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Display Technologies and Applications for Defense, Security, and Avionics VII

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Introduction

This year's conference was a success despite the government sequester and despite a number of related and un-related cancellations. For one thing, we enjoyed a maximum room count of some 42 attendees and an average count of 30.5, slightly better than the overall, average DSS13 conference room count of 29.4. We were well within the 10 – 15% down-turn experienced by the symposium as a whole. And whereas we went from 20 abstracts to only 11 presented papers, those papers covered a diversity of topics - ranging from display ergonomics to information management - were of high quality and great interest to our audience.

Thanks to the continuing breadth of our conference committee members from both industry and government, we were privileged to recieve papers from Esterline Control Systems (USA), Altran S.p.A. and SELEX ES S.p.A. (Italy), HRL Labs (USA), Deutsches Zentrum für Luft-und-Raumfahrt e.V. (Germany), Holoeye Systems (Germany/USA), TrackingPoint, Inc. (USA), Kopin Corp. (USA), BAE Systems (U.K.), and Universidad EAFIT (Columbia). As per last year, our one-day conference, despite the sequester, included 10 papers from industry and one from academia. However, and unfortunately, we lost all five papers from government sources.

Invited paper presentations focused on new research to establish a model for cockpit lighting SWIR radiance limits, the development of an innovative algorithm designed to create panoramic representation of a scene scanned by passive sensors, testing of a collision avoidance display utilizing high-precision navigation, advances in LCOS spatial light modulation. These papers were presented by Esterline Control Systems (USA), SELEX Galileo (Italy), Deutsches Zentrum für Luft- und Raumfahrt (Germany), and HOLOEYE Systems (USA), respectively.

The Display Ergonomics and Human Factors session (Session 1) presented information on a two-year study regarding the impact of adopting digital night vision goggle devices extending capability of light detection beyond the near infra-red to short-wave infra-red (SWIR). The paper discussed the development of a model establishing proposed cockpit lighting SWIR radiance limits. A second paper in this session was an update to an earlier paper presented to SPIE in 2012 regarding efforts towards identifying a metric to establish anti-aliasing sufficiency for stereoscopic displays. Stereoscopic disparity thresholds are dependant on pixel pitch, but the coarseness of the pitch must be chosen with regard to anti-aliasing. The paper provides equations that describe the critical level of anti-aliasing as a function of pixel pitch. Unfortunately, because the original paper was already published in a previous proceedings volume, SPIE has made the decision not to reprint it here. We nevertheless thank the author for helping us fill a gap in our oral presentation agenda.

Display Algorithms and Information Management, a new session theme for our conference, opened with an invited paper discussing development of an innovative algorithm designed to create a planar 360° panoramic representation (on an LCD display) of a scene scanned by passive sensors. It was followed by a paper presenting information regarding a "threat chip display" which facilitates rapid human-in-the-loop detection and analysis of threats in high-bandwidth visual imagery. The work and field testing were part of a Phase 2 and 3 DARPA Cognitive Threat Technology Warning System program. Yet another paper, the last in this session, explored development and test of a display for situational awareness and collision avoidance by foreseeing the hazard zone of a possible intruder. Working in conjunction with the Ohio University Avionics Department, which provided the test aircraft, the authors reported on the principal architecture of the display and initial performance results of the lateral avoidance cueing.

With a view in mind to allow our audience sufficient time to visit the last day of the Exhibitors' Hall, there was an extended lunch period (12:20 – 1:50) before resumption of the afternoon papers. These papers, starting with Session 3, looked at body-worn and man-portable displays, a topic with a long history in our conference. Although Liquid Crystal on Silicon (LCOS) technology had an unfortunate start for large-area displays, its application for miniature displays is progressing and the first paper in this session was an attempt to bring our audience up-to-date on LCOS micro-display advances, to include improved integrated circuit design and liquid crystal materials, decreased pixel pitch (<3μm), increased resolution (8K x 4K), extremely high sequential contrast ratios (100K:1), improved optical system elements (e.g., image and illumination waveguides), and new operating modes (e.g., phase mode). A somewhat unusual paper on precision guided firearms spoke to the electro-optical mechanical integration of a networked tracking scope, advanced fire-control technology and heads-up display to achieve improved long-range shooting accuracy. The paper claimed up to five (5) times increase in First Shot Success Probability (≥ 1,200 yards) compared with conventional scope technology, by eliminating aiming, trigger jerk and shot set-up miscalculation. A final paper in this session brought to our attention how implementation of higher efficiency backlights, lower power drive electronics and improved display performance have allowed marked improvements for high-brightness daytime image overlays as applied to see-through micro-displays. The paper spoke of greater than twenty-fold increases in backlight luminance to power ratios, and greater than two-fold power reductions for graphics and bi-level display drive electronics.

Yet another major and recurring topic, Head-Up Displays, was the focus of our final session, opening with information on an amazing advance in HUD technology whereby the traditional projector and combiner are replaced by an optical waveguide combiner to achieve reduced mass, reduced volume and decreased cost. Because the optical waveguide solution removes the restrictions on pilot eye positioning, this approach also allows for a substantially improved Head Motion Box. The paper addresses a first of its kind potential application for

business jet, air transport and military fast jet cockpits, achieving at least equivalent optical performance to in-service conventional HUDs. Our second paper in this final session is admittedly a paper we have seen before, although a summary and update, regarding use of head-up displays for automotive applications, discussing the main principles of optical design and the operational human-graphical interface. The final paper was an attempt to identify the requirements and key drivers for aviation head-mounted systems of the future. The paper presented key drivers such as easy portability and operation, simple installation in any platform, ease of helmet/human integration, compact, low mass display optics, and improved integration with current and planned Night Vision Aids for reduced workload in day, night and poor visibility situations. This paper, unlike others focussing on the technology aspects of HMD's, looked at the harder to define capability aspects of HMD design.

Best Paper: We would like to extend our hearty congratulations to Malcolm G. Homan of of BAE Systems as winner of this year's Best Paper award: **The use of optical waveguides in head-up display (HUD) applications** (paper 8736-14). Please join us in congratulating Malcolm on this fine achievement!

As always, it was a great pleasure seeing everyone at this year's conference, now our second in Baltimore. We who have attended this conference and the larger symposium over the years, know that networking is a fundamental plus to attending each year – there is always a potential business element in this – but on the purely human side, renewing old acquaintances year by year is something to look forward to, bringing us together as part of an extended family. So think of next year as part of old home week, a family reunion, organized around the presentation and exchange of worthwhile knowledge we can use in our professional lives. As always, we are looking to expand our conference with more and worthy papers. Please look for the Call which shall be issued late June to see our conference's wide range of topics and be sure to alert your colleagues and co-workers. Thank you, and see you in 2014!

Daniel D. Desjardins
Kalluri R. Sarma