The Exeter Microwaves Metamaterials Meeting

8 – 9 September 2022 | Rougement Hotel, Exeter

UNIVERSITY OF EXETER | EPSRC Centre for Doctoral Training in Metamaterials | EPSRC Engineering and Physical Sciences Research Council | UK META MATERIALS NETWORK

Welcome to the Exeter Microwaves and Metamaterials Meeting!

From the genesis of the field in the late 90's, the UK has always been a key player in Metamaterials research. We are currently going through a step change in interest and investment in this area, both to develop new science, and commercial solutions as the field matures. It is therefore vital now more than ever to foster closer interaction and collaboration between academic researchers, and with industry, as well as expanding our networks abroad.

This event brings together members of the UK community working in microwaves, metamaterials and electromagnetic theory, as well as prominent international researchers. The aims of XM3 are to showcase and raise awareness of some of the diverse and excellent work currently underway, and to spark new discussions, collaborations and projects going forward.

To this end, the conference has a slightly unusual format – there are several key talks and poster presentations to give an overview of research being carried out in many of the leading groups in this field. There are also "collaboration pitches" – short presentations where researchers or industrial representatives offer a problem looking for a solution, or a solution looking for problems to address. Finally there will be two round table sessions, which will focus group conversation and brainstorming about both new industrial applications, and new scientific horizons for microwave metamaterials. We have also included time for networking, with longer coffee breaks and an evening gala reception and poster session in order to give room for the kind of discussions we hope will be inspired by this event.

We hope you all enjoy the conference!

Alex Powell, James Capers and Kyle Arnold.

You are here:
Exeter, Rougemont Hotel

The impressive four-star Mercure Exeter Rougemont Hotel is an elegant Victorian building situated directly opposite Exeter Central train station and Rougemont Gardens in the heart of the city.

The building was constructed on the site of the old prison, and until quite recently there were shackles in the cellar that had survived from that era. The new hotel was constructed in 1877 and contained a billiard room, several smoking rooms, and a new kind of electrical apparatus for ringing a bell to summon a member of staff—it was claimed there were eight miles of wire in the hotel for the device.

Exeter has an unfortunate history of nice buildings burning to the ground: The tragic Theatre Royal fire of 1887 is the origin of many fire safety regulations in theatres to this day, and if you go to Cathedral Green, you can still see the remains of the last big fire from 2016. Fortunately the Rougemont has escaped this fate so far, although had a close shave in 1919 when the neighbouring Victoria Hall caught fire and burnt down: The heat from the fire broke every window and seared the painted surfaces in the window sashes in the side of the hotel that faced the blaze, and fire crews had to direct water jets at the eaves of the roof to prevent it catching fire.

An incident from 1981 created a small stir at the hotel. A 16 year old youth who had run away from home, checked into Room 202. A waiter, when called to his room, was threatened. The youth had in his room a sporting crossbow, 2 daggers, a dummy hand grenade and a smoke canister. Twenty police, some armed were called and they laid siege to the room for a period of 4 hours before the boy gave himself up, without a struggle.

The hotel has been recently refurbished, with the bedroom design inspired by Exeter's history as the centre of the old wool trade in the South West. The conference rooms are all named after the Duke of Devonshire's family and estate—Devonshire, Hartington, Burlington, Chatsworth, Cavendish, Derby and Compton. The hotel is situated in the centre of town, near all the transport links, a variety of shops and bars and within walking distance of the University and the historic Quayside.

