Final Program
Tuesday, 1 October 2013
All Sessions to be held in Pacific D

8:00 AM – 8:15 AM
Introduction to Conference
Session Chair: Richard DeSalvo, Harris Corporation, USA, Milan Mashanovitch, Freedom Photonics, USA

8:15 AM - 10:15 AM
Session TuA: RF Photonics, Fiber and Photonic Integration
Session Chair: Richard DeSalvo, Harris Corporation, USA, Milan Mashanovitch, Freedom Photonics, USA

TuA1 8:15 AM-8:45 AM (Invited)
Commercial and Defense Applications of Microwave Photonics, D. Novak and R. Waterhouse, Pharad, LLC, Hanover, MD, USA

Microwave photonics has evolved significantly in scope and technical maturity over the years [1]. Since the first pioneering experiments in the 1970’s, spurred by interest in exploiting the many benefits of optical fiber as a transmission medium for transporting analog RF signals, the field has

TuA2 8:45 AM - 9:15 AM (Invited)
Integrated Photonic Circuits for Photonic and RF-Photonic Signal Processing, Communications, and Imaging on an Avionic Platform, S.J. Yoo, University of California-Davis, Davis, CA, USA

We discuss 2D and 3D photonic integrated circuits designed for signal processing, communications, and imaging on avionic platforms with extremely high efficiency, throughput, and agility. OAWG and orbital-angular-momentum, and new applications will be discussed.

TuA3 9:15 AM - 9:45 AM (Invited)
Portable Fiber Optic Cable Processing for Avionics, A. Christopher and G. Ciolfi, kSARIA Corporation, Methuen, MA, USA

This paper discusses the advances made in applying factory automation technology in the development of portable process tools for servicing fiber optics in military platforms. Specifically addressed are curing, cleaving, and polishing processes.
TuA4  9:45 AM - 10:15 AM  (Invited)

Advancements and Challenges for Photonic Components and Avionic Interconnects, A. Nikolov, D. Guenther, APIC Corporation, Culver City, CA, USA, W. Liu, Photonic Corp., Culver City, CA, USA, R. Cendejas, APIC Corporation, Culver City, CA, USA and R. Dutt, AP, Culver City, CA, USA

Using ultra-low noise laser and receiver fiber-optic links with Noise Figure of < 5dB have been measured and dynamic range dependence on link gain investigated. RF optical links were tested successfully in an ESM system.


10:45 AM - 12:15 PM
Session TuB: RF Photonics I
Session Chair: Bill Jacobs, SPAWAR Systems Center Pacific, USA

TuB1  10:45 AM - 11:15 AM  (Invited)

Technologies for RF Photonics in Wideband Multifunction Systems, J. S. Rodgers, Lockheed Martin Advanced Technology Laboratories, Arlington, VA, USA

Key technology challenges for the use of RF photonics in high performance systems will be discussed. Challenges include Modulator sensitivity, high performance photonic oscillators in harsh environments, and integration of components onto common substrate.

TuB2  11:15 AM - 11:30 AM

30 GHZ Fully Packaged Modified Uni-Traveling Carrier Photodiodes For High-Power Applications, A. Beling, Q. Zhou, University of Virginia, Charlottesville, VA, USA, J. H. Sinsky, Bell Labs, Alcatel-Lucent, Holmdel, NJ, USA, A. S. Cross, University of Virginia, Charlottesville, VA USA, A. H. Gnauck, L. Buhl, Bell Labs, Alcatel-Lucent, Holmdel, NJ, USA and J. C. Campbell, University of Virginia, Charlottesville, VA, USA

We demonstrate packaged modified uni-traveling carrier photodiodes with 13dBm RF output power at 30GHz, an output third-order intercept point of 36dBm, and low amplitude-to-phase conversion coefficient. The PD modules are suitable to detect 42Gbit/s data streams with peak-to-peak voltages as high 2.4V.

TuB3  11:30 AM - 11:45 AM

Performance of a 40 GHz RF Photonic Balanced Link Using a Polarization Modulator, M. R. Boss, D. Evans and E. Jacobs, SPAWAR System Center Pacific, San Diego, CA,USA

The RF gain, NF, and SFDR of a 40GHz balanced intensity modulated direct detection link based on a polarization modulator is reported. NF < 28dB at 40GHz was achieved-- initial temperature dependent data are reported.
High SFDR Optical True Time Delay and Photonic Integration Opportunities, P. Morton, Morton Photonics Inc., West Friendship, MD, USA

This invited paper outlines requirements for optical True Time Delay (TTD) in high SFDR systems, describing advancements making these sub-systems practical. Opportunities for creating silicon photonics System on Chip (SoC) TTD units are discussed.

