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CONFERENCE
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Welcome to the 24th European Microwave Week

The European Microwave Week 2021 organisers would like to thank the following companies for their help and valued support throughout this year’s event.

It is with great pleasure that we welcome you to the 24th European Microwave Week (EuMW), which is taking place at ExCeL in London, UK. At the time of writing this message, the world is still in the grip of the coronavirus pandemic. The pandemic has greatly affected the way we live our lives for almost two years now. Many people around the world have lost their lives and many have had their lives changed permanently by the pandemic. One impact has been how we, the human race, interact with each other. The human instinct is usually to come together to help deal with problems, to form strategies and build partnerships, and, to celebrate successes.

EuMW is one such event that is motivated by these instincts. It is for this reason the organising team for this year’s event has worked long and hard to ensure we have an event where we can come together and meet, face to face, as a community to continue to develop and celebrate our area of science, engineering and technology. We feel that it is vital to achieve this goal. This is the third time that EuMW has been hosted in London, following on from previous highly successful events in 2001 and 2016. London is a natural venue for prestigious scientific events, being the home of such long-standing scientific institutions as the Royal Society (founded in 1660), the University of London (founded in 1836) and the Institution of Electrical Engineers (founded in 1871), as well as the home to many famous scientists, including James Clerk Maxwell, Lord Rayleigh, Charles Wheatstone, Alan Turing, etc. Our moto for this year’s EuMW is ‘United in Microwaves’. This reflects the traditional feeling of unity in our community, and, demonstrates how we can use this conference to re-establish and further develop this feeling of unity within our community of colleagues and fellow professionals, despite the recent problems caused by the pandemic.

EuMW 2021 continues the annual series of highly successful microwave events that started back in 1998. EuMW 2021 comprises three co-located conferences: European Microwave Conference (EuMC); European Microwave Integrated Circuits Conference (EuMIC); European Radar Conference (EuRAD). There are also many workshops and short courses associated with each of these conferences, along with several Special and Focused Sessions. Two particular highlights are Special Sessions on the life and works of two prominent members for our community who sadly passed during 2020; Professor Peter Clarricoats and Professor Roberto Sorrentino. Peter Clarricoats was Chair of the first European Microwave Conference (EuMC), held in London in 1969, and Chair of the 9th EuMC in the UK in 1979; he received a EuMA Distinguished Service award in 2005. Roberto Sorrentino was a founder member of the European Microwave Association and President of EuMA from 1998 to 2009. They will both be sadly missed.

In addition, there are three Forums, covering: Defence, Security and Space; Automotive; and, Beyond 5G technologies. There is also a very large trade show – the largest RF and microwave trade show in Europe – where the leading companies from our industry exhibit their very latest technological developments. EuMW 2021 also has several activities aimed specifically at students. These include: the Tom Braziel Doctoral School of Microwaves; the European Microwave Training School; the Career Platform; and, IEEE Young Professionals. There is also the Women in Microwave event, in which both women, and men, are encouraged to participate.

We sincerely hope that you will enjoy a memorable experience in London at EuMW 2021.
Welcome from the President of the European Microwave Association

On behalf of the European Microwave Association (EuMA), I warmly welcome you to the 24th edition of the European Microwave Week in London! EuMA stands up for our microwave and RF community. We foster networking between scientists, engineers, decision makers and end-users. The European Microwave Week (EuMW) is our main asset and a real networking event. It's the place to get information you can’t get anywhere else and to meet colleagues you don’t see every day.

EuMA is continuously improving itself to support our microwave community. We recently released a 22 pages White Paper ‘For a Strong & Competitive European Wireless Technologies Ecosystem’. A free download is available at our website www.eu-mwa.org. Soon EuMA will announce a new series of webinars with interesting and qualified speakers.

EuMA is very active on social media. Follow us @euassociation on Facebook, LinkedIn, Twitter, YouTube and Instagram and discover our latest posts.

Preparing and hosting the EuMW is a major effort, from paper submission and review to on-site organisation. This is accomplished by a team of volunteers year by year. My special and sincere thanks go to Nick RIDLER and John CUNNINGHAM for the 2021 General Chair and Co-chair; to Peter GARDNER, General TPC Chair; to Adrian CROSS, Treasurer; to Emma MCFHERSON and Yi WANG, EuMC Chair and TPC Chair; to Chris CLIFTON and Edward WASIGE, EuMIC Chair and TPC Chair; and to James WATTS and Matt RITCHIE, EuRAD Chair and TPC Chair - just to name a few on behalf of the entire team. Thank you!

The European Microwave Week is back again in UK after the successful events in 2001, 2006, 2011 and in 2016. All members of the team have been working hard to set up an outstanding technical and scientific programme and I am sure they will make your stay in London exciting, enjoyable, and a rewarding experience. In the next three years, the traditional EuMW will take place from Monday 14th and Tuesday 15th February 2022. EuMIC is the premier European technical conference for RF & microwave microelectronics as part of the European Microwave Week (EuMW).

The aim of the conference is to promote the discussion of recent developments and trends and to encourage the exchange of scientific and technical information covering a broad range of microwave, mm-wave, terahertz and related topics, from materials and technologies to integrated circuits and applications that will be addressed in all of their aspects: theory, simulation, design and measurement.

Monday is a busy day with a large offering: beyond the Opening Session, there will be ten regular sessions as well as the traditional Foundry Session. This lively Foundry session brings together key representatives of the RF and microwave semiconductors and foun- dries and will run together with the EuMIC Cocktail Reception, once again kindly sponsored by the GAAAS Association, to conclude the day. On Tuesday, there will be two regular sessions, two joint sessions with EuMC, two poster sessions, one jointly with EuMC, and the Closing Session. A number of the regular sessions will feature keynote industry talks on topical themes.

The EuMIC Opening Session will feature two keynote addresses by eminent speakers. Sir Christopher Snowden, Fellow of the Royal Society and Chair of the ERA Foundation, will speak on ‘III-V Nitride Semiconductors for Microwave Applications’; while Zoya Popovic, Distinguished Professor, Department of Electrical, Computer and Energy Engineering at the University of Colorado, Boulder, USA, will speak on ‘High-Efficiency PAs for Broadband High-PAR Signals’.

This year, the EuMIC Closing Session will start with the celebration of our best contributors. The EuMIC Prize for the best paper and the EuMIC Young Engineer Prize will be awarded by the EuMIC Prize Committee. For the second year, the traditional GAAS Association Fellowship Award will be replaced with the Tom Brazil Fellowship Award (by the GAAAS Association) in dedication to a friend and colleague who made such significant contributions to our microwave community. This award will focus on promoting and encouraging the achievements of research students and further announcements on the details will be made prior to the conference. This session will be conclud- ed by two keynote presentations, one by Dr. Ebrahim Bushehri, CEO and Founder of Lime Microsystems (UK) on ‘Flexible and Open Source: The brave new world of Software Defined Radio and Open RAN’, followed by Dr. Nadine Collaert, Program Director at imec on ‘6G - Known Technologies with a Twist or Maybe Not?’.

We take this opportunity to show our appreciation to our authors for their technical contributions and for choosing to disseminate their work at EuMW and the dedication of the reviewers and TPC members who have spent their free time making the selections in order to provide the best possible programme. Workshops and Short Courses are a major offering of the EuMW and so we would also like to thank the organisers for gathering key experts to cover the latest developments. We also wish to acknowledge the support of the previous EuMIC teams, in particular Utrecht, who were always ready to advise. Finally, we would like to thank the 2021 EuMC and EuRAD teams for sharing their experiences as well as to all our colleagues working in the background supporting EuMW as a whole.

We look forward to welcoming you personally in London for an exciting EuMIC!
Welcome to the 51st European Microwave Conference

Welcome to EuMC 2021! Never before has communications technology been so important for the world to retain functionality – last year we had the first virtual conference of this series and while the organisation meetings have largely been done remotely for this event, we are delighted to be able to hold this conference in-person, and, be “United in Microwaves”.

This year is the 51st edition of the conference, returning to London, the city where EuMC was first hosted back in 1969. EuMC is the largest event in Europe dedicated to a broad range of high frequency topics ranging from novel semiconductor and packaging technologies, photonics, passive and active microwave/mmWave circuits and antennas, up to system level, with innovative solutions for many applications including for example, biomedical, mobile and IoT.

We have received over 440 submissions from 46 countries for EuMC 2021. Our conference programme provides you the perfect platform to meet colleagues and to learn about the latest advances in filters, antennas, characterisation techniques and applications. There is also the Asia-Pacific focused session when we will hear from several expert speakers.

In the EuMC Closing Session, also on Thursday, the EuMC microwave prize and two young engineer prizes will be awarded. The Closing Session features a keynote by Tadao Nagatsuma, Osaka University, entitled “Challenges and opportunities for terahertz communications – towards 6G and beyond”, and a keynote on the (RE)volution of wireless communications”, by Eric Hawthorn from Radio Design. Finally, on Friday there are four more short courses and workshops on advanced manufacturing/packaging, microwave superconductivity, terahertz and AI.

It is our pleasure to welcome you to the 18th European Radar Conference (EuRAD 2021) which will be held from the 16th to 18th February 2022 in London, UK, as part of European Microwave Week 2021. This radar conference is the major European event for the present status and the future trends in the field of radar research, technology, system design and applications. The EuRAD conference will bring together a global network of researchers, practitioners and institutes working on topics related to the following four areas of focus: 1) Radar Sub-systems and Phenomenology, 2) Radar Signal and Data Processing, 3) Radar Architecture and Systems and finally 4) Radar Applications.

For many delegates this will be the first face-to-face large-scale event they attend in a long time, and we hope to put on an excellent conference by bringing world class radar researchers together. The ability to interact in person at conference is a brilliant opportunity that is difficult to replicate and as the first physical EuRAD conference for two years we hope attendees can enjoy this experience and get the most out of it. We are proud to put on the EuRAD 2021 conference at the London ExCel centre. While at the conference our delegates can enjoy the sights and sounds of London.

In the Wednesday Opening Session, we will host an excellent speaker on the cutting-edge perspective of radar & EW research. Barry Trimmer will be speaking on Trends in Defence Electronics – Technological Convergence in Radar & EW. He is presently VP (technical) for Intelligence, Surveillance and Reconnaissance (ISR) within Thales UK, with particular responsibilities for Electronic Warfare, Radar, Airborne Mission Systems and Unmanned Air Systems. This will be followed by a talk by Eva Rajo Iglesias, Professor at the Department of Signal Theory and Communications, University Carlos III de Madrid. Eva will describe the state of the art in antenna technologies for millimetre and sub-millimetre wave radar.

The Closing Session plenary talk will be provided by Nigel Clarke, Nigel led on All-terrain and Autonomy Sensing Research at Jaguar Land Rover Research, and he will show how the role that microwave radar must play in making a Level 5 fully autonomous car realisable.

The EuRAD 2021 organisers would like to especially thank all the excellent reviewers and expert TPC members for their support. Despite the need for a fast turn around and high-quality reviews during the peak holiday period we still achieved a rigorous level of peer review. Without our reviewers it would not be possible to put on this event, many thanks. All that is left is to thank the EuRAD conference delegates for your attendance and contributions to EuRAD 2021.
Welcome from the General TPC Chairs

I am delighted that we have been able to host the European Microwave Week in London again. Although much has changed since EuMW 2016, when we last were here, the UK capital city continues to be one of the great global centres for culture, the arts, sport, entertainment, shopping and tourism. I look forward to seeing you during EuMW 2021 as you enjoy our excellent conference programmes, and I hope you will be able to experience some of the other opportunities that this city offers while you are here.

As General Technical Programme Committee Chair, I would like to thank the many people who have worked through very difficult, challenging and frequently changing circumstances to generate what I am sure you agree is an excellent set of conference programmes.

First of all, of course, the paper authors and presenters. Excellent research and development work has continued in our widespread scientific and technical community despite the difficulties and complications caused by the pandemic lockdowns and other restrictions, and this has been reflected in a very high quality set of submitted papers. I must also thank the authors for their patience as circumstances forced us to change submission deadlines several times and postpone the conference.

We now share a distinction with the 2020 Olympics and the European Soccer championships, in holding our event during the year after that appears in the name!

I also owe huge thanks to the excellent group of over 500 expert reviewers who scrutinised and provided constructive critiques on over 700 submitted papers to enable the Technical Programme Committee to select the best of them for our conferences. The delayed timing of the review period made this task more challenging this year, and I am extremely grateful to all those who fitted in their review tasks during or around their well-earned vacation periods.

For the second time, the Technical Programme Committee meeting has been conducted as a distributed virtual event, because of pandemic related travel constraints. I owe huge gratitude to the EuMW 2020 team for establishing the processes that made it possible to do this efficiently and effectively, and to the EuMW 2021 Operations Team and the EuMA Software Officers who made it work so well again this time. Of course, I would also like to acknowledge the excellent work done by the TPC chairs of the three individual conference programmes and our Technical Programme Committee, over 100 highly experienced experts in their fields. In their 26 sub-committees, they considered all of the reviewed papers and selected the best, with an overall acceptance rate of approximately 65%, and they formed them into the coherent and attractive set of 84 sessions on key topics in our discipline that make up our three conferences. Several of the sessions also feature invited talks from industry experts, to highlight the industrial context of those key topics. The programmes for the week as usual feature a set of specialist workshop and short courses.

Ours is a dynamic and constantly evolving discipline. As always, the EuMW programmes cover the important and fast developing themes, including: new applications and new passive and active technologies for the high mm-wave and low THz bands; advanced manufacturing processes creating new possibilities in component design and system integration; artificial intelligence (AI), both as a tool in design and fabrication and as a new paradigm in signal processing; new applications for radar in many different aspects of our lives; and the many technologies and applications associated with communications systems, including 5G and beyond.

It has been a pleasure and a privilege to serve as General TPC Chair for EuMW 2021. I look forward to seeing you in London in February 2022.

International Journal of Microwave and Wireless Technologies: EuM 2021 Special Issue

The International Journal of Microwave and Wireless Technologies was created in 2009 by the European Microwave Association (EuMA) and Cambridge University Press for the benefit of the microwave research community in Europe and overseas.

The journal is published ten times a year. It allows academic and industrial researchers to promote their work and stay connected with the most recent developments in microwave and RF technology. The journal is referenced in databases such as Scopus and Google Scholar and is indexed in the Thomson Reuters Web of Science. Following the success of previous microwave weeks, the journal will again publish a special issue dedicated to European Microwave Week 2021.

The authors of several highly ranked papers presented at the conferences will be invited to submit an extended version for publication in the journal. The special issue will be guest edited by Yi Wang, TPC chair of EuMC 2021, Edward Wasige, TPC chair of EuMIC 2021, and Matthew Ritchie, TPC chair of EuRAD 2021.

Accepted papers will be published online at http://journals.cambridge.org/MRF and can be referenced using their DOI (Digital Object Identifier). Once all submissions are received, the articles will be collated into the Special Issue, which is expected to appear in June 2022.

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Ron Ginley
Microwave Journal, USA

Buhl Chair
European Microwave Association
2020 European Microwave Week in Utrecht

Best Paper Prizes: EuMC

EuMC Prize
Sponsored by Eindhoven University of Technology

Authors
Mikko Hietanen¹, Jere Rusanen¹, Janne P. Aikio¹, Nuutti Tervo¹, Timo Rahkonen¹, Aarno Pärssinen¹
¹University of Oulu

Paper Title
Ka-Band TDD Front-End with Gate Shunt Switched Cascade LNA and Three-Stack PA on 22 nm FDSOI CMOS Technology

EuMC Young Engineer Prize
Sponsored by Eindhoven University of Technology

Authors
Anton Sieganschin¹, Thomas Jaschke¹, Arne F. Jacob¹
¹Hamburg University of Technology

Paper Title
A Compact Low-Noise Frontend for Rx/Tx-Integrated SatCom Arrays

EuMC Young Engineer Prize
Sponsored by Antenna Company

Authors
J. Gabriel Buckmaster¹, Thomas H. Lee¹
¹Stanford University

Paper Title
An Electronically Steerable Millimeter-Wave Reflectarray for Wireless Power Delivery

2020 European Microwave Week in Utrecht

Best Paper Prizes: EuRAD

EuRAD Prize
Sponsored by THALES

Authors
Hasan Iqbal¹, Andreas Löffler¹, Mohamed Nour Mejdoub¹, Frank Gruson¹
¹Continental AG

Paper Title
Realistic SAR Implementation for Automotive Applications

EuRAD Young Engineer Prize
Sponsored by HENSOLDT

Authors
Julius Tilly¹, Fabio Weishaupt¹, Ole Schumann¹, Jürgen Dickmann¹, Gerd Wanielik²
¹Mercedes-Benz AG, ²TU Chemnitz

Paper Title
Road User Classification with Polarimetric Radars
This is a new prize, named in remembrance of Roberto Sorrentino. The prize has been initiated by Linda Di Carlo Sorrentino in cooperation with RF Microtech, the Italian EM Society (SIEm) and EuMA. Awarded every year for at least ten years, it will recognize an outstanding young professional who has distinguished technical achievements (not on a single paper) within the microwave field. The technical achievements may include technical papers in journals and/or conferences/symposia sponsored or technically sponsored by EuMA. The technical achievements may also include services as a committee member for these Journals and/or conferences/symposia. This prize focuses on the individual rather than the achievements and would preferably be in yearly alternation between university and industry.

A nominee must be a member of the EuMA and no more than 38 years of age at the time of nomination deadline (i.e. not having reached their 39th birthday). To help bridge the gender gap in the microwave community however, this deadline is postponed by one year per child for women that have had children. A nomination must be made by a EuMA member (not a student member) who has known the nominee for more than 2 years. Self-nomination is not allowed. Two references in addition to the nominator are required. A selection panel, chaired by a member of the EuMA Board of Directors, selects every year a suitable number of panel members (from 5 to 7), whose names are not public. The Chair does not vote. Because of the large financial coverage, the Jury has one member designated by RF Microtech and one by SIEm, respectively.

The annual prize comprises a certificate, a medal and a financial award of 4,000 €, contributed by Mrs Linda Di Carlo Sorrentino, RF Microtech, SIEm, and EuMA. Collectively this might sustain the prize for a longer period as it is intended to keep the amount of the prize at 4,000 € therefore increasing the number of years of availability of the prize beyond 10 years. The prize will be presented at the Opening Session of the European Microwave Week. The first prize will be presented during EuMW 2021.
Richard V. Snyder is the President of RS Microwave (Butler, NJ, USA, founded 1981). He is the author of 145 papers, three book chapters and holds 27 patents. Interests: E-M simulation, network synthesis, dielectric and suspended resonators, high power notch and band-pass filters and active filters, BS, MS and PhD degrees from Loyola-Marymount, USC, and Polytechnic Institute of New York University. Served the IEEE North Jersey Section as Chairman, 14 year Chair of the MTT-AP chapter. Chaired the IEEE North Jersey EDS and CAS chapters for 10 years.

He twice received the Region 1 award. January 1997: named a Fellow of the IEEE and is now a Life Fellow. January 2000: received the IEEE Millennium Medal. General Chairman for IMS2003, in Philadelphia, and was Emeritus Chair for IMS2018 also in Philadelphia. He was elected to the MTT-S ADECOM in 2004. Within the ADECOM, he served as Chair of the TCC and Liaison to the EuMA. He served as an MTT-S Distinguished Lecturer from 2007 – 2010, continuing as a member of the Speakers Bureau.

He served three years as Associate Editor for the IEEE Transactions on Microwave Theory and Techniques, responsible for most of the filter papers submitted. Member of the American Physical Society, the AAAS and the New York Academy of Science. MTT-S President for 2011. IMSEC Chair 2016 – 2019, N&A Chair at present. Reviewer for IEEE-MTT and EMC publications. Reviewer for the EuMA International Journal of Microwave and Wireless.

Teaches and advises at the New Jersey Institute of Technology. Visiting Professor at the University of Leeds, in the U.K. Serves on TPC committees, as reviewer and/or Chair, for IMS, EUMW and other global conferences. He served 7 years as Chair of MTT-8 (now MTT-5 on Filters) and continues in MTT-5/TPC work. He is the organizer of the annual IWS conference in China. He currently serves the EuMA General Assembly as the North American (Region 15) delegate.

Stephen (Steve) Nightingale received his Electrical Engineering degree from the CEI in 1974 and a PhD in Electronics from Kent University in 1980. He worked for Philips Research Laboratories, UK, designing microwave circuits and systems until 1982. He then joined General Electric, Syracuse, USA, as the EHF Technology Manager supervising and designing Gallium Arsenide MMICs up to 94 GHz with specific responsibility for the US Milstar and DSCS programmes. From 1986 to 1996, he worked for THORN EMI Electronics/Racal/Thales as a MMIC Technology Consultant, Department Manager and Technology Manager responsible for technology acquisitions for Radar and EW systems. This included technology acquisitions for the 4-nation military phased-array radar programme, COBRA.

In 1996, he joined ERA Technology/Cobham, UK, designing and manufacturing Mach-Zehnder optical modulator drivers operating at 2.5 and 10Gb/s. Production reached over 12,000 per annum and the developed designs became industry standards. From 2001, he became Chief Consultant for Electronic Design developing interference mitigation systems for civil and military platforms using direct RF cancellation and TDM. Notable deliveries were for the US Rescue 21 programme, various Australian Army equipment upgrade programmes and a number of UK MoD requirements.

Steve was appointed a Visiting Professor at Surrey University in 2002 sponsored by the Royal Academy of Engineering.

He was a Founder Member and Past Director of the EuMA. He has served the EuMA and the EuMC in various capacities for more than 30 years and was Chair of the EuMW and EuMC in 2001. Steve has also served on various boards in UK universities and industries, including Imperial College, London, and ECIT, Belfast.

Steve has published and lectured widely in the UK and abroad, has contributed to 4 books and been awarded 8 patents in the microwave field. He became a Fellow of the IEEE in 2002 with the citation ‘For Contributions to Planar Microwave and Millimetrewave Circuits’. He has also received several Sir Alan Cobham Awards for technical innovation, team leadership and sustainability.
EuMA and EuMW Committees

**EuMW General Assembly**

**Board of Directors:** Frank van den Bogart • Gilles Dambrine • Patrice Gamaon • Andrew Gigond • Willem Hol • Kerans Lombard • Luca Perugini • Herbert Zeh • Hans van Vliet • Thomas Zach

**EuMA Chairs:** Frank van Vliet, EuMA’20 • Nick Ridler, EuMA’21 • Luca Perugini, EuMA’22

**EuMA General Meetings:** Sergio Vondracek • Group 1 – Ingmar Kaifuss, Group 2 – Alessandra Costanza, Group 3 – Cheng Li, Group 4 – Dominique Schuurman, Group 5 – Vitaly Zhurbenko, Group 7 – Jan Vrba, Group 8 – Bartlomiej Salski, Group 9 – Katarina Arhypo, Group 10 – Ignacio Hernandez-Machado, Group 11 – Albania, Bosnia and Herzegovina, Croatia, Group 12 – Armenia, Azerbaijan, Georgia, Moldova, Ukraine, Group 13 – Altai, Astana, Bosnia and Herzegovina, Croatia, Group 14 – Bulgaria, Group 15 – Bulgaria, Group 16 – Andorra, Portugal, Spain, Group 17 – North America – Group 18 – Iceland, Norway, Sweden, Group 19 – Denmark, France, Islands, Finland, Greece, Group 20 – Balgaria, Czech Republic, Hungary, Korea, Slovakia, Group 21 – Estonia, Latvia, Lithuania, Poland, Group 22 – Armenia, Azerbaijan, Georgia, Moldova, Ukraine, Group 23 – Almaty, Astana, Bosnia and Herzegovina, Croatia, Group 24 – Cyprus, FYR Macedonia, Montenegro, Greece, Israel, Serbia, Slovenia, Turkey, Group 25 – Belgium, Russia, Group 26 – Austria, Liechtenstein, Switzerland, Group 27 – Andorra, Portugal, Spain, Group 28 – North America – Group 29 – Asia-Pacific Group 31 – Africa and Middle East countries

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**EuMA Reviewers to our reviewers: Thank you for your great work!**

**EuMA and EuMW Committees**

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**EuMW 2021 Reviewers**

Dominic Funke • Vincent Fusco

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**EuMW and EuMA Committees**

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**EuMW 2021 Reviewers**

Dominic Funke • Vincent Fusco

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Dominic Funke • Vincent Fusco

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**EuMW 2021 Reviewers**

Dominic Funke • Vincent Fusco

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Travel Information

GETTING TO EXCEL LONDON

With two on-site Docklands Light Railway Stations (DLR), parking for 3,070 cars and London City Airport just under 10 minutes away, getting to ExCeL London couldn’t be easier.

VENUE ADDRESS
Royal Victoria Dock, 1 Western Gateway, Royal Docks, London E16 1XL, UK.

The entrance for European Microwave Week is the East Entrance. By DLR, alight at the Prince Regent station for the event.

LONDON UNDERGROUND & DLR

The Jubilee Line and the DLR are the quickest routes to ExCeL London. Alight at Canning Town on the Jubilee Line and change onto a Beckton-bound DLR train for the quick two-stop journey to ExCeL. Prince Regent for ExCeL (for the east entrance). DLR services: All trains towards Beckton/Gallions Reach will stop at Prince Regent.

BY RAIL

Your point of departure will determine the best service to take and at what station your train will arrive into London. London’s main rail stations are:

- Charing Cross (27 mins from ExCeL)
- Euston (32 mins)
- Kings Cross/St Pancras International (32 mins)
- Liverpool Street (26 mins)
- London Bridge (16 mins)

BY CAR

You can download our parking map which shows you the location of the car parks on campus. If you’re arriving via the M11, the North Circular (A406) or the A13, as you get closer to ExCeL you’ll pick up signs for Royal Docks, City Airport and ExCeL London. If you’re using satellite navigation, please enter the postcodes below.

E16 XVL – If you are travelling from the west to ExCeL from Blackwall Tunnel, Limehouse Link, A12 or central London.

E16 XFR – If you are travelling from the east to ExCeL from the M11, A13 or into London from the east.

E16 XAL – If you are using the Royal Victoria Car Park (MSCP). Approximately a 5 minute walk from the venue.

For full details on how to reach ExCeL London by underground & DLR, rail, air and driving please visit: https://www.excel.london/visitor/getting-here

HOTEL RESERVATION

Horizon House has teamed up with Connex Hotels and Events, our official hotel booking supplier, to offer you the ability to book your accommodation for EuMW at the most competitive rates available. It is very easy to make an immediate hotel booking.

