URSI 2020

XXXV Simposium Nacional de la Unión Científica Internacional de Radio

Málaga, 2 al 4 de septiembre de 2020

LIBRO DE ACTAS

UNIVERSIDAD DE MÁLAGA

U.R.S.I.

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Organización

UNIVERSIDAD
DE MÁLAGA

E.T.S. DE INGENIERÍA DE
TELECOMUNICACIÓN
UNIVERSIDAD DE MÁLAGA

Bienvenida del comité Organizador

La Escuela Técnica Superior de Ingeniería de Telecomunicación de la Universidad de Málaga tiene el placer de recibiros en el XXXV Simposio Nacional de la Unión Científica Internacional de Radio, URSI 2020, que se celebra en sede virtual entre los días 2 y 4 de septiembre de 2020.

Este año 2020 se ha convertido en un año diferente para todos nosotros y nos acompañará en nuestros recuerdos en el futuro. Es un año donde todos nos hemos visto inmersos en una pandemia que ha cambiado paradigmas establecidos tanto en el trabajo en la empresa como en la docencia. El cambio ha sido tan abrupto que de un día para otro hemos tenido que cambiar nuestra forma de trabajar y enseñar.

URSI 2020 debía celebrarse de forma presencial como en ediciones anteriores en Málaga. Después de esperar un tiempo ampliando plazos con la esperanza de que pudiera ser una URSI normal, hubo que tomar la decisión de celebrar esta edición en formato remoto. Esperamos que la experiencia sea positiva para todos.

URSI reúne anualmente a más de doscientos investigadores, profesionales y estudiantes del ámbito de las Tecnologías de la Información y las Comunicaciones (TIC) con el foco en la tecnología radio para de presentar sus trabajos de investigación y desarrollo tecnológico. El Simposio, que viene celebrándose de manera ininterrumpida desde 1980, tiene como principal objetivo ser un foro técnico de referencia para el sector de las telecomunicaciones, y así fomentar la colaboración entre investigadores de las universidades y las empresas del sector. El número de comunicaciones se ha visto mermado con relación a las últimas ediciones debido a la situación especial de este año 2020. No obstante, más de 140 comunicaciones serán presentadas en el Simposio. Las previsiones que inicialmente consideramos en la organización se han visto gratamente sobrepasadas. Por lo tanto, es necesario agradeceros a todos el interés y el esfuerzo por presentar vuestros trabajos.

En el ámbito nacional, el Simposio es el principal lugar de encuentro para todos los que, en las universidades, centros de investigación y empresas trabajan en la investigación básica y/o aplicada dentro de áreas clave de las TIC como el electromagnetismo, los sistemas radiantes y de radiocomunicación, física e ingeniería electrónica, tratamiento digital de señales para audio, video y comunicaciones, o ingeniería telemática. Su objetivo es proporcionar una plataforma idónea para debatir, intercambiar experiencias y abrir posibilidades de colaboración entre los distintos grupos de trabajo existentes en áreas TIC de la ingeniería y de las ciencias experimentales. Asimismo, es una excelente oportunidad para que los jóvenes investigadores se inicien en las

labores de publicación y difusión de sus trabajos y aportaciones de investigación.

Para finalizar, quiero agradecer a todas las personas que con su apoyo hacen posible URSI cada año y especialmente esta edición. En este sentido, quiero expresar mi agradecimiento a todos lo miembros del comité organizador y del comité científico por su trabajo y apoyo, a los revisores que han aportado su visión crítica para evaluar y mejorar los trabajos y a todos los que colaboran en la presidencia de las sesiones de URSI 2020 por su tiempo y disposición en todo momento.

Un fuerte abrazo para todos.

Enrique Márquez Segura
Presidente del Comité Organizador URSI 2020

Comité organizador

Organización

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Universidad de Málaga

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Luis Javier García Villalba
Pere L. Gilabert Pinal
Rafael Godoy Rubio
Miguel Ángel Gómez Laso
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Marco Guglielmi
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Francisco Javier Hernando Pericas
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Jaime Lloret Mauri
Antonio Lozano Guerrero
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José Margineda Puigpelat
Enrique Márquez Segura
Jesús Martel Villagrán
Ferran Martín Antolín
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Miguel Navarro-Cía
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Eva Rajo Iglesias
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Javier Reina Tosina
José Manuel Riera Salís
Juan Manuel Rius Casals
Raúl Rodríguez Berral
Rafael Rodríguez Boix
José Rodríguez García
Fernando Roldán
Lorenzo Rubio Arjona
Jesús Rubio Ruiz
Jorge A. Ruiz Cruz
Miguel A. Salas-Natera
Oriol Sallent
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Jorge Teniente Vallinas
Matías Toril Genovés
Germán Torregrosa Penalva
Ana María Torres Aranda
Antonio Valdovinos Bardají
Juan Francisco Valenzuela Valdés
Alejandro Valero Nogueira
Ángel Vegas García
José María Zamanillo Sainz de la Maza

Áreas Temáticas

El Comité Científico invita a todos aquellos autores que deseen participar a que contribuyan con sus comunicaciones con nuevos trabajos de investigación o de desarrollo tecnológico, preferentemente, en las áreas temáticas siguientes:

Sesiones regulares

- Antenas
- Aplicaciones Biomédicas
- Aplicaciones Matemáticas: Modelado y Simulación
- Circuitos y Dispositivos Activos de Microondas
- Compatibilidad Electromagnética
- Componentes y Circuitos Pasivos de Microondas
- Comunicaciones Digitales
- Comunicaciones Móviles e Inalámbricas
- Comunicaciones por Satélite
- Educación: Nuevas Tecnologías y Herramientas
- Electromagnetismo
- Fotónica y Comunicaciones Ópticas
- Metamateriales
- Procesado de Señal: Voz, Imagen y Datos
- Radar
- Radiación, Dispersión y Radiopropagación
- Radioastronomía
- Tecnología y Aplicaciones a Frecuencias de THz
- Telemática: IoT, interfaces de comunicación, e-learning, gamificación

Sesiones especiales

- Técnicas y tecnologías de fabricación para antenas y dispositivos de RF
- Reflectarrays, Transmitarrays and Periodic Structures
- Avances en modelado y simulación de circuitos no-lineales
- Arquitecturas amplificadoras de alta eficiencia y linealización de amplificadores
- Comunicaciones por satélite
- Nuevos diseños y aplicaciones de antenas y circuitos basados en ondas de fuga
- Tecnologías de voz y habla, música y otras señales sonoras y de audio
- Dispositivos fotónicos
- Inteligencia Artificial para Comunicaciones Celulares
- Aplicaciones en ingeniería biomédica

Premio Jóvenes Científicos URSI 2020

La Unión Científica Internacional de Radio (URSI) concede dos Premios para Jóvenes Científicos a los dos mejores artículos presentado en el Simposio y cuatro Accésit (está previsto que los premios sean entregados durante la cena de gala de URSI 2020).

Condiciones para optar al premio

Según lo acordado en la asamblea URSI celebrada en Leganés (7 de septiembre 2011), aquellos autores que deseen optar al Premio Jóvenes Científicos URSI 2020 deberán enviar el trabajo completo en inglés y cumplir las siguientes condiciones:

- Ser menor de 35 años a fecha de 30 de septiembre de 2020.
- Ser el primer autor de un trabajo aceptado en el Simposio.
- El candidato al premio deberá exponer el trabajo en el Simposio.
- Solicitar la participación siguiendo las instrucciones correspondientes al envío de trabajos.

El jurado encargado de evaluar y seleccionar los artículos premiados estará compuesto por un comité internacional de expertos.

La selección de los artículos premiados tendrá en cuenta la evaluación recibida por los artículos durante el proceso de revisión del congreso (25% de la puntuación total), la evaluación realizada por el comité internacional de expertos (50% de la puntuación total), y la evaluación recibida por la presentación del artículo en el congreso (25% de la puntuación total).

Asimismo, según lo acordado en la asamblea URSI celebrada en Pamplona (2 de septiembre 2015), se valorará que los trabajos cuenten con un número reducido de autores.

Sede

Sede virtual del Congreso

E.T.S. Ingeniería de Telecomunicación, Universidad de Málaga.

Universidad de Málaga

La historia de la UMA no se entiende sin Málaga: el impulso de la provincia en todos sus frentes (ciudadanos, personalidades y medios de comunicación) resultaría clave en la consecución de nuestra Universidad. El proceso de creación de la Universidad de Málaga comienza en 1968 con la creación de la "Asociación de Amigos de la Universidad de Málaga": organizada para conseguir que la provincia tuviera su universidad, logró concienciar a la sociedad malagueña sobre su importancia y movilizar a la misma hasta su fundación.

A partir de ahí, comenzó un largo proceso de avance en el que destacaron la creación del Colegio Universitario de Málaga en 1971, y la agrupación de las ya existentes Escuela de Ingenieros Técnicos, Escuela Normal, Facultad de Ciencias Económicas y Empresariales (dependiente en aquel entonces de la Universidad de Granada) y Seminario.

Finalmente, el 18 de agosto de 1972, mediante decreto, se aprobó la fundación de la Universidad de Málaga. La Facultad de Ciencias Económicas y Empresariales y la Facultad de Medicina serían las primeras en formar parte de la universidad global que es hoy la Universidad de Málaga.

Con el objetivo de convertirse en una institución completa y de máximo nivel, la UMA desarrolló un plan de expansión en cuanto a ramas de conocimiento e infraestructuras se refiere. De esta manera, una vez asentada en el Campus de El Ejido, se desarrolló en la ciudad universitaria de Teatinos, área que en un primer momento albergaría las Facultades de Medicina, Filosofía y Letras y Ciencias para poco a poco crecer y convertirse en un campus cada vez más completo tanto en oferta académica como en servicios universitarios.

A la vez que la UMA crecía físicamente, también lo hacía cualitativamente: desde finales de los años 90, destaca la fuerte apuesta por las nuevas tecnologías y la investigación.
En este sentido, la Universidad de Málaga inicia una estrategia para convertirse en referente de innovación y desarrollo científico en del sur de España. Como resultado diseña un extenso marco de colaboración con el Parque Tecnológico de Andalucía, multiplica sus proyectos de investigación de carácter nacional e internacional y en 2007 entra en la Red Española de Supercomputación con el Supercomputador Picasso.

En la actualidad, la Universidad de Málaga sigue apostando por el desarrollo científico y la innovación como vía para aportar progreso al conjunto de la sociedad. Destaca en estos años el fomento de la movilidad y el esfuerzo por atraer talento internacional, logrando una universidad abierta, cosmopolita y capaz de integrarse en proyectos científicos de máximo nivel.

Casi 50 años después de su creación, la Universidad de Málaga cuenta con más de 35.000 estudiantes, 58 títulos de Grado, 53 títulos de Máster y 278 grupos de investigación.

Innovación, dinamismo e internacionalización son los principios que marcan la historia de la UMA y a su vez, la base establecida por la universidad para superar las dificultades actuales y reforzar su servicio por el conocimiento, por la sociedad y por el futuro.

(http://www.uma.es)

Escuela Técnica Superior de Ingeniería de Telecomunicación

Los primeros estudiantes que comienzan sus estudios para obtener la titulación de Ingeniería de Telecomunicación lo hacen en octubre de 1988. En aquel momento la Escuela no disponía de edificio propio y comenzó su andadura en el antiguo edificio de la Escuela Universitaria Politécnica de la Universidad de Málaga. La creación de nuestro centro se refleja en el decreto 145/1988, de 23 de marzo, por el que se crea en la Universidad de Málaga la Escuela Técnica Superior de Ingenieros de Telecomunicación. Más tarde se aprobaría en nuestra Junta de Escuela el cambio a la denominación actual de Escuela Técnica Superior de Ingeniería de Telecomunicación. Los primeros estudiantes que egresan de nuestra Escuela lo hacen a finales de 1993.

En 1995 se inaugura el nuevo edificio en el que actualmente nos encontramos, coincidiendo con el comienzo de la impartición de los títulos de Ingeniería Técnica de Telecomunicación que conformarían, junto con el título de Ingeniero de Telecomunicación, el catálogo de títulos ofertados en nuestra Escuela hasta la llegada de los actuales Grados en 2009.

A día de hoy son más de 2500 los estudiantes egresados de la Escuela. Ellos conforman el patrimonio más importante de nuestra Escuela ocupando, en muchos casos, cargos de gran relevancia en instituciones y empresas tanto a nivel nacional como internacional.

