

IMS2020

LOS ANGELES

21-26 JUNE 2020

AT THE LOS ANGELES CONVENTION CENTER

WWW.IMS-IEEE.ORG



International Microwave Symposium

CALL FOR PAPERS



Come join us in Los Angeles at the intersection of 5G, aerospace, and automotive technologies to hear the latest developments in microwave theory, techniques, and applications at the International Microwave Symposium (IMS). The IEEE Microwave Theory and Techniques

Society's 2020 International Microwave Symposium (IMS2020) will be held 21-26 June 2020 at the Los Angeles Convention Center in Los Angeles, California. IMS2020 is the centerpiece of Microwave Week 2020 comprising the RFIC Symposium (www.rfic-ieee.org) and the ARFTG Conference (www.arftg.org).

Microwave Week, with more than 9000 participants and 600 industrial exhibits of state-of-the-art microwave products, is the world's largest gathering of radio-frequency (RF) and microwave professionals and the most important forum for the latest research advances and practices in the field. IMS2020 offers something for everyone, including the following:

- Technical Program – Oral / Poster Sessions, Workshops and Short Courses
- 5G Summit showcasing the next-generation wireless technologies for mobility, V2X and IoT
- RF Bootcamp intended for students, engineers, and managers from non-microwave engineering disciplines
- Job Fair for students offering employment opportunities within our exhibitor community.
- Exhibitor workshops and application seminars featuring presentations by the preeminent technologists from our exhibitors, explaining the technology behind their products
- Small Business / Entrepreneurs' area on the exhibitor floor
- Discounted pricing for students with a SUPERPASS offering access to all conference events
- Competitions for Best Industry Paper, Advanced Practices Paper, Student Paper Award, Three Minute Thesis (3MT), Student Design Competitions and Student Demonstrations. A Student Demonstration event for showcasing the prototypes developed by students presented in the technical papers
- Project Connect for underrepresented minority engineering students, and the Ph.D. Student Initiative for new students
- Networking events for Amateur Radio (HAM) enthusiasts, Women in Engineering (WIE)/Women in Microwaves (WIM), and Young Professionals (YP)
- STEM Program featuring hands on activities and exhibitions designed to help students in middle and high school expand their understanding of what it is to be an engineer
- Guest hospitality suite and tour programs for attendees and their guests

Paper Submission: Authors are invited to submit technical papers describing original work microwave, millimeter-wave, and terahertz theory and techniques. The deadline for submission is 4 December 2019. A double-blind review process will be used to ensure anonymity for both authors and reviewers. Detailed instructions on submitting a double-blind compliant paper can be found at www.ims-ieee.org. Papers will be evaluated on the basis of originality, content, clarity, and relevance to IMS.



PAPER SUBMISSION INSTRUCTIONS:

1. All submissions must be in English.
2. Authors must adhere to the format provided in the template, which can be downloaded from www.ims-ieee.org.
3. Authors must submit their paper at www.ims-ieee.org by 11:59 PM Hawaii Standard Time on 4 December 2019. Late submissions will not be considered. The initial submission should be between 3 to 4 pages, must be in PDF format, must be double-blind compliant, and cannot exceed 2 MB in size. Hardcopy and email submissions are not accepted.

Page Limit: For the initial submission deadline, the paper length should be 3 to 4 pages. Papers longer than 4 pages will not be considered. The final page length for papers accepted for publication in the proceedings is 3 to 4 pages.

Paper Selection Criteria: Papers are reviewed by IMS2020 Technical Program subcommittees. The selection criteria will be:

- **Originality:** Is the contribution unique and significant? Does it advance the state of the art of the technology and / or practices? Are proper references to previous work by the authors and others provided?
- **Quantitative content:** Does the paper give a comprehensive description of the work with adequate supporting data?
- **Clarity:** Is the paper contribution and technical content presented with clarity? Are the writing and accompanying figures clear and understandable?
- **Interest to MIT-S membership:** Why should this work be reported at this conference?

Technical Areas: During the paper submission process, authors will choose a primary and two alternative technical areas (see the Technical Areas). The paper abstract should contain information that clearly reflects the choice of the area(s). Author-selected technical areas will be used to determine an appropriate committee for reviewing the paper. The technical areas are divided into five different categories that are used to organize the paper presentation schedule. It is permissible to choose primary and alternative technical areas that are in different categories.

