Plates

*Shailendra Gade, India*

## **VULNERABILITY AND SURVIVABILITY POSTER SESSION (P5)**

**WEDNESDAY 13:00 - 16:50**

719 - Victim's Posture And Protective Clothing Changes The Approach In An Edged-Weapon Attack

*Debra Carr, United Kingdom*

734 - Damage Of Different Types Of Components Against Blast Wave

*Denis Leriche, France*

764 - Modelling Civilian Armoured Vehicles Subject To Mine Blast Loading

*Mark French, UK*

762 - Clear Ballistics Gel®: Retarding Force Analysis Of Paraffin-Based Alternative To Gelatin-Based Lead-Free Bullet Testing

*Michael Courtney, USA*

778 - Dynamic Mechanical Analysis Of Fiber Based Ballistic Protection Materials

*Marcin Cegla, Poland*

779 - Selected Issues Of Lightweight Bulletproof Vest Design And Testing

*Mikolaj Bogajczyk, Poland*

859 - The Influence Of Wind On Gunshot Localization Accuracy

*L. Koene, Netherlands*

861 - A New Model For Experimental Modeling Of Fragmentation Warheads

*Cedric Archambaud, France*

892 - Study On The Adaptability Of Insensitive Explosives In Shaped Charge

*Ji Long, China*

908 - Projection Criteria For Insensitive Munitions And Hazard Classification

*Martijn van der Voort, Belgium*

964 - Research On Ground Target Recognition Algorithm Based On Multiple Column Array Laser Radar

*Wu Junan, China*

970 - Controlling The Fragment Distribution For A Fragmentation Warhead And Its Effect On Lethality

*Hüseyin Emrah Konokman, Turkey*

994 - Investigating Potential Solutions To Increase Ballistic Protection Level Of Swas In Armored Vehicles / Kaddb Experience

*Riyad Ratrou, Jordan*

1005 - Assessment of the Possibility to use X-Ray Diagnostic Systems - Electron Linear Accelerator and MU17F 225-9 System in Non-Destructive Ammunition Tests of the Ammunition

*Marcin Nita, Poland*

1007 - Behind Armor Blunt Trauma: Recreation Of Field Cases For The Assessment Of Backface Signature Testing

*Cynthia Bir, USA*

1040 - Comparing The Backface Deformation Behavior Between Soft And Hard Body Armors

*Karin Rafaels, USA*

## 30th International Symposium on Ballistics

1046 - The Effects Of Composite Sandwich Plate On Explosive Charge By Fragment Impact  
*Fang Wang, China*

1079 - Effect Of Blast Mitigation From Multiple Fluid Containers  
*Eric Chengchou Yang, Australia*

1121 - A Review Of Aircraft Fuel System Vulnerability And Study Of Events Due To Ballistic Impacts  
*Derek Taylor, United Kingdom*

### **INTERIOR BALLISTICS AND LAUNCH DYNAMICS POSTER SESSION (P6) WEDNESDAY 15:00 - 16:50**

743 - Analysis Of Dynamic Vivacity Curves Obtained On The Basis Of Valved Closed Vessel Test Data  
*Radoslaw Trebinski, Poland*

758 - The Influence Of Nozzle Diameters On The Interaction Characteristic Of Combustion-Gas Jets And Liquid  
*Xiaochun Xue, China*

768 - Numerical Analysis Of The Internal Ballistic Properties Of Underwater Launched Gun With A Gas-Curtain  
*Xinwei Zhang, China*

792 - Synthesis And Performance Of Insensitive Ladder-Like Nitrocellulose  
*Zhenggang Xiao, China*

805 - Research Progress Of Pressure Testing Technology For Electrothermal-Chemical Launch  
*Hui Tian, China*

808 - Research On The Influence Of Rail Length And Inductance Gradient Distribution To Launch Efficiency  
*Yingtao Xu, China*

826 - Dynamic Analysis Of Apfsds In The Barrel Of Railgun  
*Gang Wan, China*

828 - Prediction Of Real Gas And Non-Equilibrium Effects In The Gas Dynamics Of Canister Launch Missile  
*Sudhakar Rayabarapu, India*

842 - Experimental Study On The Influence Of The Annular Slot On Continuous Rotating Detonation Engine  
*Wanli Wei, China*

