



S&T IN-DEPTH

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH LITERATURE

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TECHNICAL ARTICLES

Feature topic – Sensors

Selected Conferences

- IEEE Sensors - 2012
28 Oct - 31 Oct 2012, Taipei, Taiwan
Sponsor: IEEE
- MSS Electro-Optical & Infrared Countermeasures - 2012
01 May 2012 - 03 May 2012, Laurel, MD
Sponsor: SENSIAC
- Optical Sensors (SENSORS)
24 June - 28 June 2012, Monterey, CA
Sponsor: Optical Society of America
- SPIE Defense, Security, and Sensing 2012
Apr 23, 2012 - Fri, Apr 27, 2012, Baltimore, MD
Sponsor: SPIE

Selected Journals

- Applied Optics (OSA)
- IEEE Sensors journal
- Journal of Applied Remote Sensing

Selected Organizations

- Optical Society of America
- SENSIAC
- SPIE

Articles

History highlights and future trends of infrared sensors (Italy)

Corsi, C.

Source: Journal of Modern Optics Volume: 57 Issue: 18 Pages: 1663-86 2010 DOI: 10.1080/09500341003693011

ABSTRACT: Infrared (IR) technologies (materials, devices and systems) represent an area of excellence in science and technology and, even if they have been generally confined to a selected scientific community, they have achieved technological and scientific highlights constituting 'innovation drivers' for neighbouring disciplines, especially in the sensors field. The development of IR sensors, initially linked to astronomical observations, since World War II and for many years has been fostered essentially by defence applications, particularly thermo-vision and, later on, smart vision and detection, for surveillance and warning. Only in the last few decades, the impact of silicon technology has changed the development of IR detectors dramatically, with the advent of integrated signal read-outs and the opening of civilian markets (EO communications, biomedical, environmental, transport and energy applications). The history of infrared sensors contains examples of real breakthroughs, particularly true in the case of focal plane arrays that first appeared in the late 1970s, when the superiority of bi-dimensional arrays for most applications pushed the development of technologies providing the highest number of pixels. An impressive impulse was given to the development of FPA arrays by integration with charge coupled devices (CCD), with strong competition from different technologies (high-efficiency photon sensors, Schottky diodes, multi-quantum wells and, later on, room temperature microbolometers/cantilevers). This breakthrough allowed the development of high performance IR systems of small size, light weight and low cost - and therefore suitable for civil applications - thanks to the elimination of the mechanical scanning system and the progressive reduction of cooling requirements (up to the advent of microbolometers, capable of working at room temperature). In particular, the elimination of cryogenic cooling allowed the development and commercialisation of IR Smart Sensors; strategic components for important areas like transport, environment, territory control and security. Infrared history is showing oscillations and variations in raw materials, technology processes and in device design and characteristics. Various technologies oscillating between the two main detection techniques (photon and bolometer effects) have been developed and evaluated as the best ones, depending on the system use as well as expectable performances. Analysis of the 'waving change' in the history of IR sensor technologies is given with the fundamental theory of the various approaches. Highlights of the main historical IR developments and their impact and use in civil and military applications is shown and correlated with the leading technology of silicon microelectronics: scientific and economic comparisons are given and emerging technologies and forecasting of future developments are outlined.

Number of References: 69

Providing OS Support for Wireless Sensor Networks: Challenges and Approaches (China)

Wei Dong; Chun Chen; Xue Liu; Jiajun Bu

Source: IEEE Communications Surveys & Tutorials Volume: 12 Issue: 4 Pages: 519-30 Published: Fourth Quarter 2010 DOI: 10.1109/SURV.2010.032610.00045

ABSTRACT: Recently, wireless sensor networks (WSNs) attract a great deal of research attention, and are envisioned to support a variety of applications, including military surveillance, habitat monitoring, and infrastructure protection, etc. Operating system (OS) support for WSNs plays a central role in building scalable distributed applications that are efficient and reliable. Over the years, we have seen a variety of OSes emerging in the sensornet community to facilitate developing WSN applications. Aside from the basic system implementations, there is also a large body of work devoted to improving OS capabilities in different dimensions. In this paper, we provide a comprehensive review of existing work in sensornet OS design. We first examine the challenges in the OS design space. We then introduce the major components of a sensornet OS. Next, we provide an overview of existing work, present a taxonomy of state-of-the-art OSes, and discuss various approaches to address the design challenges. Finally we discuss evaluations of a sensornet OS and present some recommendations from the perspectives of OS developers and OS users. We have also identified several open problems that need further investigation to make the OS provide stronger support for WSNs.

