Final Program

TUESDAY, 13 NOVEMBER 2018

7:30 am–5:00 pm **Windsor Foyer**

Registration

8:00 am–8:30 am **Belmont A, B & C**

Breakfast

8:30 am–10:00 am **Windsor Ballroom**

Session TuA **Electro-Optic Modulators**

Session Chair Milan Mashanovitch, *Freedom Photonics, Santa Barbara, CA, USA*

8:30 am–9:00 am ***(Invited)***

TuA1 **Gain, SFDR and NF for Analog Links with with Arbitary Transfer Functions,** Stephen E. Ralph, Varghese A. Thomas, Christian G. Bottenfield, Stephen M. Hurst, and Gareeyasee Saha, *Georgia Institute of Technology, Atlanta, GA, USA*

We present general expressions for RF gain, spurious free dynamic range and noise figure for analog links with arbitrary transmittances. We apply these to links comprised of simulated and fabricated integrated modulators.

9:00 am–9:30 am ***(Invited)***

TuA2 **Sources of RF Intermodulation Distortion in Silicon Photonic Modulators,** Navid Hosseinzadeh, Aditya Jain, Roger Helkey, and James Buckwalter, *University of California, Santa Barbara, Santa Barbara, CA, USA*

We present a model of intermodulation distortion in RF silicon photonic modulators to highlight mechanisms that limit the device linearity. We compare the SFDR of two MZMs to show a common IMD limitation and indicate methods to improve linearity in silicon photonic RF modulators.

9:30 am–9:45 am

TuA3 **Linear Ring Modulators with DC Kerr Phase Shifters,** Aditya Jain, *University of California, Santa Barbara, Santa Barbara, CA, USA*, Xinru Wu, *Chinese University of Hong Kong, Hong Kong*, John E. Bowers, Roger Helkey, and James F. Buckwalter, *University of California, Santa Barbara, Santa Barbara, CA, USA*

We demonstrate a silicon ring modulator with linear phase shift versus voltage, derived from the interplay between plasma dispersion effect and DC Kerr effect. The dynamic range is 103.6 dB. $Hz^{2/3}$ at a 1.2 GHz carrier.

9:45 am–10:00 am

TuA4 **Single-Sideband Thin Film Lithium Niobate (TFLNTM) Electro-Optic Modulators for RF over Fiber,** D. Brown, S. McKeown, *UES, Inc., Dayton, OH, USA*, B. Griffin, *Air Force Research Laboratory, Wright Patterson, OH, USA*, V. Stenger, J. Toney, S. Sriram, *SRICO, Inc., Columbus, OH, USA*, and R. Nelson, *Air Force Research Laboratory, Wright Patterson, OH, USA*

A high speed thin film lithium niobate modulator device is integrated with a Bragg grating for in situ sideband filtering. The configuration has potential for high efficiency linear intensity modulation at bandwidths exceeding 70 GHz. This proof of concept study explores the benefits ofin...

10:00 am–10:30 am **Belmont A, B & C**

Exhibits / Coffee Break

10:30 am–11:30 am **Windsor Ballroom**
Session TuB **RF Photonic Processing**
Session Chair Charles Middleton, *Harris Corporation, USA*

10:30 am–11:00 am ***(Invited)***

TuB1 **Develop RF-Photonic Technology for Wideband Spectrum Analyses,** Weimin Zhou, Michael R. Stead, *Army Research Laboratory, Adelphi, MD, USA*, Eric Magi, Moritz Merklain, and Benjamin Eggleton, *University of Sydney, Sydney, Australia*

We are developing new RF-Photonic technologies to provide fast wideband RF spectrum analyses up to 100 GHz. These include an analog time-domain auto-correlation processer technique which provides an “instant picture” of the RF spectrum and a stimulated Brillouin scattering-based fast scanning RF spectrum analyzer.

11:00 am–11:15 am

TuB2 **GHz-Band RF Receiver and Spectrometer Based on Laser Speckle in Multimode Waveguides,** Adam C. Scofield, George A. Sefler, T. Justin Shaw, Andrew D. Stapleton, and George C. Valley, *The Aerospace Corporation, El Segundo, CA, USA*

We report the experimental demonstrations of compressive sensing RF receiver and spectrometer with photonic systems in which the measurement matrices are implemented using speckle in multimode waveguides. We calibrate by measuring a dictionary of single frequency RF sinusoids and recover multiple tones with both systems.

11:15 am–11:30 am

TuB3 **Large Bandwidth Channelized RF Receiver Based on Chirped Pulses Mixing,** Yuduo Guo, FeiFei Yin, Kun Xu, and Yitang Dai, *Beijing University of Posts and Telecommunications, Beijing, China*

Here we report a technology of channelized wide band RF signal receiver. It utilizes the mixing characteristics of a chirped pulse and its own delay to produce adjustable chirp local oscillators. The setup covers the band from DC to 40 GHz.

