MWP2019

2019 IEEE INTERNATIONAL TOPICAL MEETING
ON MICROWAVE PHOTONICS

OCTOBER 7-10, 2019
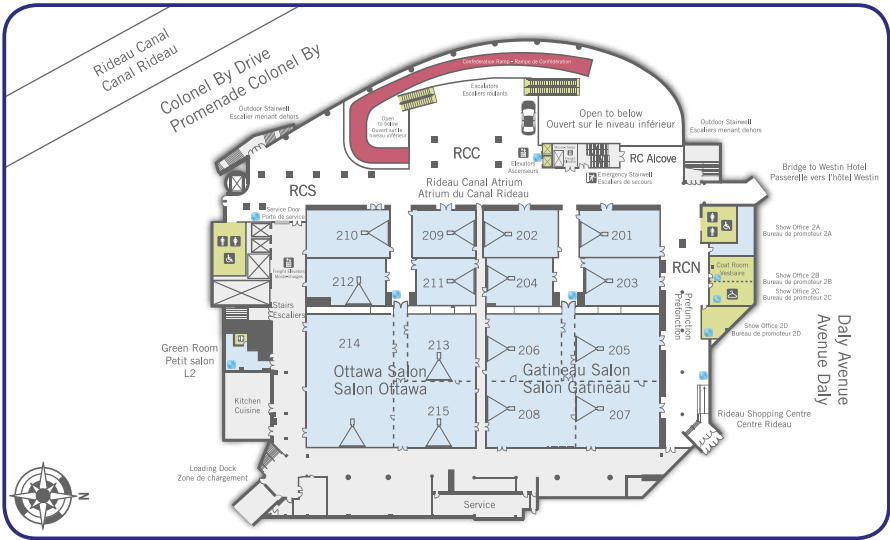
SHAW CENTRE, OTTAWA, CANADA

MWP2019.ORG

PROGRAM

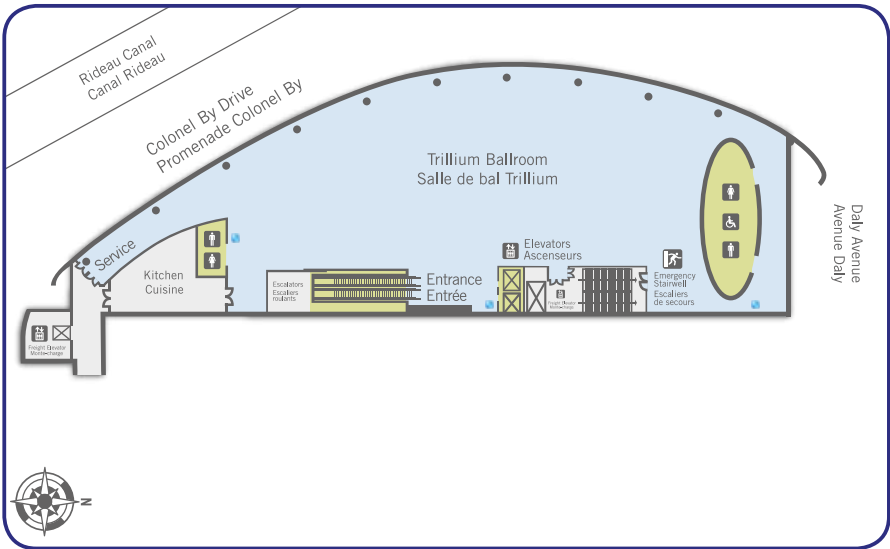# MEETING FLOOR PLAN

2ND FLOOR:

Rideau Canal / Canal Rideau
Colonel By Drive / Promenade Colonel By

Confederation Ramp • Rampe de Confédération
Escalators / Escaliers roulants
Outdoor Stairwell / Escalier menant dehors
Open to below / Ouvert sur le niveau inférieur
Outdoor Stairwell / Escaliers menant dehors

RCC
RC Alcove
Elevator / Ascenseurs
Emergency Stairwell / Escaliers de secours
Bridge to Westin Hotel / Passerelle vers l'hôtel Westin

RCS
Service Door / Porte de service
Rideau Canal Atrium / Atrium du Canal Rideau

Freight Elevator / Montecharge
Show Office 2A / Bureau de promoteur 2A

210 209 202 201

RCN
Coat Room / Vestiaire
Show Office 2B / Bureau de promoteur 2B
Show Office 2C / Bureau de promoteur 2C

212 211 204 203

Prefunction / Préfonction
Show Office 2D / Bureau de promoteur 2D

Stairs / Escaliers

Green Room / Petit salon L2

214 213 206 205

Ottawa Salon / Salon Ottawa
Gatineau Salon / Salon Gatineau

Rideau Shopping Centre / Centre Rideau

Kitchen / Cuisine

215 208 207

Daly Avenue / Avenue Daly

Loading Dock / Zone de chargement

Service

4TH FLOOR:

Rideau Canal / Canal Rideau
Colonel By Drive / Promenade Colonel By

Trillium Ballroom / Salle de bal Trillium

Service
Kitchen / Cuisine

Escalators / Escaliers roulants
Entrance / Entrée

Elevators / Ascenseurs

Emergency Stairwell / Escaliers de secours

Freight Elevator / Montecharge

Daly Avenue / Avenue Daly

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PROGRAM AT A GLANCE

MONDAY, OCTOBER 7, 2019

11:00 - 16:00	**Registration for Workshops ONLY** Rideau Canal Atrium
13:00 - 15:00	**Workshop 1 - Integrated microwave photonics**
15:00 - 15:30	**Coffee Break**
15:30 - 18:30	**Workshop 2 - Photonics for 5G and beyond: analogue or digital fronthaul?**

TUESDAY, OCTOBER 8, 2019

07:15 - 19:30	**Registration** Rideau Canal Atrium
08:15 - 08:30	**Welcome and opening remarks**
08:30 - 10:00	**Plenary Session 1**
10:00 - 10:30	**Coffee Break**
10:30 - 12:15	**Tu1 - Photonic microwave processing, sensing, and measurements 1**
12:15 - 13:30	**Lunch Break**
13:30 - 14:30	**Tutorial 1 - Analog photonic systems: features & techniques to optimize performance**
14:30 - 15:15	**Tu2 - Opto-electronics**
15:15 - 16:45	**Coffee Break and Tu3 - Poster Session 1**
16:45 - 18:15	**Tu4 - Photonic techniques for microwave signal generation and distribution**
18:30 - 20:30	**Welcome Reception** Rideau Canal Atrium South

WEDNESDAY, OCTOBER 9, 2019

08:00 - 17:00	**Registration** Rideau Canal Atrium
08:30 - 10:00	**We1 - Integrated microwave photonics 1**
10:00 - 10:30	**Coffee Break**
10:30 - 12:15	**We2 - Integrated microwave photonics 2**

12:15 - 13:30	**Lunch Break**
13:30 - 15:15	**We3 - Innovative applications of microwave photonics**
15:15 - 16:45	**Coffee Break and We4 - Poster Session 2**
16:45 - 18:15	**We5 - Photonic microwave processing, sensing, and measurements 2**
18:30 - 21:30	**Banquet** Trillium Ballroom

THURSDAY, OCTOBER 10, 2019

08:00 - 16:00	**Registration** Rideau Canal Atrium
08:30 - 10:00	**Th1 - Radio-over-fiber techniques and optical-wireless**
10:00 - 10:30	**Coffee Break**
10:30 - 11:15	**Plenary Session 2**
11:15 - 12:15	**Tutorial 2 - What can photonics bring to radars?**
12:15 - 13:30	**Lunch Break**
13:30 - 15:15	**Th2 - Photonic microwave processing, sensing, and measurements 3**
15:15 - 15:45	**Coffee Break**
15:45 - 16:30	**Th3 - Postdeadline Session and Wrap-Up**

WELCOME FROM THE GENERAL CHAIRS

Jianping Yao
General Chair
University of Ottawa,
Canada

Afshin S. Daryoush
General Co-chair
Drexel University,
Philadelphia, USA

Daniel Dolfi
General Co-chair
Thales Research &
Technology, France

Christina Lim
General Co-chair
University of
Melbourne, Australia

Welcome to the 2019 IEEE International Topical Meeting on Microwave Photonics (MWP2019) in the beautiful capital city of Canada, Ottawa! MWP2019 is jointly sponsored by the IEEE Photonics Society, the IEEE Microwave Theory and Techniques (MTT) Society, and the IEEE Ottawa Section. This is the third time that MWP conference is being held in Canada, and the first time in the Canada's capital. We welcome delegates from more than 15 countries to the technical conference, which is organized in the Shaw Centre (Ottawa Convention Centre) in the downtown Ottawa.