(http://www.etsit.uma.es)

Conferencias plenarias

Conferencias plenarias

Conferencia plenaria 1 — Miércoles, 02/09/2020, 11:00-12:20

Establishing New National Measurement Systems for Millimetre-wave and Terahertz Frequencies

Nick Ridler

National Physical Laboratory, UK

Synopsis

The National Physical Laboratory (NPL) is the UK's National Measurement Institute. As such, NPL is tasked with developing, maintaining and disseminating measurement capability at the very highest levels of accuracy. NPL develops measurement capability in areas of relevance to science and technology. As new science and technology is developed, new measurement capability is required to underpin and validate the new science and technology. In recent years, much use has been made of the millimetre-wave and terahertz parts of the electromagnetic spectrum. This is for applications in electronics and telecommunications, defense and security, radio astronomy and atmospheric science, and, healthcare and pharmaceuticals. All these applications have driven the need for accurate and reliable measurement capabilities at these frequencies. This talk will review some recent developments being made at NPL to establish such measurement capabilities.

Biography

Nick Ridler is the Head of Science in the Department of Electromagnetic and Electrochemical Technologies at the UK's National Physical Laboratory. He has almost 40 years' experience working in industrial, government and academic research establishments. His main area of interest is precision high-frequency electromagnetic measurement (from 1 kHz to 1 THz). He is a Visiting Professor at the University of Leeds (Pollard Institute), the University of Surrey (Advanced Technology Institute) and the University of Liverpool (Department of Electrical Engineering and Electronics). He is also a Non-Executive Director of LA Techniques Ltd. He is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), a Fellow of the Institution of Engineering and Technology (IET) and a Fellow of the Institute of Physics (IOP).

Conferencia plenaria 2 Jueves, 02/09/2020, 16:00-17:00

Huygens' Metasurfaces for Controlling Electromagnetic Waves

George V. Eleftheriades

Department of Electrical and Computer Engineering

University of Toronto, Canada

Synopsis

We will describe the concept of the Huygens' metasurface which comprises co-located electric and magnetic dipoles forming an electrically dense array of Huygens' sources or scatterers. These engineered surfaces can be designed to control electromagnetic waves at will. Both passive and active Huygens' metasurfaces can be envisioned. Unlike traditional antenna transmitarrays, Huygens' metasurfaces can be made sub-wavelength thin and devoid of spurious Floquet modes, while preserving excellent impedance matching characteristics. Huygens' metasurfaces can be used to manipulate the phase, magnitude and polarization of incident electromagnetic waves, including those from nearby elementary antennas, for a variety of applications. For example, Huygens' omega bi-anisotropic metasurfaces enable wave refraction at extreme angles without any reflections. They also allowed the demonstration of generalized flat reflectors having arbitrary angles of incidence and reflection and with 100% theoretical efficiency. Examples of Huygens' metasurface applications include 'perfect' wavefront refraction, focusing and lensing, polarization control including chirality, active and passive cloaking, high-aperture efficiency/low-profile antennas, and antenna aperture beamforming with simultaneous magnitude and phase control.

Biography

George V. Eleftheriades earned the M.S.E.E. and Ph.D. degrees in electrical engineering from the University of Michigan, Ann Arbor, MI, USA, in 1989 and 1993, respectively. From 1994 to 1997, he was with the Swiss Federal Institute of Technology, Lausanne, Switzerland. Currently, he is a Professor in the Department of Electrical and Computer Engineering at the University of Toronto, ON, Canada, where he holds the Canada Research/Velma M. Rogers Graham Chair in Nano- and Micro-Structured Electromagnetic Materials. He is a recognized international authority and pioneer in the area of metamaterials. These are man-made materials which have electromagnetic properties not found in nature. He introduced a method for synthesizing metamaterials using loaded transmission lines. Together with his graduate students, he provided the first experimental evidence of imaging beyond the diffraction limit and pioneered several novel antennas and microwave components using these transmission-line based metamaterials. His research has impacted the field by demonstrating the unique electromagnetic properties of metamaterials; used in lenses, antennas, and other microwave and optical components to drive innovation in fields such as wireless and satellite communications, defence, medical imaging, microscopy, and automotive radar. Presently, he is

leading a group of graduate students and researchers in the areas of electromagnetic and optical metamaterials, and metasurfaces, antennas and components for broadband wireless communications, novel antenna beam-steering techniques, far-field super-resolution imaging, radars, plasmonic and nanoscale optical components, and fundamental electromagnetic theory.

Prof. Eleftheriades served as an Associate Editor for the IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION (AP). He also served as a member of the IEEE AP-Society administrative committee (AdCom) from 2007 to 2012 and was an IEEE AP-S Distinguished Lecturer from 2004 to 2009. He served as the General Chair of the 2010 IEEE International Symposium on Antennas and Propagation held in Toronto, ON, Canada. Papers that he co-authored have received numerous awards such as the 2009 Best Paper Award from the IEEE MICROWAVE AND WIRELESS PROPAGATION LETTERS, twice the R. W. P. King Best Paper Award from the IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION (2008 and 2012), and the 2014 Piergiorgio Uslenghi Best Paper Award from the IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS. He received the Ontario Premier's Research Excellence Award and the University of Toronto's Gordon Slemon Award, both in 2001. In 2004 he received an E.W.R. Steacie Fellowship from the Natural Sciences and Engineering Research Council of Canada. In 2009, he was elected a Fellow of the Royal Society of Canada and received the 2018 Research Leadership Award from the University of Toronto. He is the recipient of the 2008 IEEE Kiyo Tomiyasu Technical Field Award, the 2015 IEEE John Kraus Antenna Award and the 2019 IEEE AP-S Distinguished Achievement Award.

Conferencia plenaria 3 — Viernes, 04/09/2020, 12:30-14:00

How to write a technical paper (and get it published)

Luca Perregrini

University of Pavia, Italy

Synopsis

The talk will focus on the various aspects related to the writing of a technical paper. In particular, the preparation phase, the organization of the manuscript, the appropriate referencing, and some stylistic aspects will be discussed.

Moreover, the peer review process will be presented in details, with specific reference to the IEEE journals, and, in particular, to the hands-on experience of the speaker.

Last but not least, ethical issues related to the scientific research are also addressed.

Biography

Luca Perregrini (M'97-SM'12-F'16) was born in Sondrio, Italy, in 1964.

He received the "Laurea" degree in Electronic Engineering and the Ph.D. in Electronics and Computer Science in 1989 and 1993, respectively. In 1992 he joined the Faculty of Engineering of the University of Pavia, he is currently full professor of electromagnetic fields and responsible of the Microwave Laboratory. He has been a visiting professor at the École Polytechnique de Montréal, Québec, Canada in 2001, 2002, 2005, and 2006.

He has been responsible of many research contracts with prominent international research centers and companies. His main research interests have been focused on the development of numerical methods for electromagnetics, and the design of microwave passive components and antennas. He authored or co-authored more than 100 journal papers and more than 300 conference papers, six book chapters, two textbooks, and co-edited the book Periodic Structures, (Research Signpost, 2006).

Prof. Perregrini has been an invited speaker at many conferences, and has delivered invited seminar talks in Universities and research centers worldwide.

He is a member ex-officio of the Administrative Committee of the of IEEE Microwave Theory and Technique Society (MTT-S), a member of the Board of Directors of EuMA, and a member of the Technical Committee MTT–15 (Microwave Field Theory) of MTT-S. He was a member of the General Assembly of the European Microwave Association (EuMA) from 2011 to 2013, and he served as a member of prize committees for several conferences/societies.

In 2016 he has been elevated Fellow of the Institute of Electrical and Electronics Engineers (IEEE) "for contributions to numerical techniques for electromagnetic modelling". He was the co-recipient of several best paper awards at international conferences.

He was the Technical Program Committee Chair of the International Microwave Workshop Series on Advanced Materials and Processes (IMWS-AMP 2017), Pavia, Italy, in 2017, of the IEEE MTT-S International Conference on Numerical Electromagnetic Modeling and Optimization (NEMO2014), Pavia, Italy, in 2014, and of the European Microwave Conference, Rome, Italy, in 2014.

He has been Editor in Chief of the IEEE Transactions on Microwave Theory and Techniques for the term 2017-2019. He was Associate Editor of the IEEE Microwave and Wireless Components Letters from 2010 to 2013, of IEEE Transactions on Microwave Theory and Techniques from 2013 to 2016, of the International Journal of Microwave and Wireless Technologies from 2011 to 2016, and of IET Electronic Letters from 2015 to 2016. He was Guest Editor of the IEEE Transactions on Microwave Theory and Techniques in 2015 and of the International Journal of Microwave and Wireless Technologies in 2015.

Programa

Programa

XXXV Simposium Nacional de la Unión Científica Internacional de Radio

Miércoles, 02/09/2020

9:00 - 10:30	**Sesión 1.1: Sesión Especial: Nuevos diseños y aplicaciones de antenas y circuitos basados en ondas de fuga** Lugar: **Sala Virtual 1** Presidente: **José Luis Gómez Tornero** Presidente: **Elena Abdo Sánchez**	**Sesión 1.2: Comunicaciones por satélite** Lugar: **Sala Virtual 2** Presidente: **Mariano Baquero Escudero** Presidente: **Jorge Teniente Vallinas**	**Sesión 1.3: Comunicaciones Móviles, Inalámbricas e IoT I** Lugar: **Sala virtual 3** Presidente: **José Ignacio Alonso Montes** Presidente: **Oscar Castañeda Aguadero**
10:30 - 11:00	**Pausa** Lugar: **Cafetería Virtual**		
11:00 - 12:20	**AAS: Acto de Apertura del Simposio URSI 2020** Lugar: **Sala de plenarias virtual** Presidente: **Francisco Medina Mena** Presidente: **Enrique Márquez Segura**	**Plenaria 1: Conferencia Plenaria - Nick Ridler - Establishing New National Measurement Systems for Millimetre-wave and Terahertz Frequencies** Lugar: **Sala de plenarias virtual** Presidente: **Enrique Márquez Segura**	
12:20 - 12:30	**Pausa** Lugar: **Cafetería Virtual**		
12:30 - 14:00	**Sesión 2.1: Electromagnetismo** Lugar: **Sala Virtual 1** Presidente: **Jesús María Rebollar Machain** Presidente: **Jesús Martel Villagrán**	**Sesión 2.2: Sesión Especial: Técnicas y tecnologías de fabricación para antenas y dispositivos de RF I** Lugar: **Sala Virtual 2** Presidente: **Pablo Padilla de la Torre** Presidente: **José Luis Masa Campos**	**Sesión 2.3: Comunicaciones Móviles, Inalámbricas e IoT II** Lugar: **Sala virtual 3** Presidente: **MATIAS TORIL GENOVES**
16:00 - 17:30	**Sesión 3.1: Antenas I** Lugar: **Sala Virtual 1** Presidente: **Carlos Camacho Peñalosa** Presidente: **Jesús Rubio Ruiz**	**Sesión 3.2: Sesión Especial: Técnicas y tecnologías de fabricación para antenas y dispositivos de RF II** Lugar: **Sala Virtual 2** Presidente: **José Luis Masa Campos** Presidente: **Pablo Padilla de la Torre**	**Sesión 3.3: Fotónica y Comunicaciones Ópticas** Lugar: **Sala virtual 3** Presidente: **Miguel del Castillo Vázquez** Presidente: **Alejandro Ayala Alfonso**
17:30 - 18:30	**Mesa Redonda: El doctorado y sus expectativas laborales** Presidente: **Miguel Ángel Gómez Laso**		

Jueves, 03/09/2020

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Índice y horario de sesiones

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Resúmenes de las ponencias

Resúmenes de las ponencias

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Sesión 1.1. Sesión Especial: Nuevos diseños y aplicaciones de antenas y circuitos basados en ondas de fuga

Presidente de la sesión: José Luis Gómez Tornero, Elena Abdo Sánchez

Planar leaky-wave dual-band antenna array, with a single layer metasurface

Nafsika Memeletzoglou, Eva Rajo-Iglesias
Universidad Carlos III de Madrid, España

In this paper we propose the design of a planar leaky-wave antenna array, with grating lobe suppression using a metasurface. The basic element of the array is a dual-band leaky-wave antenna, that is formed by a stacked patch antenna that radiates inside a resonant cavity that is defined by a partially reflective surface (PRS) on top. The proposed dual- band metasurface, consists of a single layer. In addition, it allows independent directivity control at each frequency, leading to a thinned array with good grating lobe suppression. The array operates at 10.5 GHz and 13 GHz. The attenuation of the grating lobes is -12.7 dB at the lower frequency, and -10.6 dB at the higher frequency for inter-element spacing of $1.8\lambda_1$ and $2.3\lambda_2$ respectively.