Simply visit their booking page: http://www.connexhotelsandevents.com/eumw-london.html and make your booking, or email: sally@connexhotelsandevents.com.

You will find a wide range of accommodation to suit every budget. Alternatively, see the hotel booking pages within this programme.

PERSONAL INVITATION (VISA)

A valid passport will be required for entry into the organising country. In this case the UK. A UK visa may also be required for the purpose of attending EuMW. You can check whether you will need a visa by visiting the following website: https://www.gov.uk/apply-to-come-to-the-uk. If you are registering as a speaker, a delegate or an exhibitor and you need a visa, we recommend that you contact the UK Consulate, in your own country at least 3 to 4 months prior to EuMW.

The organisers will be pleased to send a letter of invitation to any speaker, exhibitor or conference delegate requesting it to assist with their visa application.

In order to request a letter of invitation, please download and complete the request form https://www.eumw2021.com/docs/EUMW2021_VisaForm.zip and send it to the visa operational officer: visas@eumw2021.org.

Hotel Booking Form

February 2022

Rooms are held on a guaranteed basis. For this reason, you are asked to supply a credit card number and full company details. If your travel plans change and you wish to cancel your accommodation, please contact Sally Garland on +44 (0)7775 344193 or email sally@connexhotelsandevents.com to avoid any non-arrival or cancellation charges, as each hotel has a different cancellation policy, full cancellation details will be clearly marked on every booking confirmation. Prepay rates are non-refundable and non-cancelable.

FOR MORE HOTEL OPTIONS AND TO RESERVE YOUR ROOM ONLINE VISIT http://www.connexhotelsandevents.com/eumw-london.html

Or complete the booking form below and email to sally@connexhotelsandevents.com

Contact Name
Company
Address
City
Post Code
Telephone
Fax
Email
Number of rooms required

First choice Hotel

Second choice Hotel

Guest Names

In order to guarantee the accommodation, please provide us with your credit card details:

Credit Card Number
Name on Card
Expiry Date

I authorise that any no show or late cancellation charges, as stipulated in the Hotelzon / Connex booking confirmation will be charged to this credit card

Signed
Date

Tel: +44 (0)7775 344193
Email: sally@connexhotelsandevents.com
Local Information and Insurance

**HOTEL**

- **ALOFT LONDON HOTEL – ****
  - 1 Eastern Gateway, Royal Victoria Dock, London E16 1FR
  - Special Event Rate including Breakfast**

- **MOXY LONDON EXCEL – ****
  - 1014 Dockside, London E16 2FQ
  - Special Event Rate including Breakfast**

- **HAMPTON BY HILTON LONDON DOCKLANDS – ****
  - Dockside Road, London E16 2FQ
  - Special Event Rate including Breakfast**

- **HOLIDAY INN EXPRESS – LONDON EXCEL – ****
  - 1019 Dockside Road, London E16 2FQ
  - Special Event Rate including Breakfast**

- **DOUBLETREE BY HILTON LONDON EXCEL – ****
  - 2 Festoon Way, London E16 1RH
  - Special Event Rate including Breakfast**

- **CROWNE PLAZA LONDON EXCEL – ****
  - 7 Western Gateway, London E16 1AA
  - Special Event Rate including Breakfast**

- **NOVOTEL LONDON EXCEL – ****
  - 3 minute walk to Excel West Entrance
  - Special Event Rate including Breakfast**

- **GOOD HOTEL LONDON EXCEL – ****
  - 6 minute walk to Excel West Entrance
  - Special Event Rate including Breakfast**

- **SUNBORN YACHT HOTEL – ****
  - Royal Victoria Dock, London E16 1AL
  - Special Event Rate including Breakfast**

- **PRINCE REGENT HOTEL LONDON EXCEL – ****
  - 9 minute walk to Excel East
  - Special Event Rate including Breakfast**

- **COURTBYRD BY MARRIOTT LONDON CITY AIRPORT – ****
  - 20 minute walk to Excel East
  - Special Event Rate including Breakfast**

- **HOLIDAY INN EXPRESS – ROYAL DOCKS – ****
  - 12 minutes by DLR to Excel East
  - Special Event Rate including Breakfast**

- **IBIS LONDON EXCEL DOCKLANDS – **
  - 4 minute walk to Excel West Entrance
  - Prepay £170.00 &B&B

- **IBIS STYLES LONDON EXCEL – **
  - 4 minute walk to Excel West Entrance
  - Prepay £74.00 &B&B

- **IBIS BUDGET LONDON CITY AIRPORT – **
  - 16 minute walk to Excel East
  - Prepay £37.00 &B&B

*The above rates are based on single occupancy, during the main days of the event and the standard room type of the hotel. Other room types or pre and post event nights may have different prices. All rates quoted include VAT at the current rate.*

**Special Event Rates are only bookable via this form or direct with Sally@connexhotelsandevents.com**

Prepay: Room rate will be charged at the time of booking, to the credit card used to guarantee the reservation, after this the room is non-refundable.

Flexible: Room rate can be cancelled or amended up until a few days before arrival, individual policy will be stated on the booking confirmation.

RO: Room rate does not include breakfast, however, breakfast is available at the hotel at an extra cost.

&B&B: Room rate includes breakfast.

**WI-FI**

- WI-FI is available in the exhibition hall and conference area. Login details can be found within your delegate bag.

**ELECTRICITY**

- Electricity is supplied at 240V, 50 Hz. UK 3-pin plug.

**CREDIT CARDS**

- All major hotels and most restaurants and shops will accept credit cards. It is advisable to carry other identification as well. Visa and MasterCard are the most widely accepted cards.

**HISTORY & SIGHTSEEING**

- London is the cultural, political and economic heart of the United Kingdom. It is the capital city of England and the United Kingdom – a 21st century city with history dating back to Roman times. At its centre stand the imposing Houses of Parliament, the iconic ‘Big Ben’ clock tower and Westminster Abbey, site of British monarch coronations. Across the River Thames, the London Eye observation wheel provides panoramic views of the South Bank cultural complex, and the entire city. London is famous for world-class museums, galleries, royal palaces, shopping destinations, West End theatre shows and award-winning restaurants. For more information, visit [https://www.visit-london.com](https://www.visit-london.com).

**INSURANCE**

- It is highly recommended that all participants carry the proper travel and health insurance, as the organiser cannot accept any liability for any accident, illness, or injury that occur during or when travelling to the event. Please also insure that personal items are covered for loss, damage or theft either through a personal policy or by a corporate policy. We cannot accept any liability for personal items that are lost, damaged or stolen during or travelling to and from European Microwave Week 2021.

**Conference Information**

**BADGES AND REGISTRATION**

- The registration area will be located near the entrance to the Exhibition Hall as signposted. Online registrants will automatically be e-mailed their badge barcode and an order confirmation receipt immediately after they pay. All those who have pre-registered should bring their badge barcode and confirmation with them to the conference where they can print out their badge by scanning their barcode at the Fast Track desk onsite. Processing will be quick and easy but queues may form at busy times, so please arrange to collect your badge well in advance of your first conference session. Those who have not pre-registered can do so on site until 18th February 2022. There will be on-site registration terminals located within the registration area, where delegates can enter their details and pay immediately by swiping their credit or debit cards through the card readers attached to the terminals. Alternatively, you can pay at the Cashier desk if you require a printed receipt. If you have any questions regarding registration procedures and payment, please email: [eumwreg@aventri.com](mailto:eumwreg@aventri.com).

**CONFERENCE ROOMS**

- Conference rooms are located in ICC Capital Suite – Level 3 as signposted. The conferences will be held in different rooms over the conference dates. Please refer to the Conference Matrix at the back of this booklet for a detailed overview. Delegates can register for one, two or all three of the conferences. Registration at one conference does not allow any access to other conference sessions. Those who wish to register for two or more conferences will receive a discount on these registrations.

**INTERACTIVE SESSIONS**

- The interactive poster papers will be presented on electronic screens, which are located in the exhibition area as signposted on Tuesday, Wednesday and Thursday.

**EXHIBITION HOURS**

- The exhibition area will be located in Exhibition Halls N20–N23 as shown on the Floor Plan in this booklet. As a registered delegate you will have full access to the exhibition area.

- The exhibition opening hours are:
  - Tuesday 15th February 2022, 9.30 – 18.00
  - Wednesday 16th February 2022, 9.30 – 17.30
  - Thursday 17th February 2022, 9.30 – 16.30

- See the back cover for a full listing of the exhibitors (correct at the time of going to press).

**CONFERENCE PROCEEDINGS**

- All papers published for presentation at your chosen conference will be available to download from an online repository. Four weeks prior to the event, downloading instructions will be communicated to conference registrants.
Partner Programme
Things to see and do in London!

London is the cultural, political, and economic heart of Britain, famous for world-class museums, galleries, royal palaces, shopping destinations, West End theatre shows and award-winning restaurants. With so much to do, it’s hard to narrow down the long list of reasons to visit, but below you’ll find our favourites.

HOP ON HOP OFF BUS TOUR

Explore London at your own pace with the Golden Tours hop-on hop-off Bus Tour. Choose between four routes and hop off at more than 60 stops, including Shakespeare’s Globe and Westminster Abbey. As well as having your transport covered, you can enjoy added extras including free walking tours and a 24-hour Thames River pass.

THE TOTAL LONDON EXPERIENCE – FULL DAY TOUR

Hop aboard a private, air-conditioned coach for a whistle-stop tour of central London.
First, explore one of the city’s most magnificent buildings: St Paul’s Cathedral. Step inside Sir Christopher Wren’s architectural masterpiece and discover its striking interior, before climbing up to the Golden Gallery for sweeping views of the capital.
Then, head to Buckingham Palace for a quintessential display of British pomp and pageantry, as you watch the famous Changing the Guard ceremony. There, you’ll get the chance to go on a one-of-a-kind tour of the palace with a Yeoman Warder, or “Beefeater”. Learn about the Tower’s fascinating history, stand where famous heads have rolled, get to grips with swords and armour, and take a closer look at the priceless Crown Jewels.
Next, it’s time to jump aboard a riverside boat for a relaxing ride along the Thames to one of London’s most charming and underrated neighbourhoods: Greenwich – The home of time. Greenwich is where eastern and western hemispheres meet. Discover its historic attractions, impressive buildings, and panoramic views on a guided walking tour. You’ll take in iconic sights including the world’s last surviving tea clipper, Cutty Sark, and another one of Sir Christopher Wren’s architectural gems, the Old Royal Naval College.
As you head back into central London by boat, sit back and enjoy the city’s skyline, before seeing it from above with a thrilling ride on the London Eye. At 135 metres, this feat of design and engineering has become the modern symbol representing the capital and a global icon. The experience showcases breath-taking 360-degree views of the capital and its famous landmarks and has been the number one visitor experience in the city for the past decade.
Adult ticket from £24.50
Child ticket from £22.00

TOP ATTRACTIONS

LONDON EYE

At 135 metres, the London Eye is the world’s tallest cantilevered observation wheel; a feat of design and engineering, it has become the modern symbol representing the capital and a global icon. The experience showcases breathtaking 360-degree views of the city and its famous landmarks, and has been the number one visitor experience in the city for the past decade.
Duration: Approx. 7 hours (with transportation)
Step on to authentic sets, discover the magic behind spellbinding special effects and explore the behind-the-scenes secrets of the Harry Potter film series. Don’t miss Royal Beasts and learn about the wild and wondrous animals that have inhabited the Tower, making it the first London Zoo.
Discover the priceless Crown Jewels, join an iconic Beefeater on a tour and hear their bloody tales, and enjoy a guided walking tour. You’ll take in iconic sights including the world’s last surviving tea clipper, Cutty Sark, and another one of Sir Christopher Wren’s architectural gems, the Old Royal Naval College.
As you head back into central London by boat, sit back and enjoy the city’s skyline, before seeing it from above with a thrilling ride on the London Eye. At 135 metres, this feat of design and engineering is the world’s tallest cantilevered observation wheel. The 360-degree views are incredible and perfect for a romantic evening.
Adult ticket from £22.00
Child ticket from £20.00

WARNER BROS. STUDIO

Step on to authentic sets, discover the magic behind spellbinding special effects and explore the behind-the-scenes secrets of the Harry Potter film series. Don’t miss Royal Beasts and learn about the wild and wondrous animals that have inhabited the Tower, making it the first London Zoo.

Admission: £31.45

HM TOWER OF LONDON

Despite the Tower of London’s grim reputation as a place of torture and death, within these walls you will also discover the history of a royal palace, an armury and a powerful fortress. Don’t miss Royal Beasts and learn about the wild and wondrous animals that have inhabited the Tower, making it the first London Zoo.
Adult ticket from £28.90
Child ticket from £14.40

THE SHARD

The View from The Shard allows you to go inside The Shard building and look out over London from the viewing platforms on levels 68 and 69. You can also head up to the Skydeck on level 72 - an open-air platform offering spectacular views over London.
While you’re enjoying the views, grab a drink or snack served by one of the bars. You can also book an all-inclusive experience in advance, which includes a glass of champagne and souvenir photos of your visit.
Adult ticket from £45.00
Children under 4 – Free

The View from The Shard allows you to go inside The Shard building and look out over London from the viewing platforms on levels 68 and 69. You can also head up to the Skydeck on level 72 - an open-air platform offering spectacular views over London.

Adult ticket from £45.00
Child ticket from £30.00
FREE LONDON ATTRACTIONS

From London’s exquisite parks to world-class museums, historic houses and stunning art galleries, there are some amazing free experiences to be had in London. You may need to book tickets in advance, even if entrance is free.

There are many more places to visit in London. For more ideas go to: www.visitlondon.com.

TATE MODERN
NATIONAL GALLERY
KENSINGTON GARDEN
NATURAL HISTORY MUSEUM
VICTORIA AND ALBERT MUSEUM
SKY GARDEN BRASSERY
BRITISH MUSEUM
SOMERSET HOUSE
SHOREDITCH

Social Events

EuMIC Cocktail Reception
Monday 14th February 2022
18:00 – 20:00
Cost: Free to all EuMIC delegates
(Sponsor: GAAS’ Association)
(Location: Onsite in the Exhibition Hall N19 – N23)
This event will start at 18:00 to permit attendees to also join the Foundry Session which begins at 18:30. However, there will be plenty of food and drinks for attendees who will join the event after the final EuMIC papers finish at 18:20 - so please join us when you are free!

EuMW Welcome Reception
Tuesday 15th February 2022
18:30 – 21:30
Cost: Free to conference delegates & invited exhibitors
(Location: The Platinum Suite (level 1))
All registered conference delegates, as well as invited representatives from companies participating in the exhibition are invited to the EuMW 2021 Welcome Reception, sponsored by Keysight Technologies, Horizon House Publications and EuMA. Delegates will need to bring their badge and exhibitors their invite along with them to gain entrance. The evening will begin with drinks at 18:30 followed by the General Chairs’ handover from EuMW 2021, London to EuMW 2022, Milan as well as an address from the Platinum Sponsor, Keysight Technologies. The open-buffet dinner will be served from 19:00.

The EuM Cruise on the River Thames
Wednesday 16th February 2022
19:00 – 22:00
Cost: ₤ 39.00 for all guests
(Location: North Greenwich Pier (by the O2))
Join us aboard City Alpha and City Gamma boats for a traditional three hour Thames sightseeing cruise leaving at 19:00. The cruise will take you along the Thames into Central London before turning and heading back down river to Greenwich. This unique sightseeing experience will be complemented with drinks and canapes. Tickets are limited, so register today!

EuRAD Lunch
Friday 18th February 2022
13:00 – 14:00
Cost: Free to registered EuRAD delegates
(Location: ICC Capital Suites 14 – 16)
A seated hot plated lunch for EuRAD delegates to catch up and round off a busy week.
Workshops and Short Courses List

Despite the organisers' best efforts to ensure the availability of all listed workshops and short courses, the list below and the numbering are subject to change. Please refer to www.eumw2021.com before registration for final availability and numbering.

Sunday 13rd February 2022

WS01  EUMC  Full Day  Advances of wireless sensing in harsh and severe environments
WS02  EUMC/EUMC  Full Day  Terahertz device, circuit and system fundamentals and applications
WS03  EUMC  Full Day  millimeter Wave Plastic Waveguide High Date Rate Communication
WS04  EUMC  Full Day  New trends in microwave and millimeter-wave filters
WS05  EUMC  Full Day  On-chip and scalable RF packaging solutions with integrated antennas for 5G mmWave and 6G applications
WS06  EUMC/EUMC  Full Day  Progress and status of Gallium Nitride monolithically microwave integrated circuits
WS07  EUMC  Half Day AM  RF reliability status and challenges for 5G mmWave and 6G applications
WS08  EUMC  Full Day  Technology for RF 5G and satcom: from material to packaged demonstrators
WS09  EUMC  Full Day  Research in power and S-parameters measurements at millimeter and terahertz frequencies
SS01  EUMC  Half Day PM  Advanced non-linear characterization and design of highly efficient power amplifiers using load pull data for sub GHz and mmWave applications
SS02  EUMC  Full Day  Fundamentals of microwave PA Design
SS03  EUMC  Half Day PM  5G mmWave OTA measurements: best practices for fast and reliable results
SS04  EUMC  Half Day AM  Terahertz technology, instrumentation and applications

Monday 14th February 2022

WM01  EUMC  Half Day PM  Optimizing modulation quality measurements on wide bandwidth signals - from conformance through H&D
WM02  EUMC/EUMC  Full Day  Advances in circuits and systems for mmWave radar and communication in silicon technologies
WM03  EUMC  Full Day  Sensing, imaging and biological tissues characterization using microwaves and millimetric waves
WM04  EUMC  Full Day  RF on-wafer calibration and measurement eco-system workshop
WM05  EUMC  Half Day AM  Novel technologies for emerging on-board microwave equipment based on surface mounted electromagnetic relays
WM06  EUMC  Full Day  Recent developments in wireless power transfer and energy harvesting
WM07  EUMC  Half Day AM  Beyond 5G mmWave and terahertz technologies at 6G research
WM08  EUMC  Half Day AM  H&G trends and challenges in RF/PA for medium/high-volume products
SM02  EUMC  Half Day PM  Intuitive microwave filter design with EM simulation
SM03  EUMC  Half Day PM  Phase-noise in next-generation aerospace/defense and commercial wireless communications
SM04  EUMC  Half Day AM  Solid-state microwaves applications in industrial, scientific and medical fields

Tuesday 15th February 2022

WS01  EUMC/EUMC  Full Day  Technologies for 6G FEMs
WS02  EIRAD  Full Day  Virtual validation of automotive sensors
WS03  EIRAD  Half Day AM  Joint range-angle superresolution MIMO radar
WS04  EIRAD  Half Day PM  Radar design from the ground up

Wednesday 16th February 2022

WS01  EUMC/EUMC  Full Day  Advances in drone antenna measurement techniques for Satcom and RADAR applications
WS02  EIRAD  Half Day AM  Advanced manufacturing and packaging
WS03  EIRAD  Half Day PM  Paradigm change in automotive non-Wave radar applications - from technology push to demand pull
WS04  EUMC  Full Day  Innovative THz technologies for imaging, radar and communication
WS05  EIRAD  Full Day  Advanced processing and deep learning approaches for indoor sensing using short range radars
SM01  EUMC  Half Day AM  AI techniques for microwave antenna and filter design: from theory to practice
SM02  EUMC  Half Day AM  Microwave superconductivity: applications of SQUID and Josephson junctions in microwave circuits

Thursday 17th February 2022

WF01  EIRAD/EIRAD  Half Day AM  Advances of wireless sensing in harsh and severe environments
WF02  EIRAD  Half Day PM  Paradigm change in automotive non-Wave radar applications - from technology push to demand pull
WF03  EUMC  Full Day  Innovative THz technologies for imaging, radar and communication
WF04  EIRAD  Full Day  Advanced processing and deep learning approaches for indoor sensing using short range radars
SF01  EUMC  Half Day AM  AI techniques for microwave antenna and filter design: from theory to practice
SF02  EUMC  Half Day AM  Microwave superconductivity: applications of SQUID and Josephson junctions in microwave circuits

Registration Information

CONFERENCE REGISTRATION DETAILS
See pricing table on the following page.

ONLINE REGISTRATION
- All online registrations should be made at www.eumw2021.com.
- Registrations completed up to and including 31st December 2021 will be charged at the ‘Advance Discounted Rate’ and those from 1st January 2022 will be charged at the ‘Standard Rate’.
- Online registration is open from mid October 2021 up to and during the event until 18th February 2022.

ONSITE REGISTRATION
- Onsite registration is available:
  - Saturday, 12th February 2022, 16:00 – 19:00
  - Sunday, 13th February 2022, 08:00 – 17:00
  - Monday, 14th February 2022, 08:00 – 17:00
  - Tuesday, 15th February 2022, 08:00 – 17:00
  - Wednesday, 16th February, 2022, 08:00 – 17:00
  - Thursday, 17th February 2022, 08:00 – 17:00
  - Friday, 18th February 2022, 08:00 – 10:00
- Onsite registration will be charged at the Standard Rates.

HOW TO REGISTER
If you have any questions regarding registration procedures and payment, please contact: eumwreg@aventri.com

ONLINE
- Delegates can register for one, two or all three of the conferences.
- Discounts will be given to those registering for two or more conferences.
- In addition to the conferences, delegates can register for forums, short courses or workshops.
- Discount is given when combining a forum, short course or workshop registration with a conference registration.
- Payment can be made online using Amex, Visa, Mastercard or Bank Transfer.
- Delegates can choose to ‘Pay at Cashier’ and then proceed to the Cashier Point and pay using credit cards or cash. Receipts will be given accordingly.

ONSITE
- The registration area will be outside the Exhibition Halls as signposted.
- There will be Self Service terminals in the registration area where delegates can enter their details and pay immediately by swiping their credit cards through the readers attached to the terminals.
- Delegates can also choose to ‘Pay at Cashier’ and then proceed to the Cashier Point and pay using credit cards or cash. Receipts will be given accordingly.
- Delegates choosing to pay by Bank Transfer will receive their confirmation, but their receipt and badge barcode will be sent only once payment has been received and cleared by Horizon House.
- Please note that fees are not subject to VAT.
## Registration Fees

Get the most out of this year’s Microwave Week with a Full Week ticket. Combine all three conferences with access to all forums (the Defence, Security and Space forum and the 5G and Beyond forum) except the Automotive forum, as well as all Workshops and Short Courses.

Registration at one conference does not allow access to the sessions of the other conferences.

Subsidised lunchboxes are £7 each (one per day). They are available to all who attend EuMW, and should be ordered at the time of registration, either online or on-site.

Reduced rates are offered if you have society membership to any of the following: EuMA®, GAAS®, IET or IEEE. Reduced rates for the conferences are also offered if you are a Student/Senior (Full-time students 30 years or younger and Seniors 65 or older as of 13th February 2022). The fees shown below are invoiced in the name and on behalf of the European Microwave Association. All payments must be in £ (pound sterling) - cards will be debited in £ (pound sterling).

### CONFERENCE TECHNICAL CO-SPONSORS

- **51st Conference**
- **EuRAD**
- **European Microwave Student School**
- **Defence, Security and Space Forum**
- **Automotive Forum**
- **5G and Beyond Forum**
- **Tom Brazil Doctoral School of Microwaves**
- **International Journal of Microwave and Wireless Technologies**
- **AOF**
- **EurAAP**
- **IET**
- **IEEE**

### SPECIAL FORUMS AND SESSIONS

**IN COMBINATION WITH CONFERENCE REGISTRATION**

**WITHOUT CONFERENCE REGISTRATION**

### WORKSHOP AND SHORT COURSES

### EUROPEAN MICROWAVE WEEK SPONSORS

**Official Publication:**

**Supported by:**

**Co-Sponsored by:**

**Co-Sponsored by:**

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**EUMA KNOWLEDGE CENTRE**

The EuMA website has its Knowledge Centre which presently contains over 20,000 papers published under the EuMA umbrella. Full texts are available to EuMA members only, who can make as many copies as they wish, at no extra-cost.

**BECOME A MEMBER – NOW!**

EuMA membership fees: Professional £22,–/year, Student £13,–/year.

One can apply for EuMA membership by ticking the appropriate box during registration for EuMW. Membership is valid for one year, starting when the subscription is completed. The discount for the EuMW fees applies immediately.

Members have full e-access to the International Journal of Microwave and Wireless Technologies. The printed version of the journal is no longer available.

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**A KNOWLEDGE CENTRE**

A website has its Knowledge Centre of the journal is no longer available. Members have full e-access to the EuMW journal which presently contains over 20,000 papers published under the EuMA umbrella. Full texts are available to EuMA members only, who can make as many copies as they wish, at no extra-cost.

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**MEMBERSHIP FEES**

- **A membership fees: Professional £22,– / year, Student £13 ,–/ year.**

A membership applies immediately. The discount for the EuMW fees applies immediately.

A membership fees: Professional £22,– / year, Student £13,–/ year. A members can make as many copies as they wish, at no extra-cost.
EuMW 2021 Student School

Monday 14th February 2022
9:00 – 17:20, ROOM 3

Organiser: John Crute, The Technology Academy, UK
Co-organiser: Markus Funk and Jamie Lunn, Rohde & Schwarz

The aim of the EuMW 2021 Student School is to enable Undergraduate and Masters Degree Students to become familiar with a range of RF and microwave measurements using modern test and measurement (T&M) equipment. A series of technical presentations will introduce students to key RF and microwave measurements and best practice operation of T&M equipment.

Working in small teams, students will then use various T&M instruments, including vector network analysers, spectrum analysers and power meters, to perform a range of RF and microwave measurements. Students will also learn how to correctly care for and clean connectors and cables to improve measurement quality and reduce the risk of expensive damage to laboratory test equipment.

Leading test equipment manufacturer Rohde & Schwarz will provide a range of modern test equipment for the workshops, which will be supported by expert staff. Attendees will each receive a student pack containing various useful items. Teams will be assessed throughout the workshops and prizes will be awarded for the best overall team and runners-up.

Programme

SESSION 1: TECHNICAL PRESENTATIONS

09:00 Introduction to the Student School
John Crute, The Technology Academy

09:05 Vector Network Analyzer (VNA) Measurements
Jamie Lunn, Rohde & Schwarz

09:50 Spectrum Analyzer Measurements
Markus Funk, Rohde & Schwarz

10:35 Coffee

11:00 Power Measurements
Markus Funk, Rohde & Schwarz

11:45 Connector and Cable Care
Jamie Lunn, Rohde & Schwarz

12:30 Lunch

The registration fee for this event is £40 (up to & incl. 31st December 2021) or £80 (from 1st January 2022 & onsite). For further information please visit: https://www.eumw2021.com.