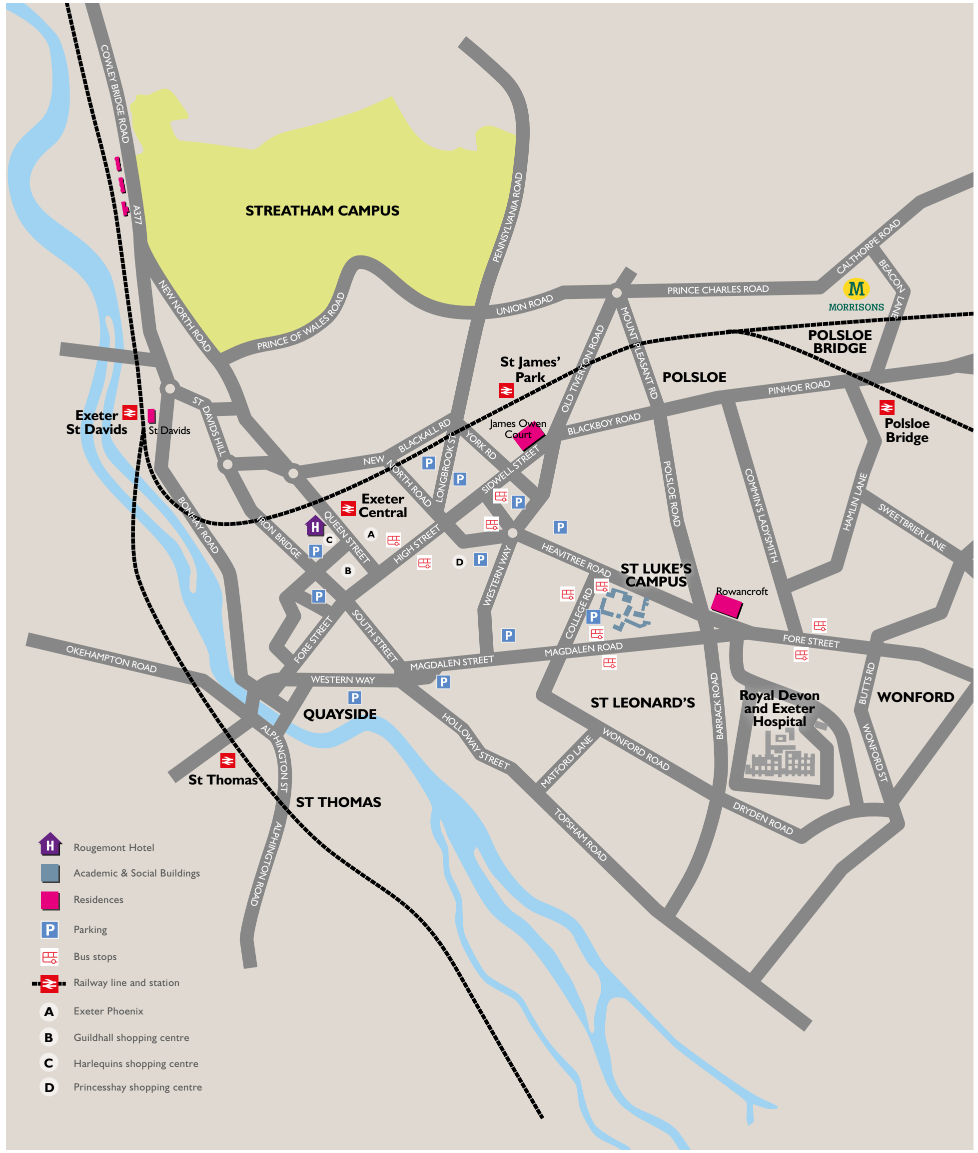
The Rougemont Hotel, circa 1880. The area opposite, that is now Central Station, was a park until the 1930's.

Sources: exetermemories.co.uk | visitexeter.com

Parking

Charged car parking facilities are available at the hotel, subject to availability and cannot be reserved prior to arrival.

There are several additional paid car parks within a 2 minute walk of the hotel.



Agenda

Thursday 8 September	
09:00	Registration opens and coffees
09:45	Welcome Address Dr Alex Powell - University of Exeter
10:00	Plenary Talk Prof. Pavel Ginzburg - Tel Aviv University
11:00	Coffee Break
	Applied Microwave Metamaterials 1
11:30	Prof. Alexandros Feresidis - University of Birmingham
11:50	Prof. Akram Alomainy - Queen Mary Univerity of London
12:10	Prof. Qammer Abbasi - University of Glasgow
12:30	Lunch
	New electromagnetic theory
13:30	Dr. Philipp del Hougne - Université de Rennes
13:50	Dr. Francisco Rodríguez-Fortuño - Kings College London
14:10	Prof. Simon Horsley - University of Exeter
14:30	Collaboration pitches
15:15	Coffee Break
15:45	Round table discussion 1 Applying microwave metamaterials to new industrial challenges
16:45	Day one Round up
17:00	Break
19:00	Posters, canapés and cocktails
20:00	Gala Dinner