Presentation Format: IMS offers three types of presentation formats. The authors' preference will be honored where possible, but the IMS2020 Technical Program Committee (TPC) reserves the right to place papers in the most appropriate technical area and presentation format.

4. Full-length (20 minute) papers report significant contributions, advancements, or applications in a formal presentation format with questions and answers (Q&A) at the end.
5. Short (10 minute) papers typically report specific refinements or improvements in the state of the art in a formal presentation format with Q&A at the end.
6. Interactive forum papers provide an opportunity for authors to present their theoretical and/or experimental developments and results in greater detail and in a more informal and conversational setting. Papers will be presented on large electronic displays in the interactive forum arena. In addition, authors have the opportunity to display hardware, perform demonstrations, and conduct discussions with interested IMS attendees.

Notification: Authors will be notified of the decision by 5 February 2020 via the email address(es) provided with the initial paper submission. For accepted papers, an electronic version of the final manuscript (3 to 4 pages, to be published in the Symposium proceedings) along with a copyright assignment to the IEEE must be submitted by 4 March 2020. Authors will be required to submit their presentation slides using the approved template by 20 May 2020, and these will be made available to all attendees at the conference. The submission instructions will also be provided through emails and can be accessed through the Symposium website. The Symposium proceedings will be recorded on electronic media and archived in IEEE Xplore.

Clearances: It is the authors' responsibility to obtain all required company and government clearances prior to submitting a paper. Authors are strongly urged not to wait until the last day to start the paper submission process. Those unfamiliar with the process may encounter paper formatting or clearance issues that may

take time to resolve. A statement certified by the submitting author that such clearances have been obtained and a completed IEEE copyright form must accompany the manuscript of each accepted paper. Details regarding clearances will be available during the paper submission process.

Student Superpass: IMS2020 enthusiastically invites participation from students at all levels to attend IMS2020. All students will be offered the opportunity to purchase a SUPERPASS allowing access to the IMS, RFIC, and ARFTG conferences, all workshops, short courses and panel sessions, and most other events over the course of the week. Superpass prices are significantly discounted to encourage student participation.

Student Paper Competition: Eligible students are encouraged to submit papers for the Student Paper Competition. These papers will be reviewed in the same manner as all other contributed papers. First, second, and third prizes will be awarded based on content and presentation. To be considered for an award, the student must be a full-time student during the time the work was performed, be the lead author, and personally present the paper at IMS. During the submission process, the student is required to provide the email address of the faculty advisor, who will be asked upon the selection of the paper to certify that the work is primarily that of the student. Please refer to www.ims-ieee.org for full eligibility details.

Industry and Advanced Practice Paper Competitions: Eligible authors from industry are encouraged to submit papers for the Industry Paper Competition. Additionally, any author who submits a paper on advanced practices may be entered into the Advanced Practice Paper Competition. A paper on advanced practices describes an innovative RF/microwave design integration technique, process enhancement, and/or combination thereof that results in significant improvements in performance and/or in time to production for RF/microwave components, subsystems, or systems. The papers will be evaluated using the same standards as all contributed papers. Please refer to www.ims-ieee.org for details.

Workshops, Short Courses, Focus and Special Sessions, Panel and Rump Sessions: Topics being considered for these areas include, but are not limited to, next-generation wireless systems (5G and beyond), emerging RF/microwave applications, latest technologies for RF/microwave measurements, and advances in RFIC technology. Please consult www.ims-ieee.org for a more detailed list of desired topics and instructions on how to prepare a proposal. Proposals must be received by 18 September 2019.

MicroApps and Exhibitor Workshops: Microwave Application Seminars (MicroApps) continue as a forum on the exhibition floor for IMS exhibitors to present the technology and special capabilities behind their commercial products. In addition, the Exhibitor workshops provide IMS exhibitors a unique opportunity to provide more in-depth presentations of technical topics to the attendees. Both events are open to all conference and exhibit attendees. Exhibitor workshops require a nominal fee while MicroApps are free of charge.

Student Design Competition: All eligible students or student teams are invited to participate in the student design competitions (SDCs) during the IMS2020. Several design challenges will be presented in advance as an opportunity to showcase microwave engineering and design skills. Please refer to www.ims-ieee.org for full eligibility details, a list of IMS2020 SDCs, and the rules for each SDC.

Student Demonstrations: Student authors of accepted oral and interactive forum papers are invited to demonstrate prototype hardware or software results in a special session. This will be a unique opportunity for students to showcase research results presented during technical sessions. Please refer to www.ims-ieee.org for full details.