Microwave photonics is concerned with the use of photonic devices, systems and techniques for applications in microwave, millimetre-wave, and THz wave engineering, and also encompasses the development of high-speed photonic components for microwave system applications. The field is continuing to experience significant growth, fueled by the recent interest and development in integrated microwave photonics and microwave/millimetre-wave photonics for 5G applications and beyond. The conference starts with two workshops on Monday afternoon October 7 and followed with single technical oral and poster sessions starting on Tuesday October 8 and ends on Thursday October 10. We received 109 contributed submissions from Americas, Europe and the Middle East, and Asia-Pacific regions.

Ottawa is a city known as Silicon Valley North, where we have world leading microwave and photonics companies. Ottawa is also a city with universities and research institutes, where active research in microwave and photonics is being performed. With quality technical program and a number of commercial exhibitions, MWP2019 will provide opportunities for learning about the state of the art in all technical and commercial aspects of the rapidly growing microwave photonics field. The conference is located in the heart of Ottawa, a home to famous landmarks including the Parliament Hill and the Rideau Canal (a UNESCO World Heritage Site), cultural attractions and celebrations. Ottawa is also a home to natural beauty including the National Algonquin Park and the Ottawa River.

We hope that our delegates will enjoy the technical program offered by the conference and cultural activities offered by the Capital city of Canada.

WELCOME FROM THE TECHNICAL PROGRAM COMMITTEE CHAIRS

Lawrence R. Chen

*TPC Chair
McGill University,
Canada*

Ivana Gasulla

*TPC Co-chair
Europe
Universitat
Politècnica de
València, Spain*

Ming Li

*TPC Co-chair
Asia-Pacific
Chinese Academy of
Sciences, China*

Jason McKinney

*TPC Co-chair
Americas
Naval Research
Laboratory, USA*

On behalf of Technical Program Committee, we are pleased to welcome you to the 2019 IEEE International Topical Meeting on Microwave Photonics (MWP 2019). The meeting will begin on Monday, October 7, with two workshops, one on Integrated Microwave Photonics and the second on Microwave Photonics for 5G and Beyond. The meeting will then proceed over three days from Tuesday, October 8 until Thursday, October 10 with plenary, tutorial, oral, and poster presentations.

In addition to the three plenary presentations, two tutorials, and ten invited talks, there were 109 contributed submissions of which the committee accepted 80 for either oral or poster presentations. The oral presentations have been grouped into nine sessions that focus on high-speed optoelectronic devices; integrated microwave photonics; photonic techniques for microwave signal generation and distribution; photonic microwave processing, sensing, and measurements; THz techniques and applications; radio over fiber techniques, fiber-wireless communications, and 5G; and innovative applications of microwave photonics. The poster papers are grouped into two sessions and will also feature presentations by finalists for the Best Student Paper competition.

The three plenary presentations describe advances of interest to the microwave photonics community and include Antonella Bogoni, "Photonic for Microwave Systems", Marco Loncar, "Integrated Lithium Niobate Photonics and Applications", and Hiroshi Murata, "Millimeter-Wave Band Electro-Optic Modulators for MWP Applications". There are also two tutorials given by leading experts: Edward Ackerman, "Analog Photonic Systems: Features & Techniques to Optimize Performance" and Shilong Pan, "What can Photonics Bring to Radars?".

The technical program will conclude with oral presentation of post-deadline papers that have been reviewed and accepted by the Technical Program Committee.

We hope you enjoy the technical program of MWP 2019.

ORGANIZING COMMITTEES

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Jianping Yao, University of Ottawa, Canada

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Danial Dolfi, Thales Group, France

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Jerome Bourderionnet, Thales Group, France

Maurizio Burla, ETH Zurich, Switzerland

Jose Capmany, Universitat Politecnica de Valencia, Spain

Benjamin J. Eggleton, University of Sydney, Australia

Mable Fok, University of Georgia, USA

Bryan Haas, NRL, USA

Tetsuya Kawanishi, Waseda University, Japan

Jungwon Kim, Korea Advanced Institute of Science and Technology (KAIST), Korea

Yong Liu, University of Electronic Science and Technology of China, China

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Javier Marti, DAS Photonics, Spain

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Sergio Pinna, University of California, Santa Barbara, USA

Franklyn Quinlan, NIST Boulder, USA

Chris Roeloffzen, LioniX, BV, Netherlands

Eduward Tangdiongga, Eindhoven University of Technology, Netherlands

Chao Wang, University of Kent, UK

Lianshan Yan, Southwest Jiaotong University, China

Xiaoke Yi, University of Sydney, Australia

Avinoam Zadok, Bar-Ilan University, Israel

Fangzheng Zhang, Nanjing University of Aeronautics and Astronautics

Sanja Zlatanovic, SPAWAR Systems Center Pacific, USA

Xihua Zou, Southwest Jiaotong University, China

PLENARY SPEAKERS

Photonics for Microwave Systems

Antonella Bogoni, *Sant'Anna School of Advanced Studies-CNIT, Italy*

The potential of photonics in the next generation RF systems for communications and sensing is summarized in this paper. Photonics will allow for an increasing interactions between networks of sensors and communications networks, both of them more and more heterogeneous, flexible and miniaturized.

Integrated Lithium Niobate Photonics and Applications

Marco Loncar, *Harvard University, USA*

Lithium niobate (LN) is an "old" material with many applications in optical and microwave technologies, owing to its large second order nonlinearity and piezoelectric response. Conventional LN devices based on bulk LN crystals, are reaching their limits, however. I will present our work on integrated LN photonic platform that allows for dense integration of wide range of components on the same chip, including modulators, filters, frequency combs and frequency shifters, as well as their applications in optical communications, microwave photonics, and quantum information.

Millimeter-Wave Band Electro-Optic Modulators for Microwave Photonics Applications

Hiroshi Murata, *Mie University, Japan*

Recently, the optical modulation technology for millimeter-wave (MMW) signals becomes rather important owing to new MMW applications combined with photonic links: 5G/beyond-5G mobile front-haul, high-speed train communication systems, high-resolution radars, imaging for safety and security, and so on. The author has been trying to develop electro-optic modulators operating in MMW bands utilizing unique device structures. In this paper, several MMW-band optical modulators with advanced functions are discussed.

TUTORIAL SPEAKERS

What can photonics bring to radars?

Shilong Pan, Yameiz Zhang, Fangzheng Zhang, and Dan Zhu, *Nanjing University of Aeronautics and Astronautics, China*

As the only method for all-weather and long-distance target detection and recognition, radar has been intensively studied since it was proposed, and is considered as an essential sensor for future intelligent society. In the past few decades, great efforts were devoted to improve radar's functionality, precision, and response time, of which the key is to generate, control and process a wideband signal with a high speed. Thanks to the high frequency, large bandwidth, low loss transmission and electromagnetic immunity provided by modern photonics, implementation of the radars in the optical domain can provide better performance in terms of resolution, coverage and speed which may not be achievable using traditional, even state-of-the-art electronics. In this tutorial, we give an overview of the photonic technologies that are currently known to be attractive for radars. System architectures and their performance that may interest the radar society are emphasized. Emerging technologies in this area and possible future research directions are discussed.

Analog Photonic Systems: Features & Techniques to Optimize Performance

Edward Ackerman, *Photonic Systems, Inc., USA*

Both the scientific and the defense communities wish to receive and process information occupying ever-wider portions of the electromagnetic spectrum. This can often create an analog-to-digital conversion "bottleneck". This presentation will review multiple techniques for optimizing the performance of analog photonic systems that perform remoting, interference cancelling, linearizing, channelizing and frequency-converting functions that can help to alleviate this bottleneck.