Friday 9 September	
09:00	Coffees available
10:00	Round table discussion 2 Horizon scanning for microwave metamaterial concepts
11:00	Coffee
	Applied Microwave Metamaterials 2
11:30	Prof. Mohsen Khalily - University of Surrey
11:50	Dr. Melusine Pigeon - University of Bath
12:10	Prof. Will Whittow - Loughborough University
12:30	Lunch
	Applied Microwave Metamaterials 4
13:30	Dr. Michal Mrnka - University of Exeter
13:50	Dr Jiafeng Zhou - University of Liverpool
14:10	Dr Mahmoud Wagih - University of Glasgow
14:30	Coffee Break
	Industrial Perspectives
15:00	Dr. Melissa Riley - TWI
15:20	Mr. Riccardo Cacocciola - Saint-Gobian
15:40	Closing Remarks
16:00	Time for networking and grant proposals
17:00	Conference end

Pavel Ginzburg

Pavel Ginzburg is an Associated Professor at Tel Aviv University. He is a former EPSRC Research Fellow, International Newton Research Fellow, and Rothschild Fellow at King's College London. He obtained all of his degrees in Electrical Engineering at Technion and took a part in the Technion Excellence Program. He received his Ph.D. from Technion in 2011 on the special "Clore Scholars Programme" course. In his research, he was also involved in the discoveries of several novel phenomena and it was awarded the "Hershel Rich Innovation Award". His Ph.D. thesis was awarded by QEOD Thesis Price for Applied Aspects (EPS). Nowadays, Pavel holds a prestigious Alon Fellowship, designated for young faculty members.

Pavel Ginzburg is the head of 'The dynamics of Nanostructures Laboratory, encompassing theoretical group, optical spectroscopy, and radio waves labs. The Laboratory runs multidisciplinary research in the field of Optics, Biophotonics Quantum Mechanics, Solid State Physics, Nano-plasmonics and Metamaterials, Optical Forces, and Radio Physics.

Pavel Ginzburg has authored 135 journal papers, over 200 conference presentations, and 5 patents. He is a co-founder of 2 start-up companies.

Radar Deception with Metamaterials | Thursday 8 September 10:00

Fundamental bounds on electromagnetic scattering from subwavelength structures play an important role in estimating the performances of many wireless communication devices. An appealing approach to increasing a scattering cross-section is accommodating several spectrally overlapping resonances within a structure. However, numerous fundamental and practical restrictions have been found and led to the formulation of Chu-Harrington, Geyi, and other limits, which provide an upper bound to scattering efficiencies. Here we demonstrate several superscatterer designs and their implementations, which allow surpassing those limits by orders of magnitude. Genetic algorithms for optimizing arrays of wires and split ring resonators were developed and resulted in ever-observed performances. Apart from the fundamental importance, the developed superscatterers can serve as chaff elements for deceiving low-frequency radars by creating multiple highly scattering artificial targets.

Our additional strategy for radar deception is temporal modulation. Dynamic control over a reflected wave phase makes it possible to deny an interrogating radar system from obtaining the instantaneous velocity of a moving object. Furthermore, this approach allows for creating an impression that a stationary object is moving. By temporally modulating the voltage, the Doppler phase shift produced by the motion of the scatterer can be completely compensated, creating the illusion that the moving target is stationary. Similarly, by properly modulating the scattered phase in time, Doppler and micro-Doppler shifts can be produced in the resulting echoes, which can deceive the investigating system. The proposed method opens the door for the use of smart time-dependent materials for passive jamming applications.

Alexandros Feresidis

Alexandros Feresidis is a Professor of Microwave and Terahertz Communications and also Head of the Metamaterials Engineering Laboratory. He leads research on electromagnetic metamaterial structures, antennas, microwave, mm-wave and THz circuits. He is an expert on the analysis and design of artificial periodic metamaterials/metasurfaces, electromagnetic band gap (EBG) structures and frequency selective surfaces (FSS), high-gain and base station antennas, leaky wave antennas, small/compact antennas, computational electromagnetics, microwave/mm-wave/THz circuits and bio-electromagnetic systems.

Reconfigurable Metasurfaces and Antennas for Millimetre-wave and Sub-THz Communications | Thursday 8 September 11:30

Millimeter-wave and sub-terahertz (THz) frequencies offer new opportunities for future communications, sensing and imaging applications, including 5G and 6G mobile communications. Highly directive and efficient antennas are required for the aforementioned applications. Moreover, the use of beam-steered reconfigurable antennas is also emerging as an important requirement for the successful deployment of the proposed high frequency communication systems. This contribution presents recent research in our group on reconfigurable metasurfaces and their use in new metasurface-based beam-steered antennas. Results will be presented at mm-waves as well as low-THz frequencies around 300GHz.