853 - Electrostaticspray Preparation And Properties Of RDX/DOS Composites  
*Jian Yao, China*

871 - Thermoelastic Analysis Of Composite Railgun Housing Under Rapid Fire  
*Hongcheng Xiao, China*

876 - Simulation Analysis Of Combustion Process Of Low Temperature Hydrogen-Oxygen Premixed Gas Using Of CLGG In Closed Burner  
*Na Zhao, China*

878 - Study Of Characteristics Of Combustion Rate Of Propellant At Different Charge Zone For Large Caliber Artillery Gun Systems  
*Yu-wei Wang, China*

880 - Theoretical Analysis Of Effects Of Combustible Cartridge Case's Parameters On Interior Ballistic Performance  
*Kui Nia, China*

898 - Experimental Investigation On Compressive Mechanical Properties And Fracture Mechanism Of AP-HTPB Base Bleed Grain  
*Zhihui Wu, China*

914 - The Research On Engraving Process Of 12.7mm Projectile  
*Li Zhongxin, China*

930 - Additive Manufacturing Of Electronic Components For High-G Launch Survival  
*Joseph South, USA*

935 - A Comparative Study Of Combustible Cartridge Case Materials  
*Yang Weitao, China*

950 - Dispersion Sensitivity Analysis And Consistency Improvement Of APFSDS  
*Sanggeta Sharma Panda, India*

969 - Cooling Methods For Gun Barrel  
*Yujia Sun, China*

978 - Numerical Investigation On Influence Of The Precursor Flow On Combustion In Muzzle Flows  
*Qiongyao Qin, China*

991 - Investigations Of Inhibitors For Double Base Propellants By The Use Of Real Time Roentgenoscopy  
*Dorota Powala, Poland*

993 - Obtaining Correlation Between Pressure Test Results Of Small Caliber Ammunition According To Different Test Standards  
*Riyad Ratrout, Jordan*

1006 - Investigation Of The In-Bore Structural Integrity Of A Kinetic Energy Projectile  
*Prashant Patil, India*

1022 - Laboratory Tests of Pyrotechnic Delay Ignition Used in the Rockets Motors  
*Marcin Nita, Poland*

1025 - Intermediate Ballistics Modelling Including Muzzle Brake  
*Oskar Parmhd, Sweden*

1028 - Testings of the Homogeneous Rocket Propellants Using the Real Time Radioscopy (RTR)  
*Marcin Nita, Poland*

1030 - Euler Computations Of A Self-Propelled 155 Mm/52-Calibre Gun-Howitzer Installed On A Truck Chassis  
*Michael Zeidler, France*

1044 - Skin-Core Structure Gun Propellants With High Combustion Progressivity  
*Weitao Yang, China*

1073 - Impact-Disrupted Gunshot Residue: A Sub-Micron Analysis Using A Novel Collection Protocol  
*Vassilia Spathis, United Kingdom*

### **EXTERIOR BALLISTICS POSTER SESSION (P7) THURSDAY 08:00 - 10:00**

748 - Test Method Investigation Of Trajectory Consistency Based On Damage Efficiency Criterion  
*Risheng Hou, China*

765 - Ballistic Characteristics Of Dual-Spin Projectile With Asymmetric Front Body  
*Tan Ju, China*

783 - External Ballistics And Accuracy Of Lead Free Bullets In 5.56x45mm NATO  
*Michael Courtney, USA*

812 - A Technology Of Ballistic Measurement For Multi Flying Targets  
*Yanning Gui, China*

844 - Ballistics Of Supercavitating Projectiles  
*Ove Dullum, Norway*

864 - Experimental Investigation Of Supercavitating Underwater Ballistic Projectile  
*Naohiro Kitayama, Japan*

866 - Using Forecast Meteorological Data To Reduce The Artillery Error Budget  
*Bernard Jones, US*

872 - Calculation Method Of Dynamic Drag Of Solid Fuel Ramjet Projectile Based On CFD  
*Yong-jie, Cao, China*

922 - Predictions Of Coupled Motion Dynamic Derivatives Of Projectile  
*Liang Chen, China*

933 - Research On Aerodynamic Characteristics Of Trajectory Correction Mortar With Circular Grid-Fin Canard  
*Dongguang Li, China*