Antena Leaky-Wave con Enfoque Escaneado en Frecuencia para Detección de Dirección de Llegada en Aplicaciones de BLE en Proximidad

Miguel Poveda García, Alejandro Gil Martínez, José Luis Gómez Tornero
Universidad Politécnica de Cartagena, España

En este trabajo se presenta la síntesis de funciones monopulso en la región de Fresnel, utilizando antenas leaky-wave enfocadas en el campo cercano (LWA). La técnica de enfoque, combinada con el comportamiento de escaneo en frecuencia de las LWAs, permite obtener diagramas de radiación bien definidos en las proximidades de la antena, que se superponen adecuadamente para obtener funciones monopulso escaneadas. Esto no es posible con antenas convencionales enfocadas en el campo lejano, en las que el diagrama de radiación está muy distorsionado en la región del campo cercano. Como prueba de concepto, se muestran ejemplos que utilizan los tres canales de advertising proporcionados por el protocolo Bluetooth Low Energy (BLE). Estos canales (#37, #38 y #39) están situados a 2.402, 2.426 y 2.48 GHz, respectivamente. La síntesis de monopulso en campo cercano es interesante para la detección de la dirección de llegada (DoA) en aplicaciones de detección en proximidad.

Leaky Wave Antenna Based on Glide Symmetry with Fast Steering Angle for Automotive Radar at 77 GHz

Adrián Tamayo-Domínguez[1], José Manuel Fernández-González[1], Óscar Quevedo-Teruel[2]

[1]Centro de Investigación en Procesado de la Información y Telecomunicaciones, Universidad Politécnica de Madrid, 28040, Madrid, Spain; [2]Division for Electromagnetic Engineering, KTH Royal Institute of Technology, Stockholm 10044, Sweden

This work presents a leaky wave antenna at W band with glide-symmetric protrusions that enhance the scanning ratio of previous works. Also, a conventional leaky wave antenna is designed for comparing the results in terms of required bandwidth and steering range. Both prototypes are based on gap waveguide technology to prevent the leakage due to air gaps between layers. In order to reduce the manufacturing cost, the designs are 3D-printed and copper plated. A Taylor amplitude modulation is conducted in the two cases to reduce side lobe levels. The glide-symmetric leaky wave antenna provides a variation of the steering angle from 17º to 62º in a band from 74 GHz to 81.1 GHz. The scanning ratio compared with the simple leaky wave antenna is enhanced by a factor of 5.76. This rapid variation of the steering angle in a narrow band (7%) is of interest for automotive radars.

Broadside Huygens' Metasurface Leaky-Wave Antenna with Reduction of Beam Squinting

Elena Abdo Sánchez[1], Ariel Epstein[2], George V. Eleftheriades[3]

[1]Universidad de Málaga, España; [2]Technion - Israel Institute of Technology, Israel; [3]University of Toronto, Canadá

In this contribution, the frequency beam scanning of a leaky-wave antenna based on a modified parallel-plate waveguide that uses a Huygens' metasurface as top plate is analysed. Simple theoretical formulas are obtained that reveal that the scanning rate can be controlled with the design parameters thanks to the high number of degrees of freedom. A design example for broadside radiation including simulation results of a physical realization of the structure are provided. The antenna achieves beam squinting of just 4º over a 8% of fractional bandwidth around broadside in the frequency band of 20 GHz.

Síntesis Directa de Antenas Leaky-Wave en Tecnología Half-Width Microstrip para Monopulso Escaneado en Frecuencia

Alejandro Gil Martínez, Miguel Poveda García, José Luis Gómez Tornero

UPCT, España

We propose a synthesis technique for half-width microstrip leaky-wave antennas (HWM LWAs) producing frequency-scanned monopulse patterns with two channels. The election of the substrate thickness and dielectric constant is of key importance to obtain the desired angular scanning in the prescribed frequency band, and with high radiation efficiency. Using the two far advertising channels of Bluetooth Low Energy (BLE) protocol in the 2.45 GHz band, we demonstrate that wide and narrow scanning designs can be directly obtained with the proposed approach, while dispensing from any numerical optimization. It is examined how different dielectric laminates and antenna sizes are convenient for each design.

Lugar: Sala Virtual 2 Miércoles, 02/09/2020: 09:00-10:30

Sesión 1.2. Comunicaciones por satélite

Presidente de la sesión: Mariano Baquero Escudero, Jorge Teniente Vallinas

Amplificador MMIC en tecnología 100 nm GaN-Si para la próxima generación de satélites vHTS en banda Ka

Rocco Giofrè[1], Paolo Colantonio[1], Lorena Cabria de Juan[2]

[1]Electronics Engineering Department, Universidad de Roma Tor Vergata, Italia; [2]TTI, España

Este artículo presenta el diseño y la caracterización experimental de un circuito integrado monolítico de microondas (MMIC) amplificador de potencia implementado en tecnología GaN sobre silicio de 100 nm de longitud de puerta, concebido para ser usado como bloque básico de construcción de un SSPA embarcado para satélites vHTS (very High Throughput Satellites). El diseño se ha llevado a cabo considerando las peculiaridades de la aplicación, por lo que selección de los puntos de polarización de los dispositivos y las topologías de red correspondientes se ha realizado cuidadosamente, considerando las restricciones térmicas de la tecnología, con el objetivo de mantener la temperatura de unión de los dispositivos por debajo de 160ºC.

Análisis de la pendiente de desvanecimientos en la banda Q de comunicaciones satelitales

Domingo Pimienta del Valle, Pedro García del Pino, José Manuel Riera Salís

Universidad Politécnica de Madrid, España

Fade slope is one of the second order parameters used to assess the propagation effects of the troposphere on satellite links. For assessing properly its statistical distribution, long data periods are needed, particularly at higher frequency bands such as the Q/V band, with few reported experiments in the technical literature. The Universidad Politécnica de Madrid is receiving the 40-GHz signal coming from the Alphasat satellite Q-band beacon, with five years of propagation measurements processed up to now. In this paper, annual and period excess attenuation distributions and fade slope results are presented, together with the comparison of fade slope results with the Rec. ITU-R P.1623-1 model. The predictions of the ITU-R model describe adequately the experimental results, with most of the differences being obtained for the higher analyzed time intervals (from 60 to 180 s) and attenuation (from 15 to 20 dB).

Analysis of the Traffic Demand on Very High Throughput Satellite for 5G

Daniel de la Torre Lazaro, Flor de Guadalupe Ortiz Gómez, Miguel Alejandro Salas Natera, Ramón Martínez Rodríguez-Osorio

Escuela Técnica Superior de Ingenieros de Telecomunicación- UPM, España

In a near future, it is expected that Very High Throughput Satellite (VHTS) systems will have a huge increase in traffic demand. However, this increase will be non-uniform over the service area due to the non-uniform users distribution and changes in traffic demand during the day. The solution to this problem is found in flexible payload architectures, which allow payload resources to be flexibly allocated to meet traffic demands in each beam, resulting in Dynamic Resource Management (DRM) approaches. In order to implement solutions to the DRM problem, prior knowledge of how the traffic demand behaves over the service area is required, which currently remains a challenge, especially now that 5G technology is expected to be deployed globally. In this sense, this paper presents an analysis of the expected traffic demand for 5G communications using a 5G-VHTS hybrid system.

Convolutional Neural Networks for Flexible Payload Management in VHTS Systems

Flor G Ortiz-Gomez, Ramon Martinez, Miguel A. Salas-Natera
Universidad Politécnica de Madrid, España

Very High Throughput Satellite (VHTS) systems are expected to have a large increase in traffic demand in the near future. However, this increase will not be uniform throughout the service area due to the non-uniform user distribution, and the changing traffic demand during the day. The solution to this problem is provided by flexible payload architectures, which allows the payload resources to be flexibly allocated to meet the traffic demands in each beam, leading to Dynamic Resource Management (DRM) approaches. However, DRM adds significant complexity to the VHTS systems; in this paper we propose the use of Convolutional Neural Networks (CNN) to manage the resources available in Flexible Payload Architectures for DRM. The VHTS system model is firstly outlined, for introducing the DRM problem statement and the CNN-based solution. A comparison with other payload architectures is performed in terms of DRM performance, for demonstrating the effectiveness of the proposed approach, and to examine all the involved challenges.

Linearly Polarized Planar Reconfigurable Active Array Antenna for Ka Band Applications

Alfonso Tomás Muriel Barrado, Jorge Calatayud Maeso, Antonio Rodríguez Gallego, José Manuel Fernández González, Manuel Sierra Pérez, Pablo Sánchez Olivares
Universidad Politécnica de Madrid, España

In this paper, a linearly polarized active phased array antenna demonstration at Ka Band (28-30 GHz) is presented. The proposed passive array consists of an 8x8 planar array arranged in column subarrays of 1x8 elements for 1D beam steering with linear polarization (LP). The radiating elements are printed circular patches connected to microstrip feeding lines through metallic vias in a multilayered structure. The amplitude and phase distribution is performed by a commercial integrated circuit (IC), designed for transmission purposes, from the common port to each of the 8 output ports. Therefore, an evaluation of the IC performance is also studied. Measurements of the proposed full integrated system will be presented at the conference.

Lugar: Sala virtual 3 Miércoles, 02/09/2020: 09:00-10:30

Sesión 1.3. Comunicaciones Móviles, Inalámbricas e IoT I

Presidente de la sesión: José Ignacio Alonso Montes, Oscar Castañeda Aguadero

Diagnóstico de conexiones problemáticas en redes celulares mediante herramientas de monitorización de tráfico

Antonio Jesús García Pedrajas[1], Matías Toril Genovés[1], Salvador Luna Ramírez[1], Victor Buenestado García[2]

[1]Universidad de Málaga, España; [2]Ericssón España

Over the last years, there has been an increase in the number of services in mobile networks. Such a trend has caused that network management is now focused on user satisfaction by ensuring Quality of Experience (QoE). A key challenge for mobile operators is to reduce the impact of network failures on user experience. In this work, an automatic method for identifying and diagnosing troublesome connections in a cellular network is presented. The proposed method relies on the fact that downlink TCP throughput may be used to identify bad performing connections. Method assessment is performed with a real dataset taken from a live 3G network by using a traffic monitoring and analysis tool, combining measurements collected in the radio access network and core network. Results show the effectiveness of the method to perform deep root cause analysis to detect hidden patterns, which cannot be done with aggregated performance counters collected at a cell level in mobile networks.

Vehicle to Everything (V2X) performance test setup characterization

Oscar Castañeda Aguadero, Janie Baños, Jose Dario Sarmiento, Rosario Trapero

DEKRA, España

Test setups are needed for the evaluation of the performance of different Vehicle-to-everything (V2X) applications. Both the test applications and the hardware radio modules needed to build the test setup must comply with strict requirements to ensure the relevant performance KPIs can be measured. In this work, the test setup, the processing of the timing and the results of the measurements are presented. The scenarios tested include several Intelligent Transport System (ITS) applications over both Dedicated Short Range communication (DSRC) and Cellular Vehicle-to-everything (C-V2X) technologies, and with both the European ITS protocol stack (based on ETSI) and the US ITS protocol stack (based on SAE and IEEE).

Un método para la separación del desvanecimiento a corto y largo plazo en comunicaciones vehiculares

Yousra Chakkour[1], Bernardo Bernardo[1], Vicent M. Rodrigo Peñarrocha[1], Herman Fernández[2], Lorenzo Rubio[1], Juan Reig[1]

[1]Instituto iTEAM, Universitat Politècnica de València, Valencia. España; [2]Escuela de Ingeniería Electrónica, Universidad Pedagógica y Tecnológica de Colombia, Sogamoso. Colombia

In this contribution, we present a method for estimating the optimal size of moving average filter to ensure a precise separation of small and large scale fading effects. The analysis of small and large scale fading of the Vehicle-to-Vehicle (V2V) measured channel has been performed from narrowband channel measurements carried out in an urban environment at 5.9 GHz. Uniform intervals, where the channel process can be considered stationary, have been identified by comparing the cumulative distribution function (CDF) of the received envelope. A relationship between the length of the uniform intervals and the velocity of vehicles has been found. Moreover, the Rice K factor has been estimated for each one of these intervals. Our results showed that the proposed method is adequate to carry out a small and large scale fading separation. The results obtained make its use interesting to process correctly measured data in vehicular environments.