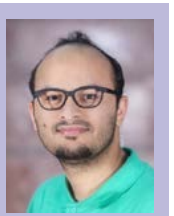
Akram Alomainy

Akram Alomainy is the Deputy Dean for Postgraduate Research in the Faculty of Science and Engineering, Head of the Antennas and Electromagnetics Research Group and Reader in Antennas & Applied EM. Associate Editor for IEEE AWPL and IEEE J-ERM. Lead of Wearable Technology and Creativity Research. Research portfolio ranging from the basics of antennas and electromagnetism to novel applications in tele-robotics, cognitive radio, wearable electronics, nano-scale networks, healthcare and bioengineering. Member of the Centre for Intelligent Sensing and Institute of Bioengineering. Over 450 publications in leading journals and international conferences (8800+ citations and H-index of 43). Recipient of the 2011 British Science Festival Isambard Kingdom Brunel Award, recipient of the QMUL Education Excellence Award 2019, participant at 'I'm a Scientist! Get me out of here' March 2012 and TEDx 2012 Speaker. Chartered Engineer, College member of EPSRC, Senior member of IEEE and member of IET.

A Terahertz Metasurface for Thin Film Biosensing | Thursday 8 September 11:50

Terahertz (THz) metasurface biosensors have attracted considerable attention in thin-film biological sensing due to their real-time and ultra-sensitive detection properties. This talk introduces a planar array of split-ring resonators (SRRs) over a dielectric substrate to study its performance for having a highly sensitive, non-label, and low-cost biosensor. By coupling the two SRRs of each unit cell, a pick in the transmission spectra occurs at 1.58 THz. Analyzing the electromagnetic field distribution and surface current flow shows the appearance of coupled electric and magnetic dipoles in the resonators. It is also shown that changing the distance between the coupled SRRs can passively tune the resonance frequency. Finally, the sensing functionality of the metamaterial is validated by simulating a human skin tissue with a refractive index of 1.6 and a thin thickness of 6 µm. The results give a remarkable theoretical sensitivity of 400 GHz/RIU. We will also present some preliminary experimental validations.

Qammer Abbasi

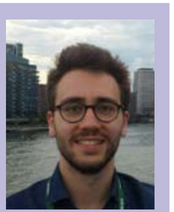


Qammer H. Abbasi (SMIEEE, MIET, FRET, FRSA), Dr Abbasi is a Reader with the James Watt School of Engineering, University of Glasgow, U.K., deputy head for Communication Sensing and Imaging group (110+ researchers), deputy theme lead for Quantum & Nanotechnology in the University's Advance Research Centre, Co-Manager for RF and terahertz laboratory. He has grant portfolio of £7M+ and contributed to more than 450+ leading international technical journal and peer reviewed conference papers including Nature portfolio and 10 books.

Intelligent Walls for Future Healthcare | Friday 9 September 12:10

In this talk, I will discuss about the work on intelligent reflective surfaces in our group and different testbeds and their results with empahsis on healthcare.

Philipp del Hougne



Philipp del Hougne is a tenured CNRS researcher affiliated with the Université de Rennes 1, France. He graduated in physics from Imperial College London, United Kingdom, and was awarded a doctorate by Université Sorbonne Paris Cité, France. He subsequently held postdoctoral positions in Nice and Rennes, France, and Lausanne, Switzerland. He currently leads the Intelligent Wave Systems group at CNRS – IETR (Université de Rennes 1), France, which combines programmable-metamaterial hardware with artificial-intelligence algorithms and mesoscopic-scattering theory to mold the flow of information through tailored wave-matter interactions for information extraction (imaging, sensing, localization), information processing (analog wave-based computing), and information transfer (wireless communications).

Intelligent Wave Systems based on Programmable Metamaterials | Thursday 8 September 13:30

I will discuss some of our recent work on molding the flow of information through tailored wave-matter interactions in order to extract, process and transfer information.

Dr. Francisco Rodríguez-Fortuño

Francisco José Rodríguez-Fortuño is a Lecturer at King's College London, where he carries out research on the topics of plasmonic devices, nano-optics, optical forces, optical nanoantennas, metamaterials and novel electromagnetic phenomena. After obtaining a degree in Telecommunications Engineering in 2008 at the Universitat Politècnica de València (UPV), Spain, he carried out his Masters' and PhD studies at UPV in the topic of plasmonic metamaterials. During his PhD, Francisco spent 9 months as a visiting researcher at the University of Pennsylvania, USA, 2011 under the supervision of Prof. Nader Engheta and 7 months at King's College London, UK, 2012, under the supervision of Prof. Anatoly Zayats and Dr. Gregory Wurtz, where he later worked as a Postdoctoral Research Assistant in 2014 and obtained a Lecturer position in 2015. Francisco has authored or co-authored 25 research papers and contributed 38 works at international conferences.