SESSION 2: HANDS-ON MEASUREMENTS WORKSHOPS

13:30 Workshop 1
14:15 Workshop 2
14:50 Workshop 3
15:30 Workshop 4
16:15 Closing Session and Awards

14:20 Microwave Near-Field Imaging of Human Tissue
Natalia Nikolaeva, McMaster University, Canada

15:10 New Frontiers in Terahertz Technology
Mona Jarrahi, University of California Los Angeles, USA

16:00 Break

16:40 Superconducting microwave circuits for quantum computing
Peter Leek, University of Oxford, UK

17:30 THz applications for artworks and cultural heritage
Emilio Giovenale, ENEA, Italy

18:20 Tom Brazil Fellowship Award (by the GAAS® Association) student essay competition shortlist announcement

11th Tom Brazil Doctoral School of Microwaves

Emerging Technologies and Techniques for Imaging and Computing

Monday 14th February 2022
9:00 – 18:30, ROOM 4

Organiser: Lai Bun Lok, University College London, UK
Co-organiser: Claudio Paoloni, Lancaster University, UK

The 2021 European Microwave Week features the 11th Tom Brazil Doctoral School of Microwaves, sponsored by the GAAS® Association. It offers postgraduate students and postdoctoral researchers a focused interactive hands-on workshop and technical lecture series in microwaves that go beyond the standard conference programme.

In the hands-on workshop, attendees will learn the system design of modern digital radios. After interactive demonstrations using a commercial software defined radio, the instructor will lead groups to design one key building block of the modern digital radio. You will learn to simulate and lay out a selected radio component, fabricate it on-site and measure its performance with a USB vector network analyzer (NanoVNA), which you keep after the workshop.

A technical lecture series devoted to emerging microwave topics is provided by four invited speakers in the afternoon. The Doctoral School concludes with an announcement of the Tom Brazil Fellowship Award (by the GAAS® Association) shortlist by representatives of the GAAS® Association.

Programme

09:00 Hands-on workshop: Digital Radio Systems & interactive demonstrations
David Ricketts, North Carolina State University, USA

10:40 Hands-on Workshop: design, build & measurement of radio components
David Ricketts, North Carolina State University, USA

11:20 Lunch

14:20 Microwave Near-Field Imaging of Human Tissue
Natalia Nikolaeva, McMaster University, Canada

15:10 New Frontiers in Terahertz Technology
Mona Jarrahi, University of California Los Angeles, USA

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16:40 Superconducting microwave circuits for quantum computing
Peter Leek, University of Oxford, UK

17:30 THz applications for artworks and cultural heritage
Emilio Giovenale, ENEA, Italy

18:20 Tom Brazil Fellowship Award (by the GAAS® Association) student essay competition shortlist announcement

Ph.D. students can register for this event. The registration fee is £40 (up to & incl. 31st December 2021) or £80 (from 1st January 2022 & onsite). The number of registrants is limited to 50. Any questions please email: student.activities@eumw2021.org
Tom Brazil Fellowship Award (by the GAAS® Association) Student Essay Competition

The Role of Microwaves in Contributing to the Realisation of a more Sustainable World

Monday 14th and Tuesday 15th February 2022
Exhibition Hall (MicroApps) + Other Locations

Programme

As part of the Tom Brazil Fellowship Award (by the GAAS® Association), we would like to announce the following essay competition which will be open to students pursuing a research degree in RF/Microwave/mmWave electronics. The first prize will be 1500 € with a runner-up prize of 750 €. You must register for one of the conferences to enter the essay competition.

The student should write a maximum of 4000 word essay or max of 12 pages including diagrams and tables, on the role of microwaves so far in reducing the carbon footprint and what kind of future activities will be important and why. In particular, what aspects of their own research work would be applicable.

Guidance: What we’re looking for is a summary of the role so far of RF/Microwaves/mmWave in telecommunications and other fields which have contributed to remote working (especially during the COVID pandemic) and reducing travel/commuting. Also for enabling developing countries to build sustainable agricultural and other industries that require good communications infrastructure. The use of THz for forecasting of catastrophic weather events has also been an important and ongoing development. Microwave activity can help in reducing carbon footprint: for example high efficiency power amplifiers and other components for base station applications, high efficiency antenna beam steering architectures, use of THz for weather forecasting and warning of catastrophic weather/natural events.

We are looking for creative and original ideas and suggestions on how future microwave related research work can be best directed in fulfilling our contribution in reducing climate change and mitigating the effects that we already have to manage.

The shortlist of 4 selected essays will be announced at the end of the Tom Brazil Doctoral school on 14th February and these finalists will be asked to do a final pitch at 8:30am – 9:30am on Tuesday 15th February in the MicroApps area of the Exhibition Hall. The winner and runner-up will be announced during the awards session at the EuMIC closing event on 15th February afternoon.

Submissions: Please submit your essay by the deadline of 18th January 2022 (before midnight UK time) to grants@eumw2021.org.

IEEE Young Professionals Activities
Expanding Your Global Network

Wednesday 16th February 2022
13:00 – 16:00 (Lunch from 13:00), ROOM 15

Programme

IEEE Young Professionals is the group of IEEE members and volunteers who have graduated from their first professional degree within the past 15 years. It is an international community, whose members are interested in elevating their professional image, expanding their global network, connecting with peers locally and giving back to their community. Since it encompasses all members from recent university graduates to experienced professionals and entrepreneurs, the group is highly diverse in what it has to offer. To join the IEEE Young Professionals community, you need to be an IEEE member.

Following last years’ initiative, EuMW 2021 will have a Young Professionals track devoted to students, young researchers and young industry professionals. The track comprises of a couple of technical and self-development sessions. The sessions are organised and co-sponsored by IEEE MTT-Society Young Professionals, IEEE Young Professionals and IEEE UK and Ireland Young Professionals, and in collaboration with IEEE Region 8 Young Professionals. It is not necessary to be an IEEE member or a Young Professional to attend this event. Everyone is very welcome!

Guest speakers to be announced soon. Keep a close eye on the conference website (www.eumw2021.com) and on our social media platforms to stay up to date.

For additional questions, please contact mtt-yp@ieee.org.
Women in Microwave Engineering
Stronger Together

Tuesday 15th February 2022
13:00 – 18:00, ROOM 15

Chair: Dr. Noushin Karimian, Manchester Metropolitan University, UK
Co-Chair: Dominique Scheurs, KU Leuven, Belgium

We continue the tradition of holding the Women in Microwave Engineering event, sponsored by IEEE MTT-S during the European Microwave Week. Both women and men are welcome.

This year’s event will take place in London, a leading global city and a world cultural capital. The event will focus on inspiring women in engineering and will end with a guided tour of the Cutty Sark.

Two invited speakers will give presentations on their current research and success as a woman in Engineering. At the end of the panel session a guided tour to the Cutty Sark will take place.

The Career Platform has been an integral part of EuMW since 2013. The aim is to foster the dynamic between young researchers, engineers and the job market in the RF and microwave field. It includes a dedicated meeting area for these young people to speak with human resources and recruitment specialists from the companies and organisations that sponsor the platform.

A special conference session will be held to explain more about the industrial market, and to share ideas on career development, which interested young people are invited to attend free of charge.

EuMW 2021 will also continue its e-Platform initiative, which provides a free-to-use job portal for the European RF and Microwave community at http://rf-and-microwave-jobs-in-europe.eu.

For further information, contact the Career Platform Chairs:
Dr. Noushin Karimian
Manchester Metropolitan University
career.platform@eumw2021.org
Helen Duncan
MWE Media Ltd.
helen.duncan@mwemedia.com

Programme

SPECIAL PANEL SESSION ON “INSPIRING WOMEN IN ENGINEERING” – A WOMEN IN MICROWAVE ENGINEERING EVENT
Registration: Free

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<td>Special Session: The European Microwave Industry Market</td>
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<td>12:00</td>
<td>Career Platform Lounge</td>
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Events

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<td>13:00</td>
<td>Panel Session “Inspiring Women in Engineering”</td>
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<td>14:30</td>
<td>Visit to Cutty Sark</td>
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<td>Special Session: The European Microwave Industry Market</td>
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<td>Career Platform Lounge</td>
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Register (free of charge) for this event via www.eumw2021.com – Register as a free EXHIBITION ONLY VISITOR. To attend, please pre-register by sending an email to women.microwaves@eumw2021.org subject: EuMW 2021 – Attend WiM Event
The Automotive Forum
Automotive Radar Sensors and Testing

Monday 14th February 2022
9:00 - 18:20, ROOM 14
+ Dinner on Monday evening

Chair: Thomas Zwick, Karlsruhe Institute of Technology, Germany
Co-Chairs: Martin Kunert, Robert Bosch GmbH & Frank Gruson, Continental AG, Germany
Local Arrangement Chair: Xiaobang Shang, National Physical Laboratory, UK

Following applications like keyless entry and tire pressure monitoring systems, mobile communications and recently automotive radar made microwave technologies a strong pillar inside the automotive world. The first 77 GHz automotive radar sensors entered the European market in 1999. In 2019, the European Microwave Association (EuMA) for the first time organized the Automotive Forum to provide an open platform for industrial experts to discuss technical aspects, concepts and radar architectures as well as market issues in the area of microwaves in the automotive industry.

The forum consists of a good mix of technical presentations, plenary and panel discussions as well as networking time. This year’s event will focus on the following topics:
1. Radar testing technologies
2. Virtual radar testing
3. Imaging radar for autonomous driving
4. Radar market, technology and game changers

The forum is mainly devoted to technical experts from automotive industry throughout the whole supply chain. Keynote speakers will present their views on special technical solutions as well as regulatory or strategic issues. Early registration is recommended.

Programme

SESSION 1: RADAR TESTING TECHNOLOGIES
(Chair: Thomas Zwick, Karlsruhe Institute of Technology, Germany)

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Programme

SESSION 1: RADAR TESTING TECHNOLOGIES
(Chair: Thomas Zwick, Karlsruhe Institute of Technology, Germany)

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SESSION 2: VIRTUAL RADAR TESTING
(Chair: Xiaobang Shang, National Physical Laboratory, UK)

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SESSION 3: IMAGING RADAR FORAUTONOMOUS DRIVING
(Chair: Frank Gruson, Continental AG, Germany)

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SESSION 4: RADAR MARKET, TECHNOLOGY AND GAME CHANGERS
(Chair: Martin Kunert, Robert Bosch GmbH, Germany)

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Registration and Programme Updates
Advanced Registration fee (up to & incl. 31st December 2022) is £240 for those who registered for a conference and £290 for those not registered for a conference. Standard Registration fee (from 1st January 2022 & on-site) is £330 for those who registered for a conference and £390 for those not registered for a conference. The Conference Special Events section of the EuMW website will give further details and updates.
RF sensing from spaceborne systems is undergoing a revolution. Leveraging the vast legacy of orbital RF sensors, and powered by the latest advances in RF and satellite technologies, next-generation missions, from radar satellites to spaceborne radiometers, are rapidly emerging.

Around the world, there are innovative and new systems in operation, development or concept design stages, some of which involve large-scale radial satellite constellations for the first time ever. Driven by current and future user demands in remote sensing, security and defence, they are pushing the limits of the possible in terms of the fidelity of their sensing outputs, the rate with which these outputs are provided, and their RF sensing instrumentation that enables it, all while the size of spaceborne platforms themselves is reducing.

The purpose of this year’s Defence, Security and Space Forum is to encapsulate the current state of the art in spaceborne RF sensing, and to discuss its key technical enablers as well as the challenges it faces moving forward. World-renowned experts from aerospace primes, SMEs, space agencies and government across Europe will present their work on this exciting topic, from new concepts and RF technologies to established systems currently in operation, with an emphasis on technological aspects that impact civilian and military applications.

**Programme**

**Wednesday 16th February 2022**
11:20 – 18:20, ROOM 8 – 11

Chair: Prof. Chris Baker, University of Birmingham, UK
Co-chair: Dr. Michail Antoniou, University of Birmingham, UK

**RF Sensing from Space: Modern Trends and Challenges**

**Moderators:** Chris Baker and Michail Antoniou

**11:20 – 13:00**

**EuRAD Opening**

**10:40**

**Coffee Break**

**11:20**

**RF Sensing from Space: Modern Trends and Challenges**

**13:00**

**Free Lunch Boxes Provided on-site by Microwave Journal**

**14:20**

**Microwave Journal Industry Panel Session**

**13:00 – 18:30**

**14:20**

**Microwave Journal Industry Panel Session**

**16:00**

**Coffee Break**

**16:40**

**Round table discussion**

**18:20**

**EuRAD Closing**

**Registration and Programme Updates**

Registration fee is £20 for those who registered for a conference and £60 for those not registered for a conference. The Conference Special Events section of the EuMW website will give further details and updates.
5G and Beyond Forum
Trailblazing the Future

Thursday 17th February 2022
9:00 - 17:15, ROOM 14

Chair: Dr Lutfi Albashe, American University of Sharjah, UAE
Co-Chair: Dr Chris Clifton, Sony Europe B.V.

The forum focus is on technologies beyond 5G. State of the art developments in the fields of wireless technologies for 5G and beyond will be discussed. The forum is for one-day with invited speakers from academia and industry. The topics of the forum cover a wide range of subjects that pertain to next generation communications. This includes 6G standardization, environment aware networks, advanced sensing and low power radars. The forum will include a panel session, coffee breaks and packed lunch.

### Programme

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00</td>
<td>Registration and Morning Coffee</td>
</tr>
<tr>
<td>09:00</td>
<td>Welcoming Notes</td>
</tr>
<tr>
<td>09:15</td>
<td>Chair</td>
</tr>
<tr>
<td>09:15</td>
<td>RoF Technology for Beyond 5G Radio’s Design</td>
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<tr>
<td>10:00</td>
<td>Fadhel M. Ghannouchi, IEEE Fellow</td>
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<tr>
<td>10:05</td>
<td>Andreas Roessler, Technology Manager Rohde&amp;Schwarz USA, Inc.</td>
</tr>
<tr>
<td>11:30</td>
<td>Mohammed-Slim Alouini, Fellow IEEE</td>
</tr>
<tr>
<td>11:30</td>
<td>King Abdullah University of Science and Technology (KAUST), Saudi Arabia</td>
</tr>
<tr>
<td>12:15</td>
<td>On the Application and Performance of Intelligent Reflective Surfaces in 6G</td>
</tr>
<tr>
<td>12:15</td>
<td>Emad Aloua, Department of Electrical and Electronic Engineering, University of Manchester</td>
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<tr>
<td>13:00</td>
<td>Lunch</td>
</tr>
<tr>
<td>13:00</td>
<td>Panel Session</td>
</tr>
<tr>
<td>14:00</td>
<td>All speakers Moderator: Co-Chair</td>
</tr>
<tr>
<td>15:00</td>
<td>What is the Role of Intelligent Reflecting Surfaces in 6G?</td>
</tr>
<tr>
<td>15:00</td>
<td>Emil Björnson, KTH Royal Institute of Technology, Stockholm, Sweden</td>
</tr>
<tr>
<td>15:45</td>
<td>High Frequency MMICs and Characterization Considerations</td>
</tr>
<tr>
<td>15:45</td>
<td>Lyndon Pattison, IconicRF, Belfast, Ireland</td>
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<tr>
<td>16:30</td>
<td>Low Power Stretched-Processed Miniaturized Receiver Radar Sensors</td>
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<tr>
<td>16:30</td>
<td>Lutfi Albashe, American University of Sharjah, UAE</td>
</tr>
<tr>
<td>17:15</td>
<td>Forum Closing Remark</td>
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</tbody>
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**5G and Beyond**

Mobile telephony for everyone
Mobile broadband enhanced
Embracing a networked society
Enabling a smart sustainable society

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<table>
<thead>
<tr>
<th>Generation</th>
<th>Technology</th>
<th>Capacity</th>
<th>Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1G</td>
<td>Wireless</td>
<td>~1980</td>
<td></td>
</tr>
<tr>
<td>2G</td>
<td>Wireless</td>
<td>~1990</td>
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<tr>
<td>3G</td>
<td>Wireless</td>
<td>~2000</td>
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<tr>
<td>4G</td>
<td>Wireless</td>
<td>~2010</td>
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<tr>
<td>5G</td>
<td>Wireless</td>
<td>~2020</td>
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<tr>
<td>6G</td>
<td>Wireless</td>
<td>~2030</td>
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**Wireless Network Development**

- **1G**: Basic voice service, Analog based protocols
- **2G**: Designed for voice, First digital standards (GSM, CDMA)
- **3G**: Designed primarily for data, IP based protocol
- **4G**: Designed for voice and data, First mobile broadband, Voice through circuit & Data-Packet Switching
- **5G**: 1000 x increase in capacity, Support for 100+ billion connections, Below 1 ms latency
- **6G**: Extension to (sub) mmWave frequencies, Real-time cloud computing

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**Time-line**

- **1980**: The foundation of mobile telephony
- **1990**: Mobile telephony for everyone
- **2000**: Mobile broadband enhanced
- **2020**: Embracing a networked society
- **2030**: Enabling a smart sustainable society

---

**Registration and Programme Updates**

Advanced Registration fee (up to & incl. 31st December 2021) is £60 for those who registered for a conference and £70 for those not registered for a conference. Standard Registration fee (from 1st January 2022 & onsite) is £80 for those who registered for a conference and £90 for those not registered for a conference. The Conference Special Events section of the EuMW website will give further details and updates.
### SUNDAY OVERVIEW

<table>
<thead>
<tr>
<th>Room</th>
<th>09:00 – 13:00</th>
<th>14:20 – 18:20</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>WS01 Advances of Wireless Sensing in Harsh and Severe Environments</td>
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<td>4</td>
<td>WS02 Terahertz Device, Circuit and System Fundamentals and Applications</td>
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<td>6</td>
<td>WS03 Advanced Non-linear Characterization and Design of Highly Efficient Power Amplifiers Using Load-Pull Data for sub-6GHz and mmWave Applications</td>
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<td>7</td>
<td>WS04 New Trends in Microwave and mmWave Filters</td>
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<td>8</td>
<td>SS01 Fundamentals of Microwave-PA Design</td>
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<td>9</td>
<td>WS05 New On-Chip and Scalable RF Packaging Solutions with Integrated Antennas for 5G mmWave and 6G Applications</td>
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<td>10</td>
<td>WS06 Progress and Status of Gallium Nitride Monolithic Microwave Integrated Circuits</td>
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<td>11</td>
<td>WS07 RF Reliability Status and Challenges for 5G mmWave and 6G Applications</td>
<td>SS03 5G mmWave OTA Measurements – Best Practices for Fast and Reliable Results</td>
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<tr>
<td>12</td>
<td>WS08 Technology for RF 5G and Satcom: From Material to Packaged Demonstrators</td>
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<td>13</td>
<td>SS02 Terahertz Technology, Instrumentation and Applications</td>
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<td>14</td>
<td>WS09 Research in Power and S-parameters Measurements at mmWave and Terahertz Frequencies</td>
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<td>17</td>
<td>WS10 mmWave Plastic Waveguide High Data Rate Communications</td>
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### MONDAY OVERVIEW

<table>
<thead>
<tr>
<th>Room</th>
<th>09:00 – 10:40</th>
<th>11:20 – 13:00</th>
<th>14:20 – 16:00</th>
<th>16:40 – 18:20</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>SM01 R&amp;D Trends &amp; Challenges in RFPAs for Medium/High-Volume Products</td>
<td>WM01 Optimizing Modulation Quality Measurements on Wide Bandwidth Signals - from Conformance Through R&amp;D</td>
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<tr>
<td>2</td>
<td>WM02 Advances in Circuits and Systems for mmWave Radar and Communication in Silicon Technologies</td>
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<td>Student School</td>
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<td>Two Brasil Doctoral School of Microwaves</td>
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</table>
### ROOM 10 - EuMIC01

**Large signal and Non-linear Characterization Techniques**  
*Chair: Vincent M. M. van Breemen  
Co-Chair: Vittorio Mangione \*  
University of Málaga, University of Aveiro / Instituto de Telecomunicações*

**Programme**

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>09:00</td>
<td>Welcome Address: Opening of the European Microwave Conference</td>
</tr>
<tr>
<td>09:15</td>
<td>EuMIC Opening Session</td>
</tr>
</tbody>
</table>

### ROOM 11 - EuMIC02

**Silicon Based RF Solutions**  
*Chair: Peter Hagen*  
National Institute for Applied Physics (INAF), Belgium

**Programme**

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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>10:30</td>
<td>High-Efficiency PAs for Broadband High-PAR Signals</td>
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</table>

### ROOM 12 - EuMIC03

**Transceiver MMICs**  
*Chair: Moritz Kaukasus  
Co-Chair: Holger Schier*  
Technical University of Darmstadt, Germany

**Programme**

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<thead>
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<tbody>
<tr>
<td>11:15</td>
<td>III-V Nitride Semiconductors for Microwave Applications</td>
</tr>
</tbody>
</table>

### ROOM 7 - 9 - EuMIC04

**EuMIC Opening Session**  
*Chair: Chris Clifton  
Co-Chair: Edward Wasige*  
OMMIC S.A.S, France

**Programme**

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</table>

### ROOM 10 - EuMIC01-1

**Load-pull measurement of SiGe, HBT in BiCMOS 55 nm featuring 11 dBm of output power at 185 GHz**  
*Caroline Haem  
University of Technology, University of Erlangen*

**Programme**

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</table>

### ROOM 10 - EuMIC01-2

**Nonlinear Characterization of Wideband Power Amplifiers with frequency dependent match load**  
*Gunter Schiebel*, Hugo Bergman, Guido Schramm, Maria E. Jacob*, Mario Pernice, Wolfgang Schirmer, Simon Pfeifer

**Programme**

<table>
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<tr>
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</table>

### ROOM 10 - EuMIC01-3

**Intermodulation Products of a CMOS 69 GHz Antenna Switch: Results Comparison Between an Experimental Test-Bench and a Corresponding Simulated Virtual Test-Bench**  
Technische Universität Dresden, Germany

**Programme**

<table>
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<tbody>
<tr>
<td>11:00</td>
<td>III-V Nitride Semiconductors for Microwave Applications</td>
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</table>

### ROOM 10 - EuMIC01-4

**A computationally-efficient self-consistent large signal model for GaN HEMTs based on ASH-HEMT**  
*Gustaf Kynkauden*, Toni Mäkelä*, Arto Pulkkinen, Jarkko Ilmoniemi

**Programme**

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<tr>
<td>11:45</td>
<td>III-V Nitride Semiconductors for Microwave Applications</td>
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### ROOM 10 - EuMIC01-5

**Large-Signal Modeling for Nonlinear Analysis of Experimental Devices in 22nm FDSOI Technology**  

**Programme**

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### ROOM 11 - EuMIC02-1

**SiGe BiCMOS as enabling technology for next generation RF & THz Systems**  
*Peter Hagen*  
National Institute for Applied Physics (INAF), Belgium

**Programme**

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<tr>
<td>11:15</td>
<td>EuMIC Opening Session</td>
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### ROOM 11 - EuMIC02-2

**Analysis of the Relaxed Contacted-Poly-Pitch Effect on the RF Performance of Stranded-Silicon p-FETs in 22nm FDSOI Technology**  
*Stephan Herr*, Maria E. Jacob*, Ute Hermann, Christine Neumann, Zheng Zhao, Thomas Ruge*, Matthias Budde

**Programme**

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### ROOM 11 - EuMIC02-3

**Design Methodology of Wide Tuning Range DGS-based VCO for K-band Applications in 0.18um CMOS Technology**  
*Rupak Dutta*, *Siddhanta Sarathi*, *Subhendu Banerjee*, *Ayush K. Bhattacharyya*

**Programme**

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### ROOM 12 - EuMIC03-1

**mmH II-V/III Hetero-junctions: The 3rd generation of II-VI processes to complement Si:RF solutions**  

**Programme**

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### ROOM 12 - EuMIC03-2

**A Bidirectional 28 GHz RF Transceiver Front-End with Test and Calibration Interface for SiGe-HBT Phased Arrays**  

**Programme**

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### ROOM 12 - EuMIC03-3

**A 2-channel TX and 4-channel RX in SiGe-BiCMOS for X-band MIMO Radar Applications**  
*Katharina Kolb*, Julian Potschka*, Tim Maiwald*

**Programme**

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### ROOM 12 - EuMIC03-4

**Two-Element 81-86 GHz SiGe Transmitter Beamformer for Backhaul Applications**  
*Jan Veltman*, *Jens Barfod*, *Gary Staff*

**Programme**

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</table>

### ROOM 12 - EuMIC03-5

**A W-Band Single-Chip Receiver in a 60 nm GaN-on-Silicon Foundry Process**  
*Robert Holzke*, *Benjamin Kuhnt*, *Marius Dietz*, *Jan Roß*, *Stefan Schug*, *Sven M. Schulte*, *Dietmar Aurich*, *Frank Haiden*, *Giles Office*  
Fraunhofer Institute for Applied Solid State Physics (IAF), Technische Universität Dresden, Germany

**Programme**

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**Welcome Address: Opening of the European Microwave Conference**

**Chair: Chris Clifton**
MONDAY 14:20 – 16:00

**Room 5**
EuMIC05 Integrated Circuit Modelling and Design Methodology
Chair: Maria-Magdalena Goering
- Technical University Braunschweig
- Infineon Technologies

**Room 10**
EuMIC06 Integrated PKs for 5G, SATCOM and Vehicular Applications
Chair: Joseph Huang
- National Chiao Tung University
- National Taiwan University
- University of Cambridge

**Room 17**
EuMIC07 Frequency-Converting Circuits
Chair: Jingyu Ruan
- University of Michigan
- University of Wisconsin

**Room 1**
A 30- to 30 GHz Active and Passive Combined Down-Conversion Variable Gain Mixer with Low OP21B Variation in 65-nm CMOS
- M. S. Mohamed
- University of Manchester
- Manchester University

**Room 3**
A Ka-Band MMIC Single-Chip Frequency Converter for Telecommunication Satellite Applications
- Francesco Sanguinetti
- University of Pisa
- University of Florence

**Room 4**
A Low-Power Ka- and V-Band Miller Heterostructures for Sub-GHz and mmWave RF devices
- Satoshi Tanaka
- National Institute of Information and Communications Technology
- Tokyo Institute of Technology

