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Sensors, and Command, Control, Communications, and Intelligence (C3I) Technologies for Homeland Security and Homeland Defense IX

Edward M. Carapezza
Editor

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Introduction

The interest in sensors and command, control, communications, and intelligence technologies for homeland security and homeland defense and applications has dramatically increased over the past several years. Systems are being developed in support of homeland security, intelligence, and law enforcement applications around the world. Government agencies are making significant investments to develop improved sensors, sensor networks, communication systems, and command, control, and decision-making technologies. This SPIE conference series is devoted to papers on recent technological advancements in related technologies and applications

The conference included 90 talks, with 6 keynote and 84 technical paper presentations, organized into 15 session topics covering recent advances in cyber security, communication technologies, non-lethal weapon technologies and systems, decision support/command, control, and intelligence, perspectives on global health, biomarkers, nanomaterials: biomedical applications and health effects, biosensors and molecular diagnostics, imaging sensors and surveillance systems, ground surveillance systems, counter sniper, maritime and port surveillance, air transportation security: counter manpad systems, and material and concealed object inspection.

Additionally there was an all day series of joint technical sessions with the Unattended Ground, Sea, and Air Sensor Technologies and Applications conference 7693 on counter sniper, ground surveillance systems, and maritime and port surveillance systems. The following six keynote talks were given and we sincerely thank all of these speakers for very stimulating and relevant presentations:

- 1) **"Enhanced Cyber Security with CyLab Technologies"** by Jonathan McCune from Carnegie Mellon University
- 2) **"Next Generation Non-Lethal Weapons (NLW) versus Current Joint Non-Lethal Weapons Capability Gaps"** by David Law from the Joint Non-Lethal Weapons Directorate
- 3) **"Command and Control in Homeland Security"** by David G. Boyd from the U.S. Dept. of Homeland Security
- 4) **"Extreme Health Sensing: the Challenges, Technologies, and Strategies for Active Health Sustainment of Military Personnel during Training and Combat Missions"** by Mark J. Buller from the U.S. Army Research Institute of Environmental Medicine
- 5) **"Emergency Responder Location Tracking Program: Technologies and Challenges"** by Jalal Mapar from the U.S. Dept. of Homeland Security
- 6) **"DHS Counter-MANPADS Program: Scope and Results"** by Kerry D. Wilson from the U.S. Dept. of Homeland Security

Thanks to those who prepared and presented the technical papers and for their contribution to a very successful meeting. The success of this conference is attributed to the participation of the commercial, university, and government research-and-development community, as well as the organizing efforts of the diverse and talented program committee.

Thanks to our program committee members for their dedication, time and assistance in conference planning and organizing and especially to those members who were able to participate as session chairs including: **Zoraida P. Aguilar**, Ocean Nanotech, LLC; **John G. Blitch**, ARACAR: Alliance for Robot Assisted Crisis Assessment and Response; **George V. Cybenko**, Dartmouth College; **Michael J. DeWeert**, BAE Systems; **Mildred A. Donlon**, Defense Advanced Research Projects Agency; **John S. Eicke**, Army Research Lab.; **Konrad Faulstich**, Embedded System Engineering GmbH (Germany); **Jeffrey R. Heberley**, U.S. Army Armament Research, Development and Engineering Ctr.; **Todd M. Hintz**, Space and Naval Warfare Systems Command; **Myron E. Hohil**, U.S. Army Research, Development and Engineering Command; **Ivan Kadar**, Interlink Systems Sciences, Inc.; **Pradeep K. Khosla**, Carnegie Mellon Univ.; **Peter Kiesel**, Palo Alto Research Ctr., Inc.; **Han Q. Le**, Univ. of Houston; **Daniel Lehrfeld**, Blue Marble Group, LLC; **Baochuan Lin**, U.S. Naval Research Lab.; **Tariq Manzur**, Naval Undersea Warfare Ctr.; **Igor L. Medintz**, U.S. Naval Research Lab.; **Paul F. Morgan**, U.S. Special Operations Command; **Richard M. Ozanich**, Pacific Northwest National Lab.; **Dennis J. Reimer**, National Memorial Institute for the Prevention of Terrorism; **Steven A. Ripp**, The Univ. of Tennessee; **Kim E. Sapsford**, U.S. Food and Drug Administration; **Glenn T. Shwaery**, Univ. of New Hampshire; **Šárka O. Southern**, Gaia Medical Institute; **Nino Srouf**, Army Research Lab.; **Aurel Ymeti**, Ostendum R&D BV (Netherlands)

Very special thanks to 5 program committee members who worked especially hard to help organize this challenging conference: Todd M. Hintz, Myron E. Hohil, Tariq Manzur, Daniel Lehrfeld, and Šárka Southern. Dr Šárka Southern deserves special thanks for organizing four new Global Health related sessions. She hopes to stimulate more interest in this important technical area and to hopefully develop these sessions into a stand-alone homeland security related conference in future years. We could not have had so successful a technical conference without the excellent help and dedication of these five people.