Near-field directional coupling from dipolar and multipolar sources | Thursday 8 September 13:50

I will present our team's theoretical and experimental results on near-field directionality of point sources, such as circularly polarised dipoles exciting nearby waveguides only in one direction, and related near field phenomena such as so-called Huygens and Janus dipole directionality in the near field. These concepts were developed in the nano-optical domain, but apply to the whole electromagnetic spectrum.

Simon Horsley

I am a theoretical physicist funded by a Royal Society TATA Fellowship, working at the University of Exeter on wave physics. In recent years I've been looking at the application of topology, graded loss and gain, inverse design techniques, and time variation in metamaterial design.

How should we calculate the response of a time varying metamaterial? | Thursday 8 September 14:10

Most previous work on metamaterials has considered them as purely spatial arrangements of matter. But what about materials that are structured in time as well as space? These offer the possibility for tailoring the frequency spectrum of an incident wave, something which is impossible with a static linear material. Yet, it is a theoretical challenge to describe time varying materials, because they are inevitably also dispersive. In this talk I will illustrate a new theoretical approach to describe EM waves in dispersive time varying materials, where the continuous wave reflection and transmission coefficients are replaced with operator expressions that modify the spectrum of any incident wave. In addition to comparing this approach to existing numerical and analytical techniques, we find that the eigenfunctions of these operators represent pulses that do not change their spectra after interaction with the time-varying, dispersive material. In addition, the poles of these operators represent the non--time harmonic bound states of the system.

We are holding a 3 course gala dinner at the Rougemont Hotel on the evening of Thursday 8 September.

Appetisers:

Roast tomato & red pepper (V, GF)

Smoked salmon, black pepper cream cheese, capers & shallots

Warm mature cheddar cheese tartlet, picked grapes walnut and watercress (V)

Main:

Sweet potato, chickpea, spinach & coconut curry, basmati rice (V, Ve, GF)

Herb crusted cod, crushed potato, lemon & caper sauce

Lamb rump, rosemary & garlic parmentier potatoes, res currant jus (GF)

Dessert:

Roast pineapple, dark rum caramel, vanilla ice cream (V, Ve, GF)

Sticky toffee pudding, sticky toffee sauce

Mascarpone tiramisu, espresso sauce

Mohsen Khalily

Dr Mohsen Khalily is a Associate Professor in antennas and propagation and head of Surface Electromagnetics Lab (SEMLAB) at the Institute for Communication Systems (ICS), University of Surrey, U.K. His research interests include surface electromagnetics, electromagnetic engineered Metasurfaces, phased arrays, THz Metadevices, and mmWave & THz propagation. He has published 4 book chapters and almost 160 academic articles in international peer-reviewed journals and conference proceedings and has been the principal investigator on research grants totalling in excess of £1million in the field of surface electromagnetics. He is an IEEE Senior member, delegate member of the ETSI Industrial Specification Group (ISG) on Reconfigurable Inteligent Surfaces, and a fellow of the U.K. Higher Education Academy. He was a Lead Guest Editor in several journals, including IEEE Antennas and Wireless Propagation Letters and IEEE Open Journal of Antennas and Propagation with the focus on Metasurface engineering.

Application of Electromagnetic Metasurfaces in Wireless Communication | Friday 9 September 11:30

Melusine Pigeon

I received an MSc from the National School of Civil Aviation (ENAC), Toulouse, France, in 2007 and my PhD in Electromagnetics in 2011 from the University of Toulouse. I have held different positions in academia and industry designing antenna for a wide range of applications and frequencies. I am now a lecturer in Engineering Design at the University of Bath.

The use of RFID in Wireless Medical Devices | Friday 9 September 11:50

Wireless Medical Devices usage increased significantly in the last decade. There are still challenges to be able to efficiently transmit an RF signal from or through a biological tissue. I will discuss how RFID is actually a technology which fits well the requirements of medical devices. It will cover UHF RFID, NFC and CRFID.

Will Whittow

Prof. Whittow is a Professor in Radiofrequency Materials and Head of the Wireless Communications Research Group. He has > 20 years of experience in RF devices and materials. He became a Lecturer in 2012, a Senior Lecturer in 2014, a Reader in 2018 and a Professor in 2020. He has specialist expertise in metasurface, metamaterials, 3D printed RF devices, measurement of dielectric properties, inkjet printed antennas, RFID tags, and wearable antennas.

