

## **PREFACE**

*“The vastness of return is illustrated by the fact that the total cost of all basic research, from Archimedes to the present, is less than the value of ten days of the world’s present production.”*

*Victor Weisskopf, Physics Today August 1969*

## **Background**

Inaugurated in 1957, the Army Science Conference (ASC) biennial event is the Army’s premier professional forum for the science and technology (S&T) community to discuss the latest developments and emerging technologies and their impact on the current and future force. The ASC provides a unique opportunity for members of the S&T community to exchange and leverage ideas across all the scientific and engineering disciplines that are relevant to the Army’s mission. In addition, the conference publicly recognizes scientists and engineers who have distinguished themselves through proven scientific and technical excellence as exemplified in the work they perform for the Army.

This volume contains the seventy-five papers presented at the 24<sup>th</sup> Army Science Conference which was held on November 29 – December 2, 2004 in Orlando, Florida under the sponsorship of the Assistant Secretary of the Army for Acquisition, Logistics and Technology. Original scientific and technical papers written by scientists and engineers from the U.S. government, industry, academia, and allied and coalition partners were presented at the conference. Keynote speakers, exhibits and posters presentations focused on the conference theme, *“Transformational Science and Technology for the Current and Future Force,”* emphasizing the critical role of S&T in enabling Army Transformation and helping to win the global war on terrorism.

This was the second ASC that accepted papers relevant to the Army mission from industry, academia and other government organizations, and the first that accepted papers from allied and coalition partners. More than 1600 people from over 30 different nations attended the conference. The Technical Program Committee reviewed over 800 abstracts and selected the top 290 for either oral or poster presentations. Those selected were also peer reviewed for the ASC Best Paper Awards.

## **Theme of the 24<sup>th</sup> ASC**

The U.S. Department of Defense has embarked on an extraordinary process of change called Transformation – the creation of a highly responsive, networked, joint force capable of making swift decisions at all levels and maintaining overwhelming superiority in any battle space. In support of this

process, the Army is developing the Future Combat System (FCS), a major element of its future force, which will be smaller, lighter, faster, more lethal, and smarter than its predecessor. Transformation will require that the Army make significant reductions in the size and weight of major warfighting systems, at the same time ensuring that U.S. troops have unmatched lethal force and survivability. It also means that the Army and other military services, as well as coalition forces, will be interdependent. "*Transformational Science and Technology for the Current and Future Force*" was selected as the theme for the 24<sup>th</sup> ASC to focus attention on current force needs and the global war on terrorism, as well as the goals and challenges for the future force. Special focus was given to those opportunities that would accelerate future force technologies into current force needs.

## **Keynote Speakers**

Presentations by key Army, industry and academic leaders from both the United States and abroad expounded upon a broad range of transformational initiatives that could enable current and future force needs. In support of the conference theme, among the many highlights of the conference was the keynote address by The Honorable Michael W. Wynne, the Under Secretary of Defense for Acquisition, Technology, and Logistics (Acting). Mr. Wynne spoke about "*Strategic Priorities for Transformation*" and described a road map that contains seven Department of Defense goals for acquisition, technology and logistics.

Additional keynote speakers on the first day of the conference included GEN Richard A. Cody, Vice Chief of Staff of the Army, who discussed "*Army Transformation for Full Spectrum Operations*"; the conference host, The Honorable Claude M. Bolton Jr., Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA(ALT)) who provided a presentation on "*Current and Future Force Acquisition Strategies*", and GEN Benjamin S. Griffin, Commanding General, U.S. Army Materiel Command, who spoke on "*Accelerating the Pace of Army Transformation Through S&T.*" Mr. Dean Popp, the Principal Deputy Assistant Secretary of the Army for Acquisition, Logistics and Technology, introduced Mr. Bolton and remained to provide an update on ongoing rebuilding and construction activities in Iraq, from where he had recently returned.

Mr. Mike Markin, Officer of the Order of the British Empire and United Kingdom Ministry of Defense Science and Technology Director, provided an international perspective to the conference. Mr. Jim Albaugh, President and CEO, Boeing Integrated Defense Systems, The Boeing Company, discussed industry's role in providing transformational technology to the 21<sup>st</sup> Century warfighter. The first day's speeches concluded with presentations by Dr. Thomas H. Killion Deputy Assistant Secretary of the Army for Research and Technology/Chief Scientist on "*Creating Future S&T for our Soldiers,*" and a

visionary address by Dr. Ray Kurzweil, founder and Chief Executive Officer of Kurzweil Technologies, Inc. on “*Warfighting in the 21<sup>st</sup> Century – The Remote, Robotic, Robust, Size-Reduced, Virtual Reality Paradigm.*” Dr. Kurzweil provided an extraordinary vision of the future out to the year 2050 largely dominated by paradigm shifts coming about through genetics, nanotechnology and robotics.