Three Minute Thesis (3MT®) Workshop: A full-day Sunday workshop on presenting technical work for broader audiences, concluded by a 3MT® competition for eligible student and young professional finalists selected following TPRC acceptance of their papers and subsequent video submissions. The 3MT® contestants will make a presentation of three minutes or less, supported only by one static slide, in a language appropriate to a non-specialist audience.

IEEE T-MTT Special Issue: Authors of all papers presented at IMS2020 can submit an expanded version of their IMS papers to the Special Issue of the IEEE Transactions on Microwave Theory and Techniques (IEEE T-MTT) devoted to the IMS2020. Please refer to www.ims-ieee.org for details.

TECHNICAL AREAS:

Field, Device, and Circuit Techniques

- 1 Field analysis and guided waves** – Novel guiding and radiating structures, new physical phenomena in transmission lines and waveguides, and new analytical methods for solving guided-wave and radiation problems.
- 2 Numerical techniques & CAD algorithms** – Finite-difference, finite-element, integral equation, and hybrid methods for RF, microwave, and THz applications. Simulation, modeling, uncertainty quantification, and design optimization; circuit-, EM-, multi-physics-, and statistics-based, including surrogate modeling, space mapping, and model order reduction techniques.
- 3 Instrumentation and measurement techniques** – Theoretically supported and experimentally demonstrated linear and nonlinear measurement techniques for devices and materials, error correction, de-embedding, calibration, and novel instrumentation.
- 4 Microwave device modeling** – Active and passive, linear and nonlinear device and structure modeling (physical, empirical, and behavioral) including characterization, parameter extraction, and validation.
- 5 Nonlinear circuit and system analysis, simulation, and design** – Distortion, stability and qualitative dynamics analysis; circuits and systems (C&S) simulation techniques and applications; behavioral modeling of nonlinear C&S (excluding PAs); and nonlinear C&S design and implementations.

Passive Components and Packaging

- 6 Transmission-line structures** – Novel transmission-line structures and devices, transmission-line equivalent circuits, artificial transmission lines and metamaterial structures, transmission-line applications for devices and systems.
- 7 Passive circuit elements** – Couplers, dividers/combiners, hybrids, resonators, and lumped-element approaches.
- 8 Planar passive filters and multiplexers** – Planar passive filters and multiplexers including lumped elements, theoretical filter and multiplexer synthesis methods.
- 9 Non-planar passive filters and multiplexers** – Resonators, filters and multiplexers based on dielectric, waveguide, coaxial, or other non-planar structures.
- 10 Active, tunable, and integrated filters** – Integrated (on Si, LTCC, LCP, MCM-D, GaAs), active, and tunable filters.
- 11 Microwave acoustic, ferrite, ferroelectric, phase-change, and MEMS components** – Surface and bulk acoustic wave devices including FBAR devices, bulk and thin-film ferrite components, ferroelectric-based devices, and phase-change devices and components. RF microelectromechanical and micromachined components and subsystems.
- 12 Packaging, MCMs, and 3D manufacturing techniques** – Component and subsystem packaging, assembly methods, inkjet printing, multi-chip modules, wafer stacking, 3D interconnect, heterogeneous integration, and integrated cooling. Novel processes related to 3D printing or additive manufacturing techniques.

Active Devices

- 13 Semiconductor devices and process characterization** – RF, microwave, and mm-wave devices on III-V, silicon and other emerging technologies. MMIC and Si RFIC manufacturing, reliability, failure analysis, yield, and cost.
- 14 Low-noise amplifiers, variable-gain amplifiers and receivers** – LNAs, VGAs, detectors, receivers, integrated radiometers, cryogenic amplifiers and models, and characterization methods for low-noise integrated circuits and components up to 110 GHz.
- 15 Signal generation, modulators, frequency conversion, and signal shaping ICs** – CW and pulsed oscillators in silicon and III-V processes including VCOs, DROs, YTOs, PLOs, and frequency synthesizers, signal modulators, and frequency conversion ICs in silicon and III-V processes, such as IQ modulators, mixers, frequency multipliers/dividers, switches, and phase shifters up to 110 GHz.
- 16 Mixed-signal and wireline ICs** – High-speed mixed-signal components and subsystems for transmission; equalization and clock-data recovery techniques for electrical backplanes and electro-optical interfaces. High-speed mixed-signal components and subsystems, including ADC, DAC and DDS technologies.
- 17 High-power RF and microwave amplifiers** – Advances in discrete and IC power amplifier devices and design techniques based on III-V and LD-MOS devices, demonstrating improved power, efficiency, and linearity for HF, UHF, VHF, RF and microwave bands (< 26 GHz). Power-combining techniques for SSPA and vacuum electronics for RF and microwave.
- 18 Millimeter-wave power amplifiers** – Advances in IC power amplifier devices, design techniques and power combining based on III-V devices demonstrating improved power, efficiency, and linearity for millimeter-wave bands (> 26 GHz); vacuum electronics for millimeter-wave.