**Room 8**
EuMIC08 Components and Subsystems for 100 GHz and Above
Chair: Christophe Kerhervé
- Thales
- University of Bordeaux

**Room 9**
EuMIC09 High Performance LNAs
Chair: D限量
- University of Tokyo
- University of Tokyo

**Room 11**
A DC to 20 GHz Variable Gain Amplifier Working up to 90°C
- Ronald Freund
- Technical University of Dresden
- Technical University of Stockholm

**Room 12**
A 140 GHz Low-Noise Amplifier with an Average Noise Temperature of 44.5 K and 24.8 mW Power Consumption
- Jens Kühn
- National Institute of Information and Communications Technology
- Tokyo Institute of Technology

**Room 13**
A 140 GHz to 270 GHz Active Tunable Noise Source Development in SiGe BiCMOS 55 nm Technology
- Peter Kowarsch
- Ferdinand-Braun-Institut
- Technical University of Dresden

**Room 14**
A 415 GHz Breakthrough Gain Amplifier Technology Using a 22 nm FDSOI Technology
- M. S. Mohamed
- University of Manchester
- Manchester University
MONDAY 18:30 – 20:00

Panel Session.
Panel comprising leading III-V and Silicon foundries with a lively discussion on the merits of each cutting-edge technology for the next generation of communication devices.
TUESDAY 09:00 - 10:40

ROOM 16
EuMIC/EuMC01
Advanced Packaging and Interconnect Technologies for Emerging Applications
Chair: Michael Koppes
At Chair: Michael Kolbe
10:00 – 10:20
EuMIC/EuMC01
A Millimeter-Wave Substrate Integrated Waveguide Filter in SiGeB Technology
Speaker: Michael Küpper
10:20 – 10:40
EuMIC/EuMC01
Optoelectronic Millimeter-Wave Embedded Circuits Fabricated at 8 GHz
Speaker: Daniel Schreiber

ROOM 1
EuMIC/EuMC01
Novel Filtering Devices in Integrated Technologies
Chair: Marius K. Matthes-Kanninen
10:00 – 10:20
EuMIC/EuMC02
A SiGe Based 0.48 THz Signal Source with 45 GHz Tuning Range
Speaker: Michael Küpper
10:20 – 10:40
EuMIC/EuMC02
Noise Modeling of GaAs HEMT
Speaker: Franziska Schmitt

ROOM 4
EuMIC/EuMC12
Device Modelling and Simulation of Parasitic Phenomena
Chair: Martin Broy
10:00 – 10:20
EuMIC/EuMC12
The Effect of Surface Passivation for Sub-THz Silicon Gradient Reflective Index Lens
Speaker: Michael Küpper
10:20 – 10:40
EuMIC/EuMC12
A TCAD simulation study on gated-avalanche diodes for microwave applications
Speaker: Michael Küpper

ROOM 13
EuMC101
10:00 – 10:20
EuMC101
A 285 GHz Bandpass Filter Employing Shielded Folded Rigid Quarter-Mode SIW Resonator in CMOS Technology
Speaker: Michael Küpper
10:20 – 10:40
EuMC101
A CAD simulation study on gated-avalanche diodes for microwave applications
Speaker: Michael Küpper

ROOM 14
EuMC101
10:00 – 10:20
EuMC101
A Low Phase Noise Phase-Locked Loop with Short Settling Times for Automotive Radar
Speaker: Michael Küpper
10:20 – 10:40
EuMC101
A D-Band Power Amplifier with 39.5GHz Colpitts Quadrature VCO in 65nm HBT Technology
Speaker: Michael Küpper

ROOM 17
EuMC14
10:00 – 10:20
EuMC14
Advances in mmWave and High Power Integrated PA Technologies
Chair: Franz Kemper
10:20 – 10:40
EuMC14
A 100 GHz Class-F-like InP-HBT PA with 28.9% P1dB and 11.1% PAE DAT based Power Amplifier in InP 130nm HBT Technology
Speaker: Michael Küpper

ROOM 6
EuMW01
10:00 – 10:20
EuMW01
Teaching Methods for Microwave Engineering
Chair: Valeria Brunel
10:20 – 10:40
EuMW01
Teaching 10 remote students hands-on microwave design: Building a 3G QAM radio at home by hand
Speaker: Michael Küpper

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TUESDAY 09:00 - 10:40

ROOM 16
EuMC01
Advanced Packaging and Interconnect Technologies for Emerging Applications
Chair: Michael Koppes
At Chair: Michael Kolbe
09:00 – 09:20
EuMC01
A Millimeter-Wave Substrate Integrated Waveguide Filter in SiGeB Technology
Speaker: Michael Küpper
09:20 – 09:40
EuMC01
Optoelectronic Millimeter-Wave Embedded Circuits Fabricated at 8 GHz
Speaker: Daniel Schreiber

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ROOM 1
EuMC01
10:00 – 10:20
EuMC01
A 285 GHz Bandpass Filter Employing Shielded Folded Rigid Quarter-Mode SIW Resonator in CMOS Technology
Speaker: Michael Küpper
10:20 – 10:40
EuMC01
A CAD simulation study on gated-avalanche diodes for microwave applications
Speaker: Michael Küpper

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ROOM 4
EuMC101
10:00 – 10:20
EuMC101
A 285 GHz Bandpass Filter Employing Shielded Folded Rigid Quarter-Mode SIW Resonator in CMOS Technology
Speaker: Michael Küpper
10:20 – 10:40
EuMC101
A CAD simulation study on gated-avalanche diodes for microwave applications
Speaker: Michael Küpper

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ROOM 13
EuMC101
10:00 – 10:20
EuMC101
A Low Phase Noise Phase-Locked Loop with Short Settling Times for Automotive Radar
Speaker: Michael Küpper
10:20 – 10:40
EuMC101
A D-Band Power Amplifier with 39.5GHz Colpitts Quadrature VCO in 65nm HBT Technology
Speaker: Michael Küpper

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ROOM 14
EuMC101
10:00 – 10:20
EuMC101
A Low Phase Noise Phase-Locked Loop with Short Settling Times for Automotive Radar
Speaker: Michael Küpper
10:20 – 10:40
EuMC101
A D-Band Power Amplifier with 39.5GHz Colpitts Quadrature VCO in 65nm HBT Technology
Speaker: Michael Küpper

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ROOM 17
EuMC14
10:00 – 10:20
EuMC14
Advances in mmWave and High Power Integrated PA Technologies
Chair: Franz Kemper
10:20 – 10:40
EuMC14
A 100 GHz Class-F-like InP-HBT PA with 28.9% P1dB and 11.1% PAE DAT based Power Amplifier in InP 130nm HBT Technology
Speaker: Michael Küpper

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ROOM 6
EuMW01
10:00 – 10:20
EuMW01
Teaching Methods for Microwave Engineering
Chair: Valeria Brunel
10:20 – 10:40
EuMW01
Teaching 10 remote students hands-on microwave design: Building a 3G QAM radio at home by hand
Speaker: Michael Küpper
TUESDAY 10:40 – 13:30

Exhibition Hall

EuMIC15
EuMIC Posters
Chair: Mustafa Bakr
University of Oxford

EuMIC15-1
Field-Plate Mixer
Simon J. Mahon¹, Michael Heimlich¹
¹Macquarie University

EuMIC15-3
A derating-rules compliant Ka-Band GaN-on-Si power amplifier designed for highly reliable satellite applications
Ferdinando Costanzo¹, Lorenzo Pace¹, Patrick Ettore Longhi¹, Walter Ciccognani¹, Sergio Colangeli¹, Rémy Leblanc², Ernesto Limiti¹
¹University of Rome “Tor Vergata”, ²OMMIC

EuMIC15-5
Benefits of AlGaN/GaN thermal ROM coupling with industrial non-linear transistor model
Christophe Chang¹, Laurent Brunel¹
¹United Monolithic Semiconductors SAS

EuMIC15-7
A 300 GHz Frequency Doubler in Transferred Substrate InP DHBT Technology
Arsen Turhaner¹, Maruf Hossain², Mohamed Brahem², Tom Keinicke Johansen¹
¹Technical University of Denmark, ²Ferdinand Braun Institut (FBH)

EuMIC15-9
Full Octave Continuously Tunable Side-Band LC VCO in Ku-Band
Christian Bredendiek¹, Klaus Aufinger², Nils Pohl³
¹Fraunhofer FHR, ²Infineon Technologies AG, ³Ruhr-Universität Bochum

EuMIC15-11
A Ka-Band 40 W Output Power and 31 %PAE GaN MMIC Power Amplifier for Satellite Communication
Aniello Franzese¹, Nebojsa Maletic¹, Mohamed H. Eissa¹, Muh-Dey Wei², Renato Negra², Andrea Malignaggi¹
¹IHP - Leibniz-Institut für innovative Mikroelektronik, ²HFE RWTH-Aachen

EuMIC15-13
Probabilistic Poly Harmonic Distortion Model
Anna Manjaly¹, Justin King¹
¹Trinity College Dublin

TUESDAY 11:20 – 13:00

Room 7 – 12

EuMW02
EuMW/EuMC Opening Session
Chair: Nick Ridler ¹, General Chair
Co-Chair: Emma MacPherson ², EuMC Chair
¹National Physical Laboratory, UK, ²University of Warwick, UK

11:20
Welcome Address: Opening of the European Microwave Week
Nick Ridler ¹
¹General Chair

11:25
Greetings from the IEEE MTT-S
Gregory Lyons ¹
¹IEEE MTT-S President

11:35
Greetings from the EuMW 2021 Platinum Sponsor
Keysight Technologies

11:40
What’s Next for mmWave?
Mike Geen ¹
¹Filtronic

11:45
Awards Ceremony
Nick Ridler ¹
¹General Chair

EuMA Welcome Address
EuMA Outstanding Career Award
EuMA Distinguished Service Award
Roberto Sorrentino Prize

12:00
Announcements and Notifications
Emma MacPherson ¹
¹EuMC Chair

12:30
55% Fractional-Bandwidth Doherty Power Amplifier in 130-nm SiGe for 5G mm-Wave Applications
Aniello Franzese¹, Nebojsa Maletic¹, Mohamed H. Eissa¹, Muh-Dey Wei², Renato Negra², Andrea Malignaggi¹
¹IHP - Leibniz-Institut für innovative Mikroelektronik, ²HFE RWTH-Aachen
<table>
<thead>
<tr>
<th>Time</th>
<th>Room 4</th>
<th>EuMIC16</th>
<th>Room 17</th>
<th>EuMW03</th>
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</thead>
<tbody>
<tr>
<td>14:20</td>
<td>EuMIC16-1</td>
<td>An S-band 34dBm Stacked-HBT Phase-Fe Driver in 0.25um SiGe BiCMOS Technology for GaN-Based Phased-Array Radar Transmit Chain</td>
<td>EuMIC05</td>
<td>Novel Structures for Power Combines and Couplers</td>
</tr>
<tr>
<td>14:40</td>
<td>EuMIC16-2</td>
<td>A Phase Coherent DC-25 GHz 6-bit SiGe BiCMOS Step Attenuator with IP3@-20 dBm</td>
<td>EuMIC06</td>
<td>3D to 2D Transitions and New Materials for mmWave System Integration</td>
</tr>
<tr>
<td>15:00</td>
<td>EuMIC16-3</td>
<td>Remembering Roberto Sorrentino: A man inspired by knowledge and culture</td>
<td>EuMIC07</td>
<td>Nanofanular Filters II</td>
</tr>
<tr>
<td>15:20</td>
<td>EuMIC16-4</td>
<td>A 26 GHz to 34 GHz Active Phase Shifter with Tunable Polychrome Filter for 5G Wireless Systems</td>
<td>EuMIC08</td>
<td>Digital Predistortion, PA Optimisation and MIMO Architectures</td>
</tr>
<tr>
<td>15:40</td>
<td>EuMIC16-5</td>
<td>A 270 - 330 GHz Vector Modulator Phase Shifter in 10nm SiGe BiCMOS</td>
<td>EuMIC08-1</td>
<td>A Hybrid Heuristic Search Control Assisted Optimisation of Dual-Input Doherty Power Amplifier</td>
</tr>
</tbody>
</table>

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<tr>
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<th>Room 16</th>
<th>EuMIC16</th>
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<tbody>
<tr>
<td>16:40</td>
<td>EuMC05-2</td>
<td>A Miniaturized and Hybrid Si/III Resonator Solution for Filtering Power Divider and Antenna Array</td>
<td>EuMC06-1</td>
<td>Low-Loss 145-375 GHz MIMI-to-Waveguide Transitions and MIMI-to-MIMI Interconnections</td>
</tr>
<tr>
<td>17:00</td>
<td>EuMC05-3</td>
<td>My time with Roberto</td>
<td>EuMC06-2</td>
<td>A Compact K/Ka-Band Waveguide Transition with Integrated Diplexer and Power Divider</td>
</tr>
<tr>
<td>17:20</td>
<td>EuMC05-4</td>
<td>A Novel Compact Four-Way Power Combiner with an Embedded Microstrip-to-Waveguide Transition for K-band Power Amplifiers</td>
<td>EuMC06-3</td>
<td>3-D Metal Printed High-Q In-Line Filter With Helical Antenna Using Strong Mixed Coupling Resonator</td>
</tr>
<tr>
<td>17:40</td>
<td>EuMC05-5</td>
<td>When academic excellence gets inspired by new challenges: the growth of RF Miotech</td>
<td>EuMC06-4</td>
<td>A Hybrid Heuristic Search Control Assisted Optimisation of Dual-Input Doherty Power Amplifier</td>
</tr>
<tr>
<td>18:00</td>
<td>EuMC05-6</td>
<td>W-d-band Compact 3x3-88 Waveguide Directional Coupler Using Solted-Microstrip Based Unit-Cells</td>
<td>EuMC06-5</td>
<td>Analog and Digital Predistortion of RF Power Amplifiers</td>
</tr>
</tbody>
</table>
## TUESDAY 16:40 – 18:20

### Room 12

**EuMC09**

**Metasurfaces and Frequency Selective Surfaces**

Chair: Francisco Medina

- University of Sevilla, University of Birmingham

**Presenters**

- Alejandro Fernández

**INDUSTRIAL KEYNOTE**

The role of materials and technologies in next-generation communication systems

- Abstract:

  The fifth generation mobile networks radically changes the way components in the Radio Access Networks (RAN) are designed and implemented. This trend is likely to continue into the 6G era where software-defined radios covering up to THz frequency bands could bring about some exciting and demanding opportunities for future front-end IC and module technologies. In parallel, there is a major effort in telecommunication industry to virtualize the RAN, accelerated by the initiatives such as the O-RAN Alliance. The overall objective is to allow for the adoption of web scale technologies and software into 5G and future 6G networks. Web scale technologies rely primarily on open source software and general availability of programmable hardware solutions for which adoption in RAN poses a number of challenges.

**Programme**

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<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>16:40</td>
<td>Awards Ceremony</td>
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<tr>
<td>16:50</td>
<td><strong>EuMIC Prize</strong></td>
</tr>
<tr>
<td>16:55</td>
<td><strong>EuMIC Young Engineer Prize</strong></td>
</tr>
<tr>
<td>18:20</td>
<td>Closing remarks and invitation to EuMIC 2022</td>
</tr>
</tbody>
</table>

**EuMIC 2022 Chair**

**EuMIC 2021 Chair**

**EuMIC 2022 Chair**

**EuMIC Prize**

**EuMIC Young Engineer Prize**

**Tom Brazil Fellowship Award** (by the GAAS® Association)

**Charles Algani**, EuMIC Co-chair

**Serena Beri**, EuMIC Co-chair

**Edward Wasige**, EuMIC TPC Chair

**EuMIC 2021 Chair, EuMIC 2022 Chair**
**Wednesday 09:00 – 10:40**

### EuMC13
**Non-planar Passive Components**
- Chair: Cristiano Tomassoni
- Co-Chair: Ke Wu

#### EuMC13-1
**Hybrid Orthomode Transducer for E-band Point-to-Point Communication Systems**
- Raffaele Scuderi, Harry O’Sullivan, Constanze Stuehler
- Université de Brest, France

#### EuMC13-2
**Methods for Terminating and Terminating Waves in Ridge Gap Waveguide at W-Band: Carbon-Loaded Foam, Carbonyl Iron Paint, and Nickel Plating**
- Andrea Klimov, Alexey Klimov, Andrey Mozharovskiy, Dariia Herasymova
- Radio Gigabit LLC, Russia

#### EuMC13-3
**Design of Compact and High-Q Y-Band 9-Band Cavities in 0.1μm CMOS Technology**
- Ryo Ishikawa, Kazuhiko Honjo
- MinWave Technologies, Japan

#### EuMC13-4
**Compact Coaxial Wilkinson Power Divider in Empty Substrate Integrated Coaxial Line**
- Ben Hanning, Chris Hands, Michael Boyd
- Northumbria University, UK

#### EuMC13-5
**Full-Band Millimeter Wave Waveguide Map of Power Dividers for Manufacturing Ability**
- Gregory Million, Ngai-Ping Tsang
- University of Glamorgan, UK

### EuMC14
**Electromagnetic Scattering and Diffraction Effects**
- Chair: Professor Tatsuo Itoh
- Co-Chair: Pierre Bouchet

#### EuMC14-1
**Triple-Dependent Reflectivity of Waveguide Absorbers at Oblique Wave Incidence**
- Andrea Klimov, Alexey Klimov, Andrey Mozharovskiy
- Radio Gigabit LLC, Russia

#### EuMC14-2
**Time and Frequency Analysis of Rough Surface Scattering in the TTS Spectrum**
- Zbigniew Baldin, Yuya Igakura, Hideyuki Hirose, Takashi Ishii
- National Institute of Information and Communications Technology, Japan

### EuMC15
**Metamaterial Based Devices and Applications**
- Chair: Professor Tatsuo Itoh
- Co-Chair: Pierre Bouchet

#### EuMC15-1
**Metamaterial Lens for Monopulse Beamforming with a 77-GHz Long-Range Radar**
- Daisuke Kojima, Michael Jakoby, Andreas Fanke
- Technische Universität Darmstadt, Germany

#### EuMC15-2
**Stacked MetaSurfaces for MIMO Alignment Improvement of WPT Systems Using Spiral Resonators**
- Tatsuya Nakashima, Tomonori Maruo, Shashi K. Pandey
- Kyushu University, Japan

#### EuMC15-3
**Beam-Scanning Leaky-Wave Antenna Based on Dielectric Image-Line for Millimeter-Wave Applications**
- Masatoshi Kurata, Yuta Sakaguchi, Shusuke Yamada
- Osaka City University, Japan

#### EuMC15-4
**On the Capacitance of Slotted Metamaterial Resonators for Frequency-Variation Permittivity Sensing**
- Michael Braum, Gerhard Thiele, Thomas Fink
- Tampere University of Technology, Finland

#### EuMC15-5
**Ultra-Compact Ka-band Metamaterial Waveguide Filters, Fabricated by Lost-Wax Casting**
- Hiroshi Mizutani, Ryo Ishikawa, Kazuhiko Honjo
- MinWave Technologies, Japan

### EuMC16
**Integrated Components for Transceivers**
- Chair: Jean-Michel Marchand
- Co-Chair: Arne F. Jacob

#### EuMC16-1
**Receive and Transmit Beamforming SiGe BiCMOS ICs for Scalable E-Band Phased Arrays**
- Christian Aurinsalo, Jussi Säily, Mikko Varonen, Jukka Simonen
- TUT Technical Research Center of Finland, Finland

#### EuMC16-2
**A Q-band Capable Sampler for Direct Microwave Sampling in Software Defined Radio Context**
- Hendrik Bauer, Martin Ritter, Christoph Schürmann, Marko Wöhrer
- Technische Universität München, Germany

#### EuMC16-3
**Amplifier Bias for M pineum Noise Figure in Normally Constrained Systems**
- Boris Segers, Marc Amblard, Thomas Jauch, Jean S. Jakub
- Technische Universität München, Germany

#### EuMC16-4
**A Novel GaN/SIC MMIC Gain Figure Using a Reconfigurable Bidirectional FET Amplifier**
- Björn Klotz, Bernd Haken, Alexander Schäfer, Boris Steinhöfel
- Technische Universität München, Germany

# Wednesday Overview

**Room 1**
- New Design Concepts for Microwave Filters in Planar and Hybrid Technologies

**Room 2**
- Exhibitor Workshops

**Room 3**
- Exhibitor Workshops

**Room 4**
- EuMC13 Non-planar Passive Components
- EuMC14 Electromagnetic Scattering and Diffraction Effects

**Room 5**
- Exhibitor Workshops

**Room 6**
- EuMC13 Non-planar Passive Components
- EuMC14 Electromagnetic Scattering and Diffraction Effects

**Room 7**
- EuMC14 Opening Session

**Room 8**
- EuMC14 Defence, Security and Space (DSS) Forum

**Room 9**
- EuMC15-1 Metamaterial Lens for Monopulse Beamforming

**Room 10**
- EuMC15-2 Stacked MetaSurfaces for MIMO Alignment Improvement of WPT Systems Using Spiral Resonators

**Room 11**
- EuMC15-3 Beam-Scanning Leaky-Wave Antenna Based on Dielectric Image-Line for Millimeter-Wave Applications

**Room 12**
- EuMC15-4 On the Capacitance of Slotted Metamaterial Resonators for Frequency-Variation Permittivity Sensing

**Room 13**
- EuMC15-5 Ultra-Compact Ka-band Metamaterial Waveguide Filters, Fabricated by Lost-Wax Casting

**Room 14**
- EuMC16 Integrated Components for Transceivers

**Room 15**
- EuMC16-1 Receive and Transmit Beamforming SiGe BiCMOS ICs for Scalable E-Band Phased Arrays

**Room 16**
- EuMC16-2 A Q-band Capable Sampler for Direct Microwave Sampling in Software Defined Radio Context

**Room 17**
- EuMC16-3 Amplifier Bias for M pineum Noise Figure in Normally Constrained Systems

**Room 18**
- EuMC16-4 A Novel GaN/SIC MMIC Gain Figure Using a Reconfigurable Bidirectional FET Amplifier

**Room 19**
- EuMC16-5 Ultra-Compact Ka-band Metamaterial Waveguide Filters, Fabricated by Lost-Wax Casting
The presentation does not attempt to define a single route forward for sensing RF systems, but rather presents the challenges and opportunities presented by technological, industrial and human / AI trends.

None of the above happens in a vacuum (space examples on unmanned systems and secure networks to enable truly sensing – referencing in particular the advance of low cost and communications technologies to illustrate the maturing systems). The presentation provides an updated perspective on the evolution of radar systems to the high band of the spectrum implies new challenges in all aspects including the design of the antenna systems.

An overview of the emerging antenna technologies with application in these frequency bands will be presented in this talk, with special emphasis on the use of gap waveguide technology and its application to radar systems.

The presentation provides an update of this perspective. It was first presented in 2011 in Microwave Journal, which focussed on two competing visions of the future: The potential to converge the front end function of RF sensor systems – given the increasing ability to digitise at credible bandwidths – to create very capable large scale sensor systems – given the increasing ability to digitise at credible bandwidths – to create very capable large scale sensor systems with multiple functions; The potential to combine larger numbers of relatively low cost sensor systems to create networks of sensing that could replace large mono-lithic systems.

The presentation provides an update of this perspective. It examines: Examples of convergence between RF sensing and communications technologies to illustrate the maturity of multiple functions served by a single technology (either as a converged system or as a source of technology), and evolution of systems capability in networked sensing – referencing in particular the advance of low cost unmanned systems and secure networks to enable truly cooperative sensing solutions.