Optical Network Element Simulation Results for Avionic WDM LANs, D. Richards, College of Staten Island, CUNY, Staten Island, NY, USA, S. Habiby, Applied Communication Sciences, Red Bank, NJ, USA, J. Mazurowski and L. Cashdollar, Pennsylvania State University Electro-Optics Center, Freeport, PA, USA

Simulation results for cascaded Optical Crossconnects in an avionic WDM LAN platform are presented, taking into consideration effects of optical network element loss and optical amplification. The simulations are based on measurements performed for a prototype test-bed with 2.5Gb/s and 10Gb/s digital signals.


An optical, deterministic, Ethernet network suitable for avionic use with COTS ethernet chipsets is demonstrated. This uses ruggedised active and passive components and the Deterministic Ethernet Fault Tolerant NETwork (DEFTNET) concept developed by BAE Systems.

Feasibility of High-Speed Transparent Photonic Links in Airborne Free-Space Optical Communication, K. Büchter and A. Sizmann, Bauhaus Luftfahrt e.V., Munich, Germany

We envision hybrid RF-optical networks with the key elements photonic high-capacity backbone, RF links with short-range limited-bandwidth capability, and high-altitude platforms (HAPs) as relay stations for permanent ACN-to-ground connectivity. Here we discuss the feasibility of agile, multi-span transparent photonic links in an airborne environment.
TuC4  2:45 PM - 3:00 PM

Power Saving Technique Suitable for DWDM-PON on Aircraft, E. Murphy, BAE Systems Advanced Technology Centre, Bristol, UK, C. Michie, University of Strathclyde, Glasgow, UK, H. White, BAE Systems Advanced Technology Centre, Bristol, UK and W. Johnstone, University of Strathclyde, Glasgow, UK

A network has been proposed to facilitate the implementation of WDM on aircraft. To reduce overall network power consumption, the use of an amplifier to reduce the power consumption of the transmitters has been modelled. Savings of 40% are feasible in a realistic environment.

TuC5  3:00 PM - 3:15 PM

Fast Burst-Mode Wavelength Router, L. A. Johansson, S. Estrella, S. Kumar, J. S. Barton and M. L. Mašanovic, Freedom Photonics, Santa Barbara, CA, USA

A wavelength switched router architecture for burst mode or optical packet switching applications is outlined. The RZ-DPSK modulation format allows packet CDR with eliminated preamble. An integrated Si-photonics RZ-DPSK receiver and a demonstration of fast header recognition and packet forwarding has been demonstrated.

3:15 PM - 3:45 PM  Coffee Break/Exhibits: Pacific A, B, & C

3:45 PM - 5:30 PM
TuD:  Optical Fiber Components
Session Chair: Mark Beranek, NAVAIR, USA

TuD1  3:45 PM - 4:00 PM

Fiber Management on a Printed Circuit Board: Ensuring Long-Term Reliability , J. Lauzon, E. Talbot, N. Bélanger and L. Leduc, CMC Electronics Inc., Montreal, Canada

We present a proven configuration to integrate optical fiber pigtailed electro-optics components on a printed circuit board for practical installation, manipulation, maintenance and long-term reliability in avionics environments. The hermetic fiber feedthrough strain relief approach will be addressed, as well as the optimal connector position.

TuD2  4:00 PM - 4:15 PM

Contamination Effects in Butt Coupled and Expanded Beam Singlemode Fibre Optic Connectors, G. Proudley and H. White, BAE SYSTEMS, Bristol, UK

This paper discusses contamination effects in butt-coupled and expanded-beam singlemode fibre optic connectors. Insertion loss and back reflection repeatability are reported in the presence of various aircraft contaminants. Cleaning results are also discussed.
Effects of Low Temperature and Hot Steam on Reliability of Specialty Optical Fibers Designed for Avionics Applications, A. A. Stolov, A. S. Hokansson, R. S. Dyer, K. L. Marceau, B. E. Slyman, D. J. Cote, J. Li and C. R. Ciardiello, OFS, Avon, CT, USA

Optical fibers with different glass and coating design were immersed in liquid nitrogen and hot steam. Harsh environment effects on key fiber properties were studied with a goal of optimizing fiber design for avionics applications.