968 - Perturbation Studies For Separation Dynamics Of Store During Release From Aircraft  
*Sunil Hiwale, India*

974 - Optimal Design Of The Aerodynamic Parameters For A Supersonic Two-Dimensional Guided Artillery Projectile  
*Ke Liang, China*

1031 - A Statistical Method For The Evaluation Of Projectile Dispersion  
*Daniel Corriveau, Canada*

1058 - Influence Of Silencer Use On External Ballistics Of Projectiles  
*Bartosz Kozera, Poland*

1059 - Influence Of Muzzle Devices Use On Accuracy Of Competition Weapons  
*Bartosz Kozera, Poland*

1062 - An Aerodynamic Shape Optimum Study For Long-Range Guided Rockets To Maximize The Range And Increase The Hit Accuracy  
*Runduo Cao, China*

1067 - A Systematic Approach For Efficiency And Safety Improvement For Mortar Fire  
*Eugene Adamovski, Israel*

## TERMINAL BALLISTICS POSTER SESSION (P8)

THURSDAY 10:00 - 11:40

739 - Bending Failure Criterion And Structure Optimization Of Projectile In High-Speed Normal Penetrating  
*Cheng Wu, China*

741 - Ballistic Performance Of Ceramic Targets Against 25mm APDS-T Projectile  
*Alon Weiss, Israel*

777 - Modelling Of Impact Test And Selection Of Material Parameters For The Strength Model Of The 9 Mm Parabellum Projectile  
*Adam Wisniewski, Poland*

791 - Experiment Study On Anti-Penetration Performance Of Liquid Composite Armor To Shaped Charge Jet  
*Tan YaPing, China*

793 - New Approaches To Modeling And Simulation Of Ultra High Molecular Weight Polyethylene  
*Arash Ramezani, Deutschland*

809 - Research On Armor Debris Cloud Characteristic Of Shaped Charge Jet Penetrating Target Vertically  
*Zu XuDong, China*

810 - Research Of Wave Interaction For Multiple Jets Penetration Into Concrete  
*Xiao QiangQiang, China*

814 - Deceleration-Time Data For The Verification Of Calculation Models Of The Penetration With Erosion In Target  
*Mikhail Sotskiy, Russian Federation*

816 - A Fast Running Model For IED Disruption  
*Richard Potter, United Kingdom*

821 - Numerical Analysis Of Behaviour Of The Nanostructured Bainitic Steel Used In Armor  
*Adam Wisniewski, Poland*

823 - The Analysis Of Possibility To Use The Composites Panels With Graphene As Protective Layers  
*Adam Wisniewski, Poland*

838 - Flexible Bulletproof Armour With Modular Interlayer  
*Dawid Pacek, Polska*

904 - Study On Killing Effect Of Different Quality Of Little Fragment To The Personnel Target  
*Wenmin Yan, China*

907 - Research On Kinetic Characteristic And Dynamic Simulation Of Direction Controllable Active Electromagnetic Armor  
*Jia Xin, China*

911 - Study On The Performance Of The Ceramic Composite Projectile Penetrating Ceramic Composite Target  
*Rongcheng Yi, China*

939 - Effect Of Fragment Shape On The Impact Damage Of Carbon\Aluminum Laminated Shell Structure  
*Mingming Xu, China*

955 - Numerical Study Of High-Density Titanium Alloy Shaped Charge Jet Penetration Into Concrete  
*Zhu QiFeng, China*

958 - Experimental And Numerical Investigation On New Type Of Annular Shaped Charge  
*Wang Cheng, China*

966 - Experimental And Numerical Results Of High-Speed Penetration Of Projectiles With Concrete And Soil  
*Vladislav Veldanov, Russia*

1015 - Medium-Weight Combat Vehicles Mine Protection Development Methodology  
*Itzhak Kuchuck Katalan, Israel*

1026 - Design Of Blast Resistant Litter Bins  
*Stanislav Rolc, Czech Republic*

1027 - Reactive Panels With Non-Metallic Cover Plates  
*Ewa Lidén, Sweden*

1035 - Experimentation Using Hot And Cold Steel Plate Targets Against 7.62mm Ammunition  
*Phil Pitcher, United Kingdom*