None of the above happens in a vacuum (space examples notwithstanding). There are substantial influences that will make the deployment of converged or co-operative systems possible – or impossible. The presentation gives a sample of these influences for consideration – expanding on: The evolution of / need for network security and robustness; The increase in complexity of the environment (UAS proliferation, wind farms etc.). The evolving relationship between automation (leading to autonomy) and human control; The evolving maturity of low cost, complex technology for commercial communications – providing alternative development routes for complex sensing systems.
WEDNESDAY 11:20 – 13:00

**ROOM 1**

**EuMC17**
New Design Concepts for Microwave Filters in Planar and Hybrid Technologies

Chair: Jian-Bing Huang
Co-Chair: Demetris Psychogiou

**Room 4**

**EuMC18**
Frequency Generation, Conversion and Nonlinear Modelling

Co-Chair: Tarek Mezrag

**Room 13**

**EuMC19**
3D Printing: Processes and Reliability

Co-Chair: Jonathan Powell

**Room 14**

**EuMC20**
Advanced High Efficiency Power Amplifier Techniques

Co-Chair: Philip Beattie

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**ROOM 2**

**EuMC18-1**
A Static Frequency Divider in GaN HEMT Technology

Hugo Kusters

**EuMC18-2**
Blind Receiver Distortion Compensation

Thierry Martin

**EuMC18-3**
A Wideband Highly-Effective Linearizable 70W Doherty Power Amplifier

Ole Martin, Jørn Eikland

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**ROOM 3**

**EuMC18-4**
A Real-Valued 4D Memory Algorithm for Matrix Factorization

Jia Li

**EuMC18-5**
Different Metallization Techniques Using a 3D Printed E-Band Ophthalmic Transducer

Kuo-Chu Huang

**EuMC20-1**
Phase Compensation Sequential Loop Modulated Balanced Amplifier Using Harmonically Tuned Control Amplifier

Paul Stalder

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**ROOM 4**

**EuMC18-6**
A Novel Technique for the Generation of Dual-Waveform Time-Dispersive Frequency Modulated Waveforms

Morteza Marandi

**EuMC18-7**
Channel Stability Analysis of 3D Printed Resonators Using Novel Materials

Rohit Desiraju

**EuMC20-2**
A Wideband Highly-Efficient Linearizable 70W Doherty Power Amplifier

Ole Martin, Jørn Eikland

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**ROOM 5**

**EuMC18-8**
Reconfigurable Transfer Function N-path Frequency Down-converter

Tanvir Hossain

**EuMC18-9**
Analysis of inductively injection locked oscillators at an integer frequency ratio

Rasko Rasko

**EuMC20-3**
An Enhanced Active Load-Pull Technique for Faster Convergence

Jiasheng Hong, Long Qing

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**ROOM 6**

**EuMC18-10**
Performance of SCM and DQPSK 3D Printed Ka-Band Resonators with Printed Warmup

Jia Li

**EuMC18-11**
Performance of CMOS Analog and Hybrid Technologies

Chair: Nils Weimann

**EuMC20-4**
A 2-GHz 79%-PAE Power Amplifier with a Novel Harmonic Tuning Circuit Using Only CRH TLs

Shinichi Tanaka

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**ROOM 7**

**EuMC18-12**
Reconfigurable Bandpass Filter Using Modified Asymmetric Step-Edge Impedance Resonators

Dezhong Wang

**EuMC18-13**
A Real-Valued 4D Memory Polynomial Algorithm for Matrix Modelling

Hui Sun

**EuMC20-5**
Bandwidth and Power Back-Off Performances of a Class-EB/F3 Power Amplifier

Nguyen Ngoc Minh, Anh Pham

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**ROOM 8**

**EuMC18-14**
Incubation Center, Kun Shan University

Shi-Peng Chen¹, Yung-Wei Chen², Sung-Pu Wu¹, Hung-EuMC17-5
Colorado at Boulder

¹University of Michigan, Ann Arbor, ²University of

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**ROOM 9**

**EuMC19-1**
Space Qualified Additive Manufacturing for RF Components

Programme Chair: Carlos Lázaro

**EuMC20-6**
A 9.6-GHz 79%-PAE Power Amplifier with a Novel Harmonic Tuning Circuit Using Only CRH TLs

Shinichi Tanaka

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**ROOM 10**

**EuMC19-2**
Reliability Investigations of Additive Manufactured RF-Structures on Low-Cost PCB Materials Based on Inkjet Technology

Chair: Giorgio Chelucci

**EuMC20-7**
A Wideband Highly-Efficient Linearizable 70W Doherty Power Amplifier

Ole Martin, Jørn Eikland

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**ROOM 11**

**EuMC19-3**
Thermal Stability Analysis of 3D Printed Resonators Using Novel Materials

Rohit Desiraju

**EuMC20-8**
A Wideband Highly-Efficient Linearizable 70W Doherty Power Amplifier

Ole Martin, Jørn Eikland

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**ROOM 12**

**EuMC19-4**
Performance of SCM and DQPSK 3D Printed Ka-Band Resonators with Printed Warmup

Jia Li

**EuMC20-9**
A Wideband Highly-Efficient Linearizable 70W Doherty Power Amplifier

Ole Martin, Jørn Eikland

---

**ROOM 13**

**EuMC19-5**
Different Metallization Techniques Using a 3D Printed E-Band Ophthalmic Transducer

Kuo-Chu Huang

**EuMC20-10**
A Wideband Highly-Efficient Linearizable 70W Doherty Power Amplifier

Ole Martin, Jørn Eikland

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**ROOM 14**

**EuMC20-11**
Bistatic and Power Back-Off Performances of a Class-EB/F3 Power Amplifier

Nguyen Ngoc Minh, Anh Pham

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**ROOM 15**

**EuMC20-12**
A Wideband Highly-Efficient Linearizable 70W Doherty Power Amplifier

Ole Martin, Jørn Eikland

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**ROOM 16**

**EuMC20-13**
A Wideband Highly-Efficient Linearizable 70W Doherty Power Amplifier

Ole Martin, Jørn Eikland

---

**ROOM 17**

**EuRAD02-1**
A Hump-H active Distance Control System Using Incorhealing, Cooperative FM CW Radar Sensors

Chair: Massoud Asselin

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**ROOM 18**

**EuRAD02-2**
Polarmic UV-deployed FM CW Radar for Buried People Detection in Rescue Scenarios

Chair: Tariq El-Abid

---

**ROOM 19**

**EuRAD02-3**
Ground penetrating capabilities of Airborne SAR System SETI

Chair: Paul Tasker

---

**ROOM 20**

**EuRAD02-4**
Improved RBNN-Based Rainfall Estimation: Initial Result

Chair: Mayazzurra Ruggiano

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**ROOM 21**

**EuRAD02-5**
An Approach for Sleep Apnea Detection based on Radar Spectrogram Envelopes

Chair: Adrian Porch

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**PROGRAMME**

**ROOM**

**ROOM**

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**ROOM**

**WEDNESDAY 13:50 - 16:40**

**WEDNESDAY 14:20 - 16:00**

**Exhibition Hall**

**EuMC25**

EuMC Posters 2

Chair: Mustafa Assistant Professor

“University of Oxford”

**EuMC25-1**

A Linear-to-Circular Polarization Converter with Wide Angular Stability and High Efficiency for Ka-Band Applications

15:00

**EuMC25-2**

Integrated Antenna Module for 5G Applications

15:20

**EuMC25-3**

A Wideband Circularly Polarized Horn Antenna using Transmission Type Linear to Circular Polarization converter for 4-4 Band Applications

15:40

**EuMC25-4**

A Linear-to-Circular Polarization Converter with Wide Angular Stability and High Efficiency for Ka-Band Applications

14:20

**EuMC25-5**

Rational Fitting with Weighted Iteration (RFWI) with Application to Chaos Antenna

14:40

**EuMC25-6**

Reflection-Chamber Performance of the Oscillating-Wall Slit Antenna for Estimating Antenna Efficiency

15:00

**EuMC25-7**

A Local Hot-Cold Antenna Measurement System

15:20

**EuMC25-8**

Wideband-Dual-Circularly-Polarized 4-4 Band Antenna for Beyond Applications

15:40

**EuMC25-9**

Wideband Dual Polarized Shared Aperture Antenna for LTE Applications

14:20

**EuMC25-10**

A Dual-Band Flexible Printed Graphene Antenna Array for 2.4 and 5 GHz WLAN IoT Applications

14:40

**EuMC25-11**

Miniaturized Superheated Simulated Antenna

15:00

**EuMC25-12**

High performance C/Ku band dual polarization feed system for large reflector antennas

15:20

**EuMC25-13**

Air-filled cavity-backed 28 GHz Antenna array implemented by 2.5D PCB process and Network Analysis

15:40

**EuMC25-14**

20 GHz Dual-Polarized Array Antenna With Low Cross-Polarization and High Gain

14:40

**EuMC25-15**

The GAWA Project: Development of a GaN-based Multi-Frequency Multi-Purpose Antenna

15:00

**EuMC25-16**

Miniaturized Antenna for Multiplication of Excitation

15:20

**EuMC25-17**

Wideband Dual Polarized Shared Aperture Antenna for LTE Applications

15:40

**EuMC25-18**

Routing of the Antenna Array

14:20

**EuMC25-19**

Miniaturized Superheated Simulated Antenna

14:40

**EuMC25-20**

Wideband-Dual-Circularly-Polarized 4-4 Band Antenna for Beyond Applications

15:00

**EuMC25-21**

Wideband-Dual-Circularly-Polarized 4-4 Band Antenna for Beyond Applications

15:20

**EuMC25-22**

Wideband-Dual-Circularly-Polarized 4-4 Band Antenna for Beyond Applications

15:40

**EuMC25-23**

Wideband Dual Polarized Shared Aperture Antenna for LTE Applications

14:20

**EuMC25-24**

Wideband Dual Polarized Shared Aperture Antenna for LTE Applications

14:40

**EuMC25-25**

Wideband-Dual-Circularly-Polarized 4-4 Band Antenna for Beyond Applications

15:00

**EuMC25-26**

Wideband-Dual-Circularly-Polarized 4-4 Band Antenna for Beyond Applications

15:20

**EuMC25-27**

Wideband-Dual-Circularly-Polarized 4-4 Band Antenna for Beyond Applications

15:40
**EUMW 2021**

**Thursday 09:00 - 10:40**

**Room 6**
- **EuMC29**
  - No Egger than a Pocketwatch: Niko Tesla’s Early Vision of the Information Age
  - Chair: Daniel Bolognesi
  - Co-Chair: Paolo Giaccone

**Room 9**
- **EuMC30**
  - Advanced Retrospective System for Beam NPT
  - Chair: William O'Brien
  - Co-Chair: Victor Fischetti

**Room 10**
- **EuMC31**
  - Tesla and Marconi: Wireless Technology, No Bigger than a Pocketwatch:
  - Chair: Yi Wang
  - Co-Chair: Kamran Ghorbani

**Room 11**
- **EuMC32**
  - The Potential for Viruses as Nanoscale Microwave Transmitters
  - Chair: Michael Lopez-Nicolas

**Room 13**
- **EuMC33**
  - Fifth Generation Sub-6GHz Antennas Design Challenges for 5G
  - Chair: Sampson Hu

**Room 17**
- **EuMC34**
  - RFID and WPT technologies
  - Chair: Alejandro Cortes

**Room 4**
- **EuRAD04**
  - Distributed and Multistatic Radar
  - Chair: Stephen Harman

**Room 7**
- **EuRAD05**
  - Enhancing Angular Resolution Using Neural Networks in Automotive Radars
  - Chair: Francoise Ferhat

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**Programme details continue...**
### THURSDAY 09:00 – 10:40

**Room B**

**EuRAD06**

**Radar Characteristics Measurement, Modelling and Simulation**

- **Chair:** Andrew Stove
- **Co-Chair:** Stéphane Méric

1. **EuRAD06-1**
   - **Time:** 09:00 – 09:20
   - **Title:** Signal Reduction Due to Layer of Water at Low-THz Frequency for Automotive Radar Applications
   - **Authors:** Quoc Duy Nguyen, Viettel High Technology Industries Corporation

2. **EuRAD06-2**
   - **Time:** 09:20 – 09:40
   - **Title:** Synthetic Sea-Clutter Modelling for STAP
   - **Authors:** Sabrina Machhour, Stéphane Kemkemian, Thales Defence Mission Systems (TDMS)

3. **EuRAD06-3**
   - **Time:** 09:40 – 10:00
   - **Title:** Numerical Analysis of Radar-Plasma-Signatures of a Sphere in a Mach 10 Hypersonic Wind Tunnel Flow
   - **Authors:** René Petervari, Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR

### THURSDAY 10:40 – 13:30

**Exhibition Hall**

**EuMC/EuRAD03**

**Posters**

- **Chair:** Mustafa Bakr
  - **University of Oxford**

1. **EuMC/EuRAD03-1**
   - **Design of narrow wall slotted waveguide planar array for 3D S-band radar with very low side lobelvel**
   - **Authors:** Quoc Duy Nguyen, University of Birmingham, 83R, NSA

2. **EuMC/EuRAD03-2**
   - **Transmission Line Based Frequency Modulated Continuous Wave Radar for Monitoring Airbag Deployment Processes**
   - **Authors:** Björn Möhring, Uwe Siart, Sebastian Schweizer, Thomas F. Eibert, Technical University of Munich, Audi AG

3. **EuMC/EuRAD03-3**
   - **Compressed Sensing for MIMO Radar using SIW Antennas for High Resolution Detection**
   - **Authors:** Cristian-Alexandru Alistarh, Laura Anitori, Wim van Rossum, TNO Defense, Safety and Security, The University of Edinburgh

4. **EuMC/EuRAD03-4**
   - **Spectrum Estimation for Very High Frequency RF Systems**
   - **Authors:** Emidio Marchetti, University of Birmingham

5. **EuMC/EuRAD03-5**
   - **Enhanced Self-Interference Cancellation by Means of Adaptively Calibrated Filters**
   - **Authors:** Jennifer Neugebauer, Technical University of Munich

6. **EuMC/EuRAD03-6**
   - **Design of a Miniature Smart Pill Antenna**
   - **Authors:** Hubregt Visser, Esmee Huismans, Minyoung Song, Yao-Hong Liu, Imec Netherlands, Eindhoven University of Technology, Imec

7. **EuMC/EuRAD03-7**
   - **Status and Ongoing Development of a kW-level Broadband W-band Gyro-TWA**
   - **Authors:** Liang Zhang, Craig Donaldson, Colin Whyte, Adrian Cross, University of Strathclyde

8. **EuMC/EuRAD03-8**
   - **Dosimetric Analysis of Plane Wave Propagation in Biological Tissues: Comparison Between Planar Multilayer vs Realistic Anatomical Models**
   - **Authors:** Micol Colella, Simona Di Meo, Paolo Marracino, Micaela Liberti, Sapienza University of Rome, Rise Technology srl, Rome

9. **EuMC/EuRAD03-9**
   - **Design of a Miniature Smart Pill Antenna**
   - **Authors:** Hubregt Visser, Esmee Huismans, Minyoung Song, Yao-Hong Liu, Imec Netherlands, Eindhoven University of Technology, Imec
## Thursday 11:20 – 13:00

### ROOM 1

<table>
<thead>
<tr>
<th>Time</th>
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| 11:20  | **EuMC/EuRAD01**<br>High Resolution Methods in Range and Azimuth for Environmental Perception<br>Chair: Thomas Buchmann<br>Co-Chair: Fredrik G抱歉，文本内容不完整。
THURSDAY 11:20 – 13:00

**Room 4**

**EuRAD07**

**Drone Detection and Recognition**

Chair: Francesco Fontana

Co-Chair: Duncan A. Robertson², TU Delft; University of St Andrews

- **EuRAD07-1**
  - **IRAD: Development of an Active and Passive, Multistatic Enabled, Radar System**
  - Perleyomy, Masato Kamado

- **EuRAD07-2**
  - **ARESOR: A Multicircle RF Sensor based on the Xilinx RFSoC**
  - Ronald, Eric, Harald, Hubert

**Room 9**

**EuRAD08**

**Radar Antennas, Arrays and Calibration**

Chair: Matthias Dörfel²

Co-Chair: Thomas Jäckle¹

- **EuRAD08-1**
  - **Design of Antennas with Capacitively Coupled Patches for Enlarged Bandwidth in the B0 GHz Band**
  - Christopher H. Schinzer¹, Maximilian Bock²,4, Marcus Blätter³,4, Marco T. Schätzle²

- **EuRAD08-2**
  - **Phase Distortion Correction of 79 GHz Frequency-Modulated Continuous Wave Radar**
  - André Guner, Francisco Fraga,4,4,4, Fabio Bergamini,1, Francesco Colone4,4

**Room 10**

**EuRAD09**

**Positioning and Localization Systems**

Chair: Marc Halimi²

Co-Chair: Markus Stock¹

- **EuRAD09-1**
  - **Near Field Doh Keel estimation utilizing a Large Aperture MIMO Array Radar with TX Beamforming**
  - Berthold Rehbein¹, Rolf Pfeiffer¹

- **EuRAD09-2**
  - **Outlier Rejection Approach for Direction of Arrival Estimation in Low SNR Conditions**
  - André Guner, Francisco Fraga,4,4,4, Fabio Bergamini,1, Francesco Colone4,4

**THURSDAY 13:50 – 16:40

**Exhibition Hall**

**EuRAD12**

**EuRAD Posters**

Chair: Mustafa Bakr¹

- **EuRAD12-1**
  - **Detection of Helicopters on a Single Range-Doppler Map Using LSTM Networks**
  - Siying Wang¹, Reinhold Herschel¹

- **EuRAD12-2**
  - **Efficient Velocity Disambiguation with Hypothetical Ambiguity Assessment**
  - Canisio Barth¹, Ric Romero¹, Douglas Fouts¹

- **EuRAD12-3**
  - **FGPA Implementation of a Low-Rate Sampling Composite Detection**
  - Cees Bertl¹, Michiel Brouwer², David Froriep²

- **EuRAD12-4**
  - **Fast 3D-CFAR for Drone Detection using MIMO Radars**
  - Minsung Eo¹, Jongseok Kim¹

- **EuRAD12-5**
  - **Quantum Enabled Staring Radar with Low Phase Noise**
  - Kansah Manci², Chris Bauer¹, Këshkëbi¹

- **EuRAD12-6**
  - **Fast Range-Angle Super-resolution Estimation for Frequency Division MIMO Radar**
  - Canisio Barth¹, Ric Romero¹, Douglas Fouts¹

**Room 9**

**EuRAD13**

**An Inexpensive SDR System for Emitter Localization**

Chair: Joachim Oberhammer¹

- **EuRAD13-1**
  - **2D Matched Filtering with Time-Stretching: Application to Orthogonal Matching Pursuit (OMP)**
  - Jonathan Schreiner¹, Fabio Juric¹,4,5,4,4,4,5,3

- **EuRAD13-2**
  - **Cognitive Radar Tracking with Adaptation of Update Interval and Integration Time**
  - Myriam Bernard¹, Thao Spang³

- **EuRAD13-3**
  - **Remote Sensing for Oil-Spill Detection using L-Band Interferometry**
  - Marco Ménard², Michelle Stein⁴

- **EuRAD13-4**
  - **Radar Characterization for Robust Detection of Small Moving Targets using Digital Beam-Forming**
  - Michael Magnabosco², Giovanni Cilfone²,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3

- **EuRAD13-5**
  - **Cluster Characterization for Robust Detection of Small Moving Targets using Digital Beam-Forming**
  - Michael Magnabosco², Giovanni Cilfone²,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3

**Room 4**

**EuRAD14**

**Realistic Simulation of Drone Micro-Doppler Signatures**

Chair: Christopher Bennett³

Co-Chair: Stephen Turner²,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3

- **EuRAD14-1**
  - **Realistic Simulation of Drone Micro-Doppler Signatures**
  - Christopher Bennett³, Stephen Turner²,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3

- **EuRAD14-2**
  - **Dual-Polarized Multilayer L-Band Asymmetric Subarray with Transmitted Electric Walls Separation for Airborne SAR Applications**
  - Hatice Karanlık¹, Mohammad Chehda³, Arie Sarné½, Binh-Minh Tran¹,1, Michael Alfano¹,1, Nikos Hadjileontis³,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3

- **EuRAD14-3**
  - **Experimental deep learning assisted super-resolution radar imaging**
  - Hatice Karanlık¹, Mohammad Chehda³, Arie Sarné½, Binh-Minh Tran¹,1, Michael Alfano¹,1, Nikos Hadjileontis³,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3

**Room 7**

**EuRAD15**

**Detection of-Man in Motion with MIMO Radars**

Chair: Francesco Fontana

Co-Chair: Duncan A. Robertson², TU Delft; University of St Andrews

- **EuRAD15-1**
  - **Detection of-Man in Motion with MIMO Radars**
  - Perleyomy, Masato Kamado

- **EuRAD15-2**
  - **Efficient Velocity Disambiguation with Hypothetical Ambiguity Assessment**
  - André Guner, Francisco Fraga,4,4,4, Fabio Bergamini,1, Francesco Colone4,4

**Room 9**

**EuRAD16**

**Positioning and Localization Systems**

Chair: Marc Halimi²

Co-Chair: Markus Stock¹

- **EuRAD16-1**
  - **Near Field Doh Keel estimation utilizing a Large Aperture MIMO Array Radar with TX Beamforming**
  - Berthold Rehbein¹, Rolf Pfeiffer¹

- **EuRAD16-2**
  - **Outlier Rejection Approach for Direction of Arrival Estimation in Low SNR Conditions**
  - André Guner, Francisco Fraga,4,4,4, Fabio Bergamini,1, Francesco Colone4,4

**Room 10**

**EuRAD17**

**Positioning and Localization Systems**

Chair: Marc Halimi²

Co-Chair: Markus Stock¹

- **EuRAD17-1**
  - **Detection of Helicopters on a Single Range-Doppler Map Using LSTM Networks**
  - Siying Wang¹, Reinhold Herschel¹

- **EuRAD17-2**
  - **Quantum Enabled Staring Radar with Low Phase Noise**
  - Kansah Manci², Chris Bauer¹, Këshkëbi¹

- **EuRAD17-3**
  - **Fast Range-Angle Super-resolution Estimation for Frequency Division MIMO Radar**
  - Canisio Barth¹, Ric Romero¹, Douglas Fouts¹

- **EuRAD17-4**
  - **Radar Characterization for Robust Detection of Small Moving Targets using Digital Beam-Forming**
  - Michael Magnabosco², Giovanni Cilfone²,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3,4,4,4,5,3
### THURSDAY 14:20 - 16:00

#### Room 1

**EuMC/EuRAD04**
- **Radar Architectures**
  - Chair: David Gong
  - Co-Chair: Marco Gatzke
  - University: UK, “York University, Beacham

#### Room 6

**EuMC40**
- **Advances in Biological and Medical Applications**
  - Chair: D. Agarwal
  - Co-Chair: M. Khayam
  - University: Darmstadt, ²O.

#### Room 11

**EuMC41**
- **Material and In-Water Measurements**
  - Chair: K. Gupta
  - Co-Chair: S. Kolar
  - National Physical Laboratory (NPL), UK

#### Room 12

**EuMC42**
- **Antennas Using Advanced Manufacturing and Novel Substrate Materials**
  - Chair: A. Fontana
  - Co-Chair: M. Fischer
  - University of Birmingham, "Interuniversity Microelectronics Centre (IMEC)

#### Room 13

**EuMC43**
- **Sensing and Dynamic Technologies**
  - Chair: A. Gelbarg
  - Co-Chair: I. Batta
  - University of Birmingham, "Interuniversity Microelectronics Centre (IMEC)

#### Room 15

**EuMC44**
- **Efficient Calibration of Very Large mm-Wave Radars by Virtual Phase Center Analysis**
  - Chair: P. Kozloski
  - Co-Chair: R. Mariel
  - University of Edinburgh, "University of Oxford, "University of Cambridge"

#### Room 17

**EuMC45**
- **Computationally Effective Microwave Antennas and Propagation**
  - Chair: M. Trumpp
  - Co-Chair: J. F. Myatt
  - University of Sheffield, "University of Oxford, "University of Cambridge"

#### Room 18

**EuMC40-1**
- **First-In-Human Clinical Investigation of the Waveline Microwave Breast Imaging System**
  - Chair: C. Palumbo
  - Co-Chair: J. Millar
  - University of Birmingham, "Interuniversity Microelectronics Centre (IMEC)

#### Room 20

**EuMC41-1**
- **In-vivo automatic adjustment of probe positions and tilt angles for EGGG probe**
  - Chair: P. Fredrick
  - Co-Chair: D. Herbst
  - National Institute of Advanced Industrial Science and Technology (AIST)

#### Room 21

**EuMC42-1**
- **Additive Manufactured Filtering Lens Antennas for Radar Measurements at 240 GHz**
  - Chair: S. Kolar
  - Co-Chair: M. Fischer
  - University of Birmingham, "Interuniversity Microelectronics Centre (IMEC)

#### Room 22

**EuMC43-1**
- **Comparison between Hybrid- and TM-polarized Bessel Beam Launchers for Wireless Power Transfer in the Radiative Near-field at Millimeter Waves**
  - Chair: F. Brown
  - Co-Chair: N. F. Mammal
  - University of Cambridge, "University of Oxford, "University of Cambridge"

#### Room 23

**EuMC44-1**
- **Impact of channel impairments on beamforming performance in Automotive MIMO Radar**
  - Chair: J. Millar
  - Co-Chair: A. M. Feder
  - University of Birmingham, "Interuniversity Microelectronics Centre (IMEC)

#### Room 24

**EuMC43-2**
- **Dielectric Measurement of Substrate Materials Using 3D-Printed Re-Entrant Cavity Resonator**
  - Chair: C. Palumbo
  - Co-Chair: J. Millar
  - University of Birmingham, "Interuniversity Microelectronics Centre (IMEC)

#### Room 25

**EuMC44-2**
- **Dielectric Measurement of Substrate Materials Using 3D-Printed Re-Entrant Cavity Resonator**
  - Chair: C. Palumbo
  - Co-Chair: J. Millar
  - University of Birmingham, "Interuniversity Microelectronics Centre (IMEC)

#### Room 26

**EuMC45-1**
- **Surface pressure sensing radar using V-Sensor**
  - Chair: J. Millar
  - Co-Chair: A. M. Feder
  - University of Birmingham, "Interuniversity Microelectronics Centre (IMEC)

#### Room 27

**EuMC45-2**
- **Terahertz Non-destructive Testing of the Mica insulation of Power Generator Bars in PMCW Measurements with a Dielectric Waveguide Antenna**
  - Chair: C. Palumbo
  - Co-Chair: J. Millar
  - University of Birmingham, "Interuniversity Microelectronics Centre (IMEC)

#### Room 28

**EuMC45-3**
- **Holographic Conical Beam Antenna Design and Fabrication**
  - Chair: P. Fredrick
  - Co-Chair: D. Herbst
  - National Institute of Advanced Industrial Science and Technology (AIST)

#### Room 29

**EuMC45-4**
- **Differential Analysis in Microwave Diode Testing of a Window Using Multi-Dimensional Spatial Variability Assessment for Automotive Radar**
  - Chair: P. Kozloski
  - Co-Chair: R. Mariel
  - University of Edinburgh, "University of Oxford, "University of Cambridge"

#### Room 30

**EuMC45-5**
- **Comparison of ZF and MF filters for Adaptive Pre-CFAR Gridmaps for Automotive Radar**
  - Chair: F. Brown
  - Co-Chair: N. F. Mammal
  - University of Cambridge, "University of Oxford, "University of Cambridge"
aggressively seeking a use of terahertz (THz) waves whose frequency is over 100 GHz for ultrahigh-speed wireless links. This talk will overview latest advances in THz communications research and testbeds, and will discuss the future perspective and directions with respect to technological challenges and applications towards 6G and beyond.