New Perspectives on Precision Cleaning Direct Contact and Expanded Beam Fiber Optic Connections, E. Forrest, ITW Chemtronics, Marietta, GA, USA

There are five zones in most direct connect and three zones in the expanded beam fiber optic connection. Myriad debris and contamination types influence capacity and speed as removal approaches first time capability.

Testing of Optical Fiber Components for Harsh Environments, J. Bohata, Czech Technical University in Prague, Prague 6, Czech Republic

The paper is focused on the influence of fluctuating temperature in a harsh environment on optical connectors. Typical airplane conditions with various temperature sections were tested along with establishment of long term scenario.

Measurement of Insertion Loss Versus Fiber Recession in Fiber Optic Connectors, E. Lindmark, PROMET International, Shoreview, MN, USA

The effect of optical fiber recession on insertion loss of fiber optic connectors was studied using a proprietary polishing method to preferentially wear away the fiber at discreet increments and measuring the corresponding insertion loss.

A Multi-Fiber Ferrule for Harsh Avionic Environments, S. Li, nanoPrecision Products Inc., El Segundo, CA, USA, R. R. Vallance, T. Mengesha, M. Gean, nanoPrecision Products Inc., Camarillo, CA, USA and M. Barnoski, nanoPrecision Products Inc., El Segundo, CA, USA

Avionic systems route data and control signals through optical fiber cables for high bandwidth and immunity to electro-magnetic interference. This paper describes a novel, multi-fiber Football Ferrule™ and alignment sleeve under development for the harsh environments in avionic applications.
Wednesday, 2 October 2013

8:00 AM - 10:00 AM
WA: Advanced Component Technology for Analog Links
Session Chair: Gregory Abbas, EOSpace, USA

WA1 8:00 AM - 8:30 AM  (Invited)

A Path to Realizing High-Performance 100-GHz Analog Links, C. H. Cox III and E. I. Ackerman, Photonic Systems, Inc., Billerica, MA, USA

To date, the best noise figure and dynamic range results for analog optical links have been reported below 12 GHz. We identify the link architecture with the best path to high performance at up to 100 GHz, and discuss challenges to achieving this performance.

WA2 8:30 AM - 8:45 AM


The replacement of coaxial cable with single mode fiber on various airborne platforms has a number of advantages. The use of fiber optic cable, in addition to reducing the size, weight, and cross section of the point to point links, offers greater immunity to electromagnetic

WA3 8:45 AM - 9:00 AM

High-Index Contrast, Low-Voltage Lithium Niobate Modulators, P. Rabiei, Partow Technologies LLC, Orlando, FL, USA

Y-cut thin film lithium niobate optical modulators with Vp.L of 4V.cm are demonstrated by making high index contrast waveguides of lithium niobate. Preliminary high speed measurement results are shown.

WA4 9:00 AM - 9:30 AM  (Invited)

Hybrid Electro-Optic Polymer Modulators for RF Photonics, R. A. Norwood, College of Optical Sciences, University of Arizona, Tucson, AZ, USA

EO polymers can impact RF photonics due to both their exceptionally large intrinsic bandwidth and their large figures of merit. We will discuss our use of state-of-the-art EO polymers in hybrid optical modulators that can provide both high link gain and low noise figure.

WA5 9:30 AM - 10:00 AM  (Invited)

Photonic Components and Subsystems for Electronic Warfare, K. Davis, J. Gray and A. Stark, Georgia Tech Research Institute, Atlanta, GA, USA
A tremendous burden exists in maintaining the survivability of aircraft in the modern contested electromagnetic environment. Photonics stands out as a versatile technology for mitigating current and future Electronic Warfare challenges.

10:00 AM - 10:30 AM    Coffee Break/Exhibits: Pacific A, B, & C

10:30 AM – 12:15 PM
WB: RF Photonics II
Session Chair: John Gallo, Xadair Technologies, USA

WB1 10:30 AM - 11:00 AM    (Invited)

**Photonics Enabled Millimeter Wave Systems**, T. Clark, T. McKenna and J. Nanzer, *JHU Applied Physics Laboratory, Laurel, MD, USA*

We discuss the potential advantages of millimeter wave systems for mobile platforms and how photonic implementations will help realize these advantages in the near-future as well as identify developments required for future systems.