1043 - A Preliminary Study In The Variables Of Thoracic Ballistic Trauma  
*Amy Pullen New Zealand*

1051 - Ballistic Performance Of Reground Resin In Extruded Polycarbonate Plates  
*Timothy Talladay, USA*

## 30th International Symposium on Ballistics

**1054 - A Note On The Dynamic Spherical Cavity Expansion Of Concrete With Liquid Constitutive Model**

*Jie Wang, China*

**1063 - Aluminium Block Against Oblique Perforation Of Tungsten Alloy Long Rod**

*Jianming Yuan, Singapore*

**1069 - The 9X19 MM Ammunition Rebound Phenomenon**

*Przemyslaw Sidelnik, Poland*

**1095 - Experimental Round Robin For Predicting Electronic Component Response From High-g Loads**

*Hayley Chow, USA*

**1116 - Material Characterization Of Ballistic Roma Plastilina No. 1 Clay**

*Timothy Zhang, USA*

**1117 - Delay Compensation In HILS Of Aerospace Systems**

*Lav Sanhith Rao, India*

**1120 - Dynamical Compressive Tests In UHMWPE Samples With Different Thickness/Diameter Ratio**

*Iaci Pereira, Brazil*

**1123 - Predicting The Rupture Of Composite Plates Following A Hypervelocity Impact**

*William Schonberg, USA*

**1124 - Design, Development And Test Of A 12.7 Mm Enhanced Lateral Effect Projectile**

*Sarel Janse van Rensburg, South Africa*

**1125 - Cumulative Distribution Ballistic Impact Failure Models Of Common Twisted Pair Data Cables At Orbital Speeds**

*Joshua Miller, USA*

### **EXTERIOR BALLISTICS POSTER SESSION (P9)**

**THURSDAY 13:00 - 14:40**

**721 - Research On The Effect Of Structure Parameters On The Dynamic Characteristics Of Terminal Sensitive Projectile**

*Shengtao Lv, China*

**737 - Modeling And Control Of Supercavitating Vehicle**

*Tianhong Xiong, China*

**782 - Coexisting Attractors In A Underwater Supercavitating Vehicle System**

*Yi-pin Lv, China*

**786 - An Improved Hybrid Extended Kalman Filter Based Drag Coefficient Estimation For Projectiles**

*Weiping Zhou, China*

**789 - Experimental And Numerical Analysis Of Supersonic Mortar Projectiles**

*Tomasz Merda, Poland*

**877 - Numerical Simulation Of Submerged Jet Of Hydrodynamic Cavitation**

*Na Zhao, China*

**879 - Analysis Of Characteristics Of Projectile Angle Motion With Projectile-Borne Magnetometer Sensor Test**

*Long Zhang, China*

**930 - An On-Board Recording Technique To Correlate Simultaneous Leeward And Windward Pressure Measurements To Ground-Based Aerodynamic Range Measurements**

*T. Gordon Brown, USA*

**977 - Innovative Course Correction Devices: MANEGE Program - Conclusion and Following Current Step**

*Eric Carette, France*

**987 - Determination Of Aerodynamic Co-Efficients Of Fin Stabilized Armour Piercing Penetrator Using Yaw Cards**

*Bora Muralidhar, India*

**1010 - Computational Analysis Of The Aerodynamics Of A Bending Body Projectile At Supersonic Speeds**

*Sidra Silton, USA*

**1012 - AR-15 Barrel Motion As A Function Of Weapon Mount Configuration**

*Kenneth Paxton, USA*

**1020 - Prediction Of Spatial Distribution Of Fragments From A Preformed Fragmentation Warhead Using Mathematical Modeling**

*Satyendra Singh, India*

**1045 - PROBASE: A Software Application To Estimate Drag In Base Bleed Technology Units Using Large Eddy Simulation**

*Francisco Nicolás Pérez, Spain*

**1061 - Trajectory Tracking Study Based On Integrated Guidance And Control**

*Lindong Zhao, China*

**1065 - Simulation Studies For MRSI Of Artillery Gun Systems**

*Padmanabhan Sundaram, India*

**1045 - PROBASE: A Software Application To Estimate Drag In Base Bleed Technology Units Using Large Eddy Simulation**

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