James Clerk Maxwell died before his prediction of the existence of Radio Waves was proved experimentally. Since then, wireless communications have revolutionised the way we communicate and the way we live. Where did it come from, where are we now and where are we going? In this presentation I will briefly outline some of the key historical achievements that have contributed to the evolution of wireless communications, take a look at some of the technology advancements that have contributed to the success of today’s systems and discuss how this revolutionary technology might continue.
## Friday, 09:00 – 10:40

<table>
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<th>Programme</th>
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| Room 4 | EuRAD16 Waveforms<br>Chair: Aliakmed Cathaband
d Co-Chair: Michele Cini<br>Office: University of Cote d'Azur, CNRS, LEAT, France<br>Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany | EuRAD17 Multi-and Fusion Techniques<br>Chair: Michael Antoniou<br>Co-Chair: Alex Gabbouj<br>University of Birmingham, UK |
| Room 11 | EuRAD18 Object Classification Techniques<br>Chair: Alex Gabbouj<br>Co-Chair: Alex Gabbouj<br>University of Birmingham, UK |
| Room 5 | EuRAD19 Frequency Comb Generation for High Range Resolution GOFDM Radar<br>Alessandro Dei - Università di Bologna, Italy | EuRAD17 Multi-Radar Fusion for Failure-tolerant Vulnerable Road Users Classification<br>Permanent Address: F. Dei di Scalco<br>Police Traffic Management Unit, Italy |
| Room 6 | EuRAD18 Effects and Countermeasures at In bands for an OFDM Radar<br>Permanent Address: F. Dei di Scalco<br>Telecom Italia, Italy | EuRAD17-1 Object Classification Techniques<br>Chair: Marie-Kathleen de Roo<br>Co-Chair: Alex Gabbouj<br>University of Birmingham, UK |
| Room 7 | EuRAD20 Cognitive FMCW-Radar Concept<br>Permanent Address: T. Biagi<br>PNA Labs, Italy | EuRAD17-2 Transfer Learning-Based Fully-polarimetric Radar - Image Classification with a Retraction Option<br>Permanent Address: A. Lahrichi<br>University of Paris-Est, France |
| Room 8 | EuRAD19 Frequency Comb Generation for High Range Resolution GOFDM Radar<br>Alessandro Dei - Università di Bologna, Italy | EuRAD20-1 Convolutional Neural Networks for Drone Model Classification<br>Permanent Address: PTI, Germany |
| Room 9 | EuRAD20-2 Sequential Sampling Pulse Radar<br>Permanent Address: T. Biagi<br>PNA Labs, Italy | EuRAD18-1 On two approaches to radar band fusion<br>Permanent Address: A. Lahrichi<br>University of Paris-Est, France |
| Room 10 | EuRAD19-1 Frequency Comb Generation for High Range Resolution GOFDM Radar<br>Alessandro Dei - Università di Bologna, Italy | EuRAD18-2 Classification of Unmanned Aerial Vehicles (UAVs) Carrying Payloads with Polarimetric Radar<br>Permanent Address: A. Lahrichi<br>University of Rome Tor Vergata, Italy |
| Room 11 | EuRAD18-3 Q-transmitter Digital Prediction for an OFDM Radar<br>Permanent Address: T. Biagi<br>PNA Labs, Italy | EuRAD18-3 Modelling of Extended Targets with Dual-Band MIMO Radar Networks<br>Permanent Address: A. Lahrichi<br>University of Rome Tor Vergata, Italy |
| Room 4 | EuRAD16 Waveforms<br>Chair: Aliakmed Cathabandi<br>Co-Chair: Michele Cini<br>Office: University of Cote d'Azur, CNRS, LEAT, France<br>Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany | EuRAD18-4 Contactless Inspection of Handwritten Documents with Terahertz Imaging<br>Permanent Address: A. Lahrichi<br>University of Rome Tor Vergata, Italy |
| Room 5 | EuRAD17 Multi-and Fusion Techniques<br>Chair: Michael Antoniou<br>Co-Chair: Alex Gabbouj<br>University of Birmingham, UK | EuRAD18-4 Object classification based on UWB scattered field and SEM data using machine learning algorithms<br>Permanent Address: A. Lahrichi<br>University of Rome Tor Vergata, Italy |
| Room 6 | EuRAD18 Effects and Countermeasures at In bands for an OFDM Radar<br>Permanent Address: F. Dei di Scalco<br>Telecom Italia, Italy | EuRAD18-5 Fruit Sorting with Amplitude-only Measurements<br>Permanent Address: A. Lahrichi<br>University of Rome Tor Vergata, Italy |
| Room 7 | EuRAD19 Frequency Comb Generation for High Range Resolution GOFDM Radar<br>Alessandro Dei - Università di Bologna, Italy | EuRAD18-5 Multi-Radar Fusion for Failure-tolerant Vulnerable Road Users Classification<br>Permanent Address: F. Dei di Scalco<br>Police Traffic Management Unit, Italy |
| Room 8 | EuRAD20 Cognitive FMCW-Radar Concept<br>Permanent Address: T. Biagi<br>PNA Labs, Italy | EuRAD17-1 Object Classification Techniques<br>Chair: Marie-Kathleen de Roo<br>Co-Chair: Alex Gabbouj<br>University of Birmingham, UK |
| Room 9 | EuRAD20-2 Sequential Sampling Pulse Radar<br>Permanent Address: T. Biagi<br>PNA Labs, Italy | EuRAD17-2 Transfer Learning-Based Fully-polarimetric Radar - Image Classification with a Retraction Option<br>Permanent Address: A. Lahrichi<br>University of Paris-Est, France |
| Room 10 | EuRAD19-1 Frequency Comb Generation for High Range Resolution GOFDM Radar<br>Alessandro Dei - Università di Bologna, Italy | EuRAD17-2 Classification of Unmanned Aerial Vehicles (UAVs) Carrying Payloads with Polarimetric Radar<br>Permanent Address: A. Lahrichi<br>University of Rome Tor Vergata, Italy |
| Room 11 | EuRAD18-3 Q-transmitter Digital Prediction for an OFDM Radar<br>Permanent Address: T. Biagi<br>PNA Labs, Italy | EuRAD18-3 Modelling of Extended Targets with Dual-Band MIMO Radar Networks<br>Permanent Address: A. Lahrichi<br>University of Rome Tor Vergata, Italy |
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| Room 7 | EuRAD19 Frequency Comb Generation for High Range Resolution GOFDM Radar<br>Alessandro Dei - Università di Bologna, Italy | EuRAD18-5 Multi-Radar Fusion for Failure-tolerant Vulnerable Road Users Classification<br>Permanent Address: F. Dei di Scalco<br>Police Traffic Management Unit, Italy |
The Long and Winding Road that Leads to Autonomy?

14:20

Presentation

Autonomous vehicles continued to be a significant growth area for radar sensing. The most manufactured radars in the world will be for automotive sensing and hence it represents a key use case of RF sensors but sensing is only part of the full challenge. This talk focuses on the difficulties faced in trying to build a Level 5 fully autonomous car in terms of sensors and scenarios whilst highlighting the role that microwave radar must play in making a robust sensor system for it. Examples highlights will be reviewed of UK research into what higher frequencies than the standard automotive 76 GHz can bring to making full autonomy more realisable.

15:00

Award Ceremony

15:20

EuRAD Conference Prize

EuRAD Young Engineer Prize

15:40

Closing Remarks and Invitation to EuRAD 2022 in Milan
Welcome from the Workshop and Short Courses Chairs

As the first physical event in the field of microwave engineering after the outbreak of COVID-19 pandemic, EuMW 2021 committee is uniting students, academics, and industrial experts in a less formal format at our workshops and short courses sessions. After careful considerations, we are pleased to offer an extensive and diverse programme of workshops and short courses throughout the entire week.

The wide-ranging programme of half-day and full-day workshops and short courses has been chosen to cover a range of important topics of interest to the whole EuMW community. The short courses will cover fundamental knowledge of specific areas or hands-on experience such as power amplifier designs, filter simulation, radar signal processing, and AI technology. Designing antennas and filters will also be covered.

We are very grateful to all the organizers, presenters and authors of workshops and short courses for their hard work and dedication before and during the conference. Each workshop and short course is individually endorsed by one or two of the conferences of EuMW. However, they are available and accessible to any scientist or engineer wishing to gain a broader perspective on microwave and RF systems and devices, or to learn about a new specialism within our broad field. Workshop organizers have been asked to provide panel sessions with their events for discussion and interaction, and we hope that you will benefit from participating in the international networking opportunity that this will present.

The workshops and short courses are mainly arranged on Sunday, Monday and Friday with few on Wednesday and Thursday. The EuMC endorsed sessions are distributed over the entire week and the EuRAD endorsed sessions are scheduled on Wednesday onwards, after the end of the main EuMIC conference sessions. We are confident that this structure will enable you to attend multiple workshops or short courses to incorporate into your schedule for the week, to enhance conference experience in London.

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Finally, we would like to welcome you all in London in February 2022 and be United in Microwaves.

Welcome from the Workshop and Short Courses Chairs

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SS04 EuMC

Terahertz Technology, Instrumentation and Applications
Chair: Miguel Navarro-Cía
University of Birmingham
Room 13

AGENDA

1. Why THz now? Historic introduction of THz science and technology.
2. Current applications, trends and potential opportunities.
3. Challenges from the material point of view.
5. THz technology: Passive components; sources (thermal, electrical and optical/laser based); detectors (thermal, coherent, others); commercial instruments, including cameras; my own experience: Abmm, TPS Spectra 3000, TERA K15 and non-commercial near-field TDS; TDS in detail: generation & detection.
6. TDS in detail: generation & detection.
7. Applications

The research on wireless sensors and IoT devices is proceeding at full speed, and the potential of such technologies as game changers in different application scenarios is rapidly emerging. IoT devices can bring a significant support to industry, providing the correct tools to implement continuous condition monitoring of production processes, inventory, and supply chains (the so-called Industry 4.0 and Industrial IoT). In such a context, one of the main bottlenecks to achieve full deployability of the IoT devices is their reliability. Indeed, production facilities are characterized by harsh and severe environments (such as high temperature, humidity, and electromagnetic interferences) which can threaten the device integrity and deteriorate the quality of the wireless links. Additionally, due to the considerable extension of industrial buildings and farms, wireless sensor networks must be deployed over large and remote areas, which hinders the possibility to perform maintenance and to guarantee continuous power supply to the single sensor nodes. Similar challenges are faced by IoT devices utilized in different contexts, such as Smart Cities and Structural Health Monitoring, which makes the design of electronics for harsh environments a transversal topic. The present workshop aims at providing an extended overview of the current advances in wireless sensing for harsh and severe environments. The impact of adverse operating conditions on devices and signals will be analyzed, and this study will be used to derive models and design strategies for IoT devices. The most recent outcomes in such context will be described and discussed, and future directions will be outlined.

PROGRAMME

Terahertz technology, instrumentation and applications
Miguel Navarro-Cía
University of Birmingham

WS01 EuMC

Advances of Wireless Sensing in Harsh and Severe Environments
Chair: Valentina Palazzi
Co-Chair: Smaïl Tedjini
University of Perugia, University Grenoble Alpes
Room 1

AGENDA

1. Why THz now? Historic introduction of THz science and technology.
2. Current applications, trends and potential opportunities.
3. Challenges from the material point of view.
5. THz technology: Passive components; sources (thermal, electrical and optical/laser based); detectors (thermal, coherent, others); commercial instruments, including cameras; user experience: Abmm, TPS Spectra 3000, TERA K15 and non-commercial near-field TDS; TDS in detail: generation & detection.
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PROGRAMME

Additively manufactured wireless sensors for rugged IoT, structural health monitoring, smart agriculture and smart cities applications
Nuno Borges Carvalho
University of Innsbruck

Emerging design strategies and technologies for wireless sensing in harsh environments
Valentina Palazzi
University of Perugia

End-to-end characterization of wireless sensor links for the Industrial IoT
Alexandre Couto
University of Aveiro

Accurate wireless sensor connectivity simulations in industrial environments
Lotge Verbeek
University of Aveiro

Autonomous sensors for environmental monitoring
Manos M. Tentzeris
Georgia Institute of Technology

Reliability enhancements with frequency diverse RFID systems
Manav Mehta
University of Loughborough

Passive HF RFID repeater for communicating with tags in metal housings
Jason Simpson
University of Technology

Development and implementation of RFIDsensors for the monitoring of cheeseindustry
Nuno Borges Carvalho
University of Aveiro

RFID battery-less sensing in generators and transformers of hydroelectric power plants
Rahmat Zaman
U-blox

Wireless, batteryless and packageless SAW sensors for harsh environments
Eduardo Rojas
Université de Lorraine

Additions on packaging additive manufacturing for harsh environment wireless sensors
Eduardo Rojas
U-blox

Smaïl Tedjini
University Grenoble Alpes
**SUNDAY 09:00 – 18:20**

**Terahertz Device, Circuit and System Fundamentals and Applications**

Chair: Dimitris Pavlidis¹

Co-Chair: Imran Mehdi¹ and Javier Mateos¹

¹Florida International University, ²Jet Propulsion Laboratory, ³University of Salamanca

Room 4

The technology has reached a certain degree of maturity but there are still important developments necessary for implementing it to systems. At the same time, there are still needs for device and circuit studies in order to improve, frequency, power, sensitivity performance and provide integrated solutions to system requirements. The workshop will provide the opportunity to new generations of scientists and engineers to learn about the unique features of Terahertz technologies, while at the same time addressing the latest achievements in the field. THz applications to be discussed extending among sensing and spectroscopy to communications and imaging. The workshop will bring together experts from various academic, national labs and commercial enterprises to discuss the most recent advances in their respective fields and to provide insight into what the future might hold for exploration of this frequency range. It will focus on a variety of materials such as traditional III-Ns, III-Nitrides, Silicon, Graphene and Transition metal dichalcogenides (TMDs), as well as various device concepts for efficient THz generation and detection. The operation of the components to be discussed is based on plasmonics, photoconductors, plasma waves, photomixing, resonant tunneling, Negative Differential Resistance, CMOS and High-Electron Mobility Transistors. Devices such as Quantum Cascade Lasers, Self-switching Dioders and Uni-Traveling-Carrier Photodiodes and nanoscale Vacuum Transistors will also be addressed. Advanced Sensing, Imaging and Communications and terrestrial, space applications will be discussed. The Workshop is intended for young scientists and engineers who are interested in learning about this emerging field, as well as individuals with a more advanced understanding of related concepts. The topics addressed include fundamental and engineering considerations together with the latest results in Terahertz technology.

**PROGRAMME**

**THz applications: from devices to space systems**

InP HBTs for THz microsystems

Miguel Uezu

Jet Propulsion Laboratory

Low-power consumption THz metasurface quantum-cascade VECSELs.

Espen Millichamp

University of California Los Angeles

Tlz devices and systems: from technology to applications

Shahab Davoudi, J. L. Edgar, T. P. Pearsall and I. Shih

CMOS - University of California

Terahertz communications using resonant tunneling diodes

Mohsen Azizi

Dalhousie University

Resonant-tunneling-diode THz oscillators and applications

Safar Safaei Farad and Mahshid Azadi

School of Technology

High-speed terahertz wireless is hot, how about its contrary?

Raman Sarpotdar

Virginia Tech

Challenges and advances in terahertz antennas

Marc Alonso del Pino

KU Leuven University of Technology

THz spectroscopy of agricultural samples

Dominic Morgan, Matthew Kavanagh

University of Salamanca

**mmWave Plastic Waveguide High Data Rate Communication**

Chair: Didier Belot¹

Co-Chair: Eric Kerhervé²

¹CEA, ²IMS Bordeaux

Room 17

Driven by the requirements of emerging applications such as the autonomous driving, the mini-cell base stations, the e-health and the industry 4.0, the enabling of high-speed, low-latency, and low-power communication technologies is a key challenge to unlock the forthcoming sixth generation standard for wireless communications technologies (6G). Leveraging the availability of cost effective high performance silicon technologies, CMOS and BiCMOS sub-THz integrated circuits (IC) have demonstrated impressive performances (both in terms of achievable data rate and low power consumption) leading to innovative product introduction on the market. However, most of those developments have been focusing on wireless link and are consequently limited by the spectrum regulation (in terms of usable bandwidth). This limits the optimization that can be achieved at the system level in order to propose the best trade-off between power consumption and data rate. Europe is leading the thematic, with exploratory labs as KU Leuven, IMS Bordeaux and CEA-LETI Grenoble.

Maximum data-rate transmitted with this technique is 36Gb/s over 1m, and maximum distance is 15m with 1.5Gb/s transmitted. These technologies are needed to transmit data:


- The Electromagnetic coupling element, generally an antenna structure that must be as efficient as possible to limit the losses.

- The plastic fiber, where material specificities as Epsilon R and Tangent Delta are the main, but not the only key factors. Main challenges for this technique are:

  - How to address 10Gbs over 1m for Data-center market.
  - How to increase data rate at medium-long distance (5m-2Bm) reducing losses for other connectivity markets (vehicles, mini-cells, home, factories, …)

- How to aim the pJ/bit increasing as far as possible the efficiency to reduce the power consumption, thus the environmental impact.

- Which plastic material to reduce the environmental impact?

This Workshop will propose state of art presentations from research public and private organizations, and will give the opportunity to the audience to deeply discuss the potential of this technology. At the end of the Workshop, a Panel discussion will be organized with the speakers and Audience will be able to discuss with them to understand more this approach.

**PROGRAMME**

**A 140GHz SFP28 PMF module achieving 25Gbps and 50Gbps with channel equalization**

Philippe Bernard

Teledyne Scientific Company

Loss/sensitivity optimized X-shaped millimeter-wave plastic waveguide

Anthony Ghiotto

KU Leuven

Plastic and hybrid communication links at 60GHz and 140GHz

Jim Cal-Kansson Grenier

KU Leuven

High data-rate mmWave plastic fiber for evolved 5G and 6G base stations

Yves Tournay, Jean Bernard

Thales, France, Sweden

First mmWave transceiver IC product for plastic communications and contactless communications

Lliont Alay

Thales

Plastic waveguide: which connectivity market for this solution?

Arumugan P. Dey

CEA

Demonstration

Didier Belot¹

CEA

- How to address 10Gbs over 1m for Data-center market.
- How to increase data rate at medium-long distance (5m-2Bm) reducing losses for other connectivity markets (vehicles, mini-cells, home, factories, …)
- How to aim the pJ/bit increasing as far as possible the efficiency to reduce the power consumption, thus the environmental impact.
- Which plastic material to reduce the environmental impact?

This Workshop will propose state of art presentations from research public and private organizations, and will give the opportunity to the audience to deeply discuss the potential of this technology. At the end of the Workshop, a Panel discussion will be organized with the speakers and Audience will be able to discuss with them to understand more this approach.
The aim of the workshop is to provide the attendees with a comprehensive overview of the most recent advances and the major research trends in area of microwave and millimetre-wave filters. Besides being a key component of any RF system, filters represent a major portion of the research activity on passive components, and attract special interest both in the academia and in the industry. Currently, all main applications (from 5G/6G to space) require filters with superior performance and specific fabrication properties.

The workshop includes 10 presentations (possibly one more will be subsequently added). The topics covered by the presentations will range from innovative design techniques to novel technological and manufacturing processes. The hot topic of tunable filters will be discussed, along with applications to space. World-recognized authorities in the field will illustrate their recent achievements, and ample time will be devoted to the discussion, with the audience with a panel session that will cover approximately 25% of the total allotted time.

**PROGRAMME**

**WS04 EuMC**

**New Trends in Microwave and mmWave Filters**

**Chair:** Maurizio Bozzi  
**Co-Chair:** Cristiano Tomassoni

*University of Pavia, University of Perugia*  
*Department of Computer Science, University of Perugia*

**Recent researches and future trends of millimeter-wave on-chip bandpass filters**

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Institution</th>
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<tbody>
<tr>
<td>Wenhao Chen</td>
<td>University of Electronic Science and Technology of China</td>
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<td>Guoxian Shao</td>
<td>Hong Kong University of Science and Technology</td>
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**High Q tunable filters using a single tuning element**

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<tr>
<td>Fudong Wang</td>
<td>Xidian University</td>
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**Shape optimization of microwave cavity filters**

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<th>Speaker</th>
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<tr>
<td>Xiaohai Ji</td>
<td>Donghua University</td>
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**RF system-integration approaches and integrated antennas for 5G mmWave and 6G**

**Architectural challenges for 5G mmWave and 6G sub mmWave radio base stations**

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<th>Speaker</th>
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<tr>
<td>Arulchandran Varadarajan</td>
<td>University of Edinburgh</td>
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**Technology and chip-design considerations for 5G/6G beamforming solutions**

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<th>Speaker</th>
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<tr>
<td>Raimo Helttula</td>
<td>VTT Technical Research Centre of Finland</td>
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**Transceiver frontends in BiCMOS technology for 6G communications**

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<th>Speaker</th>
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<tr>
<td>Vanina Grasso</td>
<td>University of Milan</td>
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**New on-chip, packaging, integrated-antenna and beamforming-architectures as well as chip-package co-optimization and multiphysics techniques will be presented. Recent results of some national/international 5GmmWave/6G projects such as SERENA (5G-mmWave EU Project), mmWave-JPCC (Important Project of Common European Interest) and 6GKom (first 6G O-band-module project funded by German Federal Ministry of Education & Research) will also be discussed.**
SUNDAY 09:00 – 18:20

**WS06**

**EuMIC/EuMC**

**Progress and Status of Gallium Nitride Monolithic Microwave Integrated Circuits**

*Chair: Rüdiger Quay¹*  
*Co-Chair: Farid Medjdoub² and Ernesto Limiti³*  
¹Fraunhofer IAF, ²U. Lille/IEMN, ³University of Rome

**Room 10**

This workshop gives an overview of the progress of important Gallium Nitride MMIC technologies available to the microwave and RF community for frequencies from 400 MHz to 200 GHz. Prominent industrial vendors of GaN MMICs have been invited and have agreed to participate. Several international speakers will give their view to the evolution of important applications such as sensing, data com, with emphasis on mm-wave IC technology. Several roadmaps will be provided to enable the audience to estimate the progress of MMIC on a global scale. Further, the research progress with respect to higher frequency scaling beyond commercial technologies is addressed. The workshop thus will provide an overview on the overall status of MMIC technology, device technology, circuit design, reliability, and integration.

**PROGRAMME**

- **Self-configuring, adapting and reconfigurable GaN MMICs**  
  Charis Campbell¹  
  ¹Qorvo (USA)

- **Recent development of GaN power technology applied to RF sensors**  
  Olivier Fontan  
  ²UMS (France, Germany)

- **State of the art mmWave GaN/Si MMICs**  
  Max Huber¹  
  ²Imec

- **Design of high performance microwave and millimeter wave GaN HPA's**  
  Allin Laggio³  
  ³Rohde & Schwarz

- **Design of GaN power amplifier MMICs operating beyond 100 GHz**  
  Marco Spagnol³  
  ³Rohde & Schwarz

- **Mm-wave space applications using GaN at ESA**  
  Paolo Fasano⁴  
  ⁴European Space Agency

- **Reliability evaluation, failure modes and mechanisms of scaled RF GaN high electron mobility transistors**  
  Fabio Zuccari⁵, Matteo Marinelli⁵, Carl De Santi⁵, Fabio Meloni⁵ and Giuseppe Brambilla⁵  
  ⁵University of Rome

- **mmWave GaN HEMTs and enhanced reliability**  
  Fabio Medjdoub¹  
  ¹U. Lille/IEMN

- **Multifunctional front-end integration for radar/earth observation at mmWaves**  
  Ernesto Limiti¹  
  ¹University of Rome

- **Reliability evaluation of GaN HEMTs and their applications**  
  Enrico Zanoni¹, Matteo Buffolo¹, Carlo De Santi¹, Matteo Meneghini¹ and Gaudenzio Meneghesso¹  
  ¹University of Padova

- **Technological development towards high performance**  
  Allin Laggio³  
  ³Rohde & Schwarz

SUNDAY 09:00 – 13:00

**WS07**

**EuMC**

**RF Reliability Status and Challenges for 5G mmWave and 6G Applications**

*Chair: Fernando Guarin¹*  
*Co-Chair: Mark Ingels²*  
¹Global Foundries, ²Imec

**Room 11**

In this workshop, the current status of reliability methods as well as the challenges faced for the reliability assessment and qualification for 5G and 6G mmWave applications will be examined. Each of the material systems will be discussed for each of the major technology solutions being offered for 5G-6G: GaN, SiGe and Silicon CMOS RF (including SOI). While some of the underlying degradation mechanisms will be common, each material system will have its own properties, unique failure mode and reliability risks, as well as limitations on operating temperature as they will have different self-heating profiles. A careful review and consideration for the performance/reliability balance will be given for each of the technology solutions (GaN,SiGe, Si CMOS-RF). One of the major goals will be to provide a practical overview of the key reliability mechanisms and methodologies for reliability characterization. We will also discuss the challenges faced by reliability engineers when assessing the reliability of 5G-6G/mmWave/RF applications.

**PROGRAMME**

- **System level reliability requirements**  
  Mark Ingels²  
  ²Imec

- **SiGe mmWave reliability status and challenges**  
  John Crowther⁶  
  ⁶Empreva

- **GaN mmWave reliability status and challenges**  
  Jose Jimenez¹  
  ¹Qorvo

- **GaN HEMTs reliability status and challenges for 5G applications**  
  Joe Shenoy⁷  
  ⁷Qorvo

- **SOI mmWave reliability status and challenges**  
  Purushothaman Srinivasan  
  ³Global Foundries
This workshop is dedicated to GaN Front-End and Back-End technologies to fulfill microwave circuits and packaging solutions for 5G telecommunications and Satcom applications. In this workshop, an overview of GaN MMIC advanced epitaxial materials and processes on Si and SiC substrate working from Ka to E band is presented. Advanced materials are keys for achieving electrical performances and high power at millimeter wave frequencies for 5G and more generally telecommunication applications. Wide band gap (WBG) semiconductor materials based on GaN are expected to enable superior electrical performances and package for Satcom applications. The partners of the European project GaN2 work on epitaxial layer deposition on optimized substrate materials. The Project 5G_GaN2 work on epitaxial layer deposition on optimized substrate materials. The circuits and materials to be used are the key functions to comply with 5G telecommunication requirements. Microwave function designs using advanced GaN technologies are addressed. FEM (Front-End Module) at 39GHz, high efficiency and linear HPA, E band HPA, Tx/Rx at 28GHz are the key functions to comply with 5G requirements. The circuit design phase is carried out including the effects of the package selected for the housing. In this scope, the integration of the circuits into low-cost package as SMD plastic or Fan Out Wafer Level Package (FOWLP) is presented. Main challenges for packaging are thermal dissipation, heterogeneous integration (Si and GaN), reliability and cost price. All these aspects covering the complete value chain from wafer suppliers, semiconductor fabrication and system integration are reviewed and trade-offs are proposed to fulfill the 5G telecommunication requirements.
This half day workshop will cover a broad range of topics which include 30GHz high efficiency power amplifier design using load pull data, the need and benefit of isolating trapping effect In GaN Characterization and finally a technical analysis of wide bandwidth load pull systems and how they are helping both designers and test engineers better their designs and test times for modulated applications. As Satellite, 5G networks and mobile devices are being deployed worldwide, the need for efficient sub 6GHz and mmWave power amplifiers is in high demand and will continue to grow.