WB2 11:00 AM - 11:15 AM


We demonstrate optical-millimeter-wave (MMW) signal generation for highly accurate frequency-modulated continuous-wave (FM-CW) radar as well as optical frequency domain reflectometry (OFDR). The generated MMW FM-CW has a bandwidth of 92-100 GHz and the OFDR with a 5-us pulse is evaluated with various SMF lengths successfully.

WB3 11:15 AM - 11:30 AM

**Origin of High Linearity In Radio-over-Fiber Link With Cascaded Filter**, D. Chen, P. K. Yu, *ECE Department, University of California at San Diego, La Jolla, CA, USA* and C. Sun, *Titan Photonics, Fremont, CA, USA*

We verified experimentally that optical filters with flat bandpass region and fast roll-off properties, when incorporated in an optical transmitter, can minimize not only the fading effect in high bit rate, long distance fiber links, but also maintain the 3rd order inter-modulation distortions.

WB4 11:30 AM - 12:00 PM    (Invited)

**Advancements in RF Photonics for Signal Processing Applications on Avionic Platforms**, P. Devgan, *Air Force Research Laboratory, WPAFB, OH, USA*

The maturity of RF photonic components has reached the point where fiber optic links are being system tested to replace traditional copper coax links on avionic platforms. This paper will focus on advancements in RF photonic solutions for signal processing.
Fiber Based Multiple-Access Stable Radio Frequency Phase Delivery, Z. Wu, Y. Dai, A. Zhang, F. Yin, K. Xu and J. Lin, State Key Laboratory of Information Photonics & Optical Communications, Beijing, China

Without phase-locking loop or any tunable parts, a novel multiple-access stable phase delivery scheme is proposed. Stably distributed signal can be regenerated at arbitrary node. A phase fluctuation compression factor of 100 was achieved.

12:15 PM - 2:00 PM   Lunch Break

WC1  2:00 PM – 2:30 PM    (Invited)
National Academies Study on Optics and Photonics: Essential Technologies for Our Nation, A. Willner, University of Southern California, Los Angeles, CA, USA

This talk will describe the background and key recommendations of the recent NRC study on Optics and Photonics. In particular, the national initiative in photonics will be highlighted.

WC2  2:30 PM - 3:00 PM    (Invited)
High Power and High Linearity Photodiodes for Microwave Photonic Applications, J. Campbell, A. Beling, Q. Zhou and A. Cross, University of Virginia, Charlottesville, VA, USA

This talk will describe modified uni-traveling carrier photodiodes (MUTCs) that have achieved high RF output power and high saturation current. Discrete photodiodes, 4x1 phase matched arrays, and balanced detectors will be discussed.

WC3  3:00 PM - 3:30 PM    (Invited)
Nanophotonics Technology and Applications, Y. Fainman, University of California- San Diego, La Jolla, CA, USA

This paper explores the role of nanotechnology with focus on nanophotonics in dielectric, metal, and semiconductor inhomogeneous composition materials, devices and subsystems for optical communications, information and signal processing, and sensing.

WC4  3:30 PM - 3:45 PM
Optical Tuning of Nematic Liquid Crystal Claddings for Chip Scale Photonic Circuits, J. Ptasinski, University of California San Diego / SPAWAR Systems Center Pacific, La Jolla, CA, USA, S. Kim, L. Pang, University of California San Diego, La Jolla, CA, USA, I. Khoo, Pennsylvania State University, University Park, PA, USA and Y. Fainman, University of California San Diego, La Jolla, CA, USA
We present a chip scale, CMOS compatible, low power, active optical tuning scheme for silicon devices clad in dye-doped nematic liquid crystals. Optical tuning offers the advantage of non-contact, electrode-free and configuration flexibility.

**Development of Narrowband Modified Uni-Travelling-Carrier Photodiodes with High Power Efficiency**, Q. Zhou, A. S. Cross, Y. Fu, A. Beling and J. C. Campbell, *University of Virginia, Charlottesville, VA, USA*

Wide-band MUTC-PDs with diameters of 50 micron and 34 micron demonstrated high output RF power of 30.1dBm at 10GHz and 25.7dBm at 20GHz respectively. Numerical simulation indicate that microwave stubs can result in enhanced narrowband power and responsivity performance of 50-micron-diameter PDs at 20GHz.