- 19 Silicon power amplifiers** – Advances in RFC and digital power amplifier design and power combining techniques based on silicon CMOS and SiGe processes, demonstrating improved power, efficiency, and linearity for RF to millimeter-wave bands (< 110 GHz).
- 20 Linearization and transmitter techniques for power amplifiers** – Power amplifier design, characterization, and behavioral modeling; linearization and pre-distortion techniques; envelope-tracking, outphasing and Doherty transmitters for III-V and silicon technologies at all frequencies up to 110 GHz.
- 21 Integrated transceivers, beamformers, imaging and phased-array chips and modules** – Design and characterization of complex III-V and silicon ICs and related packaging in the RF to mm-wave including narrowband and wideband designs. Innovative circuits and sub-systems for communications, radar, imaging, and sensing applications. Integrated on-chip antennas up to 110 GHz.
- 22 Millimeter-wave and terahertz integrated circuits and systems** – Design and characterization of active components including LNAs, PAs, and frequency conversion ICs in silicon and III-V processes above 110 GHz and/or packaging in the upper mm-wave and THz regimes; innovative THz circuits systems for communications, radar, imaging, and sensing applications. Demonstrations of on-chip antennas.
- 23 Microwave photonics and nanotechnology** – Integrated devices and 1D-2D material-based technology. Multidisciplinary field studying the interaction between microwaves, THz waves, and optical waves for the generation, processing, control, and distribution of microwave, mm-wave, and THz signals. Emerging RF applications of nanophotonics, nanoplasmonics, and nano-optomechanics; nanoscale metrology and imaging.

Systems Applications

- 24 Phased arrays and beamformers** – Technology advances combining theory and hardware implementation in the areas of phased-array antennas, integrated beamformers, spatial power combining, retrodirective systems, built-in self-test techniques, broadband arrays, digital beamforming, and multi-beam systems.
- 25 Radar and imaging systems** – Microwave and millimeter-wave radar systems, automotive radars, sensors for intelligent vehicular highway systems, UWB and broadband radar, remote sensing, radiometers, passive and active imaging systems, radar detection algorithms and related digital signal processing and machine learning techniques.
- 26 Wireless, 5G and satellite communication systems** – RF to mm-wave (<300 GHz) communication systems with hardware implementation for terrestrial, vehicular, satellite, and indoor applications, point-to-point links, cognitive and software-defined radios, MIMO and full-duplex technologies, and simultaneous transmit and receive systems.
- 27 Wireless and 5G system characterization and architectures** – Wireless and 5G enabling technologies including but not limited to beamforming techniques, MIMO, massive MIMO, multiple radio access technologies, centralized radio access networks, shared and novel spectrum use, waveform design, modulation schemes, and channel modeling.
- 28 Sensing and RFID systems** – Short range wireless and RFID sensors, gas and fluidic sensors, passive and active tags from HF to millimeter-wave wave, RFID systems including wearables and ultra-low-power.
- 29 Wireless power transmission** – Energy harvesting systems and applications, rectifiers, circuits, self-biased systems, combined data and power transfer systems
- 30 RF and microwave instrumentation for biological measurements and healthcare applications** – Devices and components for biological measurements, therapeutic, and diagnostic applications; Systems and instrumentation for biomedical applications; wireless sensors and systems, and implantable and wearable devices for health monitoring and telemedicine.
- 31 RF and microwave interaction of materials and tissue** – Electromagnetic field interaction at molecular, cellular, and tissue levels; microwave characterization of biological materials and living systems; MRI and microwave imaging. Industrial and scientific, medical applications utilizing microwave power technology; microwave-enhanced chemistry; non-destructive evaluation /testing and material property measurements at nanometer to millimeter scale.

Emerging Technologies

- 32 Innovative systems and applications** – Emerging technologies and novel system concepts for RF/microwave applications such as 6G, Internet of Things (IoT), Internet of Space (IoS), quantum information science (computing, sensing and communications), wearable computing/communication systems, machine-to-machine (M2M) communication, intelligent transportation, smart cities, and smart environment.