INVITED SPEAKERS

Photonics-Based Real-Time 2D (Time-Frequency) Broadband Signal Analysis and Processing

Saikrishna Reddy Konatham and José Azaña, *Institut National de la Recherche Scientifique, Canada*

This contribution reviews recent work on a new universal analog-processing design for gap-free real-time spectral analysis of broadband microwave signals, through a continuous mapping of the input signal's short-time Fourier transform or spectrogram (SP) along the time domain. This design involves short-pulse sampling and chromatic dispersion. A photonic processor has been demonstrated for real-time SP analysis of GHz-bandwidth arbitrary microwave signals at a speed approaching 5×109 FTs/second, beyond the potential of present methods. The concept offers novel interesting opportunities for real-time, on-the-fly broadband signal processing by exploiting the powerful joint time-frequency representation framework.

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Photonics-Assisted Digital-to-Analog Conversion

Ghaya Baili, *Thales Research Group, France*

Abstract not available

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Design of Silicon Integrated Bragg Gratings for Microwave Photonics Signal Processing

Rui Cheng and Lukas Chrostowski, *University of British Columbia, Canada*

This paper reviews the basic design flow of a silicon integrated Bragg grating (IBG) to achieve an arbitrary microwave photonics (MWP) signal processor. An example of using the design methodology to achieve a multichannel MWP Hilbert transformer (HT) based on a silicon IBG is given. Then we review the adverse impact of apodization phase noise (APN) on the apodized grating response, and our recently demonstrated performance improvement of a grating-based MWP HT realized by compensating for the APN to correct the grating complex response. Finally, we give an outlook and suggestions for the future work.

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Neuromorphic Photonics for RF Signal Processing

Mable P. Fok, *University of Georgia, USA*

Neuromorphic photonics use light to imitate the neural models and systems of nature for solving complex human problems that are challenging for conventional electronic approaches. Neural algorithms are natural designs that govern the survival of the organism, therefore, are highly effective for the designated tasks. In this paper, we review two small-scale neural algorithms – spike timing dependent plasticity process for learning and jamming avoidance response in Eigenmannia, discuss the marriage of those neural algorithm and photonics, as well as explore their real-life applications in human society.

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Multi-Core Fiber Applications for Multi-Antenna Systems and Photonic Beamformers

Maria Morant, *Nanophotonics Technology Center, Universitat Politècnica de València, Spain*

Ailee M. Trinidad and Eduward Tangdiongga, *Institute for Photonic Integration, Eindhoven University of Technology, Netherlands*

Roberto Llorente*, Nanophotonics Technology Center, Universitat Politècnica de València, Spain*

This paper describes and experimentally validates different multi-antenna system applications supported by a multi-core fiber (MCF) optical fronthaul. The MCF fronthaul enables the simultaneous transmission of different optical data streams at the same wavelength by the spatial multiplexing of multiple-input multiple-output (MIMO) signals. In addition, the MCF enables simultaneous radio beamforming by transmitting the same optical data signal with different phase or time delays to each antenna element. Both MIMO and beamforming capabilities are required for 5G multi-antenna systems. Experimental demonstrations of 4×4 MIMO transmission and multi-beam 4×1 beamforming using a commercially available 4-core fiber are reported in this work. Optical beam-steering in 5G is achieved using a Si3N4 photonic chip based on optical ring resonators (ORRs) that enables the continuous and centralized tuning of the time delay applied to each antenna element.

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Field-Programmable Photonic Array for Multipurpose Microwave Photonic Applications

Daniel Pérez-López, Aitor López Hernández, Prometheus DasMahapatra, and José Capmany, *Universitat Politècnica de València, Spain*

Software-defined Programmable Photonic ICs enable the dynamic configuration of their internal building blocks to realize the desired circuit. In this paper, we introduce basic and complex software algorithms to achieve multipurpose applications with a special focus on microwave photonics and report the experimental reconfigurations of the optical core for filtering and power splitting applications.

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Comb-Based Subnoise RF Signal Detection and Wideband Signal Analysis

Stojan Radic, *University of California, San Diego, USA*

Hybrid signal processing circumvents need for full rate quantization imposed on conventional communication and sensing systems. By combining coherent frequency combs with subrate optical-to-electrical backplane, it is possible to map wideband signals to Fourier and Hilbert domains without relying on high rate digital computation.

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Brillouin-Based Signal Processing in Silicon Photonics

Peter Rakich, *Yale University, USA*

We use a new class of optomechanical waveguides to we create strong stimulated Brillouin scattering in silicon waveguides. Harnessing these interactions, we create Brillouin-based narrow-band RF-photonic filters, optical amplifiers, and lasers in silicon photonics.

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Fiber-Based Temporal Waveform Processor Enabled by Discrete Fourier transform of Fractional-Rate Modulated Optical Pulse Train

Chester Shu, *The Chinese University of Hong Kong, China*

We summarize our recent work on programmable generation of temporal waveforms. Our scheme is achieved with envelope programming of high-repetition-rate optical pulse trains through discrete Fourier transform (DFT) of modulated pulses.

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Photonics for Jamming Tolerant Wideband RF Communications

Daniel Yap, *HRL Laboratories, LLC, USA*

A microwave photonic architecture for jamming tolerant RF transmission of wideband 10-100 Mbps data is analyzed. Switched optical delays implement spread-spectrum encoding and sliding-window decoding of the RF-carrier phase. Any strong jammers are selectively attenuated by a frequency agnostic photonic limiter and further attenuated by the decoder and bandpass filter.

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LIST OF EXHIBITORS

EXHIBITOR	#
Amonics	1
PriTel	2
SystemLab	3
Testforce	4
Keysight Technologies	5
Optiwave	6
Newkey Photonics Technologies	7

EXHIBITION PLAN
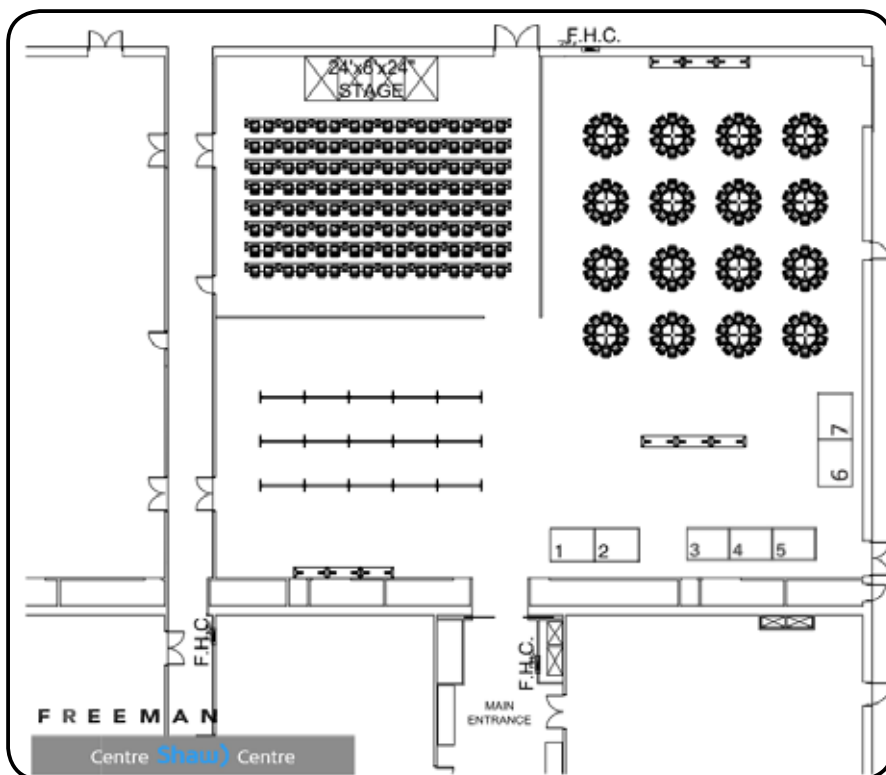
GENERAL INFORMATION

CONFERENCE VENUE
Shaw Centre
55 Colonel By Drive
Ottawa, ON K1N 9J2 Canada

REGISTRATION DESK
All participants should register at the Registration Desk to receive relevant Conference materials. The Registration Desk is located in the Rideau Canal Atrium of the Shaw Centre. It will be open at the conference venue at the following times:

Monday, October 7 (For Workshops ONLY)	11:00 to 16:00
Tuesday, October 8	07:15 to 19:30
Wednesday, October 9	08:00 to 17:00
Thursday, October 10	08:00 to 16:00

EXHIBITION HOURS

Tuesday, October 8	08:30 to 19:00
Wednesday, October 9	08:30 to 17:00

SPEAKER READY DESK
All speakers are required to check in at the Speaker Ready Desk to upload their presentation at least 1 hour prior to the start of their session. The staff will be available to answer your questions and to help you upload your presentation from your USB memory stick.