The second day focused on Network Centric Warfare and the enabling technologies and began with a keynote speech by Dr. Edward M. Siomacco, Director of Technology, Office of the Army Chief Information Officer, G-6. Dr. Siomacco spoke on “*Network Centric Warfare as a Transformational Paradigm*” and provided an insightful perspective on the future of this important area for Army transformation and operational support domains. The luncheon speaker for the second day was Professor P. C. Lui, Chief Defense Scientist, Singapore Ministry of Defense. Professor Lui emphasized the need to prepare both warriors and engineers for the future force and described Singapore’s strategy for attracting and retaining the best and brightest college graduates for military and civil service.

The third day began with a keynote address by LTG Joseph Yakovac, Jr., Military Deputy and Director/Army Acquisition Corps, ASA(ALT). He addressed the challenges in achieving survivability for light-combat systems and how this requires a radical change in our approach to survivability. The luncheon speaker was COL(P) Mark Graham, Assistant Commandant, USA Field Artillery Center and Deputy Commanding General, U.S. Army Field Artillery Center and Ft. Sill. COL Graham spoke on “*The New Frontier of Training and Simulation*” and Ft. Sill’s experience with the Institute of Creative Technologies (ICT) Joint Fires and Effects Training System (JFETS) prototype.

The fourth day began with a presentation by Professor Neil Gershenfeld, Director of the Center for Bits and Atoms, MIT, who gave a captivating presentation on a new approach to deriving communication protocols for complex networks, his laboratory’s studies on fundamental mechanisms for manipulating information, and how he and his colleagues integrate these ideas into everyday objects, such as furniture (seen in New York’s Museum of Art and used in automobile safety systems). The speaker for the awards luncheon was Dr. Alan Heeger, Nobel Laureate, University of California at Santa Barbara. He gave a most entertaining talk on “*Risk and Innovation in Science - A Personal History,*” and described how winning the Nobel Prize for Chemistry has affected his life and influenced the work of both he and his colleagues.

The highlight of the fourth day and of the conference was the 24<sup>th</sup> ASC Awards Banquet. Dr. Daniel Schacter, Professor of Psychology, Harvard University, was the guest speaker at the banquet. He gave a presentation on “*The Seven Sins of Memory – A Cognitive Neuroscience Perspective*” that demonstrated how one’s memory could be easily fooled. Awards that day were bestowed to the 2003 and 2004 Research and Development Achievement Award

winners. Also presented that day were the 24<sup>th</sup> Army Science Conference Best Paper Awards to the authors of the 15 technical papers that were peer reviewed and considered to be most significant in quality and relevance to both the fields of investigation and to the Army.

### **Topical Panels and Parallel Sessions**

Discussions by Topical Panels were held for the entire conference audience in the areas of Commander-Centric Warfare, Network Science, Force Protection, Logistics, Training and Simulation, Miniaturization, and Complexity. In addition, conferees could choose to attend any of 15 parallel sessions in their areas of interest. These were: Sensors and Information Processing, IT/C4ISR, Advanced Computing and Simulation, Power and Energy, Microelectronics and Photonics Technology, Lethality Technologies, Unmanned Systems, Force Protection/Survivability, Immersive Technology, Behavioral Sciences and Human Performance, Advanced Materials and Manufacturing Technology, Biomedical Technologies, Biotechnology, Nanotechnology, and Environmental and Engineering Geosciences.

### **New Initiatives**

A new initiative incorporated into the 24<sup>th</sup> ASC was the participation of several Junior Science and Humanities Symposium (JSHS) winners who presented their papers in appropriate technical sessions. The following JSHS winners presented their papers: Mr. Andrew Clare, "*Sonic Boom Prediction: A New Empirical Formulation and Animated Graphical Model*"; Ms. Alia Whitney Johnson, "*Responses to Global Warming in *Pieris rapae* (Lepidoptera): Consequences of Increased Nocturnal Temperature on Fitness Components*"; and Mr. Seth Flaxman, "*Heat Conduction in a Body Subject to an Oscillating Heat Source.*" Numerous people commented on the outstanding quality of these JSHS presentations. Mr. Clare's technical paper appears in this book.

In addition, a group of students who participated in the Army's annual eCYBERMISSION competition were recognized during the opening ceremonies of the conference. It is hoped that exposing these young adults to the needs and technical challenges of the Army will motivate them to continue their pursuits in science, mathematics and engineering.

### **Conclusion**

Remarks from conference attendees indicated an overwhelming consensus that the 24<sup>th</sup> ASC was one of the best ever and that the breadth of the speakers and subject matter was a significant characteristic of the conference. It enabled the Army to showcase major research, technologies and systems relevant to the current and future force and its efforts to win the global war on terrorism.

*"We need reminding, now more than ever, that the capacity of medicine to deal with infectious disease was not a lucky fluke, nor was it something that happened simply as a result of the passage of time. It was the direct outcome of many years of hard work, done by imaginative and skilled scientists, none of whom had the faintest idea that penicillin and streptomycin lay somewhere in the decades ahead. It was basic science of a very high order, storing up a great mass of interesting knowledge for its own sake, creating, so to speak, a bank of information, ready for drawing on when the time for intelligent use arrived"...Dr. Lewis Thomas, medical doctor and researcher.*

Thomas H. Killion  
Deputy Assistant Secretary of the Army  
(Research and Technology)/  
Chief Scientist