Number of References: 86

Study on Wireless Sensor Networks (China)

Tian Jing; Yi Shengwei; Yu Bing; Ma Shilong

Source: Proceedings 2010 International Conference on Intelligent System Design and Engineering Application (ISDEA 2010) Pages: (vol.2) 510-21 Published: Oct. 2010 DOI: 10.1109/ISDEA.2010.392

ABSTRACT: Constant advances in Micro Electro-Mechanical System (MEMS) technology promote miniaturization, low-cost and energy-efficiency of smart sensors. Meanwhile, Wireless Sensor Networks (WSNs) emerge as a collaborative network composed of such numerous sensors via wireless communication integrated. WSNs have a wide range of applications in the physical world, such as military surveillance, target tracking, healthcare etc. This paper illustrates a comprehensive study we contribute to in overviews, design ingredients, protocol architecture, the current research focus and the development status for WSNs with a contemporary view.

Number of References: 55

Uncooled infrared sensor technology for hostile fire indication systems (Israel)

Nadav, S.; Brodetzki, G.; Danino, M.; Zahler, M.

Source: Optical Engineering Volume: 50 Issue: 6 Pages: 061012 (12 pp.) Published: June 2011 DOI: 10.1117/1.3583567

ABSTRACT: An evolving combat arena poses an ever-growing hostile fire threat for various ground and airborne targets. Protecting both static posts and moving military platforms against these threats require high performance and affordable solutions, favoring uncooled sensing alert technologies. By analyzing accumulated target and clutter data using new algorithmic and hardware building blocks we establish improved hostile fire indication system configurations. The paper will review new system demonstrations harnessing uncooled IR sensors technology alongside empirical field testing results.

Number of References: 22

Broad-spectrum therapeutics

Broad-Spectrum Antiviral Therapeutics (USA)

Todd H Rider, Christina E Zook, Tara L Boettcher, Scott T Wick, Jennifer S Pancoast, Benjamin D Zusman

Source: PLoS ONE 6(7): e22572. doi:10.1371/journal.pone.0022572

ABSTRACT: Currently there are relatively few antiviral therapeutics, and most which do exist are highly pathogen-specific or have other disadvantages. We have developed a new broad-spectrum antiviral approach, dubbed Double-stranded RNA (dsRNA) Activated Caspase Oligomerizer (DRACO) that selectively induces apoptosis in cells containing viral dsRNA, rapidly killing infected cells without harming uninfected cells. We have created DRACOs and shown that they are nontoxic in 11 mammalian cell types and effective against 15 different viruses, including dengue flavivirus, Amapari and Tacaribe arenaviruses, Guama bunyavirus, and H1N1 influenza. We have also demonstrated that DRACOs can rescue mice challenged with H1N1 influenza. DRACOs have the potential to be effective therapeutics or prophylactics for numerous clinical and priority viruses, due to the broad-spectrum sensitivity of the dsRNA detection domain, the potent activity of the apoptosis induction domain, and the novel direct linkage between the two which viruses have never encountered.

[Full Text](#)

Development of a broad-spectrum antiviral with activity against Ebola virus

M Javad Aman, Michael S Kinch, Kelly Warfield, Travis Warren, Abdul Yunus, Sven Enterlein, et al.

Source: Antiviral Research 83, 245-251 (2009)

ABSTRACT: We report herein the identification of a small molecule therapeutic, FGI-106, which displays potent and broad-spectrum inhibition of lethal viral hemorrhagic fevers pathogens, including Ebola, Rift Valley and Dengue Fever viruses, in cell-based assays. Using mouse models of Ebola virus, we further demonstrate that FGI-106 can protect animals from an otherwise lethal infection when used either in a prophylactic or therapeutic setting. A single treatment, administered 1 day after infection, is sufficient to protect animals from lethal Ebola virus challenge. Cell-based assays also identified inhibitory activity against divergent virus families, which supports a hypothesis that FGI-106 interferes with a common pathway utilized by different viruses. These findings suggest FGI-106 may provide an opportunity for targeting viral diseases.