If your presentation includes video files, further to uploading it at the Speaker Ready Desk, please use a Coffee or lunch break at least 30 minutes prior to the start of your session to go to the room where your lecture will take place to make sure that it will run smoothly on the conference computers.

Speaker Ready Desk Schedule:

Tuesday, October 8	07:15 to 19:30
Wednesday, October 9	08:00 to 17:00
Thursday, October 10	08:00 to 15:00

INTERNET ACCESS / MOBILE PHONE

Limited WI-FI access will be made available to attendees (One connected device per attendee). To get the password please visit the MWP 2019 Registration Desk.

During the meetings, please turn off your mobile phone or set it to mute.

NAME BADGE

Please wear your name badge at all times. This will ensure your access to the conference rooms and the Exhibition Hall.

CERTIFICATE OF ATTENDANCE

An official certificate of attendance will be provided upon request at the Registration Desk.

MEALS AND COFFEE BREAKS

Coffee breaks and lunches are located in the Ottawa Salon.

DISCLAIMER

The 2019 IEEE International Topical Meeting on Microwave Photonics secretariat and organizers cannot assume liability for personal accidents, loss of or damage to private property of participants, and accompanying persons, either during or directly arising from the 2019 IEEE International Topical Meeting on Microwave Photonics. Participants should make their own arrangement with respect to health and travel insurance.

SECURITY

Please do not leave bags and luggage unattended at any time, whether inside or outside session rooms.

SECRETARIAT

Conferium / MWP 2019
Tel.: +1 418 522 8182
Email : mwp2019@conferium.com

SOCIAL EVENTS

POSTER SESSION 1
Ottawa Salon
Tuesday, October 8, 2019 - 15:15 to 16:45

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WELCOME RECEPTION
Rideau Canal Atrium South
Tuesday, October 8, 2019 - 18:30 to 20:30
Included in your registration

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POSTER SESSION 2
Ottawa Salon
Wednesday, October 9, 2019 - 15:15 to 16:45

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CONFERENCE DINNER
Trillium Ballroom
Wednesday, October 9, 2019 - 18:30 to 21:30
Included in your registration, upon booking

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WORKSHOPS

Two workshops will be held in the afternoon, October 7, 2019.

WORKSHOP I: INTEGRATED MICROWAVE PHOTONICS
Ottawa Salon - 13:00 to 15:00
Organizer: Jose Capmany, Universitat Politecnica de Valencia, Spain

13:00	**Hybrid Integrated for Microwave Photonics** **Kasper van Gasse and Gunther Roelkens,** Ghent University, Belgium
13:30	**Integrated Microwave Photonics Research in China** **Ming Li**, Chinese Academy of Sciences, China
14:00	**Integrated Mode-Locked Laser Sources for Microwave Photonics Applications** **Guillermo Carpintero**, University Carlos III of Madrid, Spain
14:30	**Silicon Nitride Integrated Microwave Photonics** **Chris Roeloffzen**, LioniX, Netherlands

WORKSHOP II: PHOTONICS FOR 5G AND BEYOND: ANALOGUE OR DIGITAL FRONTHAUL?
Ottawa Salon - 15:30 to 18:30
Organizers: Michael Eiselt (ADVA Optical Networking, Germany) and Patryk Urban (Westpomeranian University of Technology, Poland)

Abstract: High data rates at the mobile interface of the 5G network require an increased capacity of the fronthaul link between the baseband unit (BBU) and the remote radio unit (RRU). For LTE, the Common Public Radio Interface (CPRI) provides a standard to transport the baseband radio signal in a digital format over an optical link between the BBU and the RRU with a data rate of up to 24 Gbit/s, enabling the complete signal processing in the centralized BBU. The higher data rates of 5G, however, would lead to prohibitively high fronthaul data rates of more than 100 Gbit/ for each RRU. One solution to reduce this data rate is locating more signal processing functions at the RRU, with the drawback of reduced network flexibility and reduced interoperation between RRUs. An alternative solution would be the transport of the radio baseband signal in an analog format over the optical fronthaul link, reducing the required bandwidth to the order of the radio signal bandwidth, but at the same time increasing the optical system requirements on impairment tolerances and component linearities. Also, a purely analog channel might require an additional, digital optical channel for synchronization and control of the RRU.

15:30   **Analog Radio over Fiber for Fronthaul and High Capacity Wireless in 5G and Beyond**
Simon Rommel, TU Eindhoven

ABSTRACT: The continued growth of radio bandwidth especially at millimeter waves places a growing strain on the fronthaul segment of mobile networks in centralized radio access networks, or requires a partial return to a distributed radio access network. Analog radio over fiber, where the target radio waveform is directly transported over the optical fiber, not only alleviates such problems by avoiding transport of digitized radio signals, but through the use of optical heterodyning further allows simplified generation of high-bandwidth millimeter wave and THz signals. This talk will discuss analog radio over fiber and its ideal synergy with analog signal processing in microwave photonics for applications in 5G, 6G and beyond.

16:00   **The BlueSpace project ARoF front-end: concept and estimated performances**
Jerome Bourderionnet, Thales

ABSTRACT: We will discuss the analog RoF architectures envisioned in the EU BlueSpace project, and in particular how an integrated photonic front-end enables key functionalities such as versatile frequency up-conversion together with opto/RF beamforming.

16:30   **Digital signal processing (DSP)-assisted analog transport for the 5G (and beyond) fronthaul**
Philippos Assimakopoulos, University of Kent

ABSTRACT: Analog transport for the next-generation fronthaul is now of interest, as it is highly spectrally efficient. Digital signal processing techniques for analog fronthauling can circumvent re-configurability concerns, and lead to flexibility and scalability, aspects that are of fundamental importance for 5G (and beyond) radio access networks.

17:00   **Fiber-Wireless Systems for MIMO Applications**
Anthony Ng'Oma, Corning
ABSTRACT: MIMO technology, with many of its variants has emerged as a key technology enabler for high-capacity wireless systems - including 5G. In this talk we discuss fiber-based (including few-mode and signal mode fiber) analog and digital system implementations for realizing cost-effective MIMO and Massive MIMO transmission systems and networks

17:30   **The Mixed-Signal Optical Fronthaul: Beyond-5G Functionalities enabled by SDM in Multicore Fiber**
Roberto Llorente, Nanophotonics Technology Center, Universitat Politècnica de València
ABSTRACT: Optical fronthaul technology is evolving from baseband digital transmission of digitized-RoF signals to a mixed scenario where advanced functionalities are enabled by photonic processing. This talk addresses the latest approaches to a mixed-signal optical fronthaul capable of full spatial control of Beyond-5G radio signals seamless operating at high frequency bands.

18:00   **Silicon Photonics Enabled Radio-Over Fiber and 5G X-Haul Systems**
David Plant, McGill University
ABSTRACT: Silicon photonic component enabled subsystems for Radio-over-Fiber applications will be discussed. System configurations utilizing digital signal processing techniques for front haul will be reviewed.