11:30 am–12:00 pm **Windsor Ballroom**

Exhibitor Introductions I

12:00 pm–1:30 pm

Lunch Break (On Own)

1:30 pm–3:30 pm **Windsor Ballroom**

Session TuC **Integrated Photonics**

Session Chair Jason D. Mckinney, *U.S. Naval Research Laboratory, Washington, DC, USA*

1:30 pm–2:00 pm ***(Invited)***

TuC1 **RF Active Optical Cable (AOC) Leveraging the AIM Photonics RF Analog KTMA,** Rick Stevens, *Lockheed Martin ATL, Atlanta, GA, USA*, Arthur Paolella, *Harris*, Stephen Ralph, *Georgia Institute of Technology, Atlanta, GA, USA*, Andreas Beling, *University of Virginia, Charlottesville, VA, USA*, and James F. Buckwalter, *University of California, Santa Barbara, Santa Barbara, CA, USA*

An RF Active Optical Cable (AOC) can be used to directly replace coaxial cables on both commercial and military systems and addresses current challenges in cable loss, cable weight, EMI, reliability, and scalability. The RF AOC will leverage Photonics Integrated Circuit (PIC) manufacturing advances.

2:00 pm–2:30 pm ***(Invited)***

TuC2 **Low Loss Silicon Photonic Switches,** Ming Wu, *University of California, Berkeley, Berkeley, CA, USA*

Silicon photonics offers a path to large-scale photonic switches. In this talk, we review the state of the art of silicon photonic switches, with emphasis on silicon photonic MEMS switches with high port count (64 × 64 and 128 × 128), microsecond response time and low insertion loss.

2:30 pm–2:45 pm

TuC3 **Analog Photonic Timing Equalization Method for Multi-Channel RF Photonic Links,** Jianfu Wang, Suen Xin Chew, Xiaoke Yi, and Linh Nguyen, *University of Sydney, Sydney, Australia*

A new photonic timing equalization approach is presented to compensate the group delay among multiple signals in an analog photonic link. The results show the group delay variation across multiple RF photonic channels can be significantly compensated with 96.2% reduction after the equalization.

2:45 pm–3:00 pm

TuC4 **High-Power, Efficient DFB Laser Technology for RF Photonics Links,** Milan Mashanovitch, Stewart Fryslie, Bob Buckley, Keith Guinn, Gordon Morrison, and Leif A. Johansson, *Freedom Photonics, Santa Barbara, CA, USA*

We present a high power DFB laser technology, developed for operation at 1280 nm and 1550 nm, showing >250 mW laser output power and laser efficiencies up to 36%.

3:00 pm–3:15 pm

TuC5 **A Novel Comb-Optimized (COMBO) DBR Laser,** G. B. Morrison, J. Sherman, I. Gonzalez, K. Ottoson, J. Campbell, S. Estrella, P. Leisher, D. Renner, L. Johansson, and M. Mashanovitch, *Freedom Photonics, Santa Barbara, CA, USA*

We describe a novel approach to design of DBR lasers that utilizes sampled gratings to optimize mirror loss and mirror bandwidth independently. This versatile new approach has enabled a wide variety of lasers, from compact low power consumption to high power single mode designs.

3:15 pm–3:30 pm

TuC6 **Quasicoherent Receivers,** Varghese A. Thomas, Saeed Zeinolabedinzadeh, and Stephen E. Ralph, *Georgia Institute of Technology, Atlanta, GA, USA*

We present simulations of various envelope detection based quasicoherent receivers. These receivers provide sensitivity improvements of up to 18dB over direct detect receivers, while having a much simpler architecture compared to the classical coherent receiver.

3:30 pm–4:00 pm **Belmont A, B & C**

Exhibits / Coffee Break

4:00 pm–5:00 pm **Windsor Ballroom**
Session TuD **RF Photonic Applications**
Session Chair John Mazurowski, *Pennsylvania State University, PA, USA*

4:00 pm–4:30 pm ***(Invited)***

TuD1 **Photonics for Munitions Applications,** Adam J. Rutkowski and Christian Keyser, *Air Force Research Laboratory, Wright Patterson, OH, USA*

The following topics will be presented: A compact passive millimeter wave imager for navigation in fog or smoke. Low-CSWAP multispectral and/or polarimetric LiDAR systems using temporally multiplexed architectures for target identification. LiDAR laser sources based on nonlinear optics in gas-filled hollow-core photonic crystal fibers.