JOIN US IN LOS ANGELES FOR IMS2020

21-26 JUNE 2020

IMS2020 Technical Program Committee

EXECUTIVE COMMITTEE

Timothy Lee, *General Chair*
Jon Hacker, *General Vice-Chair*
Mike DeLisio, *General Vice-Chair*
Gabriel Rebeiz, *TPC Co-Chair*
Jim Buckwalter, *TPC Co-Chair*
Sherry Hess, *Finance Chair*
Kevin Miyashiro, *Marketing and Publications Chair*
Carolyn Kitamura, *Local Arrangements/Operations Co-Chair*
Andy Morishita, *Local Arrangements/Operations Co-Chair*

PLENARY SESSION

Jon Hacker, *Chair*
Mike Delisio

PROFESSIONAL STAFF

Elsie Vega, *Conference Manager*
Lee Wood, *Exhibition Manager*
Kevin Lepine, *Registration/EPMS Manager*
Amanda Scacchitti, *Marketing and Publications Manager*

SENIOR ADVISORS AND AUXILIARY CONFERENCE CHAIRS/LIAISONS

JK McKinney, *Senior Advisor*
Kevin Miyashiro, *Senior Advisor*
Larry Kushner, *IMS2019 General Chair*
Steve Kenney, *IMS2021 General Chair*

TECHNICAL PROGRAM COMMITTEE

Gabriel Rebeiz, *TPC Co-Chair*
Jim Buckwalter, *TPC Co-Chair*
Tim Hancock, *TPC Senior Advisor*
Juergen Hasch, *European Liason*
Frank Van Fliet, *European Liason*
Pierre Blondy, *European Liason*
Ke Wu, *Asian Liason (China)*
Jae-sung Rieh, *Asian Liason (Korea)*

ELECTRONIC PAPER MANAGEMENT

Sandy Owens

WORKSHOPS

Ethan Wang, *Chair*
Payam Heydari, *Co-Chair*
Jeremy Dunworth, *Co-Chair*
Danilo Manstretta, *RFIC Liaison*

5G SUMMIT

Walid Ali-Ahmad, *Chair*
Tim LaRocca, *Co-Chair*

SHORT COURSES

Hasan Sharifi, *Chair*
Joe Bardin, *Co-Chair*

RF BOOT CAMP

Larry Dunleavy, *Chair*
Joanne Mistler

PANEL SESSIONS

Fred Schindler, *Chair*
John Wood

FOCUS/SPECIAL SESSIONS

Julio Navarro, *Chair*
Gayle Collins
Mona Jarrahi

INTERACTIVE FORUM

Zaher Bardai

STUDENT PAPER COMPETITION

Chip Moyer, *Chair*
Adam Young
Laya Mohammadi

STUDENT DESIGN COMPETITIONS

Adrian Tang, *Co-Chair*
Michael Thorburn, *Co-Chair*

STUDENT DEMONSTRATIONS

Hossein Hashemi

ADVANCED PRACTICE COMPETITION

Jim Sowers

THREE MINUTE THESIS

John Bandler
Erin Kiley

MICROAPPS

Jim Weiler

INDUSTRY WORKSHOPS

Charlie Jackson

HISTORICAL EXHIBIT

Terry Cisco, *Chair*
Bob Dengler, *Co-Chair*

Important Dates

- **18 September 2019** (Wednesday)
PROPOSAL SUBMISSION DEADLINE
For workshops, short courses, focus and special sessions, panel and rump sessions
- **4 December 2019** (Wednesday)
PAPER SUBMISSION DEADLINE
All submissions must be made electronically.
- **5 February 2020** (Wednesday)
PAPER DISPOSITION
Authors will be notified by email.
- **4 March 2020** (Wednesday)
FINAL MANUSCRIPT SUBMISSION DEADLINE
Manuscript and copyright of accepted papers.
- **13 May 2020** (Wednesday)
WORKSHOP NOTES SUBMISSION DEADLINE
Electronic upload of workshop notes to the Workshop Organizers.
- **20 May 2020** (Wednesday)
FINAL PRESENTATIONS SUBMISSION DEADLINE
Electronic upload of presentations in both PDF and PPT format
- **21-26 June 2020**
MICROWAVE WEEK
IMS2020, RFIC 2020, ARFTG, and Exhibition