Impacto enlace ascendente YouTube 360° Live Video Streaming

Luis Roberto Jiménez Pérez, Marta Solera Delgado, Matías Toril Genovés
Universidad de Málaga, España

En la actualidad, el servicio más importante en las redes móviles es la transmisión de video, que se espera que genere el 82% de todo el volumen de tráfico IP para 2021. YouTube es uno de los servicios de video más populares en Internet. En marzo de 2015, YouTube agregó el servicio de transmisión de video 360º, que brinda a los usuarios una vista panorámica y les permite controlar libremente su dirección de visualización durante la reproducción de video. Este servicio se está volviendo popular debido a la reciente disponibilidad de dispositivos comerciales que admiten la interactividad de video 360 como teléfonos inteligentes/tabletas y gafas/cascos para realidad virtual. La transmisión de video en directo de 360º es muy difícil debido a requisitos de gran ancho de banda. Para abordar este problema, la calidad del video se ajusta de acuerdo con la predicción del viewport del usuario. El video de alta calidad sólo se transmite para la ventana de visualización del usuario, mientras que el resto del cuadro se transmite en menor calidad, lo que reduce el consumo general de ancho de banda, pero esta solución no es suficiente para los altos requisitos exigidos por los usuarios. Por lo tanto, la optimización de este servicio es de suma importancia para los operadores de red. En este artículo, se presenta un estudio del enlace ascendente en la sección de transmisión de video en vivo y su impacto en la calidad de la experiencia percibida por el usuario final. Los resultados muestran calidad de video, latencia de extremo a extremo y MOS (puntaje de opinión promedio). El análisis se ha llevado a cabo mediante la recopilación de trazas a nivel de red para métricas TCP / IP, trazas HAR donde se extraen los mensajes HTTP para el computo de la calidad de video y latencia extremo a extremo, y trazas a nivel de usuario de cada emisión en directo de video 360°.

Algoritmo de filtrado heurístico para medidas de geolocalización en trazas MDT

Joaquín Manuel Sánchez Martín[1], Matías Toril Genovés[1], Volker Wille[2], Mariano Fernández Navarro[1], Juan Luis Bejarano Luque[1]
[1]Universidad de Málaga, España; [2]Nokia, UK(Cambourne)

En las redes celulares, la planificación y gestión de la red es una de las tareas más importantes para que la red funcione de manera óptima. Para este propósito, se ayudan de los terminales que la componen para obtener estadísticas e información sobre cobertura, la calidad de la experiencia del usuario, etc. En la "Release 10" de la norma 3GPP, se definió el estándar de las medidas MDT (Minimization of Drive Test) con el objetivo de obtener información geográfica de los terminales correlacionada con estas estadísticas o eventos de radio. En este trabajo se propone un algoritmo de filtrado para minimizar los informes erróneos en las bases de datos MDT. Por último, se ha probado en un conjunto de datos reportados por una red real.

Logistic regression for BLER prediction in 5G

Juan Carlos Ruiz Sicilia, Mari Carmen Aguayo Torres
Universidad de Málaga, España

In this work, a block error rate (BLER) predictor for 5G based on logistic regression is presented. The regression is fed with transmission parameters and channel statistics. With these features, the predictor can model the behaviour of the transmission chain, including the low parity channel code (LDPC). In particular, for each modulation and coding scheme (MCS), the regression model uses as features the mean of the SINR over the allocated resources and the squared distance to the mean. Moreover, a single model able to cope with a set of modulation and coding schemes (MCSs) at the expense of certain accuracy loss is also proposed, and its performance evaluated. Possible applications for the regression models such as end-to-end modelling or as part of the adaptive modulation and coding (AMC) function are explored. Results show that the model has excellent accuracy in a wide set of scenarios.

Lugar: Sala Virtual 1 Miércoles, 02/09/2020: 12:30-14:00

Sesión 2.1. Electromagnetismo

Presidente de la sesión: Jesús María Rebollar Machain, Jesús Martel Villagrán

Application of Matrix Compression Methods for Efficient Preconditioning Finite Periodic Structures

Alberto Serna Martín, José Manuel Taboada Varela, Luis Landesa Porttas

University of Extremadura, España

Finite periodic structures are an attractive and present kind of problems to apply several efficient methods of electromagnetic analysis. In particular, slotFFT techniques are able to compute the solution of these problems using the surface integral equation-method of moments (SIE-MoM) in a transparent and high efficient way. Despite of the straight solution process, the analysis can be also accelerated through the use of preconditioners that improve the convergence of iterative methods. This work presents an efficient preconditioner based on a distributed matrix compression method and slotFFT techniques intended for finite periodic structures.

Formulación de Red Multimodal Equivalente para el Análisis de Dispositivos Microstrip Encapsulados

Celia Gómez Molina[1], Fernando Quesada Pereira[1], Stephan Marini[2], Miguel Ángel Sánchez Soriano[2], Alejandro Álvarez Melcón[1], Vicente Boria[3], Marco Guglielmi[3]

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The Multimode Equivalent Network (MEN) formulation was originally developed for the efficient and accurate analysis of waveguide devices. In this paper, we extend the use of the MEN to the analysis of zero-thickness, planar printed circuits in a metallic enclosure. The formulation is developed for metallic areas of arbitrary shape and includes both internal and external ports in the transverse plane to model connections to external components, and coaxial input/output ports. The Boundary Integral Resonant Mode Expansion (BI-RME) method is used for the analysis of the arbitrary shape metallizations. On this basis, shielded microstrip circuits of complex geometries are analyzed in the common frame of the MEN technique. To validate the theoretical formulation, several boxed microstrip structures are analyzed, showing good agreement with respect to commercial electromagnetic tools.

Sobre la relevancia de los hilos de interconexión en la respuesta en frecuencia de circuitos de elementos concentrados

Carlos Camacho Peñalosa[1], Jesús María Rebollar[2]

[1]Universidad de Málaga, España; [2]Universidad Politécnica de Madrid

Two simple lumped-element circuits are used to analyse, discuss, and illustrate, for educational purposes, the contribution of the interconnecting wires to their frequency response. The analysis has shown that the interconnecting wires are, in both circuits, the main cause of the limited predictive capability of classical circuit theory, even long before the maximum size of the circuit is comparable to the wavelength in vacuum. Nevertheless, it is possible to significantly increase its predictive capability by only introducing a very simple model for the wires.

Modelado mediante Ajuste Modal de una muestra de dieléctrico entre dos sondas coaxiales

Raúl Haro Báez[1], Juan Córcoles[1], Jorge A. Ruiz Cruz[1], José R. Montejo Garai[2], Jose M. Rebollar[2]

[1]UAM, Escuela Politécnica Superior, Dpto. Tecnología Electrónica y de las Comunicaciones, Madrid, España; [2]UPM, Departamento de Señales, Sistemas y Radiocomunicaciones, Madrid, España

The measurement of dielectric properties is a classic problem in microwave engineering. In this work, the mode-matching (*MM*) method is used as the analysis tool to characterize the setup where two coaxial probes are used to extract the dielectric properties of the sample. To that effect, two models are proposed. The first model is a simple waveguide structure, while the second model takes into account a finite flange that affects the general response of the problem. In both models, the use of higher-order modes in *MM* with the appropriate combination of perfect electrical wall and a perfect magnetic wall will play a key role to obtain accurate results and at the same time to ensure convergence. These two models are validated through several numerical simulations and then compared with the reference response of an external tool. The achieved results demonstrate that the two models proposed in this work can be used for the broadband dielectric characterization of this well-known problem.

Estudio de simetrías de giro en guía de onda y aplicaciones en dispositivos con polarización circular.

Ginés García Contreras, Juan Córcoles, Jorge A. Ruiz Cruz

Universidad Autónoma de Madrid, España

Waveguides are commonly used in applications designed for low losses and very high frequencies in communication systems. In these systems, some of the most used waveguide geometries are the ones with rectangular and circular section, which have well known properties. In spite of this, several additional families of transversal sections could be designed in waveguide technology, with different properties that can be proven useful for designing certain devices such as polarizers or filters. In this study the focus is put on waveguides with unconventional symmetries in their geometry, such as the one defined by a fixed-angle rotation. The electromagnetic fields in these waveguides are studied analytically and numerically to show how the section influences their properties, and how these properties are related with circular polarization. In the last section, some devices with unconventional symmetries are also studied.

Análisis de la variabilidad temporal de la exposición EM debida a comunicaciones móviles

Zhixia Li, Xiaoyan Wu, David Guerra Perea, Marta Fernandez Andres

Universidad del País Vasco / Euskal Herriko Unibertsitatea (UPV/EHU), España

En la última década, el crecimiento en el uso de dispositivos de comunicaciones móviles ha sido evidente, ya que la demanda de servicios inalámbricos ha aumentado en todo el mundo. Las tecnologías más utilizadas para proporcionar estos servicios son las llamadas Telecomunicaciones Móviles Internacionales, que incluyen todas las generaciones de redes celulares. Sin embargo, existe una preocupación social sobre los posibles efectos nocivos sobre la salud humana que podrían derivarse de la exposición a los campos electromagnéticos en los que se basa la capa inalámbrica física. Este artículo presenta un análisis de la variabilidad temporal de cada tecnología móvil actualmente activa, basada en mediciones en el campo. Antes de llegar a los resultados, se proporciona una descripción detallada del equipo, el escenario de medición y los procedimientos de procesamiento de datos. El análisis posterior puede proporcionar información útil para evaluar los riesgos potenciales causados por la exposición electromagnética debido a las comunicaciones móviles.

Lugar: Sala Virtual 2 Miércoles, 02/09/2020: 12:30-14:00

Sesión 2.2. Sesión Especial: Técnicas y tecnologías de fabricación para antenas y dispositivos de RF I

Presidente de la sesión: Pablo Padilla de la Torre, José Luis Masa Campos

Lente plana dieléctrica perforada en fabricación aditiva para reconfiguración de haz en banda W

Eduardo Salvador López, José Manuel Fernández González, Pablo Sánchez Olivares
Universidad Politécnica de Madrid, España

Flat Luneburg lenses in millimetre-wave frequency range are investigated in this paper. These lenses work in the W wideband frequency (75-110 GHz) to form directive beams with good aperture and radiation efficiency. One of the main characteristics of Luneburg lenses is that they have parabolic properties: beams emitted from the focal point make plane wave at the end of the lens. Easy beam reconfiguration is one of their advantages due to their geometric design in a big frequency range, which makes these lenses particularly useful to avoid interferences. This point, together with their reduced dimensions, cost-effectiveness, wide pointing range, and simple construction via 3D printer, make Luneburg lenses a good choice to military applications, satellite and tracking systems.

Screen-Printing-based Implementation of Radiating Elements for Radiofrequency Front-Ends for IoT Applications

Hicham Klaina[1], Imanol Picallo[2,3], Peio Lopez-Iturri[2,3], Aitor Sánchez[4], Leire Méndez-Giménez[4], Francisco Falcone[2,3]
[1]Universidade de Vigo, España; [2]Universidad Pública de Navarra, España; [3]Institute for Smart Cities, Universidad Pública de Navarra; [4]Lan Printech, Navarra

The advent of the Internet of Things (IoT) has led to embedding wireless transceivers into a wide range of devices, in order to implement context-aware scenarios, in which a massive amount of transceivers is foreseen. In this framework, cost-effective electronic and Radio Frequency (RF) front-end integration is desirable, in order to enable straightforward inclusion of communication capabilities within objects and devices in general. In this work, flexible antenna prototypes, based on screen-printing techniques, with conductive inks on flexible low-cost plastic substrates is proposed. Different parameters such as substrate/ink characteristics are considered, as well as variations in fabrication process or substrate angular deflection in device performance. Simulation and measurement results are presented, as well as system validation results in a real test environment in wireless sensor network communications. The results show the feasibility of using screen-printing antenna elements on flexible low-cost substrates, which can be embedded in a wide array of IoT scenarios.

Caracterización en banda ancha de la constante de propagación de materiales de impresión 3D

Mario Pérez Escribano, Enrique Márquez Segura
Universidad de Málaga, España

En este trabajo se propone un método para la caracterización de la permitividad relativa de materiales de impresión 3D. Este método consiste en la fabricación de líneas microstrip de diferentes longitudes cubiertas con el material que se pretende caracterizar y la medición sus parámetros S. Una vez obtenidos estos, se realizan unas transformaciones para obtener la constante de propagación de las líneas, a partir de la cual es posible extraer las características del material a estudiar. El método ha sido probado construyendo y midiendo unas líneas cubiertas con el material ABS, mostrando unos resultados muy cercanos a los de simulación electromagnética y a los mostrados en la bibliografía para este material.

Comparativa de prestaciones en el diseño de componentes en banda Ka en tecnología microstrip combinada con gap waveguide

Francisco Pizarro[1], Astrid Algaba Brazález[2], Luis Fernando Herrán Ontañón[3], Eva Rajo Iglesias[4]

[1]Pontificia Universidad Católica de Valparaiso, Chile; [2]Ericsson Reseach, Suecia; [3]Universidad de Oviedo, España; [4]Universidad Carlos III de Madrid, España

En este trabajo se presenta el diseño de una matriz de Butler 4x4 a 28 GHz realizada en tres tecnologías diferentes: microstrip convencional, microstrip convencional encapsulada e inverted microstrip gap. El objetivo de realizar estos diseños es analizar su complejidad de diseño y fabricación junto con sus prestaciones y extraer conclusiones generales sobre las ventajas y limitaciones del uso de las tres opciones de tecnologías para el desarrollo de componentes en esta banda de frecuencia.