3D printed metamaterial and metasurfaces for microwave applications | Thursday 8 September 12:10

This talk will cover 3D printed metamaterials for microwave applications. We will discuss the printable dielectric properties, how they can be printed effectively, measuring their dielectric properties, how they can be exploited for RF applications. We will also show results from 2D metasurfaces.

Michal Mrnka

Michal received the Ing. (M.Sc.) and Ph.D. degrees in electronics and communications from Brno University of Technology, Czechia in 2013 and 2017, respectively. In his doctoral thesis he focused on higher order mode dielectric resonator antennas and analysis of perforated dielectrics in microwave applications.

Between 2015-2017 he worked as a lead antenna engineer at ERA a.s. (Pardubice, Czechia), developing antennas for passive multilateration surveillance systems. In 2017 he joined the European Space Research and Technology Centre, European Space Agency, Noordwijk, The Netherlands, where he was involved in instrumentation for (sub-)millimeter-wave material characterization and compact antenna test range measurements. He is currently a research fellow with the University of Exeter working on microwave and terahertz computational imaging.

Microwave space compression optics – a path to miniaturisation of quasi-optical systems | Friday 9 September 13:30

Research on miniaturisation of optical systems has, in the last decade, mainly focused on reducing the size of bulk optical elements such as lenses and mirrors. Only recently it became known that the distances between optical elements can be reduced as well. In the talk we will discuss how a single Fabry-Perot cavity can accomplish such a task, focusing on the theoretical and practical limits, and we will present experimental results of a space compression element.

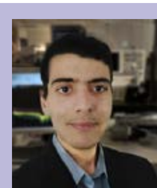
Dr Jiafeng Zhou

Jiafeng Zhou received a BSc degree in Radio Physics from Nanjing University, Nanjing, China and a Ph.D. degree from the University of Birmingham, Birmingham, U.K. His doctoral research concerned high-temperature superconductor microwave filters. He was with the National Satellite Meteorological Centre of China, Beijing, China. After completing his PhD, he was with the University of Birmingham, where his research concerned phased arrays for reflector observing systems. Then he moved to the Department of Electronic and Electrical Engineering, University of Bristol, Bristol, U.K. His research in Bristol was mainly on the development of highly efficient and linear amplifiers. He is with the Department of Electrical Engineering and Electronics, University of Liverpool, Liverpool, UK since 2013. His past and current research interests include microwave power amplifiers, filters, electromagnetic compatibility, frequency selective surfaces, energy harvesting and wireless power transfer.

Wide-Beamwidth High-Gain Metamaterial Antennas for Energy Harvesting Applications | Friday 9 September 13:50

For RF energy harvesting applications, it is very desirable for an antenna to have both a high gain and a wide beamwidth. Usually, they cannot be achieved simultaneously. In order to overcome this limitation, a multi-port antenna using a nonuniform metasurface (MTS) is presented. Three modes with complementary radiation patterns are excited. By combining the DC outputs to a single load, effectively an antenna with a wide beam and a high gain can be achieved, although each mode has the usual limitation of gain and beamwidth.

Mahmoud Wagih



Mahmoud Wagih is a UK IC Research Fellow and Proleptic Lecturer at the University of Glasgow. He received his PhD in rectenna design in 2021 from the University of Southampton, named Best in Antennas and Propagation in Europe. His interests cover RF power transmission, flexible and printed RF materials, and sustainable electronics systems, and has published over 60 papers on these topics. He is an affiliate member of the IEEE Microwave Theory Techniques technical committees on wireless power transfer and on RFID/IoT, and has received over 15 research awards.

Microwave-Enabled Energy Harvesting: Where to Use a Metamaterial? | Friday 9 September 14:10

Having appeared in the 1960s, microwave wireless power transmission (WPT) is by no means an emerging technology. Yet, its real-world applications were off to a slow start, hindered by practicalities ranging from efficiency to safety regulations. From antenna-circuit co-design to large-area RF (<10 MHz to 20+GHz) energy harvesting arrays, an overview of our recent work on WPT will be presented. Finally, novel use-cases where a metamaterial and a meta-device could transform WPT will be discussed.