SCIENTIFIC PROGRAM

TUESDAY, OCTOBER 8, 2019

WELCOME AND OPENING REMARKS
Ottawa Salon - 08:15 to 08:30

PLENARY SESSION 1
Ottawa Salon - 08:30 to 10:00
Chairs: Jianping Yao (University of Ottawa, Canada) and Lawrence R. Chen (McGill University, Canada)

08:30	**Photonics for microwave systems** **Antonella Bogoni**, Sant'Anna School of Advanced Studies-CNIT, Italy
09:15	**Integrated Lithium Niobate photonics and applications** **Marco Loncar**, Harvard University, USA

TU1 - PHOTONIC MICROWAVE PROCESSING, SENSING, AND MEASUREMENTS 1
Ottawa Salon - 10:30 to 12:15
Chair: Avi Zadok (Bar-Ilan University, Israel)

10:30	**Photonics for Jamming Tolerant Wideband RF Communications** **Daniel Yap**, HRL Laboratories, LLC, USA Gabriel Virbila, James Schaffner
11:00	**Wideband photonic image-reject RF receiver based on phase modulation and I/Q balanced detection** **Yongsheng Gao**, School of Electronics and Information, Northwestern Polytechnical University, China Bochao Kang, Yangyu Fan
11:15	**Microwave Channelizer Based on Polarization Multiplexing and Photonic Image-Reject Mixing** **Dan Zhu**, Nanjing University of Aeronautics and Astronautics, China Chenxu Xie, Wenjuan Chen, Jiang Liu, Shilong Pan

11:30   **Impact of Nonlinearity on RF-Modulated Frequency Combs with Different Modulation Depths in an MUTC Photodetector**
Seyed Ehsan Jamali Mahabadi, University of Maryland, Baltimore County, USA
Thomas F. Carruthers, Curtis R. Menyuk, Meredith N. Hutchinson, Jason D. McKinney, Keith J. Williams

11:45   **Neuromorphic Photonics for RF Signal Processing**
Mable P. Fok, University of Georgia, USA

TUTORIAL 1 - ANALOG PHOTONIC SYSTEMS: FEATURES & TECHNIQUES TO OPTIMIZE PERFORMANCE
Ottawa Salon - 13:30 to 14:30

13:30   **Tutorial 1 - Analog photonic systems: features & techniques to optimize performance**
Edward Ackerman, PHOTONICSystems Inc., USA

TU2 - OPTO-ELECTRONICS
Ottawa Salon - 14:30 to 15:15
Chairs: Xihua Zou (Southwest Jiaotong University, China) and Shilong Pan (Nanjing University of Aeronautics and Astronautics, China)

14:30   **300 GHz Photonic Self-Mixing Imaging-System with vertical illuminated Triple-Transit-Region Photodiode Terahertz Emitters**
Sebastian Dülme, University of Duisburg-Essen, Germany
Marcel Grzeslo, Jesse Morgan, Matthias Steeg, Jason Lange, Jonas Tebart, Nils Schrinski, Israa Mohammad, Tom Neerfeld, Peng Lu, Andreas Beling, Andreas Stöhr

14:45   **Dual Band Millimeter-Wave Integrated Photoreceiver**
Toshimasa Umezawa, National Institute of Information and Communications Technology (NICT), Japan
Kenichi Kashima, Atsushi Kanno, Pham Tien Dat, Naokatsu Yamamoto, Tetsuya Kawanishi

15:00   **High-Power W-band to G-band Photonically-Driven Electromagnetic Emitter with 8.8 dBm EIRP**
Xiaochuan Shen, University of Virginia, USA
Robert Costanzo, Jesse Morgan, Keye Sun, Maddy Woodson, Steven Estrella, Andreas Beling, Steven Bowers

COFFEE BREAK AND TU3 - POSTER SESSION 1
Ottawa Salon - 15:15 to 16:45

Tu3.1   **Photonics-based integrated communication and radar system**
Fangzheng Zhang, Nanjing University of Aeronautics and Astronautics, China
Haijiang Nie, Yue Yang, Shilong Pan

Tu3.2   **Photonics-based super-resolution phased array radar detection applying two-dimensional multiple signal classification (2D-MUSIC)**
Fangzheng Zhang, Nanjing University of Aeronautics and Astronautics, China
Ermao Zhao, Bindong Gao, Shilong Pan

Tu3.3   **On-Chip Frequency Comb Generation Using Cascaded MZMs in SiP for Microwave Photonics Applications**
Lawrence Chen, McGill University, Canada
Zifei Wang, Ming Ma, Hao Sun, Mostafa Khalil, Kathy Yim, Rhys Adams

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Tu3.4   **On-chip Photonic Method for Doppler Frequency Shift Measurement**
Simin Li, Nanjing University of Aeronautics and Astronautics, China
Zhengze Cui, Zhenzhou Tang, Zhengqian He, Shilong Pan

Tu3.5   **A method for suppressing frequency drift of integrated microwave photonic filters based on difference scheme**
Jiachen Li, Tsinghua University, China
Hongwei Chen, Sigang Yang, Minghua Chen

Tu3.6   **Integrated all optical sampling of microwave signals in silicon photonics**
Arijit Misra, THz-Photonics group, Institut fuer Hochfrequenztechnik, TU Braunschweig, Germany
Christian Kress, Karanveer Singh, Stefan Preußler, Christoph Scheytt, Thomas Schneider

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Tu3.7   **UWB Pulses Generation with Fano Resonance Modulation**
Zhe Xu, Shanghai Jiao Tong University, China
Linjie Zhou

Tu3.8   **Si-Based GeSn Photodetector for Mid-Infrared Integrated Microwave Photonics**
Seyed Amir Ghetmiri, University of Arkansas at Pine Bluff (UAPB), USA
Huong Tran, Aboozar Mosleh, Wei Du, Jifeng Liu, Baohua Li, Mansour Mortazavi, Shui-Qing Yu

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Tu3.9   **A Monolithically Integrated and Widely Tunable Silicon Photonic Microwave Photonic Filter**
Jianping Yao, Microwave Photonics Research Laboratory, School of Electrical Engineering and Computer Science, Canada
Jiejun Zhang, Weifeng Zhang

Tu3.10　**Wideband and Continuously Tunable Microwave Photonic Phase Shifter Based on an Active InP/InGaAsP Microring Resonator**
Jianping Yao, University of Ottawa, Canada
Jian Tang, Ming Li

Tu3.11　**A Center Frequency and Bandwidth Tunable Microwave Photonic Band-Stop Filter Based on an InP/InGaAsP Micro-Ring Resonator**
Jianping Yao, University of Ottawa, Canada
Jian Tang, Ming Li

Tu3.12　**Regeneration of microwave carriers using optically injected semiconductor lasers for Doppler-insensitive homodyne detection in OFDM-RoF links**
Sheng-Kwang Hwang, National Cheng Kung University, Taiwan
Yu-Han Hung, Jhih-Heng Yan, Kai-Ming Feng

Tu3.13　**Reconfigurable fractional microwave signal processor based on a microcomb**
Mengxi Tan, Swinburne Uni of Tech, Australia
Xingyuan Xu, Jiayang Wu, Thach Nguyen, Sai Chu, Brent Little, Roberto Morandotti, Arnan Mitchell, David Moss

Tu3.14　**Silicon Photonic Microdisk Sensor Based on Microwave Photonic Filtering Technique**
Xiaoke Yi, The University of Sydney, Australia
Xiaoyi Tian, Keith Powell, Liwei Li, Suenxin Chew, Linh Nguyen, Robert Minasian

Tu3.15　**Polarization-controlled flexible dual-channel photonic RF repeater**
Yongsheng Gao, School of Electronics and Information, Northwestern Polytechnical University, China
Fangjing Shi, Yangyu Fan

Tu3.16　**Photonic Radio Frequency Memory with Controlled Doppler Frequency Shift**
Zhidan Ding, Shanghai Institute of Optics and Fine Mechanics Chinese Academy of Sciences, China
Fei Yang, Dongjin Wang

Tu3.17　**Dynamic Range Improvement of Microwave Photonic Link Based on Destructive Combination of Nonlinear Distortions**
Wenwu Zhu, Dalian University of Technology, China
Yiying Gu, Jingjing Hu, Feng Fan, Zhenlin Wu, Mingshan Zhao