Function and therapeutic potential of host defence peptides (Canada)

McPhee, J.B.; Hancock, R.E.W.

Source: Journal of Peptide Science Volume: 11 Issue: 11 Pages: 677-87 Published: Nov. 2005 DOI: 10.1002/psc.704

ABSTRACT: Cationic host defence (antimicrobial) peptides are an important component of the innate immune systems of a wide variety of plants, animals, and bacteria. Although most of these compounds have direct antimicrobial activities under specific conditions, a greater appreciation for the diversity of functions of these molecules is beginning to develop in the field. In addition to their directly antimicrobial activities, they also have a broad spectrum of activity on the host immune

system, with both pro-inflammatory and anti-inflammatory effects being invoked. Increasingly sophisticated approaches to understand the role of host defence peptides in modulating innate immunity are already serving to guide the development of novel therapeutics

Author Address: McPhee, J.B.; Hancock, R.E.W.; Dept. of Microbiol. & Immunology, British Columbia Univ., Vancouver, BC, Canada.

Number of References: 79

Steps toward broad-spectrum therapeutics: discovering virulence-associated genes present in diverse human pathogens (USA)

Chris J Stubben, Melanie L Duffield, Ian A Cooper, Donna C Ford, Jason D Gans, Andrey V Karlyshev, et al.

Source: BMC Genomics 2009, 10:501 doi:10.1186/1471-2164-10-501

ABSTRACT: New and improved antimicrobial countermeasures are urgently needed to counteract increased resistance to existing antimicrobial treatments and to combat currently untreatable or new emerging infectious diseases. We demonstrate that computational comparative genomics, together with experimental screening, can identify potential generic (i.e., conserved across multiple pathogen species) and novel virulence-associated genes that may serve as targets for broad-spectrum countermeasures. Results: Using phylogenetic profiles of protein clusters from completed microbial genome sequences, we identified seventeen protein candidates that are common to diverse human pathogens and absent or uncommon in non-pathogens. Mutants of 13 of these candidates were successfully generated in *Yersinia pseudotuberculosis* and the potential role of the proteins in virulence was assayed in an animal model. Six candidate proteins are suggested to be involved in the virulence of *Y. pseudotuberculosis*, none of which have previously been implicated in the virulence of *Y. pseudotuberculosis* and three have no record of involvement in the virulence of any bacteria. Conclusion: This work demonstrates a strategy for the identification of potential virulence factors that are conserved across a number of human pathogenic bacterial species, confirming the usefulness of this tool. [FULL TEXT](#)

Human performance enhancement

Brain Performance Enhancement for Military Operators (EU)

Jan B.F. van Erp, et al.

Source: Web

ABSTRACT: Performance of military operators depends on both physical and cognitive aspects. Enhancement of operator performance should therefore address both the body and the brain. This paper focuses on the latter. We provide an extended list of areas where neuroscientific knowledge may be important like training and mental healthcare. We zoom-in on the relevance of neuroergonomics and Brain Machine Interfaces (BMIs) and present recent data from our lab. Up till today, the majority of applied neuroscience research is aimed at assisting people with medical limitations, and not at performance enhancement for healthy users. Knowledge transfer from patient orientated applications to military brain performance enhancement offers major opportunities, for example in the design and evaluation of new systems. We foresee that the first applications of BMIs will be available for workstation operators in high risk environments. Future research should be focussed on three transitions: 1) from clinical and patient apparatus to applications and equipment for healthy users, 2) from lab (or controlled) environments to the field, and 3) from fundamental knowledge to operational applications.

[FULL TEXT](#)

Number of References: 41

Human Performance (USA)

Source: JASONS JSR-07-625, March 2008

ABSTRACT: The tasking for this study was to evaluate the potential for adversaries to exploit advances in Human Performance Modification, and thus create a threat to national security. In making this assessment, we were asked to evaluate long-term scenarios. We have thus considered the present state of the art in pharmaceutical intervention in cognition and in brain-computer interfaces, and considered how possible future developments might proceed and be used by adversaries. [FULL TEXT](#)

Number of References: 0

More than 50 years of history and accomplishments in human performance model development (USA)

Pew, Richard W.