Melissa Riley

Dr Melissa Riley, CEng, FIMMM, Consultant for Surface Engineering, has extensive knowledge of thermal spraying technology. She has significant experience in both the development of spray processes and the characterisation, properties and performance of materials deposited by these techniques, as well as significant knowledge of other coating and surface engineering technologies for a wide range of industrial applications. She has been instrumental in the development of TWI's surface engineering facilities to enable industry focussed, applied R&D at higher TRL/MRL scales, for TWI Industrial Members. This has included several high profile projects, relating to upscaling and manufacturing development of thermal spraying technologies for composite structures. Melissa is a Fellow of the Institute of Materials, Minerals and Mining (FIMMM), and a Chartered Engineer (CEng). Melissa is also a member of the Management Committee for the UK Thermal Spraying and Surface Engineering Association which issues the Code of Practice for Thermal Spraying, and also BSI STI/040 Thermal Spraying and Thermally Sprayed Coatings Committee.

Manufacturing of Metasurfaces at Scale | Friday 9 September 15:00

TWI is a world leading RTO with expertise in welding, joining and structural integrity. We have been active in surface engineering and coatings research for >30 years. We offer a wide range of processes applicable for manufacturing metasurfaces. Current activities active include development of a diverse range of functional coatings, including EMI and lightning strike protection applications, SurFlow™ data transmission through composites, as well as leading the development of novel metasurface manufacturing methods for wind turbine applications funded by DSTL.

Facilities include large scale mechanised surface preparation and coating facilities, composite manufacturing, laser processing, additive manufacturing and inspection capabilities, combined with extensive materials and surface characterisation, analysis and functional testing.

TWI has strong links to academic research to support technologies at TRL1-3, alongside manufacturing process and procedure developments to take technologies to TRL4 and above. Technologies can be demonstrated on representative components within our large scale facilities, supported by offline programming/simulation and multiple inspection capabilities for process validation and quality assurance. TWI's membership base & links with wider industry supply chains enable rapid technology transfer to end users.

Riccardo Cacocciola

Riccardo Cacocciola is a research engineer at Saint-Gobain Research Paris where he works on the functionalization of radome structures for ground-based and airborne applications. He has an engineering degree in Materials and Nanotechnologies from Denis Diderot Engineering School (Paris, France), a master's degree in Quantum Devices from Polytechnique (Paris, France) and has recently obtained his PhD in applied Physics from Paris Nanterre University (Paris, France) for his work on RF metamaterials for radome applications.

Metasurface-tuning: a camouflage technique for mechanical dielectric pieces | Friday 9 September 15:20

Radomes are weatherproof enclosures for the protection of antenna and radar systems. Ground-based radomes are large quasi-spherical domes made of dielectric panels and mechanical seams. While necessary for structural stability, the seams induce spurious scattering effects which reduce the transparency performance of the radome. In this work, dielectric radome seams are camouflaged with respect to a reference radome panel by integrating judiciously designed metasurfaces within the seam's volume. This technique, called metasurface-tuning, is analytically introduced, and applied to realize several proof-of-concept metasurface-tuned seams. Near-field and far-field measurements are performed on the prototypes and experimental validation of the camouflage effect is achieved in S-, C- and X-bands. Polarization stability, angular robustness (up to 45°) and dual-band capabilities of the proposed concept are demonstrated. The relatively low cost, easy implementation and scalability of the proposed metasurface-tuned seam design make it an attractive industrial solution to improve the performance of radomes as well as various RF systems affected by spurious mechanical pieces.

Collaboration Pitches

Dr. Rupam Das | University of Glasgow
Metamaterials for Implantable and Wearable devices
This short pitch talk will focus on my research of metamaterials for biomedical applications to explore the potential collaboration opportunities.

Mr. Oskar Zetterstrom | KTH
Twist-symmetric periodic structures for antenna applications
In this pitch, we demonstrate the attratctive properties of twist symmetries for the control of electromagnetic wave propagation.

Dr Simon Berry | QinetiQ
Working with QinetiQ

Dr. Alex Powell | University of Exeter
Measuring Microwave Angular Scattering
We have developed a setup to measure microwave scattering as a function of angle and frequency and are openly looking for collaborations to apply this to new projects.

Mr. Aaron Walker | BT
A Telecoms' Interest in Smart Surfaces

Raphael Grech | Spirent
Spirent Academia Programme

Changxu Liu | Northumbria University
Disordered plasmonic metasurfaces with unconventional optical response

Round table discussions

These will be facilitated through Vevox – please use the QR codes provided on your tables to answer questions during the sessions, either as a group or individually as directed.