Tu3.18　**High-speed Analog-to-Digital Converter Based on Dual Integrated Soliton Microcombs**
Anton Lukashchuk, EPFL, Switzerland
Johann Riemensberger, Junqiu Liu, Pablo Marin-Palomo, Maxim Karpov, Christian Koos, Romain Bouchand, Tobias Kippenberg

Tu3.19   **300 GHz Plasmonic Mixer**
Yannick Salamin, ETH Zurich, Switzerland
Tobias Blatter, Yannik Horst, Yuriy Fedoryshyn, Wolfgang Heni, Ileana-Cristina Benea-Chelmus, Michael Baumann, Christian Haffner, Tatsuhiko Watanabe, Maurizio Burla, Delwin Elder, Larry Dalton, Juerg Leuthold

Tu3.20   **300 GHz Photonic Self-Mixing Imaging-System with vertical illuminated Triple-Transit-Region Photodiode Terahertz Emitters**
Sebastian Dülme, University of Duisburg-Essen, Germany
Marcel Grzeslo, Jesse Morgan, Matthias Steeg, Jason Lange, Jonas Tebart, Nils Schrinski, Israa Mohammad, Tom Neerfeld, Peng Lu, Andreas Beling, Andreas Stöhr

Tu3.21   **High-Power W-band to G-band Photonically-Driven Electromagnetic Emitter with 8.8 dBm EIRP**
Xiaochuan Shen, University of Virginia, USA
Robert Costanzo, Jesse Morgan, Keye Sun, Maddy Woodson, Steven Estrella, Andreas Beling, Steven Bowers

Tu3.22   **Heterogeneous multicore fiber for optical beamforming**
Mario Ureña Gisbert, ITEAM Research Institute, Universitat Politècnica de València, Spain
Sergi García Cortijo, Ivana Gasulla Mestre

Tu3.23   **3D Radar Localization via Photonic Chirp Leaky-Wave Antenna Beam Scanning**
Matthias Steeg, University of Duisburg-Essen, Germany
Jonas Tebart, Kyriakos Neophytou, Marco Antoniades, Stavros Iezekiel, Andreas Stöhr

Tu3.24   **Octave-Band Microwave Frequency Synthesizer Using Mode-Locked Laser as a Reference**
Meysam Bahmanian, University of Paderborn, Germany
Johannes Tiedau, Christine Silberhorn, J. Christoph Scheytt

Tu3.25   **Widely Tunable Parity-Time-Symmetric Optoelectronic Oscillator Based on a Silicon Microdisk Resonator**
Jianping Yao, University of Ottawa, Canada
Zhiqiang Fan, Weifeng Zhang, Qi Qiu

Tu3.26   **Wideband photonic image-reject RF receiver based on phase modulation and I/Q balanced detection**
Yongsheng Gao, School of Electronics and Information, Northwestern Polytechnical University, China
Bochao Kang, Yangyu Fan

Tu3.27   **A Parity-Time-Symmetric Optoelectronic Oscillator Based on Dual-Wavelength Carriers in a Single Spatial Optoelectronic Loop**
Jiejun Zhang, Institute of Photonics Technology, Jinan University, China
Lingzhi Li, Guangying Wang, Jianping Yao

TU4 - PHOTONIC TECHNIQUES FOR MICROWAVE SIGNAL GENERATION AND DISTRIBUTION

Ottawa Salon - 16:45 to 18:15

Chair: Edward Ackerman (PHOTONICSystems, Inc., USA)

16:45   **Continuously Tunable Coherent THz Synthesizer, Referenced to Primary Frequency Standards**
Lalitha Ponnampalam, University College London, UK
Joshua R. Freeman, Martyn J. Fice, Reshma A. Mohandas, Cyril C. Renaud, Edmund H. Linfield, A. Giles Davies, Alwyn J. Seeds

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17:00   **A 325 GHz Analog Photonic Link**
Maurizio Burla, ETH Zurich, Switzerland
Claudia Hoessbacher, Wolfgang Heni, Christian Haffner, Yuriy Fedoryshyn, Dominik Werner, Tatsuhiko Watanabe, Yannick Salamin, Hermann Massler, Delwin Elder, Larry Dalton, Juerg Leuthold

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17:15   **Octave-Band Microwave Frequency Synthesizer Using Mode-Locked Laser as a Reference**
Meysam Bahmanian, University of Paderborn, Germany
Johannes Tiedau, Christine Silberhorn, J. Christoph Scheytt

17:30   **Ultra-High-Q Silicon Microring Resonator Based Optoelectronic Oscillator with Stabilized Frequency**
Yuan Yu, Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China
Haitao Tang, Xi Xiao, Yu Yu, Xinliang Zhang

17:45   **Widely Tunable Parity-Time-Symmetric Optoelectronic Oscillator Based on a Silicon Microdisk Resonator**
Jianping Yao, University of Ottawa, Canada
Zhiqiang Fan, Weifeng Zhang, Qi Qiu

18:00   **A Parity-Time-Symmetric Optoelectronic Oscillator Based on Dual-Wavelength Carriers in a Single Spatial Optoelectronic Loop**
Jiejun Zhang, Institute of Photonics Technology, Jinan University, China
Lingzhi Li, Guangying Wang, Jianping Yao

WEDNESDAY, OCTOBER 9, 2019

WE1 - INTEGRATED MICROWAVE PHOTONICS 1
Ottawa Salon - 08:30 to 10:00
Chairs: José Capmany and Daniel Pérez-López (Universidad Politecnica de Valencia, Spain)

08:30 **Design of silicon integrated Bragg gratings for microwave photonics signal processing**
Rui Cheng, University of British Columbia, Canada
Lukas Chrostowski

09:00 **Heterogeneous multicore fiber for optical beamforming**
Mario Ureña Gisbert, ITEAM Research Institute, Universitat Politècnica de València, Spain
Sergi García Cortijo, Ivana Gasulla Mestre

09:15 **300 GHz Plasmonic Mixer**
Yannick Salamin, ETH Zurich, Switzerland
Tobias Blatter, Yannik Horst, Yuriy Fedoryshyn, Wolfgang Heni, Ileana-Cristina Benea-Chelmus, Michael Baumann, Christian Haffner, Tatsuhiko Watanabe, Maurizio Burla, Delwin Elder, Larry Dalton, Juerg Leuthold

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09:30 **Coherent PM RF Photonic Link Achieving Record SFDR Performance**
Yifei Li, UMassD, USA
Peter Herczfeld, Longtao Xu, Jeffrey Rodriguez

09:45 **Nanophotonic soliton-based microwave synthesizer**
Junqiu Liu, EPFL, Switzerland
Erwan Lucas, Arslan Raja, Jijun He, Rui Ning Wang, Johann Riemensberger, Maxim Karpov, Romain Bouchand, Hairun Guo, Tobias Kippenberg

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WE2 - INTEGRATED MICROWAVE PHOTONICS 2
Ottawa Salon - 10:30 to 12:15
Chairs: Chris Roeloffzen (LioniX, Netherlands) and Lukas Chrostowski (University of British Columbia, Canada)

10:30	**Field-Programmable Photonic Array for multipurpose microwave photonic applications** **Daniel Pérez-López**, Universitat Politècnica de València, Spain Aitor López, Prometheus DasMahapatra, José Capmany
11:00	**Wideband Single-Sideband Suppressed-Carrier Modulation with Silicon Photonics Optical Filters** **Fabio Falconi**, CNIT, Italy Claudio Porzi, Suzanne Melo, Alessandro Nottola, Stefano Tirelli, Giovan Battista Preve, Marc Sorel, Antonella Bogoni
11:15	**Compact optical frequency comb source based on a DFB butt-coupled to a silicon nitride microring** **Sylvain Boust**, III-V Lab, France Houssein El Dirani, François Duport, Laurene Youssef, Yannick Robert, Alexandre Larrue, Camille Petit-Etienne, Eric Vinet, Sébastien Kerdiles, Erwine Pargon, Michaël Faugeron, Marc Vallet, Corrado Sciancalepore, Frédéric Van Dijk
11:30	**Reconfigurable photonic RF filters based on integrated Kerr frequency comb sources** **Xingyuan Xu**, Swinburne University of Technology, Australia Mengxi Tan, Jiayang Wu, Thach Nguyen, Sai Tak Chu, Roberto Morandotti, Arnan Mitchell, David Moss
11:45	**Brillouin-Based Signal Processing in Silicon Photonics** **Peter Rakich**, Yale University, USA Shai Gertler, Nils Otterstrom, Eric Kittlaus, Prashanta Kharel, Ryan Behunin