Source: *Human Factors*, v 50, n 3, p 489-496, June 2008

ABSTRACT: I provide a summary that introduces three significant threads in the development of human performance models (HPMs) - manual control models derived from engineering control theory, network models founded on the definition of human reliability, and models derived from cognitive architectures. Background: HPMs are important because they allow the quantification of human performance capacities and limitations to be included in the analysis and simulation of engineering systems. Method: For each thread, founding articles and contemporary developments are cited that illustrate the range of innovation that has taken place. Results: Many contemporary concepts are rooted in this modeling history. Conclusion: The most successful models represent circumstances for which the situational and temporal environment in which the human performance takes place is most heavily constrained. Application: Applied illustrations are drawn from vehicle handling qualities, unmanned aerial systems, and mission training, for example. Copyright © 2008, Human Factors and Ergonomics Society.

Number of References: 42

Human performance research in support of current military operations (USA)

Savage-Knepshield, Pamela; Davison, Alan; Harper, William; Morelli, Frank; Redden, Elizabeth; Vaughan, Barry, ARL
Source: *Proceedings of the Human Factors and Ergonomics Society*, p 1255-1259, 2011, DOI: 10.1177/1071181311551261;

ABSTRACT: Shoot, move, communicate, survive, and adapt are five of the most critical tasks that a Soldier will perform during combat. The extent to which Soldiers are successful at these tasks may ultimately determine not only their survivability, but also that of their unit. This panel, which is comprised of a mixture of human factors/ergonomics practitioners and researchers, discusses topic areas in which human performance issues play a critical role in current military operations. Topics include information overload in the visual channel, facial protection effects on shooting performance, video search techniques for widely defined targets, and the development of video training lanes for improvised explosive device detection. The underlying human performance issues and various approaches which have been taken to address them will be discussed. Understanding and predicting factors that influence human performance in these arenas is not only critical for the design of effective systems and programs of instruction, but also for overall mission effectiveness and Soldier survival. Panelists will discuss critical factors and insights that are generalizable across a wide range of products and industry sectors as well as those that warrant further investigation. Not subject to U.S. copyright restrictions.

Number of References: 14

Lightweight materials

Ballistic Resistant Body Armor: Contemporary and Prospective Materials and Related Protection Mechanisms (USA)

N V David, X L Gao, J Q Zheng

Source: *Applied Mechanics Reviews* (2009) Volume: 62, Issue: 5, Publisher: ASME, Pages: 050802 DOI: 10.1115/1.3124644

ABSTRACT: Modern military operations, technology-driven war tactics, and current on-street weapons and ammunition necessitate the development of advanced ballistic protection body armor systems that are damage-resistant, flexible, lightweight, and of great energy absorbing capacity. A number of studies related to new concepts and designs of body armor materials (including those derived from or inspired by nature) have been conducted in the past two decades to meet the new demands. Ballistic fabrics, ceramics, and laminated composites are among the leading materials used in modern body armor designs, and nano-particle and natural fiber filled composites are candidate materials for new-generation body armor systems. Properties and ballistic resistance mechanisms of such materials have been extensively investigated. Based on a comprehensive and critical review of the advances and findings resulting from these investigations, a comparative study on design, protection mechanisms, and performance evaluation of various types of anti-ballistic body armor is presented in this paper. Body armor systems made from different materials and exhibiting distinct ballistic energy absorption mechanisms are discussed, and key factors that influence the ballistic performance and energy absorbing mechanisms of the body armor systems are identified.

Number of references: 147

Lightweight ballistic protection materials (USA)

Robert R. Gagne

Source: US Patent application 20120052222, March 1, 2012

ABSTRACT: A class of lightweight ballistic protection material and methods of forming such materials are disclosed. The material comprises a composite of polymeric material comprising high modulus resins and ceramic materials. The composite materials offer the advantage of being relatively easy to fabricate and lower in cost than competing materials. Body armor, blast protection panels and other articles comprising the new ballistic protection materials are also disclosed.