Finally, an extra special thanks to all of the conference attendees this year for your interest and enthusiasm. The conference was well attended, with a great deal of interest in all the sessions. We hope the interest in this technology continues to grow, and that this conference will expand with even greater technical content and significance in future years.

Edward M. Carapezza

The U.S. Department of Defense Joint Non-Lethal Weapons Program

SPIE Defense, Security, and Sensing Conference
5-9 April 2010
Orlando, FL

Session: Non-Lethal Weapons (NLW) Technologies and Systems

Presenter: David Law, Technology Division Chief, Joint Non-Lethal Weapons Directorate

Date: 5 April 2010

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Purpose

- Identify DoD's high priority NLW needs through: (1) a recently completed Capabilities-Based Assessment (JCIDS) and (2) Service/COCOM's current urgent needs
- Set the stage for those JNLWP projects which will come next after this brief
 - Show how these technology development efforts mitigate and address these known joint capability-gaps
- **Goals:** (1) Forge new coordination and collaboration opportunities for NLW technology research within the DoD and all other government agencies and organizations and (2) increase and facilitate fielding of NLWs by the Services to meet today's warfare (irregular, traditional, catastrophic, and disruptive)

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Joint Non-Lethal Weapons Directorate

- *Established* as a Jointly Manned Activity in 1996/97
 - All Services plus US Coast Guard
- *Serves* as the focal point for DoD NLW Program
 - All four Services, SOCOM, and US Coast Guard
- *Manages* the day-to-day operations of the DoD Program for the Executive Agent
- *Provides* S&T and R&D funding to Milestone B/C
- *Chairs* NATO NLW Sub-committee

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DoD Non-Lethal Weapons Program Management Structure

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JNLWP Management Structure

Non-Voting Members - OSD, DOS, DOJ, DOE, DHS, NGB, Border Patrol, Combatant Commanders and Joint Staff have representation on the IPT and JCIG

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JNLWP Budget

BA-2: Applied Research (USN ONR/OSD Oversight)

NL studies and analysis to augment and support current JNLWP areas of interest as well as explore new NLW technology opportunities: Includes experimentation and model development. (TRL 2&3)

BA-3: Advanced Technology Development (USN ONR/OSD Oversight)

Next generation NLW concepts and advanced prototype development to support challenging mission needs: Includes laboratory and field testing and model verification and validation. (TRL 4&5)

BA-4: Advanced Component Development and Prototypes (ACD&P) (DC PP&O Oversight)

Primary source of funds. Supports research and development of JNLWP efforts. Includes efforts necessary to evaluate integrated technologies, prototype systems and to expedite technology transition from laboratory to operational use. (TRL 6&7)

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DoD NLW Definition

“Weapons, devices and munitions that are explicitly designed and primarily employed to incapacitate targeted personnel or materiel immediately, while minimizing fatalities, permanent injury to personnel, and undesired damage to property in the target area or environment. Non-lethal weapons are intended to have reversible effects on personnel and materiel.”

Non-Lethal Weapons Core Capabilities:

Counter-Personnel (CP)

Suppress
Move
Deny
Disable

Counter-Materiel (CM)

Stop
Disable
Divert
Deny Access

Key Attributes: Incapacitation and Reversibility

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Joint Non-Lethal Effects ICDs

JCID-JNLE ICDs

- Joint Capabilities Document signed February 2008
- CP & CM Initial Capability Documents signed April 2009

CP TASKS

- Deny
- Move
- Disable
- Suppress

CM TASKS

- Stop Vehicle
- Disable Vehicle
- Stop Vessel
- Disable Vessel
- Stop Arcft on Ground
- Disable Arcft on Ground
- Divert Arcft in Air
- Deny Access to Facility

CBA Membership

J2/J3/J8 JFCOM EUCOM	PACOM CENTCOM STRATCOM NORTHCOM	USA USCG USMC USN USAF	JNLWD OSD AT&L *HECOE
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JNLWP Priority Focus Areas

Counter-Materiel	
<ul style="list-style-type: none">• Stop Vehicle (small/medium/large, confined, single)• Stop Vehicle (medium, confined, single)• Stop Vehicle (large, confined, single)	<ul style="list-style-type: none">• Stop Vessel (small, confined, single, [friendly anchored])• Stop Vessel (small, open, single, [friendly underway])