The competitive market for such amplifiers leaves no room for average designs, and the design team needs to fully grasp all the key elements in characterization and modelling of transistors employed, as well as applying the models to design the amplifier. In this Workshop we will describe some of the key steps in designing a highly efficient 30GHz GaN SiC HEMT power amplifier as well as lower frequency designs which follow a strict characterization and design process. The steps will include pulsed IV characterisation, pulsed s-parameters, mmWave load pull, behavioural and compact modeling, importing data to design tools and final design within the CAD tools. We will discuss the challenging task of mmWave load pull on high power GaN transistors that require high gamma loads to fully explore the maximum power and efficiency contours and compare the use of active and recent passive and hybrid active load pull techniques to produce the high Gamma loads required.

**SS01**
**EuMC**
**Advanced Non-linear Characterization and Design of Highly Efficient Power Amplifiers Using Load Pull Data for Sub 6 GHz and mmWave Applications**

Chair: Vince Mallette
Focus Microwaves
Room 6

**PROGRAMME**

Using measurements to drive successful design - 30 GHz high efficiency PA example
Vince Mallette
Focus Microwaves

Isolating Trapping Effect In GaN Characterization
Vince Mallette
Focus Microwaves

"Mind the gap" the value of high bandwidth load pull systems?
Aamir Sheikh
Focus Microwaves

New 5G mmWave beamforming devices like Antenna-in-Module (AIM), mmWave-capable user equipment (UE) and customer premise equipment (CPE) designs require accurate Over-the-Air (OTA) validation and test to determine their beamforming performance. This short course introduces several real and practical challenges of mmWave OTA test, and presents considerations, trade-offs, and best practices for optimizing system calibration and measurement performance. This presentation also includes live demonstrations of the discussed OTA measurement techniques on an active antenna system, using mmWave signal generation and analysis within an RF anechoic chamber. Finally, it will introduce methodologies for speeding up the characterization of these new 5G mmWave devices.

**SS03**
**EuMC**
**5G mmWave OTA Measurements – Best Practices for Fast and Reliable Results**

Chair: Alejandro Buritica
Co-Chair: Marie Weill
NI
Room 11

**PROGRAMME**

Top challenges of 5G mmWave OTA testing
Alejandro Buritica
NI

Calculating overall Measurement Uncertainty (MU) budget
Gerardo Orozco
NI

How to overcome OTA measurement challenges
Alejandro Buritica
NI

Hands-on OTA test demonstration
Mher Minasyan
NI
R&D Trends and Challenges in RF PAs for Medium/High-Volume Products
Chair: Souheil Ben Smida¹
Co-Chair: Konstantinos Mirmis²
¹Herriot-Watt University, ²Sony Europe B.V.
Room 1

With the advent of 5G and the need for ever increasing connectivity, new requirements and restrictions of the associated applications embed the adoption of research by the industry, and hence the translation of innovative ideas into products. One of the key components – if not the most important – for any wireless communications system is the power amplifier (PA). Although PAs have been the focus of research for many decades resulting in a vast number of architectures and implementations, it is still unclear why certain types of PAs have dominated particular applications and what are the key aspects that a new architecture must possess to outplace an established solution. This course will introduce the most prominent techniques and inform them on the directions their research should focus in order to maximise their impact.

The need for high performance PAs and application requirements
Shahed Ben Smida¹ and Ali Missou²
Herriot-Watt University, ²Sony Europe B.V.
Outphasing transmitters in CMOS technology
Souheil Ben Smida¹
Wiley International
The Doherty PA in mmWave frequencies
Erik Villars
Texas RFF USA
Envelope tracking flavours and implementation considerations
Jonathan Lawes¹
⁲TU Dresden

Enabling digital predistortion for today’s power amplifiers
Chair: Souheil Ben Smida¹
*American University of Sharjah

Enabling silicon technologies for mmWave radar trends and requirements
Farid Issakov¹
Globalfoundries
An automotive radar demonstrator with a 22nm CMOS FDSOI transceiver
Ali Farid¹, Ahmed Ahmed¹, Utku Solyu¹ and Munkyo Seo¹
UC Santa Barbara
High-speed ADC (>20 GS/s) with high resolution (>10 bit) for Low-IF receiver in 22nm FDSOI
Mark Rodwell¹, Ali Farid¹, Ahmed Ahmed¹, Utku Solyu¹ and Munkyo Seo¹
*UC Santa Barbara

Design of a D-band PMCW radar transceiver in 45 nm FDSOI technology
Vladimir Vorobiev¹, Vladimir Zverev¹ and Michael Lueyer¹
TU Braunschweig, ²Weihenstephaner Technologie, ³Infineon
High-speed DACs in 22 nm FDSOI CMOS for D-band wireless communication towards 6G
Juho Järvi¹, John Shaffer¹ and Frank Binger¹
*Friedrich-Alexander Universität Erlangen-Nürnberg

High-speed ADCs for D-band radar in 22 nm FDSOI CMOS
Steven Buter¹ and Frank Binger¹
*Bradford University of Technology

Recent developments in nano-scale CMOS, allow for MOS transistors to achieve fT and fmax in excess of several hundreds of gigahertz. This enables realization of highly integrated radar and communication systems operating at mmWave frequencies. Particularly, the frequency range around 140 GHz is an interesting candidate to become approved for licensed usage world-wide in the near future for radar and for 6G wireless communication applications. In this workshop, we discuss highly-integrated radar and communication systems operating at W-band and D-band realized in advanced nano-scale CMOS and BiCMOS technologies. The workshop offers a balanced distribution between both fields. We cover a wide range of topics starting from the technology choice for mmwave applications, a talk by Globalfoundries. Bosch will provide a vision on a fully integrated automotive radar system-on-chip in 22nm FDSOI technology. The team of Prof. Zwick (IEEE Fellow) presents packaging and antenna solutions for D-band FMCW radar. Next, mixed-signal and RF part of a digitally modulated FMCW 140 GHz radar transceiver is discussed by TU Dresden and Infineon, respectively. Second half of the workshop focuses of communication transceivers towards 6G. It covers system considerations, mixed-signal part (ADCs and DACs) and novel system architectures. Finally, Prof. Mark Rodwell closes the workshop with a talk on 140 GHz MIMO array transceiver in CMOS and InP. In this workshop we have a good mixture of industry (Globalfoundries, Bosch, Infineon) and academia (PAU Erlangen, TU Dresden, TU Berlin, TU Braunschweig, Karlsruhe Institute of Technology). We have presentations from Europe and the USA. We will round up the workshop by a panel discussion in which we will address the challenges and future directions for circuit design for mmwave frequency in radar and communication transceivers.

MMIC Trends and Challenges
Chair: Vyacheslav Ponomaryov
Room 2

Packaging solutions for D-band systems in BiCMOS technologies
Mark Rodwell¹, Marco Boden, J. Anderl, J. Mileskova, A. Lortz and E. Eichler
*Technische Universität Berlin

IF receiver in 22nm FDSOI CMOS, a talk by Globalfoundries
Julius Edler¹, P. Artz¹, E. Wittenhagen¹, N. Lotfi¹ and F. Gerfers¹
*Technische Universität Berlin

D-band CMOS-InP and CMOS-only MIMO communication transceivers
Mark Rodwell, Marco Boden, J. Anderl, J. Mileskova, A. Lortz and E. Eichler
*Technische Universität Berlin

D-band CMOS FMCW radar. Next, mixed-signal part and RF part of a digitally modulated PMCW 140 GHz radar transceiver is discussed by TU Dresden and Infineon, respectively. Second half of the workshop focuses of communication transceivers towards 6G. It covers system considerations, mixed-signal part (ADCs and DACs) and novel system architectures. Finally, Prof. Mark Rodwell closes the workshop with a talk on 140 GHz MIMO array transceiver in CMOS and InP. In this workshop we have a good mixture of industry (Globalfoundries, Bosch, Infineon) and academia (PAU Erlangen, TU Dresden, TU Berlin, TU Braunschweig, Karlsruhe Institute of Technology). We have presentations from Europe and the USA. We will round up the workshop by a panel discussion in which we will address the challenges and future directions for circuit design for mmwave frequency in radar and communication transceivers.
**Microwave and mmWave Techniques for Sensing, Imaging and Characterisation of Biological Tissues**  
Chair: Alessandra Costanzo¹  
Co-Chair: Marco Pasian¹  
¹Università degli Studi di Bologna, ²University of Bologna  

The use of electromagnetic fields for sensing, imaging, and characterization of biological tissues is a field where the research and development aspects represent an hot topic, and are fundamental to move toward real-life applications. Microwave frequencies are suited for several of these applications, and mm-waves are also investigated to provide new and/or alternative solutions. In both cases, the promise is the possibility to provide new diagnostic tools, able to complement the existing ones, maintaining a high safety standard for the patient, due to the use of non-ionizing radiation, as well as easy-to-use operations and reasonable comfort. Maintaining at the same time reasonable costs, to contribute to the new healthcare paradigm, which foresees continuous and personalized medicine as one of the future pillars.

This workshop will present the state-of-the-art for some key elements, ranging from innovative applications, including invivo sensing and imaging, key considerations in measuring heterogeneous tissues, and sensing volume and tissue contributions, up to the characterization of tissues from the molecular point of view, fluctuations properties due to dehydration and robust procedure to overcome these uncertainties will be discussed. Two half-hour panel sessions will be organized within the full-day workshop during which speakers and attendees will have the opportunity to be engaged in discussions about potential applications and issues of the techniques presented during the workshop.

**RF On-wafer Calibration and Measurement Eco-system Workshop**  
Chair: Anthony Lord¹  
Co-Chair: David Viera²  
¹FormFactor Inc  
²University of Bologna  

Up until recently, on-wafer measurements of semiconductor devices, either of narrow band Integrated Circuits or broadband transistors, was typically limited to 67GHz or in some cases 110GHz. However, with the growing demand of consumer devices working in the mm-wave range, including 5G or automotive radar for example, the requirements are growing for more measurements and data not only to 110GHz, but 220GHz and beyond. Even if the operating frequencies of these devices are sub 100GHz, the need to characterize the models of the transistors and other components used in these circuits typically is much higher than the working band they are eventually used in. In addition, it’s helpful to have an understanding of the out of band performance and harmonics of the IC’s, meaning it’s becoming more common for engineers to measure all the way to 220GHz and beyond. And already emerging is the case of 6G, that could potentially be working in the 200GHz frequency band. To compound this, the variety of applications and real world environments our devices are used in, data needs to be collected over a wide temperature range – putting even more demand on todays testing. As we progress up the frequency spectrum, new developments of RF probes, instrumentation, calibration standards and techniques need to developed and integrated together to allow easy, accurate, repeatable and trustworthy data. This workshop brings together the on-wafer RF Eco-system providers and users of instrumentation, probes and calibration methods to share experiences and best practices.

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**Programme**

**Energy-autonomous for detection of fluids**  
Francesco Bena³, Alessandra Costanzo¹  
¹Università degli Studi di Bologna, ²University of Bologna  

**Perspectives for mm-wave biomedical applications for invivo sensing and imaging**  
Shohei Ono, Masai Takegahara  
University of Tokyo, Japan  

**Skin phantoms for microwave and millimeter-wave**  
Anna Maria Schiavone, Mirella Spedicato  
University of Florence, Italy  

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**Applications: A comparative study**  
Filippo Pappalardi²  
²University of Florence  

**The significance and challenges of heterogeneities in dielectric measurements of Biological Tissues**  
F. I. G. illustrative and Dominique Schneider²  
²University of Florence at Medice  

**Characterization of exposure in emerging 5G/6G bands: effect of age and impact of textile**  
Eeva Saraste, M. Johansson²  
²University of Helsinki  

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**Modeling dielectric response of biological structures at microscopic level**  
P. L. L’huillier and F. R. Ferroni²  
²University of Bologna  

**Improving measurement accuracy**  
Tom Vollmer and Dominique Schneider²  
²University of Florence  

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**Extending the Keysight 125 GHz Solution to 220 GHz**  
Saeed Sajjadi  
Keysight Technologies  

**Considerations for making planar S-parameter measurements at millimeter-wave frequencies**  
Stefan Berg  
VPI  

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**On-wafer Measurements to mmwave frequencies**  
Matthew Bauer³  
³Dominion MicroProbes Inc  

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**The advancement of THz test & measurement equipment for 5G, 6G and beyond**  
Jeffrey Roddy³  
³ThruVu Solutions Inc  

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**On-wafer load-pull measurements**  
Vito Malenzi²  
²EXA Microwave  

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**A micromachined dual-probe with for broadband single-sweep measurements**  
Xiaobang Shang³  
³Keysight Technologies  

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**Probing from home – Don’t let Covid or bad weather stop you making on-wafer Measurements**  
Gavin Fisher³  
³FormFactor Inc  

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**Broadband RF to mm-wave S-parameter measurements for semiconductor transistor and IC test**  
Vince Mallette³  
³Focus Microwaves  

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**The state-of-the-art in broadband and mm-wave S-parameter characterization for semiconductor devices**  
Anthony Lord³  
³FormFactor Inc  

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**Dealing with for broadband single-sweep**  
Jeffrey Roddy³  
³ThruVu Solutions Inc  

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**Room 6**

**Room 13**

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**Programme**

**On-wafer Measurements to mm-wave frequencies**  
Matthew Bauer³  
³Dominion MicroProbes Inc  

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**Extending the Keysight 125 GHz Solution to 220 GHz**  
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Keysight Technologies  

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**Considerations for making planar S-parameter measurements at millimeter-wave frequencies**  
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**Room 13**
Novel Technologies for Emerging On-board Microwave Equipment Based on Surface Mounted Electromechanical Relays

Chair: Vicente E. Boria¹
Co-Chair: Jorge D. Martínez²
¹UPV

The development of highly miniaturized electromechanical relays is of primary importance for the implementation of reconfigurable microwave space subsystems in line with the evolution toward more digital satellites supporting higher data capacities. The increase on the architecture complexity imposes stronger constraints in terms of cost and mass, with no compromise on reliability. This workshop will present the latest advances on the development of miniature electromechanical relays (MEMRs), which are developed within the framework of SELECTOR H2020 project. Firstly, a broad perspective on how RF PCB technology can be employed for developing future on-board microwave equipment will be given. Then, the implementation of low-loss and broadband interconnections will be presented. Embedded waveguides are essential for taking advantage of the excellent performance of novel surface mounted compatible devices, while enabling full compatibility with standard multi-layer PCB technology with higher density of integration. Then, recent technological innovations on the implementation of MEMR devices at electrical, mechanical and thermal levels will be thoroughly discussed, showing the increased frequency of operation. Lastly, a thorough analysis of the reliability tests required for guaranteeing a spacequalified product will be presented and discussed.

Programme

- Perspectives of RF on PCB technology to develop new microwave on-board equipment
  - Olivier Vendier
  - CSEM

- Embedded waveguides technologies for board-level interconnection of electromechanical relays at microwave and mmWave frequencies
  - Jose V.M. Sánchez de Rojas
  - UPV

- SMT-compatible electromechanical relay for compact redundancy ring applications
  - Ivan Marozau
  - University of Liverpool

- Reliability evaluation of SMT compatible electromechanical relay for compact redundancy ring applications
  - Jose V.M. Sánchez de Rojas
  - UPV

Recent Developments in Wireless Power Transfer and Energy Harvesting

Chair: Jiafeng Zhou¹
Co-Chair: Naoki Shinohara²
¹University of Liverpool, ²Kyoto University

The workshop will include 12 talks in the area of wireless power transfer and energy harvesting. Leading experts with both academia and industry backgrounds will introduce the latest progress in related areas. The speakers are from Japan, Korea, China, Singapore, Europe, UK, USA and Canada. The workshop will focus on low power electronics, including sensors, batteries and power management circuits, for the energy harvesting technology and its applications. It will also cover the state-of-the-art developments of near-field, mid-field and far-field wireless power transfer techniques in recent years, including the exciting project of wireless charging for space applications. The trendy topic of simultaneous wireless communication and wireless power transfer (SWPT) will also be presented in this full-day workshop.

Programme

- Wireless powered IoT sensor technology
  - Raku Shinya
  - Kyushu University

- Novel semi-solid state lithium-ion rechargeable EnerCera(r) batteries
  - Naoki Shinohara
  - Osaka University

- Low-power circuits for energy harvesters based on spiking-neuron delay elements
  - Zhizhang David Chen
  - Dalhousie University

- Midfield wireless power transfer
  - Chulhun Seo
  - Soongsil University

- Low power beat sensor
  - Xiaoguang Gu
  - University of Electro-Communications

- Near-field wireless power transfer
  - Hsiao-Hsin Wang
  - Imperial College London

- Simultaneous wireless information and power transfer
  - Xiaoqiang Gu
  - The University of Electro-Communications

- High performance wireless power transfer under misaligned conditions
  - Jianqiang Zhou
  - University of Liverpool
**MONDAY 09:00 – 13:00**

**Beyond 5G: mmWave and Terahertz Techniques of 6G Research**

Chair: Kevin Thompson¹
Co-Chair: Allison Douglas¹
¹Keysight Technologies

Room 17

mmWave and sub-terahertz frequencies (100-300 GHz) with extreme modulation bandwidths are part of 6G research. This presents many unknowns given the novelty of these wavelengths for use in communications. One of those unknowns is exploring the level of system performance that is achievable and reasonable given new frequency bands, extreme modulation bandwidths, and new waveforms. This workshop will provide insight into several of these topics by discussing new sub-terahertz system-level design and test challenges presented by 6G. These include RF MIMO channel sounding techniques for these bands, broadband component scattering parameter and noise-figure evaluation using vector network analysis, EVM measurements at 140 GHz with varying waveforms and bandwidths up to an occupied bandwidth of 10 GHz, and time-synchronization in networks involving multiple RF links (access, radio & fiber fronthaul, GPS/PPS, 3GPP air-interface frames).

**MONDAY 14:20 – 18:20**

**Intuitive Microwave Filter Design with EM Simulation**

Chair: Daniel Swanson¹
¹DGS Associates, LLC

Room 11

Microwave filters are one of the basic building blocks in RF systems along with amplifiers, mixers and oscillators. At some point, you may be called on to design or specify a filter, even though you are not a filter design expert. Fortunately, there is simple design method for narrow band filters that is easy to learn and quite universal. It can be applied to any lumped element or distributed topology and any manufacturing technology except SAW/BAW. And, the method is valid for bandwidths from a fraction of a percent up to 20 percent or more.

This short course is a “no math” approach to filter design that requires only simple algebra and no knowledge of complex filter synthesis techniques. It is suitable for industry non-experts, technical managers, students and educators. The root of the design flow is based on Dishal’s method, with the addition of EM simulation for accuracy and port tuning for updates to the filter geometry. The basic design method can also be expanded to include cross-coupled filters and multiplexers. Two design flow examples have been prepared for this short course. The first is a high Q cavity combline bandpass filter and the second is a microstrip combline bandpass filter. The design flow can be realized using software from many different vendors. Example project files will be made available to attendees.

**PROGRAMME**

**WM07**

**EuMC**

**SM02**

**EuMC**

**New sub-terahertz R&D testbed for 6G research**

Greg Jue¹
¹Keysight Technologies

**Channel sounding from mmWave to sub-THz**

Wen Zhu¹
¹Keysight Technologies

**Broadband VNA component characterization**

Suren Singh¹
¹Keysight Technologies

**Maintaining and measuring end-to-end timing integrity in networks with multiple RF links**

Mike Beyers¹
¹Keysight Technologies

**PROGRAMME**

**AGENDA**

1. Coupling coefficient concepts
2. Introduction to Dishal’s method
3. Design flow for any narrow band filter
4. Example 1:
   4a. Microstrip combline filter design
   4b. EM simulation techniques for planar filters
   4c. Port tuning for planar filters
5. Example 2:
   5a. Cavity combline filter design
   5b. EM simulation techniques for cavity filters
   5c. Port tuning for cavity filters
6. More advanced commercial design tools
7. Summary
MONDAY 14:20 – 18:20

Phase Noise in Next Generation Aerospace, Defense and Commercial Wireless Communications

Chair: Joanne Mistler¹
Co-Chair: Brooks Hanley¹
¹Keysight Technologies
Room 12

The ability to manage the effects of noise in components and systems is critical to communications link performance. Noise can be added by power supplies, modulation, thermal and additive characteristics of devices. Phase Noise, AM-Noise, Baseband Noise and Noise Figure must be fully characterized, as well as their effects on the dynamic range of communications links and on the performance of radar systems.

This course explains phase noise theory and its impact on performance in communication systems. We will describe multiple phase-noise measurement techniques, the role of the phase detector and the use of cross-correlation in optimizing sensitivity, and we’ll discuss the impact of reference sources, stimulus sources and AM on phase noise measurements. We describe the origins of noise along with AM, residual and absolute noise and cross-correlation techniques for measurement from DC to mmWave frequencies. We also discuss Phase-Noise measurements across various instruments and the effects of external mixers on mmWave noise measurements.

This course describes the origins of noise and how the resultant components affect devices and are measured. We will also show how Phase-Noise relates to Noise Figure, view the accuracy and limitations of Noise Figure Y-Factor and CoD Source methods, and describe the differences in characterizing devices, particularly amplifiers, with each Figure of Merit.

Solid-state microwave technology for Industrial, Scientific and Medical (ISM) applications is progressively gaining momentum although legacy magnetron technology still allows lower CAPEX burdens, especially for high-power applications. Apart from the hardware-linked advantages of solid-state technology (compactness, safety, parametric accuracy, life cycle extension, operating ease and flexibility), a huge boost towards extensive acknowledgement by the microwave community certainly comes from in-depth synergy with modern distributed software platforms. The short course will explore technology trends, design clues and business scenarios, especially trying to emphasize the real added value of software engineering to microwave-driven processes, obtainable through careful hardware-soft co-design based on solid-state microwave power devices, digital microprocessors and accurate sensor networks. Innovative designs of solid-state microwave systems typically adopt a distributed intelligence approach, where each generator is equipped by real-time computational capability (e.g., linked to accurate control & monitoring of frequency, phase, power, dynamic impedance mismatch conditions, etc.) and a flexible real-time cooperative functionality that enables infinite modular combinations governed by a central – local or remote – brain. The main target of enabling efficient self-regulating workflows is accompanied by equally important achievements of allowing modern big data approach to industrial applications, high testability and manufacturability and perfectly tailored software-assisted maintenance and after-sales assistance. A description of significant achievements will be presented regarding medical hyperthermia, food materials processing, experimental nanomaterials development and other innovative ISM applications.
Optimizing Modulation Quality Measurements on Wide Bandwidth Signals – From Conformance Through R&D

Chair: Kevin Thompson¹
Co-Chair: Allison Douglas¹
¹Keysight Technologies

Room 1

We can’t wait for you to join us in this workshop, confronting real-world wireless engineering challenges with real-world measurements and expert insights.

Resolution is the most critical factor for radar to detect targets and portray the object details. On one hand, range resolution is proportional to signal bandwidth. However, signal bandwidth is limited by both hardware capability and spectrum regulation. On the other hand, angle resolution depends on antenna aperture. High angle resolution implies large antenna aperture, which is subject to installation limitation. Here we propose a novel distributed MIMO radar structure which employs each antenna with different frequency, to achieve both high range resolution and high angle resolution simultaneously. Several small bandwidth signals are processed together to form an equivalent large one, and at the same time, the aperture of the whole system is enlarged. We further analyse the factors influencing the performance, such as, the number of transmit antennas, the frequency offsets between different transmit antennas, and the ratio of the aggregated bandwidth to total spreading bandwidth, etc.

AGENDA
1. High range-angle resolution MIMO radar
2. Sparse frequency allocation for wide-band aggregation radar
Carrier frequencies > 100GHz are attractive for next generation 5G cellular systems due to the large amount of available spectrum in the D- and G-bands that can be leveraged for high data rate communications. Operation at these high mmWave frequencies comes with many challenges, though, particularly in the demands placed on technology performance, integration and cost for the phased array front end. Losses on and off chip are very high. Transistor performance is significantly worse, with challenges in achieving acceptable gain, Pout, and PAE for the PA, acceptable gain and NF for the LNA and low insertion loss for the switch. Thermal management and antenna/FEM/transceiver integration will be particularly demanding due to the constraints of the lattice spacing at these frequencies. This workshop will delve into the candidate semiconductor and packaging technologies for the 6G beamformer/FEM, and will explore the unique strengths and limitations of each for addressing these challenges.

Automotive environment perception sensors, predominantly radar, lidar, and camera enable driver assistance and highly automated driving functions. The exploding number of safety requirements necessitates reliable and efficient validation and homologation methods for these automotive sensors at highly automated driving at levels L3-L5. One approach is to conduct billions of miles of field-operational road tests in a variety of driving environments and challenging scenarios; however, this option is expensive and risky for both life and property. This method also makes it hard to ensure that every edge scenario is adequately tested. Hence, complementary approaches for testing in virtual environments become increasingly necessary. In the virtual validation methods, researchers are addressing the key questions: “How can the safety of automated and connected driving functions be evaluated and assured?” To address this, the industry and academic partners are working on the design and implementation of a virtual validation tool chain, connecting software-based traffic and sensor simulations with propagation modelling and installed performance testing in virtual environment. In this workshop, state-of-the-art contributions on topics that implement virtual validation of automotive sensors will be presented. Among these, scenario-based testing using software-in-the-loop, hardware-in-the-loop and over-the-air-in-the-loop methods will be focused primarily on radar. Highly relevant topics of ray-tracing, sensor modelling and installed performance will be addressed along with measurement-based modelling and simulation of radar cross section and signatures of traffic objects.

**CHIP PACKAGE CO-OPTIMIZATION: CIRCUIT-LEVEL OPTIMIZATION WITH RDL PASSIVE COMPONENTS FOR MM-WAVE POWER AMPLIFIERS IN 22NM FDSOI**

**HIU CHANG**

University of California - Santa Barbara

**CIRCUITS AND TECHNOLOGIES FOR APPLICATIONS ABOVE 100GHz**

**SUN GOONG**

University of California - Santa Barbara

**STATE OF THE ART SOI TECHNOLOGY FOR MMWAVE FEM APPLICATIONS**

**BERND RIESS**

Siemens

**SiGe BiCMOS TECHNOLOGIES FOR 6G MILLIMETER-WAVE**

**PAUL DUSKING**

Siemens

**D-BAND CIRCUITS IN 16NM FINFET: DESIGN AND LAYOUT CONSIDERATIONS**

**PAUL DUSKING**

Siemens

**INP AND GaN DEVICES FOR THE NEXT GENERATION OF WIRELESS COMMUNICATION**

**SANDO ROY**

Siemens
This short course introduces an overarching strategy for designing radars from the ground up, covering theoretical and practical aspects. We will start with antenna design, optimization, pattern synthesis, and integration with the RF transceiver. We will introduce how to process beam characteristics such as steering angle, beamwidth, null locations, beam tapering, grating lobes, and beam squint. In addition, we will show how to design and analyze PCB-based antennas for integration in an active array including coupling, noise, and non-linear effects. You will learn how to create end-to-end system-level models of radars and process detections generated from these models or from data collected from radar systems, and how to analyze cognitive radars that operate in crowded RF shared spectrum environments.