4:30 pm–5:00 pm

TuD2 **Frequency Agile Photonic Front-End for Wideband Transmission and Reception,** Jean Kalkavage, Natalie Bos, Robert Schmid, Jay Song, and Thomas Clark, *Johns Hopkins Applied Physics Laboratory, Laurel, MD, USA*

We have developed and tested a 0–45 GHz frequency agile photonic front-end for up- and down-conversion of signals with >800 MHz instantaneous bandwidth, <1 us switching speed, and low end-to-end latency. The 3U OpenVPX system has been tested in a TRL6 demonstration.

5:00 pm–6:30 pm **Belmont A, B & C**

Welcome Reception

WEDNESDAY, 14 NOVEMBER 2018

7:30 am–5:00 pm **Windsor Foyer**

Registration

8:00 am–8:30 am **Belmont A, B & C**

Breakfast

9:00 am–10:00 am **Windsor Ballroom**

Session WA **Photonic Components**

Session Chair Benjamin Griffin, *Air Force Research Laboratory, Wright Patterson, OH, USA*

9:00 am–9:30 am ***(Invited)***

WA1 **Do Recent Advances in Repair Technology Make it a Viable Alternative to Replacement Strategies?,** Andy Voizey, *AVOptics*

Moving away from a replacement strategy to one which allows repair of fibre optic harnesses on aircraft has not been without its challenges. This paper presents work performed by AVoptics on splicing and curing that now makes repair a viable alternative to a replacement strategy.

9:30 am–9:45 am

WA2 **High-Density 12 Transmitters Plus 12 Receivers Rugged Optical Fiber Transceivers,** Gabriel Monette, Saïd El Kharraz, and Jocelyn Lauzon, *Reflex Photonics Inc., Kirkland, Quebec, Canada*

A novel optical fiber transceiver offering 24 channels at up to 14 Gbps is presented; its external dimensions are 32.3 ×13.4 × 4.5 mm; it is compatible with the VITA66.4 standard or can be embedded on a host PCB; its operating temperature range is –40 to 100°C.

9:45 am–10:00 am

WA3 **Surface Mounted Fiber Optic Sensors for Accurate Monitoring of Pressure Profiles Across an Airfoil,** John Arkwright, Anthony Papageorgiou, Luke Parkinson, Andrew Karas, Kristy Hansen, *Flinders University, Tonsley, Australia,* and Richard Kelso, *University of Adelaide, Adelaide, Australia*

We present a low profile surface mounted fiber optic pressure sensor for monitoring pressure profiles across an airfoil surface. The device has been tested on a symmetric airfoil section in a wind tunnel and shows excellent agreement with standard pressure taps.

10:00 am–10:30 **Belmont A, B & C**

Exhibits / Coffee Break

10:30 am–11:30 am **Windsor Ballroom**

Session WB **Photonic Networks and Components I**

Session Chair Chris Ward, *Georgia Tech Research Institute, Atlanta, GA, USA*

10:30 am–11:00 am ***(Invited)***

WB1 **SAE Fiber Optics and Applied Photonics,** John Mazurowski, *Pennsylvania State University, Freeport, PA, USA*

This is a status of activities for the SAE Aerospace Division Fiber Optics and Applied Photonics Committee.

11:00 am–11:15 am

WB2 **Optical Fibre Sensing for Civil Aircraft Applications: Main Perspectives and Challenges,** Alessio Cipullo, *Airbus Operations Ltd., Filton (Bristol), UK*, Sy-Dat Le, *Airbus Operations SAS, Toulouse, France*, Kevin Jones, *Smart Fibres Ltd., Bracknell, UK*, Marco Awater, *AcQ Inducom, Oss, The Netherlands*, Ethan Moss, *Airbus Operations Ltd., Filton (Bristol), UK*, Alberto Sposito, *Oxsensis Ltd., Didcot, UK*

Optical Fibre Sensing is a growing area for civil aviation. The development of "Universal" interrogators for different sensor technologies (such as FBG and Fabry-Pérot) is of particular interest. Nevertheless, significant challenges still exist for the use of single-mode fibres and mastering of the reliability aspects.

11:15 am–11:30 am

WB3 **Flexible Polymer Waveguide Technology for Low-Cost In-Car and In-Plane Optical Interconnects,** Fengyuan Shi, Nikolaos Bamiedakis, Richard V. Penty, Ian H. White, and Daping Chu, *University of Cambridge, Cambridge, UK*

Flexible polymer multimode waveguides are a promising low-cost technology for achieving high-speed optical interconnection in next-generation automobiles and aircrafts. Here, an overview of the light transmission performance of such waveguides is presented, achieving low loss, low crosstalk, high bandwidth and robust operation under strong flexure.