Transición microstrip a stripline en circuito multicapa LTCC a 20 GHz

Mariano Baquero Escudero

Universidad Politécnica de Valencia, España

En este trabajo se presenta una transición entre líneas microstrip y stripline trabajando a 20 GHz. La transición ha sido diseñada en Tecnología LTCC con múltiples capas. Una transición de microstrip a stripline, que tiene un plano de tierra común, ha sido diseñada, obteniéndose una pérdida de retorno medidas mejor que 17 dB y unas pérdidas de inserción menor que 0.22 dB con un ancho de banda del 15%

Diseño e implementación de filtros multicapa de media longitud de onda utilizando técnicas de fabricación aditiva

Héctor García Martínez[1], Germán Torregrosa Penalva[2], Carolina Blanco Angulo[1], Andrea Martinez Lozano[1], Enrique Bronchalo[2], Ernesto Ávila Navarro[1]

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This work introduces the design, manufacture and measurement of third-order multilayer filters through additive manufacturing techniques. The filter is manufactured using a conventional half-wavelength line resonator and polylactic acid polymer additive manufacturing process. The designs, performed at a centre frequency of 2.0 GHz, aim to provide enhanced performances when compared to conventional coupled line third order filters using microstrip technology on commercial substrates. In all cases, the simulated and measured responses of the manufactured prototypes are in good agreement.

Lugar: Sala virtual 3 Miércoles, 02/09/2020: 12:30-14:00

Sesión 2.3. Comunicaciones Móviles, Inalámbricas e IoT II

Presidente de la sesión: Matias Toril Genoves

Backing off from Rayleigh and Rice: Achieving Perfect Secrecy in Wireless Fading Channels

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[1]Connectivity Section, Dept. Electronic Systems, Aalborg University, Aalborg Øst 9220, Denmark; [2]Dpto. Ingeniería de Comunicaciones. Universidad de Málaga, Málaga, 29071, España

We show that for a legitimate communication under multipath quasi-static fading with a reduced number of scatterers, it is possible to achieve perfect secrecy even in the presence of a passive eavesdropper for which no channel state information is available. Specifically, we show that the outage probability of secrecy capacity (OPSC) is zero for a given range of average signal-to-noise ratios (SNRs) at the legitimate and eavesdropper's receivers. As an application example, we analyze the OPSC for the case of two scatterers, explicitly deriving the relationship between the average SNRs, the secrecy rate Rs and the fading model parameters required for achieving perfect secrecy.

Sistema decorrelador para diversidad de antenas tribanda en un portátil

Juan Ernesto Garcia Cerezo, Jesús de Mingo Sanz, Paloma Garcia Ducar, Pedro Luis Carro Ceballos, Antonio Valdovinos Bardaji

Universidad de Zaragoza, España

Se propone un sistema MIMO de antenas de bajo perfil, cubriendo tres bandas del estándar LTE, entre 1720 y 2690 MHz, reutilizadas en los estándares 5G, para aplicaciones móviles. El sistema MIMO está integrado en un sustrato FR4 con $\boldsymbol{\varepsilon}_r$ igual a 4.5. Las dimensiones de la placa son iguales a 120x60x1.54 mm^3, que es un plano típico de un teléfono móvil. Se estudian dos distribuciones diferentes de los elementos de antena MIMO para evaluar cómo una red decorreladora puede funcionar en un sistema de dos elementos donde estas antenas están copolarizadas o tienes polarizaciones cruzadas (dependiendo de la distribución de los elementos de antena). La solución innovadora creada para la red de desacoplamiento consiste en una o más ramas donde cada una de ellas está compuesta por un resonador y un elemento de desacoplamiento (inductor).

Asignación de unidades de banda base en redes de acceso radio centralizadas por teoría de grafos

Matias Toril Genoves, Carolina Gijón Martín, Salvador Luna Ramírez, Mariano Fernández Navarro

Universidad de Málaga, España

In this work, several methods are proposed for defining the best assignment of remote radio heads (RRHs) to baseband processing units (BBUs) in a centralized radio access network comprising macrocellular base stations and indoor small cells. For this purpose, the assignment process is formulated as a graph partitioning problem, which is then solved by heuristic algorithms. The solution methods considered here include state-of-the-art graph partitioning approaches, namely multilevel refinement or multistart schemes. Performance assessment is carried out with a radio network planning tool by checking interference statistics obtained with the assignment from each method in a real Long Term Evolution (LTE) heterogeneous network scenario. Results shown that, in this particular problem, adaptive multistart approaches outperform other well-known classical approaches.

Sistema para la clasificación y detección de patrones de celdas en redes móviles

José Antonio Trujillo Saborido[1], Isabel de la Bandera Cascales[1], David Palacios Campos[2], Raquel Barco Moreno[1]
[1]Universidad de Málaga, España; [2]Tupl Spain, Tupl Inc.

The new 5th generation (5G) mobile networks will bring multiple services and heterogeneous scenarios that will provide large amount of data. In this context, automatic solutions to analyze such amount of data will allow operators to manage networks more efficiently. Management actions might be applied in a different way depending on the characteristics of each cell. This paper proposes an automatic framework based on machine learning to analyze and classify cells based on Key Performance Indicators (KPI) from a live network.

Análisis de la influencia de eventos sociales en redes celulares

Juan Luis Bejarano Luque, Matías Toril, Mariano Fernández Navarro, Salvador Luna Ramírez
Universidad de Málaga, España

Tanto el contexto como el comportamiento de los usuarios tienen un gran impacto en el rendimiento de la red, sobre todo si se reúne una gran cantidad de usuarios en el tiempo y el espacio. Una de las principales causas de estas aglomeraciones son los eventos sociales, en los que la gente se reúne en el mismo lugar por motivos profesionales o de ocio, aumentando la carga de la celda y, potencialmente, afectando a la Calidad de Experiencia (QoE) de otros usuarios. Este trabajo presenta un estudio de la influencia de diferentes tipos de eventos sociales en una red actualmente en funcionamiento, utilizando datos reales obtenidos de mediciones de Gestión del Desempeño (Performance Measurements, PM) y de la información de eventos sociales (obtenida de diferentes fuentes).

Evaluación de numerologías 5G para URLLC

David Segura Ramos, Emil Jatib Khatib, Raquel Barco Moreno
Universidad de Málaga, España

In the last years, there is a growing trend to automate and integrate data exchange mechanisms in manufacturing processes, known as Industry 4.0. The fifth generation of mobile phone technologies (5G) is presented as one of the main options through its service categories. Ultra-Reliable and Low Latency Communications (URLLC) is the type of communication used by critical mechanisms, with a millisecond end-to-end delay and reduced probability of failure. In order to achieve the delay requirement, 5G defines new numerologies, with different SubCarrier Spacing (SCS) and cyclic prefix, together with mini-slots for a faster scheduling. The main challenge of this is to select the appropriate numerology according to radio conditions and packet size. In this paper, we evaluate the delay measured in the radio link, specifically, at PDCP (Packet Data Convergence Protocol) layer, for each numerology in LOS and NLOS conditions in order to assess which of them suits better URLLC delay requirements.

Lugar: Sala Virtual 1 Miércoles, 02/09/2020: 16:00-17:30

Sesión 3.1. Antenas I

Presidente de la sesión: Carlos Camacho Peñalosa, Jesús Rubio Ruiz

Agrupación de ranuras conformada sobre guía de onda circular para cobertura omnidireccional de alta ganancia

Javier Melendro Jiménez[1], Pablo Sánchez Olivares[1], José Luis Masa Campos[2], David Escalona Moreno[2], Eduardo García Marín[2], José Manuel Fernández Gonzalez[1]

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A high-gain omnidirectional-beam travelling-wave slot array antenna is designed at Ka-band. The single radiating element is formed by a triple ring of equally spaced slots displayed along a circular waveguide. The waveguide structure provides a uniform feeding distribution to each slot as a result of the excitation of the non-fundamental TM01 mode. An array antenna conformed by 16 elements is proposed in order to achieve a high-gain omnidirectional beam. Every single radiating element is designed to minimize the ripple of the omnidirectional radiation pattern as well as to achieve a uniform power distribution aimed to obtain the best directivity. The distance between elements will be adjusted to accomplish the high-gain omnidirectional-beam radiation pattern. In an effort to mitigate the grating lobe appearance, a dielectric material will be inserted into the waveguide at the expense of a power loss effect.

Diseño y optimización de una antena monopolo impresa de banda ancha para caracterización de tejido biológico

Carolina Blanco Angulo[1], Ángel Egea Canales[1], Andrea Martínez Lozano[1], Héctor García Martínez[1], Germán Torregrosa Penalva[2], José María Sabater Navarro[3], Ernesto Ávila Navarro[1]

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Este artículo presenta el diseño, fabricación y medida de una antena UWB monopolo impresa con dos ranuras para aplicaciones de caracterización de tejido biológico. Las dimensiones de la antena se han optimizado, con el software de simulación EMPro, para ampliar su ancho de banda. La antena optimizada, con un tamaño final de 36 x 40 mm², se fabricó sobre un sustrato FR4 y se midió, mostrando un rango de frecuencia entre 3 GHz y 8.8 GHz y un patrón de radiación omnidireccional en el plano H. Para analizar el efecto del tejido biológico en el comportamiento de la antena, se han realizado algunas simulaciones con dos modelos de mama, con y sin material textil. El efecto principal observado es el desplazamiento hacia bajas frecuencias del ancho de banda de la antena, obteniendo mejores resultados cuando se coloca material textil entre la antena y el material biológico.

Characteristic Mode Analysis for the Design of Wideband Circularly Polarized Antenna Loaded with a Metasurface

Ahmed El Yousfi[1,2], Abdenasser Lamkaddem[1,2], Daniel Segovia Vargas[1]

[1]Universidad Carlos III De Madrid, España; [2]Faculty of sciences, Mohamed I University Oujda Morocco

In this work we present a wideband circularly polarized antenna using metasurface (MS). Circular polarization is achieved by adding truncations to a square ring 4x4 unit cells MS. Characteristic Mode Analysis (CMA) is used to analyze different modes of the MS without feeding and explain the wide circular polarization bandwidth. The simulated results show a wide impedance bandwidth of 42%, 3dB axial ratio bandwidth of 17% and high gain of 9.5 dB.

Design and Fabrication of a Fabry-Pérot Cavity Antenna for the Ku-band

Pablo Mateos Ruiz, Alberto Hernández Escobar, Elena Abdo Sánchez, Carlos Camacho Peñalosa
Universidad de Málaga, España

A design of a directive antenna based on a Fabry-Pérot cavity is described, using a single metallic partially reflecting surface (PRS) in front of a coaxial-fed patch antenna. The main features of this type of antennas are their low profile and single feeding point. The design is initially carried out following an approximate ray model analysis using the extracted PRS characteristics from electromagnetic simulations. The antenna performance is also simulated, obtaining a directivity of 20.6 dBi for 15.25 GHz, and verifying its predicted behaviour. Furthermore, a prototype is manufactured at the group premises and some preliminary measurements are presented.

Diseño de un Array de Banda Ancha con Antenas Vivaldi de Polarización Cruzada

Paula Fernandez Martinez, Daniel Segovia Vargas
Universidad Carlos III de Madrid, España

In this work, a broadband dual-polarized base station arrays is designed. The 1400MHz-2700MHz band is covered by a single broadband Vivaldi antenna element. The array synthesis has been carried out by time-domain full-wave simulations where excitation is applied to a single element embedded in the whole array. Then, array theory is applied to estimate the far-field of the entire structure. This is computationally efficient, which allows us to optimize the performance of the array with both analytical and numerical approaches. A 9-element equispaced array is designed with peak gain greater than 12dB and sidelobe suppression above 16dB for both broadside and a downtilt of 10º at the upper frequency.

Desarrollo e Integración de un Sensor Modular y Flexible en la Banda de Ondas Milimétricas para Aplicaciones de Automoción

Francisco José Martín Bayona[1], Guillermo Villalba Calvillo[2], Mario Pérez Escribano[1], Jaime Oliva[2], Antonio Rojas[3], Sergio Cobos[3], Enrique Márquez Segura[1]
[1]Universidad de Málaga, España; [2]Iertec Smart Technologies; [3]Grupo Premo

This paper presents the development of a full prototype of a millimetre-wave sensor for automotive radar in the 77-81GHz frequency band. The interest in millimetre-wave sensors has grown significatively in the last ten years. Millimetre-wave automotive sensors are necessary to add data and complement optical devices to allow safety autonomous driving algorithms. The sensor is designed based in the use of FMCW signal in the 77-81 GHz frequency band. The sensor integrates the millimetre-wave antenna, the radio transceiver and the signal-processing unit. The communications with the rest of the vehicle systems is ensured using fast can-bus. The proposed hardware is modular so the main parts can be used for different application without the design a new set of PCB boards. Part of the system is re-utilizable between different applications.