**4:00 PM - 4:30 PM** Coffee Break/Exhibits: Pacific A, B, & C

**Thursday, 3 October 2013**

**8:00 AM – 10:30 AM**

**ThA: Aerospace Components and Systems, Manufacturing and Qualification**

*Session Chair: John Mazurowski, Penn State Electro-Optics Center, USA*

**ThA1 8:00 AM - 8:30 AM** (Invited)

**Pragmatic Mil-Aerospace Optical Transceiver Qualifications**, M. Pez, *D-Lightsys, New Haven, CT, USA*

This invited paper presents a summary of qualification data and tests applied for harsh environment optical interconnect solutions and more especially optical transceivers.

**ThA2 8:30 AM - 8:45 AM**

**Built-In Test Capable Fiber Optic Transceiver Application Concept**, C. Kuznia, *Ultra Communications Inc., Vista, CA, USA* and M. Beranek, *Naval Air Systems Command, Patuxent River, MD, USA*

This paper describes key elements to consider when developing fiber optic BIT development test plans and operational concepts. We discuss the application of transceivers with transmitter signal strength indication (TSSI), receiver signal strength indication (RSSI), and in situ optical time domain reflectometry.
ThA3  8:45 AM - 9:00 AM

Mil-Avionic Octal DWDM Transmitter, C. Kuznia, K. Kusumoto, R. Hagan and J. Ahadian, Ultra Communications Inc., Vista, CA, USA

We present an eight channel DWDM transmitter (Octal DWDM Tx) module compatible with the low-form factor (5 mm height) packaging and temperature range (-40 C to 100 C) requirements for aerospace applications.

ThA4  9:00 AM - 9:15 AM

Optically-Removed Probes for Airborne RF Sensors, L. Menager and F. Stephane, THALES Systemes Aeroportes, Elancourt, France

Improvements of radar performances and reliability may require detection and monitoring of handled powers. For this purpose, sensor concepts based on optically-remoted RF probe have been investigated. This work presents such dedicated compact photonic systems.

ThA5  9:15 AM - 9:30 AM


In this paper we present a complete functional and portable GPS-over-fiber system for aircraft attitude determination. Results of its performance are presented and discussed, namely its electrical characteristics and functional behavior in real world scenarios.

ThA6  9:30 AM - 10:00 AM  (Invited)

Challenges in Aerospace Packaging, R. Pommer, Ultra Communications Inc., Vista, CA, USA

We present the development of scalable packaging technology for electro-optic (EO) devices that leverages the advances occurring in ASIC, stacked chip packaging and apply these techniques to component packaging for harsh environments.

ThA7  10:00 AM - 10:30 AM  (Invited)


The volume production of polymer optical waveguides in a modern PCB manufacturing plant has proven to be extremely challenging. Our experience in developing scalable optical waveguide fabrication processes for manufacturing is presented.

10:30 AM - 11:00 AM  Coffee Break/Exhibits: Pacific A, B, & C

11:00 AM – 12:30 PM
ThB: New Photonic Device Applications
Session Chair: Paul Morton, Morton Photonics Inc., USA
Photic Oscillators for Small Platforms, L. Maleki, OE Waves, Inc., Pasadena, CA, USA

Emerging commercial and military platforms have demanding needs for communications systems in support of ever-increasing data rates. This in turn challenges current state of the art oscillators that provide reference signals to carry data and information as modulated sidebands. Since the frequency and spectral purity

Silicon Photonic Tunable Filters, S. Mookherjea, University of California- San Diego, La Jolla, CA, USA

We report on high-performance compact, micro-ring resonator based silicon photonic filters, which can show comparable performance, in some metrics, to much larger, bulk-optical filters.

Polarization Dependent Failure Analysis for Photonic Chips Based on Silica-on-Silicon, W. Jiang, J. Qi and X. Sun, Southeast University, Nanjing, China

Polarization dependent failure analyses for the chips based on Silica-on-Silicon with the cracks in the buffer layer are given by full-vectorial FEM, and the impacts of the cracks on chips performance are tested experimentally.

High Speed, Ultra-Compact Spectrometer Using High Contrast Grating Swept-Wavelength Detector, W. Yang, L. Zhu, University of California at Berkeley, Berkeley, USA, Y. Rao, C. Chase, M. Huang, Bandwidth10 Inc., Newark, USA and C. J. Chang-Hasnain, University of California at Berkeley, Berkeley, CA, USA

A novel ultra-compact spectrometer is experimentally demonstrated with a 1550-nm tunable high-contrast grating swept-wavelength detector. A bandwidth of 33.5 nm and a record high speed of 200 kHz are demonstrated.