11:30 am–12:00 pm **Windsor Ballroom**

Exhibitor Introductions II

12:00 pm–1:30 pm

Lunch Break (On Own)

1:30 pm–3:00 pm **Windsor Ballroom**

Session WC **Photonic Networks and Components II**

Session Chair Mark Beranek, *NAVAIR, USA*

1:30 pm–2:00 pm ***(Invited)***

WC1 **Fiber Optic Transceivers with Integrated Optical Time Domain Reflectometry,** Charlie Kuznia, *Ultra Communications*

We present the integration of optical time domain reflectometry (OTDR) technology within harsh environment fiber optic applications, including data transmission and sensing applications. We present an approach utilizing an application specific integrated circuit (ASIC) and optical coupling methods to achieve OTDR functionality.

2:00 pm–2:15 pm

WC2 **Probabilistic Shaping for VCSEL-MMF Links,** Siddharth Varughese, Justin Lavrencik, and Stephen E. Ralph, *Georgia Institute of Technology, Atlanta, GA, USA*

We analyse the benefits of probabilistic shaping in reducing received power requirements in error-free VCSEL-MMF links. Experimental results demonstrate nearly 1 dB reduction for the same net data rate. All results are through 100 m of OM5 fiber at 10^{-12} SER.

2:15 pm–2:30 pm

WC3 **Counter Directional Optical Network Using Ribbon Fiber,** John Mazurowski, *Pennsylvania State University, Freeport, PA, USA*

This network concept is directed at smaller platforms. It incorporates a source module and nodes, connected by fibers in the ribbon. To transmit, a source fiber is connected to a receiving fiber through a modulator; this signal travels in the direction opposite the source signal.

2:30 pm–2:45 pm

WC4 **Full-Duplex Communication with Photonic Based RF Self-Interference Cancellation,** Xiuyou Han, Shuo Wang, Yuchen Shao, Xinxin Su, Hanqiao Wang, and Mingshan Zhao, *Dalian University of Technology, Dalian, China*

RF self-interference is the crucial issue to be resolved necessarily for full-duplex communication. A photonic method based on an integrated dual-parallel Mach-Zehnder modulator for cancelling the RF-self interference is proposed with experimental demonstration, showing the advantages of broad bandwidth and large cancellation depth.

2:45 pm–3:00 pm

WC5 **Compact 7-Channel SiN Wavelength De-Multiplexer with Multi-Core Fiber Fan-Out,** Sarvagya Dwivedi, Weiqang Xie, Victoria Rosborough, and Jonathan Klamkin, *University of California, Santa Barbara, Santa Barbara, CA, USA*

We have demonstrated a compact and low-loss, cascaded Mach-Zehnder interferometer based 7-channels wavelength de-multiplexer realized on a SiN platform over C-band with a multi-core fiber fan-out. The measured insertion loss and channel cross-talk are found below 0.5 dB and –8 dB for all the channels.

3:30 pm–4:00 pm **Belmont A, B & C**

Exhibits / Coffee Break

4:00 pm–4:45 pm **Windsor Ballroom**
Session WD **Photonic Devices and Applications**
Session Chair: Gregory Abbas, *EOSpace, USA*

4:00 pm–4:15 pm

WD1 **High Speed, Low Power Photonic C-MOSFETs for Sub-14 nm ULSI Technology,** James N. Pan, *Advanced Enterprise and License Co., Linthicum, MD, USA*

This paper reports a novel optoelectronic sub-14nm CMOS transistor, fabricated with a tunnel light emitting diode (TLED) or quantum well laser (QWL) in the drain region, and an underlying avalanche breakdown photo diode (APD). The CMOS, QWL, and APD are integrated as one device.

4:15 pm–4:30 pm

WD2 **Design of 3D Printed Integrated Multiplexer of Spatial Domain Multiplexing Communication System,** Syed H. Murshid, Han Wang, Engin Eyceyurt, and Rayan Enaya, *Florida Institute of Technology, Melbourne, FL, USA*

This presents spatial multiplexing in optical fiber communication systems, using a novel high resolution 3D printed multiplexer, which is designed with the help of Solid Works and Zemax. Simulated and experimental results for a two channel SDM system and their output intensity profile is presented.

4:30 pm–4:45 pm

WD3 **Micro-Structured Fiber as Temperature Sensor in a Loop Architecture,** René Dominguez-Cruz, *Universidad Autónoma de Tamaulipas, Reynosa, México*, Daniel May-Arrioja, Daniel López-Cortés, Rodolfo Martinez-Manuel, *Centro de Investigaciones en Óptica Unidad Aguascalientes, Aguascalientes, México*, Oscar Baldovino-Pantaleón, and Gerardo Romero-Galván, *Universidad Autónoma de Tamaulipas, Reynosa, México*

We report a temperature sensor built by a micro-structured fiber using a Sagnac array. The waveguide is provided by a two-hole fiber (THF) which are located asymmetrically from the core. A temperature sensitivity is around 2.22 nm/°C was reached using a 2 m-long of THF.

END OF PROGRAM