Lugar: Sala Virtual 2 Miércoles, 02/09/2020: 16:00-17:30

Sesión 3.2. Sesión Especial: Técnicas y tecnologías de fabricación para antenas y dispositivos de RF II

Presidente de la sesión: José Luis Masa Campos, Pablo Padilla de la Torre

Fabricación Aditiva Mediante Sinterización Selectiva por Láser de Conversores Modales en Guía de Onda

José R. Montejo Garai[1], Miguel González Calvo[2], Jorge A. Ruiz Cruz[3], Jesús M. Rebollar[1]

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This work presents an in-depth analysis of the Additive Manufacturing (AM) technology by means of Selective Laser Sintering (SLS) applied to the waveguide mode converters manufacturing. Two different devices are presented showing the suitability of the AM-SLS depending on the geometry. The first design converts the rectangular TE10 mode into the circular TE01 mode using a slowly flared structure in Q-band. The operating relative bandwidth is 41% from 33 to 50 GHz. The prototype is implemented using aluminum alloy powder. The second design is a converter from the TE_{10 rectangular waveguide mode to the TM01 circular waveguide mode at Ku-band, center frequency 12 GHz and 17% relative bandwidth. The structure is composed of a converting section and a feeding network where the symmetry is crucial. In this case, two different alloy powders i.e., aluminum and copper, are used in order to compare their performances. To verify the theoretical results, a back-to-back arrangement using two transducers was measured in the three cases. A detailed comparison highlighting the advantages and drawbacks found for each converter is presented. This analysis can be used as a reference for other similar waveguide components.

Desfasador reconfigurable en tecnología gap-waveguide para banda V

Ángel Palomares Caballero[1], Antonio Alex Amor[1,2], Pablo Escobedo[3], Juan F. Valenzuela-Valdés[1], Pablo Padilla[1]

[1]Universidad de Granada, España; [2]Universidad Politécnica de Madrid; [3]University of Glasgow

A mechanically reconfigurable phase shifter implemented in gap-waveguide technology at mm-wave frequencies is presented. The proposed phase shifter design is based on a H-plane split waveguide and the phase shift is controlled by means of a tuning screw, which exerts pressure on a flexible metallic strip inserted inside the waveguide. Depending on the curvature radii of the flexible strip, the phase shift is determined at the output port. A cost-effective prototype based on glide-symmetric holes gap-waveguide has been manufactured for validation purposes. Impedance matching below -10 dB is achieved from 64 GHz to 75 GHz providing a 15.8% impedance bandwidth. The maximum phase shift obtained is 250º with a maximum and mean insertion loss of 3 dB and 1.7 dB, respectively.

Dual-Band Conical-Beam Array Antenna Based on a Slotted Cylindrical Waveguide

Pablo Sánchez Olivares[1], José Luis Masa Campos[2], Eduardo García Marín[2]

[1]Grupo de Radiación (GR), Universidad Politécnica de Madrid, Madrid (España); [2]Grupo de Radiofrecuencia, Circuitos, Antenas y Sistemas (RFCAS), Universidad Autónoma de Madrid, Madrid (España)

The design of a high-gain conical-beam array antenna working at dual-band is presented. It is based on a travelling-wave topology, where a cylindrical waveguide is used to progressively excite a cross-slot conformal array. Transversal slots are excited by the TM_{01} mode, generating a vertical polarization in the 26-30 GHz, while longitudinal slots are excited by the TE_{01} mode, generating horizontal polarization in the 37.5-39.5 GHz band. A compact dual-mode feeder has been designed to simultaneously excite the TM_{01} and TE_{01} in the cylindrical waveguide. In order to experimentally validate the proposed design, a prototype has been fabricated by combining 3D-printing and CNC milling, providing high performances such as measured realized gains around 14 dB as well as a total efficiency higher than 90% for both frequency bands.

Circular Polarization Antennas using Gap Waveguide Technologies at millimeter waves

Dayan Pérez Quintana[1,2], Iñigo Ederra[1,2], Miguel Beruete[1,2]

[1]Universidad Pública de Navarra; [2]Institute of Smart Cities (ISC)

In this paper, two compact antennas in Ridge Gap Waveguide (RGW) technology, working at 60 GHz, with a high-purity circular polarization (CP) within a broad bandwidth are simulated, manufactured and measured. The antennas are fed from the bottom plane with a WR-15 waveguide (V-band), which couples the wave to the RGW. CP is generated in a simple and effective way, by means of two orthogonal feeder arms that excite a CP in a diamond-shaped slot on top. Simulations and measurements are excellent agreement. A broadband matching with reflection coefficient magnitude below −10 dB ($S11 < -10$ dB) is achieved from approximately 60.3 to 69.6 GHz (> 9 GHz). Applying the axial ratio criterion (AR < 3dB) the bandwidth in CP is 14.48%, with respect to the central frequency (59 to 70 GHz). The maximum gain in both designs is obtained at 67 GHz, with a value of 5.49 and 11.12 dB respectively.

Water Drop Lens Array Antenna for 5G Communications

Pilar Castillo-Tapia, Qingbi Liao, Oscar Quevedo-Teruel

KTH Royal Institute of Technology, Suecia

Here, we propose a combination of the concepts of geodesic lenses and arrays to produce a highly efficient antenna which is able to steer in both azimuth and elevation at the millimetre-wave regime. These properties are required for new 5G communication systems. As a proof-of-concept, we designed an antenna operating between 56 and 62 GHz. The geodesic lens allows scanning capabilities between ±55° in azimuth with reduced scan losses. On the other hand, the scanning in elevation is achieved through a linear array. Since the antenna is fully metallic and the propagation is mainly in air, it presents a high efficiency at the selected frequency band. Two different manufacture techniques were considered: additive manufacturing and milling. The advantages and drawbacks of these two techniques for this specific design are discussed.

Lugar: Sala virtual 3 Miércoles, 02/09/2020: 16:00-17:30

Sesión 3.3. Fotónica y Comunicaciones Ópticas

Presidente de la sesión: Miguel del Castillo Vázquez, Alejandro Ayala Alfonso

Híbrido de 90º de banda ultra-ancha, basado en tecnología sub-longitud de onda, compatible con fabricación litográfica en la plataforma fotónica de silicio

Abdelfettah Hadij-Elhouati[1], Robert Halir[1], Alejandro Ortega-Moñux[1], J. Gonzalo Wangüemert-Pérez[1], Hugh Podmore[2], Jens H. Schmid[3], Pavel Cheben[3,4], Íñigo Molina-Fernández[1]

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High bandwidth optical communications require coherent modulation formats that rely on the retrieval of both the amplitude and phase of the received optical signal. For this purpose, the preferred solution, in terms of both simplicity and robustness, is using a 2×4 hybrid and balanced photodiodes. Conventional hybrid implementations in the silicon on insulator platform (SOI) only cover the C band, while broadband, metamaterial-based devices require feature sizes below 100nm, which is too small for mass-production with deep-UV lithography. In this work, we propose a hybrid design based on dual-etch silicon subwavelength structures that achieves a remarkable 170 nm bandwidth, covering both C and L band, with deep-UV compatible feature sizes of 150nm.

Design of an ultra-narrowband subwavelength grating-based Bragg filter for silicon photonics sensing in O-Band

Carlos Pérez Armenta[1], Jirí Ctyroký[2], Alejandro Ortega Moñux[1], Pavel Cheben[3], Jens H. Schmid[3], Robert Halir[1,4], Íñigo Molina Fernández[1,4], J. Gonzalo Wangüemert Pérez[1]

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A recently proposed structure for building ultra-narrowband Bragg filters has great potential for sensing. Its two key elements are the subwavelength grating waveguide, which is known to be very sensitive and the lateral blocks that enable bandwidths on the order of pm and thus a reduced intrinsic limit of detection, while having a minimum feature size of ~100 nm. In this work, we evaluate the bulk sensing performance of the filter by first optimizing the dimensions of the waveguide and then adjusting the bandwidth of the filter depending on the analyte loss. The design is done at an operating wavelength of 1310 nm, where the water loss is lower and make possible to use narrower linewidths than at 1550 nm. Modal simulations show that it reaches a bulk sensitivity of 507 nm/RIU, a quality factor of 26147 and an intrinsic limit of detection of $9.9 \cdot 10^{-5}$ RIU.

Towards complex refractive index sensing with a photonic integrated circuit

Antonia Torres-Cubillo[1], Jonas Leuermann[1,2], Pedro Reyes-Iglesias[1], Alejandro Ortega-Moñux[1], J. Gonzalo Wangüemert-Pérez[1], Íñigo Molina-Fernández[1,2], Robert Halir[1,2]

[1]Universidad de Málaga, España; [2]Bionand Andalusian Centre for Nanomedicine and Biotechnology

Photonic integrated refractive index sensors are a promising tool to perform a quantitative, label-Free detection of gases and biomarkers. However, hardware imperfections can preclude the accurate recovery of phase and amplitude information. Here, we propose an enhanced calibration strategy to enable simultaneous phase and amplitude readout with a coherent interferometric structure. Our technique requires only minimal hardware changes to a conventional biosensing setup and can provide a two order-of-magnitude error reduction.

Integrated Mode Converter and MUX/DEMUX in Silicon Nitride Waveguides for Intermodal Four-Wave Mixing

Francisco Jurado Romero[1], J. Gonzalo Wangüemert Pérez[1], Alejandro Ortega Moñux[1], José Manuel Luque González[1], Daniele Melati[2], Jens H. Schmid[2], Pavel Cheben[2,4], Thalia Dominguez Bucio[3], Cosimo Lacava[3], Frederic Gardes[3], Iñigo Molina Fernández[1]

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Silicon photonics is a mature technology for fabricating low-cost scalable photonic integrated circuits. These optical systems may help to withstand the increasing demand for high-speed data rates in big data centers. In this respect, optical mode division multiplexing offers not only the possibility to aggregate several data channels, but they enable the possibility of generating new wavelength components by means of non-linear phenomena. In this work, we propose an architecture for a mode converter and MUX/DEMUX intended for intermodal Four-Wave Mixing applications in a Si_xN_y platform. The device exhibits insertion loss and crosstalk below 0.5 dB and -30 dB, respectively in a bandwidth of 100 nm around λo =1.55 µm.

Efecto del desalineamiento en enlaces para comunicaciones entre vehículos con luz visible

Miguel del Castillo Vázquez, Antonio Jurado Navas, Antonio Puerta Notario

Universidad de Málaga, España

En este trabajo, se analiza el efecto del desalineamiento en enlaces de comunicaciones entre vehículos que emplean luz visible. Mediante modelado y simulación se calcula la SNR de distintos enlaces en dos escenarios urbanos que incluyen vías con tramos rectos y curvos. Los resultados obtenidos muestran que los desalineamientos que provocan las curvas de la vía pueden degradar considerablemente la SNR del canal y reducir el alcance de los enlaces. La degradación de SNR puede reducirse empleando faros que giran en las curvas. Asimismo, el alcance de los enlaces puede mejorarse empleando receptores con FOV más amplios.

Separador de polarización integrado de altas prestaciones basado en estructuras sub-longitud de onda

José Manuel Luque-González[1], Alaine Herrero-Bermello[2], Alejandro Ortega-Moñux[1], Marina Sánchez-Rodríguez[1], Aitor V. Velasco[2], Jens H. Schmid[3], Pavel Cheben[3,4], Íñigo Molina-Fernández[1,5], Robert Halir[1,5]

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Polarization management is a key factor in photonics integration platforms with high birefringence such as Silicon-On-Insulator. Here we design a directional coupler polarization beam splitter composed of two subwavelength waveguides, which only differ in the tilt angle of the silicon segments. Our simulations predict an extinction ratio higher than 20 dB over an 86 nm bandwidth with negligible losses. The fabricated device is only 14 µm long, covers a 72 nm bandwidth with sub-decibel insertion losses and exhibits an extinction ratio in excess of 15 dB.