WE3 - INNOVATIVE APPLICATIONS OF MICROWAVE PHOTONICS

Ottawa Salon - 13:30 to 15:15

Chairs: Weifeng Zhang (Beijing Institute of Technology, China) and Jiejun Zhang (Jinan University, China)

13:30 **3D Radar Localization via Photonic Chirp Leaky-Wave Antenna Beam Scanning**
Matthias Steeg, University of Duisburg-Essen, Germany
Jonas Tebart, Kyriakos Neophytou, Marco Antoniades, Stavros Iezekiel, Andreas Stöhr

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13:45 **A Microwave Photonic Radar Warning Receiver based on Deep Compressed Sensing**
Daniel Onori, Institut National de la Recherche Scientifique, Canada
José Azaña

14:00 **Photonic Stretch Receiver Using an Optical Phase Correlated Reference Signal in a Coherent-detection Link**
Ruoming Li, Institute Of Electronics Chinese Academy Of Scences, China
Wangzhe Li, Jingwen Dong, Jiyao Yang

14:15 **A Practical OEO-assisted Front-end with Low Phase Noise for X-band Multi-channel Coherent Radar**
Yiran Gao, Beijing University of Posts and Telecommunications, China
Zhonghan Wu, Jian Dai, Kun Xu

14:30 **Simultaneous Measurement of Doppler-Frequency-Shift and Angle-of-Arrival of Microwave Signals for Automotive Radars**
Shilong Pan, Nanjing University of Aeronautics and Astronautics, China
Zhenzhou Tang

14:45 **Demonstration of a Microwave Photonic Radar for High-resolution Vehicle SAR/ISAR Imaging**
Wangzhe Li, Institute of Electronics Chinese Academy of Sciences, China
Ruoming Li, Jingwen Dong, Jiyao Yang, Xiangpeng Zhang

15:00 **Optimum Mitigation of distortion induced by Rayleigh Backscattering in Radio-over-Fiber links for the Square Kilometre Array Radio-Telescope**
Jacopo Nanni, DEI-University of Bologna, Italy
Andrea Giovannini, Muhammad Usman Hadi, Simone Rusticelli, Federico Perini, Jader Monari, Enrico Lenzi, Giovanni Tartarini

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COFFEE BREAK AND WE4 - POSTER SESSION 2
Ottawa Salon - 15:15 to 16:45

We4.1   **Monolithically integrated Schottky diode and UTC-PD module for Microwave transceiver**
Chun Yang, National ASIC System Engineering Research Center,School of Electronic Science and Engineering,So, China
Zhenjie Song, Zichen Feng, Shaopeng Jia

We4.2   **Free Carrier Plasma GeSn Modulator for Mid-Infrared Integrated Microwave Photonics**
Aboozar Mosleh, University of Arkansas Pine Bluff, USA
Seyedeh Fahimeh Banihashemian, Seyed Amir Ghetmiri, Wei Du, Jifeng Liu, Baohua Li, Mansour Mortazavi, Shui-Qing (Fisher) Yu

We4.3   **Phase Noise Performance of SILPLL based Opto-electronic Oscillator using Sagnac-loop PM-IM Convertor**
KAI Wei, Drexel University, USA
Afshin Daryoush

We4.4   **Widely tunable parity-time symmetric optoelectronic oscillator based on a polarization modulator**
Peixuan Li, Southwest Jiaotong University, China
Caihong Teng, Xihua Zou, Wei Pan, Lianshan Yan

We4.5   **Microwave-optical fiber lasers stabilized by frequency-shifted feedback**
Marie Guionie, Univ Rennes, France
Aurélien Thorette, Marco Romanelli, Anthony Carré, Goulc'hen Loas, Emmanuel Pinsard, Laurent Lablonde, Benoit Cadier, Mehdi Alouini, Marc Vallet, Marc Brunel

We4.6   **An Antenna-integrated UTC-PD based Photonic Emitter Array**
Guillermo Carpintero, Universidad Carlos III de Madrid, Spain
Muhsin Ali, Robinson Cruzoe Guzmán, Frédéric Van Dijk, Luis Enrique García-Muñoz

We4.7   **Microwave Photonic Based 1/n Frequency Divider**
Shaochen Duan, Institute of Photonics Technology Jinan University Guangzhou, China
Baohang Mo, Erwin Chan, Xudong Wang, Xinhuan Feng, Bai-Ou Guan, Jianping Yao

We4.8   **Regenerative rational mode locked laser**
Vincent Billault, Thales Research and Technology, France
Vincent Crozatier, Ghaya Baili, Pascale Nouchi, Daniel Dolfi, Hugues Guillet de Chatellus

We4.9   **Photonic Generation of Dual-Chirp Microwave Pulses by Self-Heterodyne Optical Beating**
Pedro Tovar Braga, Pontifical Catholic University of Rio de Janeiro, Brazil
Jean Pierre von der Weid, Ricardo Marques Ribeiro

We4.10   **Inter-modal Laser Based RF Output Stabilization Using Forced SILPLL Technique**
Tianchi Sun, Drexel University, USA
Kai Wei, Afshin Daryoush

We4.11   **Photonic Generation of Spectrally Pure Millimeter-Wave Signal for 5G Applications**
Khan Zeb, Concordia University and National Research Council Canada, Canada
Zhenguo Lu, Jiaren Liu, Mohamed Rahim

We4.13   **A Segmented Photonic Digital-to-analog Converter with a High Effective Number of Bits**
Jiading Li, Department of Electronic Engineering, Tsinghua University, China
Xiaoxiao Xue, Yu Zha, Dexin Wu, Shangyuan Li, Xiaoping Zheng

We4.14   **Analysis of RF Photonic Link Linearization UsingnTruncated Fourier Series**
James Adleman, Naval Information Warfare Center Pacific, USA
David Chao, Sanja Zlatanovic

We4.15   **Tunable Low-Spurious Heterodyne-Dual-Injection-Locked Optoelectronic Oscillator**
Chun Yang, Southeast Universtity, China
Weijie Xu, Ziye Wang, Weiqian Zhao

We4.16   **Programmable linear frequency modulated signal generation using a compact photonics-based scheme**
Ran Cheng, Shanghai Jiao Tong University, China
Wei Wei, Weilin Xie, Yi Dong

We4.17   **Sagnac Loop Phase-Modulated RF Photonic Link for Wideband High Dynamic Range Operation**
Yifei Li, UMass Dartmouth, USA
Jeffrey Rodriguez, Massoud Massoud

We4.18   **Accurate Measurement of Propagation Delay in a Multi-Span Optical Link**
Michael Eiselt, ADVA, Germany
Florian Azendorf

We4.19   **Mode-Division Multiplexed PAM-4 Signal Transmission in a Silicon Photonic Chip**
Jianping Yao, University of Ottawa, Canada
Weifeng Zhang, Shao Tong, Houman Ghorbani

We4.20   **Polarization Diversity Photoreceiver Integration on 26 GHz PCB Leaky-Wave Antenna for Photonic Beam Steering Transmitter**
Matthias Steeg, University of Duisburg-Essen, Germany
Sebastian Dülme, Jonas Tebart, Tom Neerfeld, Vitaly Rymanov, Andreas Stöhr

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We4.21   **Bandwidth-efficient subcarrier multiplexing radio-over-fiber system based on independent-sideband modulation**
Peixuan Li, Southwest Jiaotong University, China
Xihua Zou