Step by step, we will simulate a complete multi-function radar system including scheduling and resource management with the ability to define tasks, jobs, priorities, time allowances, and the capability to efficiently handle large scenes. We will evaluate side-by-side the radar performance on realistic large-scale tracking scenarios, including bayesian state estimation, different multitarget tracking systems architectures, multi-sensor fusion engines, and track analytics. We will describe how to build a virtual platform for system-level development, facilitating debugging eventual problems before costly prototypes are available. Similar to the antenna and RF models, scenario fidelity must scale with the project phase, with increasing levels needed as the project matures.

During this short course will share with the participants different radar models based on MATLAB.

**SW02**
**EuRAD**

**WEDNESDAY 14:20 – 18:20**

**Radar Design From the Ground Up**

**Chair:** Giorgia Zucchelli¹

¹The MathWorks B.V.

**Room:** 6

**PROGRAMME**

- **Modeling RF transceivers and antenna for radar applications**
  - Giorgia Zucchelli
  - The MathWorks B.V.

- **Multisensor tracking radar design and analysis**
  - Rick Smit
  - The MathWorks B.V.

**THURSDAY 09:00 – 13:00**

**Advances in Drone Antenna Measurement Techniques for SATCOM and Radar Applications**

**Chair:** Carlos Rizzo¹

¹QuadSAT

**Co-Chair:** Joakim Espeland¹

¹QuadSAT

**Room:** 15

**PROGRAMME**

- **Drone based antenna measurements in the SATCOM market**
  - Joakim Espeland
  - QuadSAT

- **Live Demonstration of Drone Based Antenna Measurement**
  - Andrian Buchi
  - QuadSAT

- **A service perspective on drone-based field measurements**
  - Markus Ridde
  - Cetecom GmbH

**Customisation of RF Payload for drone applications**

**Chair:** Jonas Lehmke¹

¹IMST GmbH

**Room:** 15

The aim of the workshop is to present the latest developments in drone-based antenna measurements through several presentations and a real live virtual demonstration where a drone will be engaged in the measurement of a ground VSAT antenna. QuadSAT will present a real demonstration of state-of-the-art drone-based antenna measurements in the context of SATCOM applications. The global deployment of satellite terminals is well under way in the context of Earth Observation and Satellite LEO constellations. The increasing demand for satellite-based services like inflight connectivity, maritime broadband services along with growth of telecommunication sector is anticipated to generate demand for new communication satellite launching during the forecast period and an increased demand for in-situ testing. A significant rise in ground satellite antennas and the advent of new multi beam antennas in the satellite and RADAR markets is forcing end users to consider mitigating radio interference.

To find out the latest news in this field, join QuadSAT in our ‘Drone Workshop’ where our CEO, Joakim Espeland, will take you through our journey and demonstrate how this technique can bring the measurement range to the customer by providing a real demonstration of measurements of an offset 1.3m antenna and comparing results with a traditional outdoor far-field system.
**FRIDAY 09:00 – 13:00**

**Al Techniques for Microwave Antenna and Filter Design: From Theory to Practice**

**Chair: Bo Liu**
**Co-Chair: Yi Wang**

*University of Glasgow, University of Birmingham*

**Room 17**

Microwave antenna/array and filter/multiplexer design is becoming a tedious process. The success of existing design methods highly depends on designers' experience and has a low success rate when the structure is complex or the specifications are stringent. In recent years, machine learning and evolutionary computation have been introduced into microwave design, which shows promising results. For antennas, state-of-the-art AI-driven design techniques can successfully address several tens of stringent specifications without any initial design, while reducing the optimization time by more than 20 times and obtaining even better design quality compared to standard global optimization methods. For filters, state-of-the-art methods have realized increasing design automation while having a high success rate for complex structures and applied to designers of all levels. However, many microwave and antenna designers are not familiar with AI-driven microwave design techniques or are not aware of how these techniques can be used to enhance their design ability and efficiency. Hence, the overarching goal of this short course is to not only provide a timely overview of how AI techniques can be used for antenna/array and filter design but also present recently developed methods with case studies. To achieve this goal the course is structured in six complementing parts:

1. Concepts and fundamentals of machine learning and evolutionary computation
2. AI-driven antenna/array design methods
3. Challenging antenna cases solved by AI-driven design methods
4. AI-driven filter/multiplexer design with case studies
5. Tutorial on using AI-driven microwave design tools
6. MATLAB Antenna Toolbox: an interactive AI-driven antenna design environment
7. AI techniques in microwave design and communication systems: new applications and challenges

**PROGRAMME**

- **Concepts and fundamentals of machine learning and evolutionary computation; AI-driven antenna/array design methods**
  - Chair: Bo Liu
  - University of Glasgow, University of Birmingham

- **Challenging antenna cases solved by AI-driven design methods**
  - Muhammad Imran
  - University of Glasgow

- **AI-driven filter/multiplexer design with case studies**
  - Muhammad Imran
  - University of Birmingham

- **Tutorial on using AI-driven microwave design tools**
  - Giorgia Zucchelli
  - MathWorks

- **MATLAB Antenna Toolbox: an interactive AI-driven antenna design environment**
  - Giorgia Zucchelli
  - MathWorks

- **AI techniques in microwave design and communication systems: new applications and open challenges**
  - Muhammad Imran
  - University of Birmingham

**SF01 EuMC**

**FRIDAY 09:00 – 13:00**

**Microwave Superconductivity: Applications of SQUID and Josephson Junctions in Microwave Circuits**

**Chair: Daryoush Shiri**
**Co-Chair: Jonas Bylander**

*Chalmers University of Technology*

**Room 2**

With the advent of modern and efficient cryogenic techniques and availability of high-temperature superconductors (HTS), applications of these materials in microwave circuits and systems are on the rise. Examples are HTS filters and antennas in mobile base stations and satellite systems, Rapid Single Flux Quantum (RSFQ) logic in multi-GHz digital circuits and quantum bits (qubits) based on Josephson junctions (JJ), among others. On the other hand, young microwave engineers and students cannot afford spending their time reading hefty tomes to master the physics of superconductivity and low temperature physics. This pedagogical short course aims at filling this gap. In the first part of this short course, the microwave properties of bulk and nanoscale superconductors are presented based on microscopic quantum model. The circuit models of Josephson junction and superconducting quantum interference device (SQUID) are presented and their nonlinear behaviour in microwave frequencies are explained. In the second part, the applications of JJ and SQUID in microwave circuits and systems are introduced including: parametric amplifiers, mixers, and oscillators. Hands on simulation examples based on Spice® and Simulink® are presented.

**PROGRAMME**

- **Microwave superconductivity: applications of SQUID and Josephson junctions in microwave circuits**
  - Daryoush Shiri
  - Chalmers University of Technology

**AGENDA**

1. Bulk Superconductors
2. Josephson junctions and SQUID basics
3. Parametric Amplifiers
4. Mixers and Oscillators

**SF02 EuMC**
Communication systems become even more pervasive in our life. 5G systems will dramatically increase the telecommunication capabilities allowing the implementation of the so-called Internet of Things (IoT) where an incredible number of objects will communicate through the internet. Part of the 5G communications will be supported by satellite infrastructures made of very large constellations of low orbit mini/micro satellites. In such a scenario a wide variety of new applications will be required. Indeed, they will be used in a lot of different situations, from sensors to satellites. Aspects like miniaturization, packaging and advanced manufacturing become essentials. In this workshop some compact components (especially filters) will be presented together with the advanced manufacturing techniques used for their realization. Presented materials also include space applications. Ample time will be devoted to the discussion with the audience.

**Advanced Manufacturing and Packaging**

**WF01 EuMC**

**Room 1**

**Advanced Manufacturing and Packaging**

Chair: Cristiano Tomassoni¹
Co-Chair: Vicente E. Boria²
¹University of Perugia, ²Technical University of Valencia

**Programme**

**Additive manufacturing of non-conventional miniaturized filters**

Christina Gnoatto, Francesco Ettori, and Gabriele Noci
University of Perugia

**Compact Realization of Advanced Filter Responses in Planar and 3D Waveguide Technologies**

Wolfgang Böer, El-Mouhtassine Haddar, and Jorge S. Martínez
Technical University of Valencia, ²UPV - University of Valencia, ³UPV - University of València

**Advanced manufacturing approaches for the Implementation of a K-band Mushroom meta-material filter**

Nikola Todorović, Jacek L. Łukasiewicz
University of Wroclaw and Wroclaw University of Science and Technology

**Advanced Bandpass Filter Structures for W-Band Applications**

Michael Hafner, Christian Goeltemeyer, and Christian Hänisch
University of Würzburg

**Innovative THz Technologies for Imaging, Radar and Communication**

Chair: Werner Prost
Co-Chair: Daniel Erni
¹University Duisburg-Essen

**Programme**

**Micro-PL analysis of high current density resonant tunnelling diodes for THz applications**

Michele Cito
University of Glasgow

**Design of calibration structures for On Wafer S-parameters measurements up to 500GHz**

Robbe Schrauwen, Thomas Nowack
Keysight Technologies Belgium BVBA, ²University of Glasgow

**Coherent receivers based on TB-RTD/On wafer TB-RTD measurements up to 500 GHz**

Gianluca Crave
University of Wroclaw

**Antimony and indium arsenide based resonant tunnelling devices for high-speed and mid-infrared applications**

Heiko Kress
University of Duisburg-Essen

**InGaAs based resonant tunnelling diode photo detector**

Rongxin Yang
¹Technische Universität München

**Models for fully-quantum treatment of scattering in the THz and Optical domains**

Peter Wolf
²Ecole polytechnique de Genève

**Accurate quantum transport modeling and epilaxial structure design optimisation of InGaAs/AlAs double-barrier resonant tunneling diodes for high-power terahertz oscillators**

Beguem Yavas
¹University of Duisburg-Essen

**Feasibility of Travelling-Wave Microstrip RTD Oscillators**

Zhibin Jiao
¹Technische Universität München

**Wireless subharmonic injection-locked, resonant tunneling diode array with beam steering capability at 720 GHz.**

Kendrick Wang
University of Duisburg-Essen

**Semicontacting quantum dot single electron transistor as high sensitive cooled photodetector in THz bandwidth**

Kendrick Wang
²CNR Nanoscience Institute

**Advanced Terahertz imaging systems based on tailored metasurface optic**

Thomas Neugebauer
University of Göttingen

**CNR- Nanoscience Institute**

Kendrick Wang
²CNR Nanoscience Institute

**Panel Session**

Kendrick Wang
²CNR Nanoscience Institute
WF04 EuRAD

Advanced Processing and Deep Learning Approaches for Indoor Sensing Using Short Range Radars

Chair: Arkar Santra
Co-Chair: Robert Wiegert
Room 13

Radars are non-intrusive sensors and finds applications in medical care, surveillance, human-machine interface, industrial water-level monitoring to name a few. Short range radar systems, featuring light weight and low cost, offer perfect solution for indoor human sensing however they need to be offer optimal performance regarding advanced receiver processing techniques. Radar can wirelessly detect and estimate the tiny physiological movements due to heartbeat and respiration activities. Furthermore, the micro-Doppler components from the humans can be sensed and utilized by radar processing to discern meaningful insights related to their activities, gestures or people density. This workshop outlines some of the most important topics related to radar processing for indoor sensing. We present the talk on security and techniques to mitigate malicious attacks on radar sensors for their reliable operation. We present the talk on processing techniques for sequential human activity classification in the context of assisted living and gesture sensing for a practical real-time solution. We present the talk on remote vital sign monitoring for day-to-day remote patient monitoring using radars from the hybrid viewpoint of a practicing cardiologist and an electrical engineering professor. We present the talk on assisted living using radars, the advanced processing techniques including deep learning to address some of open challenges. We further present a talk on indoor people counting using radars addressing challenges of different environments and indoor artifacts. We then present a talk on kinematic and linguistic considerations that one needs for design of reliable deep neural network models for human classification tasks.

WF02 EuRAD

Paradigm Change in Automotive mmWave Radar Applications - From Technology Push to Demand Pull

Chair: Marlene Harter
Co-Chair: Andreas Himmler
Room 11

Not too long ago the use of mm-Wave Radar sensors for automotive applications had a straightforward and well understood way to go into the future. The subsequent development of L4 and L5 sensors was beyond any questioning. =>$>$ technology push

Today, these quite ambitious development directions have been re-focused: main interests are L2+ or L2++, i.e. near term results. The needs of the final user, the driver itself - i.e. all of us - have become more important. What really is an easy to use and easy to understand driver assistance system? =>$>$ demand pull/ customer orientation.

Car insurance fee reduction based on radar (or Lidar!) for secure AEB (Automatic Emergency Breaking) functions and as a 2nd step AES (Automotive Emergency Steering) are helping the customer to pay for these (not yet cheap) high-tech systems; =>$>$ changed financial/ industrial circumstances.

The direct customer orientation: How do these systems help the driver to take driving easier and make it more enjoyable, while letting him know how safe the systems are in use, is in focus today. What does all of this mean for us - the mm-Wave community? 1) Easy to handle and to understand - as well as to maintain - sensor measurement and test systems, that will make it easy to convince the customer - the driver - that he has an advantageous tool for his own safety.

2) Based on new regulations - the forced employment of mm-Wave Radar sensors for in-cabin monitoring - as a new application area. The later – in-cabin monitoring - e.g. by radar at 24, 60, 120 and 160 GHz – is becoming mandatory in new to be delivered cars from 2022 on - in Europe and the US, respectively.
Rohde & Schwarz Workshop
Tutorial Seminars and Technical Workshops

Date: Tuesday 15th and Wednesday 16th February 2022
Location: ICC Capital Suite - Level 3 - Room 3

TUTORIAL SEMINARS – RF BASICS IN TEST AND MEASUREMENT

The advances of 5G and mmWave communications – one of its key driving factors – are considerably changing the world of cellular and non-cellular communications. The automotive industry and Industry 4.0 are further technology drivers that have significantly impacted mmWave engineering development and the design of new products. Modern communications technologies, telemetry applications, radar technologies and industrial assembly of mmWave circuits increase the amount of cross-disciplinary collaboration.

Nowadays, mmWave engineers are also being confronted with the challenge of how to master the field of RF signal and digital communications. Therefore, a sound understanding of RF and mmWave testing methods is key for every mmWave engineer, since it helps them implement solutions and designs in RF and mmWave circuits.

The Rohde & Schwarz seminars covering RF basics in test and measurement will familiarise you with the fundamental aspects of signal generators, spectrum analysers and network analysers. You will learn how to benefit from the high flexibility of our T&M equipment when designing RF and mmWave circuits. The seminar on real-time spectrum analysis will introduce the methods for debugging RF and mmWave circuits in the time and the frequency domain and demonstrate the excellent benefits for analysing complex mmWave circuits. Using vector network analysers for component testing and applying various calibration techniques allows highly precise characterisation of RF and mmWave components, which are necessary for mmWave designs and digital communications systems.

TECHNICAL WORKSHOPS

TUESDAY, 15 FEBRUARY, 2022, 13:30 – 16:15
Modern RF frontend design and testing
Workshop chair: Markus Lörner, Market Segment Manager RF and Microwave Components, Rohde & Schwarz

5G is here. The focus is now on improving systems and enhancing them with mmWave. This drives the growing integration of components and creation of more efficient designs to minimise the form factor, improve energy efficiency and thereby drive overall costs down. Multifunction RF components such as beamformers are used in 5G mmWave as well as in satellite communications and defence applications. The high density of RF frontends for massive MIMO systems requires unprecedented energy efficiency to minimise the physical size while ensuring stable temperature conditions.

The workshop will provide an overview of the latest technologies and requirements of RF frontends, focusing on the topics of improved efficiency and enhanced integration. Experts from the test and measurement field and industry partners will provide solutions that meet demanding requirements.

WEDNESDAY, 16 FEBRUARY, 2022, 13:30 – 16:15
Millimeterwave and THz technology for beyond 5G
Workshop chair: Dr Taro Eichler, Market Segment Manager Wireless Communications, Rohde & Schwarz

Millimeterwave and THz technology are seen as key components for beyond 5G and 6G systems. The radio spectrum between 30 GHz and 300 GHz is used with the intention of resolving the spectrum crunch and enabling ultrabroadband mobile communications up to the terabit range. The research and development of such systems gives rise to new challenges in the area of frontend, mixed signal and baseband technology and new requirements for the test and measurement industry. Since highly integrated frontends including array antennas will be implemented, advanced over-the-air testing methods with an extremely extended frequency range up to 500 GHz will become mandatory. Furthermore, the use of extremely wideband channels up to several GHz will become a challenge in terms of broadband signal generation and signal analysers. These tasks require an interdisciplinary approach with close collaboration between semiconductor, assembly and signal processing experts.

This workshop gives an overview of recent developments in the area of broadband mmWave and THz communications systems with a special focus on radio channel and OTA measurements as well as on hardware implementation issues.

The schedule is subject to change. The latest version can be downloaded at www.rohde-schwarz.com/eumw
### SUNDAY OVERVIEW

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<td>WS04</td>
<td>New Trends in Microwave and millimeter Filters</td>
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<td>SS02</td>
<td>Advanced Non-linear Characterization and Design of Highly Efficient Power Amplifiers Using Load Pull Data for sub-6GHz and mmWave Applications</td>
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<td>New On-Chip and Scalable RF Packaging Solutions with Integrated Antennas for 5G mmWave and 6G Applications</td>
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<td>WS06</td>
<td>Progress and Status of Gallium Nitride Monolithic Microwave Integrated Circuits</td>
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<td>RF Reliability Status and Challenges for 5G mmWave and 6G Applications</td>
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<td>Technology for RF 5G and Satellite from Material to Packaged Demonstrators</td>
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<td>Research in Power and S-parameters Measurements at mmWave and Terahertz Frequencies</td>
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<td>17</td>
<td>WS10</td>
<td>mmWave Plastic Waveguide High Data Rate Communications</td>
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### MONDAY OVERVIEW

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<td>SM01</td>
<td>R&amp;D Trends &amp; Challenges in RFPA for Medium/High-Volume Products</td>
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<td>WM01</td>
<td>Optimizing Modulation Quality Measurements on Wide Bandwidth Signals - From Conformance Through R&amp;D</td>
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<td>3</td>
<td></td>
<td>Advances in Circuits and Systems for millimeter Radar and Communication in Silicon Technologies</td>
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<td>Two Brazilian School of Microwaves</td>
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<td>Microwave and millimeter Techniques for Sensing, Imaging and Characterization of Biological Tissues</td>
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**Additional Events:**
- **EuMIC02** Silicon Based RF Solutions
- **EuMIC03** Transceiver MMICs
- **EuMIC04** Intuitive Microwave Filter Design with EM Simulation
- **EuMIC05** High Performance LNAs
- **EuMIC06** Large Signal and Non-linear Characterization Techniques
- **EuMIC07** Integrated and PA for 5G, SAWCOM and Vehicle Applications
- **EuMIC08** Advances in Si and GaN Based Integrated RAS
- **EuMIC09** Silicon Based RF Solutions
- **EuMIC10** Intuitive Microwave Filter Design with EM Simulation
- **EuMIC11** Transceiver MMICs
- **EuMIC12** Phase Noise in Next Generation Aerospace/Defense and Commercial Wireless Communications
- **EuMIC13** RF On-wafer Calibration and Measurement Eco-system Workshop
- **EuMIC14** Automotive Forum
- **EuMIC15** Microwave Equipment Based on Si-EM Relays
- **EuMIC16** Microwave Applications in Industrial, Scientific and Medical Fields
- **EuMIC17** Recent Developments in Wireless Power Transfer and Energy Harvesting
- **EuMIC18** Beyond 5G mmWave and THz Techniques of 6G Research
- **EuMIC19** Frequency-Conversion Circuits
- **EuMIC20** Bandpass Integrated Circuits
- **EuMIC21** Frequency Extension 16:00 – 20:00
- **EuMIC22** Automotive Forum Technology 39:00 – 22:00
- **EuMIC23** Exhibition Area

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**EuMC** | **EuMIC** | **EuRAD** | **Students** | **EuMW** | **Exhibitors**
---|---|---|---|---|---

**EuMC** | **EuMIC** | **EuRAD** | **Students** | **EuMW** | **Exhibitors**
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<td>EuRAD04 Distributed and Multistatic Radar</td>
<td>EuRAD07 Time Detection and Recognition</td>
<td>EuRAD10 Signal Processing for Automotive Radar</td>
<td>EuRAD04 Target and Clutter Classification for Automotive Radar</td>
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<td>Exhibitor Workshops</td>
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<td>EuMC30 Special Session on MTTA – An International Project on Highly Efficient and Flexible Phased Arrays</td>
<td>EuMC40 Advances in Biological and Medical Applications</td>
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<td>EuRAD05 AI Methods in Automotive Signal Processing and Information Extraction</td>
<td>EuMC/EuRAD07 High Resolution Methods in Ranging and Alignment for Environmental Perception</td>
<td>EuMC41 Material and Driveway Measurements</td>
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<td>EuRAD04 Radar Characteristics Measurement, Modelling and Simulation</td>
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<td>EuMC/EuRAD08 Radar Antennas, Arrays and Calibration</td>
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<td>EuMC32 Calibration Techniques and Nonlinear Measurements</td>
<td>EuMC/EuRAD01 Channel and Radar Channel Identification</td>
<td>EuRAD01 Radar Processing Techniques for Automotive and Transportation</td>
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<td>EuMC34 R&amp;D and MTP Technologies</td>
<td>EuMC39 Novel IoT Technologies</td>
<td>EuMC43 Sensing and Dynamic Technologies</td>
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<td>EuRAD20 Phased Arrays and MIMO Systems</td>
<td>EuRAD07 Radar Signal Processing and Imaging</td>
<td>WF02 Paradigm Change in Automotive mmWave Radar</td>
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<td>EuMC/EuRAD02 Radar Antennas, Arrays and Calibration</td>
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<td>EuMC/EuRAD03 Channel and Radar Channel Identification</td>
<td>EuMC/EuRAD04 Radar Processing Techniques for Automotive and Transportation</td>
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<td>EuMC/EuRAD05 Human Activity Sensing</td>
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<td>EuMC/EuRAD05 Human Activity Sensing</td>
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Legend: EuMC -sessions, EuRAD -sessions, Students, Exibitors, EuMW -sessions, Exhibitors.
Venue Overview

**ICC Capital Suite - Level 3**
Rooms 1 – 17
Exhibitor Workshops: Rooms 2, 3 & 6
EuMC Plenary: Rooms 7 – 12
Coffee breaks (Sunday, Monday and Friday)

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**Registration**
Exhibition Entrance Delegate Bags

**Exhibition Halls N20 – N23**
Enterance N11
Poster Panels (Tuesday – Thursday)
Coffee Breaks (Tuesday – Thursday)
MicroApps

**Platinum Suite**
Welcome Reception (Tuesday)

**Custom House for ExCeL London**

**Prince Regent for ICC London**

**East Entrance**

**Venue Overview**

134 – WWW.EUMW2021.COM

WWW.EUMW2021.COM – 135

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Exhibitor List

A: AFT Microwave GmbH · ALPHA · RLH · American Standard Circuits, Inc. · Analog Devices GmbH · APC Technology Group plc · API Tech · AR Europe Ltd · Artech House Books
B: BAE Systems · Bits & Chips
C: Castle Microwave Ltd · CEA · Cobham Electrical and Electronic Equipment · Copper Mountain Technologies
D: dSPACE GmbH
E: E&T · Electronic Specifier Ltd · ESTER Technopole · ETL Systems Ltd · EuMA · European Microwave Week 2022 · everythingRF
F: Farran Technology Ltd · Filtronic · Focus Microwaves Group · FormFactor · Fraunhofer FHR · Fraunhofer IAF · Fraunhofer Institute for Applied Solid State Physics IAF · Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR
H: Hermetic Solutions Group · hf-Praxis
I: IEEE Microwave Theory and Techniques Society (MTT-S) · IEEE Microwaves Magazine · IEEE MTT-s International Microwave Symposium · IET · IHP GmbH · IMST GmbH · Institut d’Electronique, de Microélectronique et de Nanotechnologies (IEMN) · Intellineconnect Europe Ltd · Isola GmbH · Junkosha Inc.
K: Keysight Technologies UK Limited · Knowles Precision Devices · KOSTEC SYS Co., Ltd
L: L3Harris · Link Microtek Ltd · LPKF Laser & Electronics AG
M: Maury Microwave · MCS Test Equipment · Melcom Electronics Ltd · Mician GmbH · Microwave Applications Group · Microwave Journal · Microwave Product Digest · Microwave Products Group · Microwave Systems JSC · Microwaves & RF · Milexia · Morion, Inc · MPI Corporation · MTR S.R.L.
N: Narda MITEQ · NSI-MI Technologies · OKTAL Synthetic Environment · OMMIC · OPHIR RF Inc · Optiprint AG · Optomec
P: Pendulum Instruments S.P. 200 · Planar Monolithics Industries Inc
R: RF MORECOM COREO Co., Ltd · RF-Lambda USA LLC · RFMW UK Ltd · Rogers BV · Rogers Corporation · Rohde & Schwarz GmbH & Co KG · Rosenberger Hochfrequenztechnik GmbH & Co. KG
S: Samtec Europe Ltd · Sensorview Co., Ltd · Serma Group · SIAE MICROELETTRONICA S.p.A · Siglent Technologies Germany GmbH · Signal Integrity Journal · Silicon Radar GmbH · Smiths Interconnect · Smith Industries Industrial Group · Sonnet Software · Sumitomo Electric Europe Ltd · Synopsis Corporation Group · Synopsis Technologies · Syntony
T: Tech Comm · TNO Defence, Safety and Security · Triaxys
V: Varioprint AG · Virginia Diodes Inc. · Vishay Electronic GmbH · VTT · VTT Technical Research Centre of Finland Ltd
W: WAVEPIA Co., Ltd · Wireless Telecom Group
X: XLIM

Latest Update

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Attendees should check the latest requirement and updated advice concerning access to ExCeL from this website: https://www.excel.london