Lugar: Sala Virtual 1 Jueves, 03/09/2020: 09:00-10:30

Sesión 4.1. Antenas II

Presidente de la sesión: Francisco Medina Mena, Miguel Ferrando-rocher

Miniaturization of a compact circularly polarized implantable antenna

Abdenasser Lamkaddem[1,2], Ahmed El Yousfi[1,2], Kerlos Atia Abdalmalak[2], Daniel Segovia-Vargas[2]

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The goal of this paper is to develop a miniaturized circularly polarized (CP) implantable antenna for medical applications. The proposed antenna exhibits a wide band between 727 MHz and 998 MHz. The dimensions of the antenna are 6 x 6 x 1.27 mm3, the miniaturization of the antenna is achieved by using a meander line. By adding a U-shaped element outside the meander line, circular polarization is guaranteed.

Guía de onda ranurada con polarización circular conmutable en banda Ka y usando tecnología Gap Waveguide

Miguel Ferrando-Rocher[1,2], Jose Ignacio Herranz-Herruzo[1], Alejandro Valero-Nogueira[1], Bernardo Bernardo-Clemente[1]

[1]iTEAM, Universitat Politècnica de València, España; [2]GMECA, Universidad de Alicante

Se presenta una guía de onda ranurada con polarización dual circular y alimentada por una guía de onda Groove Gap (GGW) y que funciona en la banda Ka. Se propone un mecanismo simple para cambiar la polarización circular a derechas por circular a izquierdas, y viceversa. La tapa de la antena tiene dos piezas: una fija y otra deslizante. La pieza fija alberga ranuras en forma de T, y el bloque deslizante se encarga de ajustar el desplazamiento de las ranuras perpendiculares con respecto a las ranuras longitudinales. Los resultados preliminares muestran una relación axial por debajo de 1.5 dB para ambos sentidos de polarización circular, dentro de un ancho de banda de 1 GHz centrado en 30 GHz.

Diseño de una antena espiral compacta en cavidad de doble polarización circular

Iván Bailón-Ballesteros[1], Kerlos Atia Abdalmalak[1], Ahmed El Yousfi[1], Vicente Gonzalez-Posadas[2], Daniel Segovia-Vargas[1]

[1]Universidad Carlos III de Madrid, España; [2]Universidad Politécnica de Madrid

A dual-circular-polarized antenna is presented in this paper. The compactness of the design is the greatest contribution of this work, achieving dual circular polarization with a single antenna. The design is based on a four-arm spiral with differential feeding to achieve the desired polarization and the use of a cavity to achieve unidirectional radiation. The antenna achieves a bandwidth of 77% (from 4 to 9 GHz) for an axial ratio below 3 dB, return losses below -10 dB in practically the entire band and isolation below -45 dB. Symmetric radiation pattern is obtained with gain values between 5 dB and 8 dB and the half power beamwidth takes values from 87º to 58º.

Excitation of magnetic current surface waves in truncated periodic arrays of slots in a conducting screen: simulations and experiments.

Miguel Camacho Aguilar[1], Vicente Losada Torres[2], Rafael Rodríguez Boix[3], Francisco Medina Mena[3]

[1]Department of Electrical and Systems Engineering, University of Pennsylvania, Philadelphia, United States of America.; [2]Departamento de Física Aplicada I, E. T. S. de Ingeniería Informática, Universidad de Sevilla.; [3]Departamento de Electrónica y Electromagnetismo, Facultad de Física, Universidad de Sevilla.

In this paper the authors analyze the transmission through a truncated periodic array of slots in a conducting screen, which is illuminated by a pyramidal horn. A Method of Moments (MoM) code has been implemented to determine the magnetic current densities in the slots. The numerical results obtained indicate that a standing surface wave pattern of magnetic currents exists at the extraordinary transmission (EOT) frequency of the periodic array of slots, whereas this pattern is not present at the resonance frequency of the slots. An aluminium plate periodically perforated with slots has been fabricated and fed by means of a pyramidal horn, and the electric field behind the plate has been measured with a planar near-field system at a few centimeters from the plate. The electric field at the plane of the slots obtained with MoM has been translated to the measurement plane, and good agreement has been found between simulations and experiments. Both numerical and experimental results confirm the existence of the standing surface wave pattern at the EOT frequency, and the absence of surface waves at the slots resonance frequency.

Cálculo Analítico del Campo Lejano Radiado por una Apertura Triangular Equilátera

Lucas Polo-López, Juan Córcoles, Jorge A. Ruiz-Cruz

Escuela Politécnica Superior, Universidad Autónoma de Madrid, España

In this work an analytical closed-form formulation to compute the radiation pattern generated by the modes of an equilateral triangular aperture is presented, contributing therefore to the classical analytical models for computing the radiated electromagnetic fields from an aperture with a canonical shape. This formulation is based on the well-known equivalence principle of radiating apertures, which allows to obtain the radiated far-field from the transversal field at the aperture. First the equivalence principle and the formulation of the modal field functions associated to an equilateral triangular aperture are described. After that the equivalence principle is applied to these modal fields to obtain the closed-form expressions for the integrals required to compute the radiation pattern associated to each mode. To demonstrate the accuracy of the derived analytical formulation several examples are shown, comparing the analytical results with those provided by commercial software packages based on different numerical approaches.

Análisis rápido y riguroso de agrupaciones de antenas en posiciones arbitrarias sobre plano metálico

Jesús Rubio Ruiz, Rafael Gómez Alcalá

Universidad de Extremadura, España

Hoy en día, el método híbrido basado en el Método de Elementos Finitos (MEF) y expansión en modos esféricos es reconocido como uno de los métodos de onda completa más potentes para analizar agrupaciones finitas de antenas sobre plano metálico. Esto se debe a que el método se escala con el número de antenas, ya que cada antena se resuelve de forma aislada utilizando el MEF y modos esféricos, y posteriormente la respuesta de la agrupación se obtiene mediante el acoplamiento de modos esféricos. Sin embargo, es bien sabido que el acoplamiento de modos esféricos tiene la limitación de que los semiesferas mínimas que rodean las antenas no pueden solaparse debido al uso de los teoremas de adición. En este trabajo se supera esta limitación utilizando las propiedades de transformación entre ondas esféricas y ondas planas para acoplar modos esféricos.

Lugar: Sala Virtual 2 Jueves, 03/09/2020: 09:00-10:30

Sesión 4.2. Metamateriales

Presidente de la sesión: Rafael Rodríguez Boix, Gregorio José Molina Cuberos

THz Sensing exploiting the Anomalous Extraordinary Optical Transmission in Hole Array Metasurfaces

Irati Jáuregui López[1,2], Pablo Rodriguez Ulibarri[1], Sergei A. Kuznetsov[3], Miguel Beruete Díaz[1,2]

[1]Antennas Group-TERALAB;(& Electric and Electronic Engineering Department, Universidad Pública de Navarra; [2]Multispectral Biosensing Group, Navarrabiomed; [3]Rzhanov Institute of Semiconductor, Novosibirsk State University

Following the discovery of EOT through subwavelength hole arrays (HA) made by Ebbesen et al. [1], and the later replica of this phenomenon in other regions of the electromagnetic spectrum [2], the high field intensity near the apertures at the EOT resonance in HA has been exploited for sensing applications [3]–[5]. Although typical EOT sensors consist of square HAs unit cell [3], a rectangular unit cell allows the excitation of two different EOT resonances, depending on the wave polarization, called anomalous EOT (when the wave is polarized along the short hole periodicity) and regular EOT (when the polarization is parallel to the long HA periodicity) [6]. To excite the anomalous EOT, the HA has to be loaded with a dielectric slab with a minimum thickness and permittivity, whereas the regular EOT can exist even in absence of any dielectric slab. In this work, we perform a numerical analysis for the sensing behavior for both polarizations in ideal structures. Finally, we perform a numerical and experimental analysis in the emerging THz band (0.1 – 10 THz) of the sensing capabilities of several HAs loaded with dielectric films of different thicknesses, so that some of the structures support the anomalous EOT resonance, and others are in the limit or do not support it at all.

Dual Beam Sinusoidally Modulated Reactance Surface Antenna

Lorena Pérez Aguilar, Elena Abdo Sánchez, Teresa M. Martín Guerrero, Carlos Camacho Peñalosa

Universidad de Málaga, España

In this work, a planar dual beam Sinusoidally Modulated Reactance Surface (SMRS) antenna is presented. Our method is based on the implementation of a surface impedance modulated by the superposition of two sinusoidal functions. In particular, the full process of designing a dual beam antenna that radiates at -14º and 28º off broadside at 10 GHz is described. In a second proposed structure, manipulation of the side lobe level (SLL) is achieved by varying the leakage constant along the antenna with negligible changes in the pointing directions. SLL reductions of 3.4 dB and 1.8 dB for each of the synthesised beams are obtained through full wave simulations, as well as gains 13.4 dBi and 13.6 dBi respectively. An excellent agreement between theoretical and simulated results is observed.

Rotador de onda basado en una estructura quiral de tipo helicoidal

Miriam Mendoza-López[1], Angel Joaquín García-Collado[1], Gregorio José Molina-Cuberos[2], José Margineda Puigpelat[2]

[1]Universidad Católica de Murcia; [2]Universidad de Murcia, España

In this paper, a structure with chiral geometry and C_4 symmetry is proposed. It consists of insertions of metallic resonators in the form of helices, implemented in a high-quality dielectric material with a very low loss tangent, an essential aspect for a good electromagnetic response. We have found the structure has a remarkable rotary optical dispersion, which is maintained in a wide microwave frequency band, above 4.5 GHz, resulting in a constant wave rotator, making it an attractive structure for the telecommunication applications.

Intertwined Trifilar Spirals for Frequency Selective Surfaces

Rodrigo Cristos Martínez, Juan Andrés Vásquez Peralvo, José Manuel Fernández González

Grupo de Radiación, Dpto. de Señales Sistemas y Radiocomunicaciones, Universidad Politécnica de Madrid

In this work a compact, angular stable and wide band frequency selective surface (FSS) based on trifilar intertwined spiral is presented. The periodicity between unit cells is 0,056λo with a thickness of 0.00039λo. The Bandwidth enhancement of our design is compared with related previous work, comparing parameters such as the Figure of Merit, the resonance frequency or the Fractional Bandwidth, which we have obtained to improve. Our design is suitable for be used as a metasurface for L-Band frequencies (and if required, be used in any others by a parametric adaptation) and space limited applications where increased Bandwidth is priority such as a ground plane for mobile devices.

Frequency Selective Surfaces Using Meandered Interwoven Structures

Juan Andrés Vásquez Peralvo[1], José Manuel Fernández González[2]

[1]Universidad Politécnica de Madrid, España; [2]Universidad Politécnica de Madrid, España

In this work, an ultra-compact, angular stable, ultra-wideband, and low profile frequency selective surface (FSS) based on intertwined meandered structures extended to the 2.5-dimension is presented. The lowest dimensions of the filter are 0.22λ x 0.22λ with a thickness of 0.0004λ using air as substrate. The reduction in size is reflected as an improved Figure of Merit (FoM) in compare to previous designs. Our design is suitable to be used as a meta-surface for low frequency and space limited applications such as mobile phone terminals.

Estudio y validación de estructuras quirales para el diseño de metasuperficies con refracción anómala

Oscar Fernández Fernández, Álvaro Gómez Gómez, Angel Vegas García

Universidad de Cantabria, España

Metamaterials are subwavelength periodic structures that provide tailored electromagnetic responses. Chiral metamaterials provide a bianisotropic response useful for the control of the polarization. In this communication the authors propose the use of chiral metamaterial structures for the development of phase gradient metasurfaces. Two modified versions of the rosette structure are analyzed showing a wide range of achievable phase values. Based on these chiral unit cells, novel phase gradient metasurfaces are proposed to modify the refracted wave. This modification is twofold, transforms the incident linear polarization, thanks to their chiral behavior, and changes the refraction direction, due to the implemented phase gradient. The proposed metasurfaces provide refraction angles of up to 60º.

Lugar: Sala virtual 3 Jueves, 03/09/2020: 09:00-10:30

Sesión 4.3. Comunicaciones Móviles, Inalámbricas e IoT III

Presidente de la sesión: Carmen Botella Mascarell, Sandra Roger Varea

Estudio y evaluación de cobertura y calidad en tres zonas turísticas de la provincia de Cuenca

Ana María Torres Aranda, Patricia Belén Meneses Buitrón, Jorge Mateo Sotos
Universidad de Castilla-La Mancha, España

In the present work, a complete study of the existing 3G network in three tourist areas of the province of Cuenca has been carried out: its old town, the Ciudad Encantada and the Torcas de los Palancares. In this study all coverage and quality measures have been carried out with Orange mobile network technology. Using the Qualipoc software, the results have been analysed and the problems obtained in each of the areas can be clearly identified. Finally, using the Atoll simulation software as support and MapInfo as a geographic information system, recommendations have been made to improve coverage and quality within the city.