We4.22   **Compact Tunable Laser Array for WDM-PON in 5G wireless networks**
Rulei Xiao, Nanjing University, China
Zhirui Su, Zhenxing Sun, Jun Lu, Yuechun Shi, Xiangfei Chen

We4.23   **Coherent Microwave Photonic Channelized Receiver with Low Come Line Requirement of OFC and Image Rejection Ability**
Wu Zhang, National Key Laboratory of Science and Technology on Space Microwave, China
Xiaojun Li, Aijun Wen, Wei Jiang, Qinggui Tan

We4.24   **Microwave photonics filter assistant Vernier microwave frequency comb based fiber sensor**
Zuowei Xu, Huazhong University of Science and Technology, China
Xuewen Shu

We4.25   **Proposal of photonic analog-to-digital conversion using weighted multiwavelength pulses and balanced photodetector**
Hongxia He, College of Information Science and Electronic Engineering, Zhejiang University, China
Shuna Yang, Jun Ou, Tao Jin, Hao Chi

We4.26   **Nonuniform Microwave Photonic Delay-Line Filter For Optical Sensor Network Interrogation**
Chao Wang, University of Kent, UK
Dongrui Xiao, Tingting Han, Liyang Shao

We4.27   **Experimental Generation and De-chirping of Photonic THz Linearly Chirped Signals with Large Time-bandwidth Product**
Xianbin Yu, Zhejiang University, China
Shiwei Wang, Zijie Lu, Nazar Idrees, Shilie Zheng, Xiaofeng Jin, Xianmin Zhang

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WE5 - PHOTONIC MICROWAVE PROCESSING, SENSING, AND MEASUREMENTS 2
Ottawa Salon - 16:45 to 18:15

Chairs: Mable Fok (University of Georgia, USA) and José Azana (INRS-EMT, Canada)

16:45	**Comb-based subnoise RF signal detection and wideband signal analysis**
	Stojan Radic, University of California San Diego, USA

17:15	**High-speed Analog-to-Digital Converter Based on Dual Integrated Soliton Microcombs**
	Anton Lukashchuk, EPFL, Switzerland
	Johann Riemensberger, Junqiu Liu, Pablo Marin-Palomo, Maxim Karpov, Christian Koos, Romain Bouchand, Tobias Kippenberg

17:30	**Laser ranging with analog all-optical coherent pulse compression**
	Hugues Guillet de Chatellus, LIPHY, Université Grenoble Alpes, CNRS, France
	Vicente Duran-Bosch, Juan Clement, Carlos Fernandez-Pousa

17:45	**Photonics-assisted digital-to-analog conversion**
	Ghaya Baili, Thales Research Group, France

THURSDAY, OCTOBER 10, 2019

TH1 - RADIO-OVER-FIBER TECHNIQUES AND OPTICAL-WIRELESS
Ottawa Salon - 08:30 to 10:00
Chairs: Christina Lim (University of Melbourne, Australia) and Daniel Onori (INRS-EMT, Canada)

08:30	**Multi-core fiber technology supporting MIMO and photonic beamforming in 5G multi-antenna systems** **Maria Morant**, Nanophotonics Technology Center, Universitat Politècnica de València, Spain Ailee M. Trinidad, Eduward Tangdiongga, Roberto Llorente

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09:00	**A ultrawide-band VCSEL-based radar-over-fiber system** **Antonio Malacarne**, Scuola Superiore Sant'Anna, Italy Salvatore Maresca, Filippo Scotti, Bilal Hussain, Leonardo Lembo, Giovanni Serafino, Antonella Bogoni, Paolo Ghelfi

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09:15	**80 Gb/s 2_2 MIMO Fiber-Wireless Integrated System in W Band Using IFoF Transmission** **Dat Pham**, NICT, Japan Atsushi Kanno, François Rottenberg, Naokatsu Yamamoto, Tetsuya Kawanishi

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09:30	**Fiber Wireless A-RoF/IFoF uplink of 0.4Gb/s 16-QAM and 0.6Gb/s QPSK over a 32-element 60GHz phased array antenna for 5G fronthaul networks** **Apostolos Tsakyridis**, Aristotle University of Thessaloniki, Greece Eugenio Ruggeri, George Kalfas, Yigal Leiba, Amalia Miliou, Nikos Pleros, Christos Vagionas

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09:45	**OFDM Baud Rate Limitations in an Optical Heterodyne Analog Fronthaul Link using Unlocked Fibre Lasers** **Amol Delmade**, Dublin City University, Ireland Colm Browning, Arman Farhang, David Koilpillai, Deepa Venkitesh, Liam Barry

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PLENARY SESSION 2
Ottawa Salon - 10:30 to 11:15
Chairs: Ivana Gasulla (Universidad Politecnica de Valencia, Spain) and Jason McKinney (Naval Research Laboratory, USA)

10:30	**Millimeter-Wave-Band Electro-Optic Modulators for Microwave Photonic Applications** **Hiroshi Murata**, Mie University, Japan

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TUTORIAL 2 - WHAT CAN PHOTONICS BRING TO RADARS?
Ottawa Salon - 11:15 to 12:15
Chairs: Ivana Gasulla (Universidad Politecnica de Valencia, Spain) and Jason McKinney (Naval Research Laboratory, USA)

11:15   **Tutorial 2 - What can photonics bring to radars?**
Shilong Pan, Yameiz Zhang, Fangzheng Zhang, and Dan Zhu, Nanjing University of Aeronautics and Astronautics, China

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TH2 - PHOTONIC MICROWAVE PROCESSING, SENSING, AND MEASUREMENTS 3
Ottawa Salon - 13:30 to 15:15
Chairs: Fangzheng Zhang (Nanjing University of Aeronautics and Astronautics, China) and Chao Wang (University of Kent, UK)

13:30   **Fiber-based Temporal Waveform Processor Enabled by Discrete Fourier Transform of Fractional-Rate Modulated Optical Pulse Train**
Chester Shu, The Chinese University of Hong Kong, China
Qijie Xie, Honghui Zhang

14:00   **An Integrated Discrete-Time Microwave Photonic Filter Using Surface Acoustic Waves in Silicon**
Avi Zadok, Bar-Ilan University, Israel
Dvir Munk, Moshe Katzman, Mirit Hen, Maayan Priel, Arik Bergman

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14:15   **Multi Pole Microwave Filtering using Brillouin Scattering in Silicon**
Shai Gertler, Yale University, USA
Eric Kittlaus, Prashanta Kharel, Nils Otterstrom, Peter Rakich

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14:30   **Flat-top Microwave Photonic Bandpass Filter with Tunable Bandwidth Based on SBS and FWM**
Haitao Tang, Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China
Yuan Yu, Lu Xu, Xinliang Zhang

14:45   **Photonics-Based Real-Time 2D (Time-Frequency) Broadband Signal Analysis and Processing**
José Azaña, Institut National de la Recherche Scientifique (INRS), Canada
Saikrishna Reddy Konatham, Reza Maram, Hugues Guillet de Chatellus

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TH3 - POSTDEADLINE SESSION AND WRAP-UP
Ottawa Salon - 15:45 to 16:30
Chairs: Jianping Yao (University of Ottawa, Canada) and Lawrence R. Chen (McGill University, Canada)

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Newkey Photonics Technologies headquartered in Suzhou, China, is a pioneer in innovative microwave photonic products and solutions for high performance measurements. Newkey Photonics provides the abilities to measure the analog parameters of optoelectrical components, including: S parameters (magnitude and phase), true time delay, group delay, etc., with spectrum resolution higher than 50 kHz and delay precision up to 0.1 ps. The technologies we developed are in support of optical/5G communication, optical sensing, integrated photonics, etc.

General Optoelectrical Component Analyzer

- **Co-developed with R&S**
- S-parameter test for O-E, E-O, O-O components
- 134 GHz of one-shot test for O-O components
- 50 kHz frequency resolution

GOCA

ODM-C

ODM-S

High Precision Optical Delay Meter

- 0.1 ps presicion (0.02 mm)
- 250 µs max range (50 km)
- C/L/O bands
- <0.5s per test

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