Thursday 8 September 15:45

New applications for microwave metamaterials

This round table will foster discussions about new or upcoming ways microwave metamaterials can be used to tackle industrial challenges and move towards commercialisation in novel fields. Topics will include:

- Where are microwave metamaterials succeeding commercially?
- Where are they struggling despite clear potential for applications?
- Where are the major road blocks to success: Production? Funding? Standardisation?
- What can organisations like the UKMMN do to help?
- Which materials are highly interesting but have not been pushed towards any applications so far?
- Blue sky approaches – what new fields could metamaterials be applied to where they do not currently have a strong presence? - Food science? Agriculture? Space science? Climate research?

Friday 9 September 10:00

New Horizons for microwave metamaterials

This round table will look at new science that could be demonstrated by or applied to microwave metamaterials. Topics will include:

- Microwave metamaterial concepts that could be applied to other fields (e.g. acoustics, mechanics, food science?)
- Upcoming key concepts for metamaterials.
- New science that could be demonstrated with microwave metamaterials.
- Blue sky approaches – what interdisciplinary work could be used to spark new thinking in microwave metamaterials? - Biomimetic design? Machine Learning?

Contributed Poster Presentations

Dr. Harry Penketh University of Exeter
Microwave super-resolution imaging for cancer margin measurement

Ms. Pilar Castillo Tapia
KTH Royal Institute of Technology
Array of stacked geodesic lens antennas

Prof. Mustafa Aziz University of Exeter
Electromagnetic Wave Absorption and Resonance in Ferromagnetic Nano Particles and Metamaterials

Dr. Stephen Henthorn
University of Sheffield
Aerosol jet printed metasurfaces for mmWave

Mr. Oskar Zetterstrom
KTH Royal Institute of Technology
Planar Luneburg and Half-Luneburg Lens Antennas Based on a Glide-Symmetric Dielectric Structure

Mr. Kyle Arnold University of Exeter
Surface Impedance Calculations for Anomalous Reflection

Mr. Jenner Gudge-Brooke
University of Exeter
Superdirective helical dimers fabricated using 3D printed molds with liquid metal injection

Ms. Shohreh Nourinovin
Queen Mary University of London
THz Metasurfaces for Thin Film Sensing

Mr. Jonathon Smith University of Exeter
Radiated power of a dipole in proximity to a reflector

Ms. Leanne Stanfield University of Exeter
Microwave Demonstration of Purcell Effect Enhanced Radiation Efficiency

Mr. Joshua Glasbey University of Exeter
Accidental degeneracies and band inversion with a microwave metasurface.

Dr. Ian Hooper University of Exeter
Towards dynamically reconfigurable spatial light modulators for mm-wave and THZ radiation

Mr. James Capers University of Exeter
A new method for designing metamaterials that manipulate light

Dr. Alex Powell University of Exeter
Metamaterial methods for controlling scattering and antenna directivity

Dr Josh Hamilton QinetiQ
Investigating non-periodic arrays and metasurfaces

Mr Kevin Doyle Squadron Six Aerospace Ltd

Ms. Katie Lewis University of Exeter
Advanced Magnetic Metamaterials for Microwave Applications

Dr WIlliam Wardley University of Exeter
Fourier optics for instant dispersion plotting

Dr. Raphael Grech Spirent
Spirent Academia Programme

Mr Aakash Bansal University of Loughborough
Optimized Dielectric Lens for Travelling Wave Antennas

Ms Fatma Elhouni University of Liverpool
Reconfigurable Metamaterial Using Liquid Metal

Cameron Gallagher University of Exeter
Broadband Multilayered Artificial Magnetic Conductor with Magnetodielectric Substrate

List of Delegates

Kyle Arnold	koa201@exeter.ac.uk	University of Exeter
Jenner Gudge-Brooke	Jenner Gudge-Brooke	University of Exeter
Shohreh Nourinovin	s.nourinovin@qmul.ac.uk	Queen Mary University of London
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University of Exeter | EPSRC Centre for Doctoral Training in Metamaterials XM² | EPSRC Engineering and Physical Sciences Research Council | UK Meta Materials Network

Notes

UNIVERSITY OF EXETER | Centre for Metamaterial Research and Innovation

w www.metamaterial.center
e metamaterials@exeter.ac.uk

The Centre for Metamaterial Research and Innovation (CMRI) is harnessing research excellence from theory to application, by enabling simulations, measurement and fabrication of metamaterials and metamaterial-based devices.

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UK META MATERIALS NETWORK

w www.metamaterials.network
e info@metamaterials.ac.uk

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