Counter-Personnel	
<ul style="list-style-type: none">• Suppress Individuals (confined, single/few)• Suppress Individuals (open, many)	<ul style="list-style-type: none">• Move Individuals through an area (open, many)
<ul style="list-style-type: none">• Deny Access into/out of an area to individuals (confined, single/few/ many)• Deny Access into/out of an area to individuals (open, single/few/ many)	

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Spectrum of Response

“NLWs Provide Operating Forces Needed Capabilities”

“Increasing RANGE increases OPTIONS”

Target selected individuals

Clear personnel

Control group movements

Secure without Destroying

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DoD NLW Deployment Timeline

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Near-Term Technology Solutions

Counter-Personnel Capabilities Suppress, Move, & Deny Individuals

Optical Distractors &
Acoustics

Commercial Off-the-Shelf Human Electro-
muscular Incapacitation Devices

Advanced Materials for Non-
lethal Projectiles

Counter-Materiel Capabilities

Stop Vehicles, Stop Vessels, & Deny Access to a Facility

Electrical Vehicle Stopping

Entanglement Devices

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Mid-Term Technology Solutions

Counter-Personnel Capabilities

Suppress, Move, Deny & Disable Individuals

Long Range Human
Electro-Muscular
Incapacitation

Sheet Beam Klystron

Active Denial
Technologies

Counter-Swimmer
Human Effects

Malodorants

Counter-Materiel Capabilities

Stop/Disable Vehicles, Stop/Disable Vessels, Stop/Disable/Divert Aircraft

Directed Energy Vehicle / Vessel Stoppers

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Far-Term Technology Solutions

Counter-Personnel Capabilities

Suppress, Move, Deny & Disable Individuals

Nanosecond
Electrical Pulses for
LR HEMI

Solid State Arrays

Active Denial
Technologies

NLW Suite T&E

Synergistic NL Effects
Weapons

Ultra Short Pulse Lasers
- Neuro-effects

Ultra Short Pulse
Lasers - Flash,
Acoustics, and
Thermal Effects

Counter-Materiel Capabilities

Stop/Disable Vehicles, Stop/Disable Vessels, Stop/Disable/Divert Aircraft

Long Range DEW Vehicle / Vessel Stoppers

Counter Aircraft Capabilities

Ultra Short Pulse Lasers -
Counter-Sensor

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Non-Lethal Weapons Overall Challenges

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Human Effects & Effectiveness

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Summary

- NLWs provide warfighters with escalation-of-force options while minimizing casualties and collateral damage
- The need for non-lethal weapons continues to be relevant in today's national security environment, both domestically and abroad
- For the last 13 years, the DoD NLW Executive Agent has been successful in coordinating the Department's non-lethal weapons program
- There are a number of promising technologies, particularly in directed energy, that have the potential to greatly advanced today's non-lethal weapons capabilities

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Backup Slides

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NLW Human Effects Characterization

- Generally, the goal of lethal weapons has been to maximize a single effect
 - lethality, while meeting the constraints of LOAC, logistics, cost, etc
- For NLW, two competing objectives exist: cause a desired effect, while minimizing permanent injuries or fatalities
- Understanding human effects is critical for legal/treaty reviews, policy acceptability, and warfighter awareness

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Effects Based Design

JNLWP Human Effects Processes

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Current Cross Agency & JNLWP Collaborative Projects

- Department of Homeland Security (USCG is a voting JNLWP member)
 - Small Vessel Stopping (CM) (RF and Propeller Entanglement)
 - Science of Entanglement
 - RF Vehicle Stopping
 - Optical Interruption
 - HEMI H/W and HEMI Bio-Effects
- Department of Justice (NIJ, BoP, FBI)
 - Thermal Laser
 - HEMI Bio-Effects
 - ADT
 - Vehicle Stopping
- Department of State
 - ADT
- Department of Energy
 - Rigid Foam (CP and CM)
- National Guard Bureau
 - NL Blunt Impact munitions
 - NL Acoustics and Dazzlers
 - HEMI H/W
- Defense Threat Reduction Agency (DTRA)
 - ADS
 - Counter-Swimmer
 - Vehicle/Vessel Stopping
- Technical Support Working Group (TSWG)
 - Vehicle Stopping

Mutual Top-5 Capability-Gaps:

- Vehicle Stopping
- Vessel Stopping
- HEMI
- Active Denial Technologies (ADT)
- Optical Interruption & Acoustics

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DoD 5000 Framework & the JNLWP

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