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# ***Technologies for Optical Countermeasures X; and High-Power Lasers 2013: Technology and Systems***

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**Hans Dieter Tholl**, Diehl BGT Defence GmbH & Co. KG (Germany)
  - 3 Two Micron  
**Ian F. Elder**, SELEX ES Ltd. (United Kingdom)
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  - 6 Laser Effects  
**David H. Titterton**, Defence Science and Technology Laboratory (United Kingdom)
  - 7 Threat Detection and Discrimination  
**Markus Henriksson**, Swedish Defence Research Agency (Sweden)

## **Part B: High-Power Lasers 2013: Technology and Systems**

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**Willy L. Bohn**, BohnLaser Consult (Germany)

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**Salman Rosenwaks**, Ben-Gurion University of the Negev (Israel)
- 11 Laser-Induced Plasma Effects  
**Andrey A. Ionin**, P.N. Lebedev Physical Institute (Russian Federation)

## **Introduction to Part A: Technologies for Optical Countermeasures X**

The purpose of this conference was to provide a technical forum for attendees to gain an increased awareness of the recent developments in optical countermeasure techniques and technologies for security and defence applications. Optical countermeasure techniques have been used for thousands of years to provide a force multiplier on the battlefield and current operations continue to exploit this remarkable technology. The use of optical techniques is attractive, as they frequently offer a simple and cost-effective method of defence, especially for protecting a range of platforms. Optical methods used for alternative security applications have been discussed in the past and in other conferences during this symposium.

The development of laser technology and its use in laser-based systems has offered dramatic changes to all aspects of warfare, but other more traditional, and usually cheaper, optical technologies have also proved to be invaluable. This conference offered the opportunity to consider the impact of laser technology, and other optical techniques, on a range of operations on the battlefield, as well as for other applications. Moreover, this symposium brought together the optical community at large and enabled a discussion of novel applications of emerging techniques and technologies. Optical devices and technologies are often "dual-use" technologies, as they may be used in medicine, manufacture and detection and identification of illegal items; some of these applications were discussed at other conferences held at this symposium.

Following a keynote speaker session considering state-of-the-art sources for a range of optical countermeasures, there was a significant and very enlightening session on quantum-cascade and high-power diode laser technologies, which offer many potential advantages for countermeasure applications. Laser technology has enabled very robust defeat mechanisms to be established, so that heat-seeking missile threats can be defeated rapidly, leading to enhanced platform protection. The invited paper gave an excellent overview of the "fibre-technology" status and the supporting papers provided very good details of the techniques being applied to fibre-based laser sources.

The theme of the third session was "two micron" solid-state laser technology, which gave an insight into the progress with the development of relatively novel techniques including super-continuum generation in this very important part of the spectrum. This session also had a paper describing the technological developments of 1.6 micron devices.

There was a panel discussion considering the merits of closed-loop IRCM techniques and the perceived challenges. This was a well-attended session and produced a number of interesting debates. This technique is seen as the "holy grail" for robust countermeasure techniques, but is still very demanding technically.

The session on low-loss mid IR optical fibres opened with an outstanding review of the recent progress in the technology base and the current state-of-the-art for this critical part of the spectrum. The other invited talk in this session covered the theoretical consideration of effective super-continuum generation. The contributed paper provided a most valuable insight into the recent advances in tellurite optical fibres.

Mathematical modelling and simulation techniques provide an important tool in the definition of countermeasure approaches, enabling promising techniques to be defined for further rigorous investigation and validation in the laboratory and during field trials. The topics covered in this session included consideration of the impact of zones of extreme optical turbulence on the beam propagation characteristics and the estimate of optical transmission in the ultra-violet part of the spectrum, which is of increasing interest to countermeasure engineers.

The laser effects session was extremely well attended and the audience were provided with three outstanding papers covering laser dazzle techniques and effects. This session covered devices and the impact on potential adversaries attacking check points.

The final session, which was also well attended, covered the topics of threat detection and discrimination. The papers discussed detection of dim targets in "multiple environments", including hostile fire detection, target discrimination using optical methods and optical countermeasures against command to line-of-sight guidance.

We were very pleased to receive papers from nine nations, making it a truly international conference, which gave a strong indication of the united approach to enhancing all aspects of security and defence across the USA and Europe. We wish to thank our programme committee members for encouraging a range of interesting and relevant papers from the presenters. Moreover, we are very grateful to all of the authors for the very interesting papers they presented, which were of a very high standard enabling this to be an excellent conference. Finally, our thanks go to the session chairmen who ran the whole conference extremely well.

**David H Titterton  
Mark A. Richardson  
Robert J. Grasso**

## **Introduction to Part B: High Power Lasers 2013: Technology and Systems**

This was the second high-power laser conference and although the attendance to this conference was lower than last year the quality of the papers was still high and very innovative. In addition, intensive discussions and exchange of ideas took place among the experts in all sessions of the conference. It provided an excellent forum for attendees, specialists and newcomers, in the areas of lasers demonstrations and systems, fiber and semiconductor lasers and advanced gas lasers.

The first invited paper of the Demonstrations and Systems session was a highlight of the achievements in fiber based laser weapon systems in Europe and was also presented in the Security + Defense plenary session. This paper provided a most valuable insight into the development of a laser directed-energy weapon system and its potential value as a novel weapon system. For disk lasers, advances in high power lasers were presented, with special emphasis on the world record for fundamental mode operation. This was followed by a progress report on "eye-safe" laser technology, addressing an erbium Heat Capacity laser in the multi-kW range.

The Fiber and Semiconductor Laser Technology session was dominated by the outstanding advances in high power 2 $\mu$ m fiber technology. The specific advantages of thulium and holmium-doped materials were highlighted and impressively demonstrated in numerous experiments. Hereby the narrow band capability is of primary importance for further scaling using laser coupling technologies.

The session on Advanced Gas Lasers was exclusively devoted to the diode pumped alkali laser (DPAL). Since waste heat removal is the major issue of all high power lasers a supersonic gas flow concept was presented and discussed with detailed simulation support. This may lead the way to further power scaling of this laser scheme.

Finally, an excellent overview was given in laser-induced breakdown of optical coatings followed by a state-of-the-art review of plasma channel generation and filamentation control.

All of the sessions were well attended, and as indicated above, the discussion was most valuable. These discussions provided an invaluable insight into the way the high-power source technology is evolving and being applied to meet military capability requirements.

This conference was particularly “badly hit” by the current fiscal constraints and consequently many papers were withdrawn prior to the start of the conference. Despite this impediment, this was still a viable conference.

**Harro Ackermann**  
**Willy L. Bohn**