[FULL TEXT](#)

Novel hydrogen storage materials: A review of lightweight complex hydrides (India)

Jain, I.P. ; Jain, P.; Jain, A.

Source: Journal of Alloys and Compounds, v 503, n 2, 303-39, 6 Aug. 2010; ISSN: 0925-8388; DOI: 10.1016/j.jallcom.2010.04.250

ABSTRACT: The world is facing energy shortage and has become increasingly depending on new methods to store and convert energy for new, environmentally friendly methods of transportation and electrical energy generation as well as for portable electronics. Mobility - the transport of people and goods - is a socioeconomic reality that will surely increase in the coming years. Non-renewable fossil fuels are projected to decline sharply after 20-30 years. CO₂ emission from burning such fuels is the main cause for global warming. Currently whole world is seeking international commitment to cut emissions of greenhouse gases by 60% by 2050. Hydrogen which can be produced with little or no harmful emissions has been projected as a long term solution for a secure energy future. Increasing application of hydrogen energy is the only way forward to meet the objectives of Department of Energy (DOE), USA, i.e. reducing green house gases, increasing energy security and strengthening the developing countries economy. Any transition from a carbon-based/fossil fuel energy system to a hydrogen based economy involves overcoming significant scientific, technological and socio-economic barriers before ultimate implementation of hydrogen as the clean energy source of the future. Lot of research is going on in the world to find commercially viable solutions for hydrogen production, storage, and utilization, but hydrogen storage is very challenging, as application part of hydrogen energy totally depend on this. During early nineties and now also hydrogen storage as gas, liquid and metal hydride has been undertaken to solve the problem of hydrogen storage and transportation for the utilization as hydrogen energy, but none of these roots could became commercially viable along with the safety aspects for gas and liquid. With the result many new novel materials appeared involving different principles resulting in a fairly complex situation with no correlation between any two materials. In the present review article the fundamental understanding of the physical, chemical and structural properties of light weight hydride materials, e.g. Alanates, Borohydrides, Amide Borohydrides, Amide-Imide system, Amineborane and Alane for hydrogen storage has been presented. Lot of details of these materials has been incorporated such as synthesis, crystal structure, thermodynamics and kinetics of hydrogenation-dehydrogenation processes, reversibility and hydrogen storage capacity has been presented. [All rights reserved Elsevier].

Number of references: 372

Shock enhancement effect of lightweight composite structures and materials (USA)

Feng Zhu ; Chou, C.C. 1 Yang, K.H

Source: Composites Part B: Engineering, v 42, n 5, 1202-11, July 2011; ISSN: 1359-8368; DOI: 10.1016/j.compositesb.2011.02.014;

ABSTRACT: Polymeric foams, textile materials and metallic foams are commonly used lightweight composite structures and materials for personal protective equipment (PPE) and protective structures in the battle field, because of their capabilities in reducing the risk of damages against ballistic impact. Under blast loading, however, a "shock enhancement" phenomenon has been observed in these materials, that is, the transmitted pressure is amplified, rather than attenuated as one would expect. Experimental evidences also demonstrated that covering animals with a layer of foam or textile could markedly increase the severity of lung injury. A number of studies have been published documenting such counter-intuitive effect. This review attempts to compile the state-of-arts and latest advances in this important subject. Experimental investigations on the pressure amplification of the aforementioned materials are summarized. Analytical/computational models that describe this phenomenon, particularly emphasizing on the mechanism and some key parameters affecting shock enhancement behavior, are also included. Finally, limitations of studies reviewed herein are discussed and issues which need to be addressed in further research are highlighted. [All rights reserved Elsevier].

Number of references: 63 ■

ABOUT THIS PUBLICATION

The **S&T IN-DEPTH BULLETIN** is a compilation of selected recent technical articles on emerging fields in science and technology which may have long or short term implication for national security. Articles are selected from peer-reviewed journals and focus on providing a more detailed insight to the R&E community. Providing a comprehensive bibliography is beyond the scope of this publication. Each month we will feature a topic and provide abstracts from the most timely and relevant review articles. Full articles may be requested via the Pentagon library or via your local Command's library. Personnel assigned to the Pentagon may request articles from John Mills at john.mills@whs.mil.

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