Sistema IoT de sensorización, almacenamiento y representación de datos para espacios universitarios

Juan Cantizani Estepa, Andrés Pineda García, Sergio Fortes Rodríguez, Eduardo Baena Martínez, Alberto García Marín
Universidad de Málaga, España

In the past years, the concept of Smart City has been a main paradigm for public developments, with the objective of improving the well-being of the citizens, and the performance of public services by means of a detailed monitoring and actions over the different parameters associated to them. Among these monitoring, environmental measurements related with air quality and such are needed. The university campuses, as relevant areas with high concentration of people and infrastructure, as well as centers for education, research and innovation, are perfect areas for the adoption and testing of several projects of this kind. In this way, the present paper presents the ICT design and development of the SmartTree project in which a public infrastructure will be created with capacities such as providing clean energy and gathering environmental data in an integrated way.

GPPP y SDR como una potente herramienta científica

Carlos Baena[1], Sergio Fortes[1], Eduardo Baena[1], Juan Luis Bejarano[1], Mai Tranle[2], Raquel Barco[1]
[1]Universidad de Málaga, España; [2]Vodafone Group, Madrid

One of the greatest problems in mobile networks that researchers have always faced on, is the difficulty of obtaining data from a real network. The limited access to commercial networks or the high prices which presents the equipment encourages the use of simulators in order to get data or test some algorithms. However, these problems can be solved with the emerging of the concept of SDR and GPPP. Hence, in this work it is presented a framework which enables their use in a scientific field. Moreover, a set of video experiment has been made, whose analysis shows the flexibility that these platforms offer as well as its potential as a wide source of real network data, introducing itself in this way, as a powerful tool for researching.

Detección de parámetros y sincronización de OFDM sobre GNU Radio en sistemas multimodo

Eduardo Sánchez Muñoz, Jesús A. López-Fernández
Universidad de Oviedo, España

An Orthogonal Frequency-Division Multiplexing (OFDM) system may have different operation modes, each one with its own symbol and cyclic prefix lengths. In many cases, the receiver needs to detect the operation mode based solely on the received OFDM signal, besides performing symbol and frame synchronization. An algorithm based on the detection of the cyclic prefix to identify the operation mode and perform symbol synchronization has been implemented with software radio. In addition, we suggest an algorithm for frame synchronization. Simulations are used to evaluate the performance of the system in the presence of white noise. Results show that the algorithm perform well, even in low-SNR scenarios. An improvement to the mode detection algorithm is also proposed and evaluated.

Análisis experimental de un canal massive MIMO en una picocelda de interior

Rafael Pedro Torres Jiménez[1], Jesús Ramón Pérez López[1], José Basterrechea Verdeja[1], Luis Valle López[1], Marta Domingo Gracia[1], Lorenzo Rubio Arjona[2], Vicent Miquel Rodrigo Peñarrocha[2], Juan Reig Pascual[2]
[1]UNIVERSIDAD DE CANTABRIA, España; [2]UNIVERSITAT POLITÈCNICA DE VALENCIA, España

En este trabajo se presenta un análisis experimental del canal MIMO masivo en una picocelda de interior. El análisis está basado en los resultados de una campaña de medidas llevada a cabo en la banda de 3.2 a 4 GHz en un escenario de tamaño reducido y que presenta una geometría con grandes simetrías. Entre la comunidad científica es bien conocido que el rendimiento de los sistemas de MIMO masivo depende fuertemente del hecho de que el canal cumpla la condición de propagación favorable. Con el fin de evaluar el rendimiento del canal MIMO masivo, se incluyen en este trabajo resultados asociados con la capacidad suma del canal. Un segundo factor que determina el rendimiento de estos sistemas al trabajar sobre estructuras TDD-OFDM es la selectividad en frecuencia del canal, que limita el tamaño del bloque de coherencia. En este sentido, también se incluyen resultados de los anchos de banda de coherencia obtenidos en las medidas.

Lugar: Sala virtual 4 Jueves, 03/09/2020: 09:00-10:30

Sesión 4.4. Educación: Nuevas Tecnologías y Herramientas

Presidente de la sesión: Álvaro Pendás Recondo, Adriana Dapena

Evaluación con fines docentes de un sistema OFDM acústico desarrollado con GNU Radio

Eduardo Sánchez Muñoz, Jesús A. López-Fernández
Universidad de Oviedo, España

Software Defined Radio allows to implement the baseband processing of a communications system with software that runs on a general purpose processor. However, transmitter and receiver hardware is needed to use such system with a physical channel. In this paper, we use a PC sound card, in addition to a microphone and a baffle, as a low-cost alternative to transmitter and receiver hardware for an Orthogonal Frequency-Division Multiplexing (OFDM) acoustic system. In addition, we have evaluated the performance of the implemented system under different communication scenarios using the dispersion of the received constellation as a qualitative figure of merit of the communication quality. The proposed low-cost system is used to easily reproduce many perturbations found in a conventional communications system, such as linear and nonlinear distortion, noise or interferences. Thus, it is an alternative for teaching those effects in an interactive and affordable way.

Dispositivo para el estudio de la caída libre de los cuerpos mediante control del usuario por Bluetooth

Delfín Darias Delgado, Alejandro Ayala Alfonso, Silvestre Rodríguez Pérez, Beatriz Rodríguez Mendoza, Jonás Philipp Luke
Universidad de La Laguna, España

Una de las experiencias de laboratorio, que más comúnmente suele realizar cualquier alumno que se inicia en el campo de las ciencias, es el estudio de la caída libre de los cuerpos, donde resulta difícil efectuar con precisión medidas de tiempo mediante el empleo de un simple cronómetro. Con la realización del presente trabajo, se dispone de una práctica de laboratorio que permite, por un lado, comprobar cómo dos cuerpos de diferente masa (normalmente con forma de bola) caen en el vacío a igual velocidad y, por otro, efectuar medidas para el estudio del movimiento rectilíneo uniformemente acelerado resultante, determinando la variación con el tiempo del espacio y la velocidad de una bola que cae, obteniendo también el valor de la aceleración de la gravedad (g) y pudiendo modificar parámetros como el valor de su masa y diámetro, la presencia o ausencia de vacío e, incluso, realizar medidas a diferentes valores de presión. Para un mejor manejo del sistema implementado, se llevó a cabo una interfaz de usuario sobre un PC que se conecta con el sistema de medida mediante enlace Bluetooth.

Evaluación del impacto del uso de dispositivos de radio definida por software como herramienta docente en la materia de comunicaciones digitales

Carmen Botella-Mascarell, Antonio Soriano-Asensi, Jaume Segura-García, Joaquin Perez, Santiago Felici-Castell, Enrique Navarro-Camba, Miguel Garcia-Pineda, Mario Montagud
Universitat de València, España

Educational innovation is a process that extends beyond an academic year. In its development, the stages of planning, implementation, evaluation and feedback are distinguished in order to identify aspects that could be improved. In this contribution, we present a procedure for evaluating the impact of the use of software-defined radio devices in digital communications laboratories. This procedure evaluates the students' engagement, following more realistic

laboratory sessions that are closer to current communications systems and far from standard simulation practices. The engagement of the students is quantified, comparing the results of an experimental group with two control groups that have continued with the standard simulated sessions. The results indicate that the impact has been positive on the students' ability to face new challenges and on their perception of the relevance of the activities they carry out, although this improvement is not reflected in their ability to focus on them.

Maqueta de prácticas de comunicaciones digitales basada en el uso de USRP sobre Linux

Álvaro Pendás Recondo, Jesús A. López-Fernández
Universidad de Oviedo, España

Universal Software Radio Peripheral (URSP) is a range of front-end devices designed by Ettus Research and used to implement Software Defined Radio (SDR) applications. The main advantages of both USRP and SDR are their remarkable flexibility and versatility when it comes to the system configuration and parameters like power, bandwidth or frequency band. The aim of this work is to make use of those advantages with educational purposes. In this regard, it is also interesting the possibility that SDR offers of simulating different types of channels. We have implemented several SDR systems to be used as a case study during one or multiple laboratory sessions. The main goal is that students can get a better general understanding of digital communications systems, familiarizing themselves with using USRP and SDR along the process. The USRP selected was the model B200 by Ettus Research, and the SDR environment, GNU Radio on Linux.

Motivación y esfuerzo de los estudiantes de la E.T.S.I. de Telecomunicación de la Universidad de Malaga

Ana M. Barbancho, Isabel Barbancho, Lorenzo J. Tardón, Francisco Javier Mata, Jorge Munilla, Andrés Ortiz, Alberto Peinado
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Los resultados académicos de los estudiantes, en determinadas ocasiones, no son tan buenos como los profesores esperarían. Además de la falta de conocimientos previos, lo que es acusado en los primeros cursos, en este trabajo, se quieren analizar otras causas, como la motivación y el esfuerzo dedicado por los alumnos a los estudios. En particular, los estudiantes de la "Escuela Técnica Superior de Ingeniería de Telecomunicación" (ETSIT) de la "Universidad de Málaga" (UMA). Este estudio se apoya en cuestionarios realizados tanto a estudiantes como a profesores, con objeto de observar el grado de convergencia de las opiniones de ambos colectivos.

Aprendizaje y servicio para la ensenanza de tecnología: desarrollo de un robot

Adriana Dapena[2], Paula M. Castro[1]
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This work presents a Learning and Service project for content learning by providing a service to the community in response to the needs of a group of people with asperger syndrome. Activities and metodology have been selected considering the fact that science and technology are interesting for these collective and, on the other hand, the usefulness of this experience for the acquisition of professional competences of university students. The results obtained from the experience demonstrate the acquisition of curricular competences, training in values and the responsibility of our students who have been the true protagonists of this teaching and service activity.

Lugar: Sala Virtual 1 Jueves, 03/09/2020: 11:00-12:00

Sesión 5.1. Sesión Especial: Reflectarrays, Transmitarrays and Periodic Structures

Presidente de la sesión: Manuel Arrebola Baena, Eduardo Martínez de Rioja

Improvement of the Bandwith in Spaceborne Reflectarrays Based on a Optimization Procedure

Daniel Rodríguez Prado[1], Manuel Arrebola Baena[1], Marcos Rodríguez Prino[1], George Goussetis[2]

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Direct-to-home (DTH) applications usually require a radiation pattern with a given footprint on the surface of the Earth. They also impose stringent cross-polarization requirements in the form of crosspolar discrimination (XPD) or isolation (XPI) in a given bandwidth. This paper describes a wideband optimization procedure and performance results of a very large spaceborne reflectarray for DTH application in a 10% bandwidth. The procedure is divided into three stages to facilitate convergence towards a wideband performance. First, a initial narrowband design is obtained. Then, a broadband optimization including XPD requirements is carried out with a limited number of DoF. Finally, more DoF are included in the last stage to obtain a wideband reflectarray with improved crosspolarization performance. An improvement of 4.8 dB is achieved in the cross-polarization performance for both XPD and XPI in a 10% bandwidth, while ensuring that the copolar pattern complies with the specifications in the whole band.

Preliminary Simulations of a 1.8-m Parabolic Reflectarray Transmit Antenna for Ka-band Satellite Applications

Daniel Martinez-de-Rioja[1], Jose A. Encinar[1], Yolanda Rodriguez-Vaqueiro[2], Antonio Pino[2]

[1]Universidad Politécnica de Madrid; [2]Universidade de Vigo

In this contribution, a parabolic reflectarray antenna has been proposed to generate four spaced beams per feed in four different combinations of frequency and polarization. The parabolic surface makes it possible to reduce the complexity of the required phase distributions on the reflectarray surface. A 1.8 m parabolic reflectarray has been simulated when it is illuminated by 27 feed-horns. The simulated results show the capacity to generate 108 spot beams in good agreement with the requirements imposed in satellite communications in Ka-band. The proposed concept could be used to reduce the number of antennas and feed chains required on board the satellite to generate a multispot coverage in Ka-band, from four reflector antennas to two parabolic reflectarrays, one for transmit and other for receive.

Wideband Linear-to-Circular Polarizing Reflector for Communication Satellite Applications in Ka-band

Eduardo Martínez de Rioja[1], José A. Encinar[2]

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This contribution presents a low-profile linear-to-circular polarizing reflector with wideband operation in Ka-band. The polarizing cell consists of three parallel dipoles placed with 45º slant with respect to the direction of the incident linearly polarized field. The lengths of the dipoles are adjusted cell by cell by means of a dual-frequency optimization process, which accounts for the real angles of incidence on each cell. A 25-cm flat polarizing reflector prototype has been fabricated and tested to validate the concept. The measured axial ratio is lower than 1.8 dB within the 19-30 GHz band (a relative bandwidth of 45%), and good matching with the simulations is obtained. The proposed polarizing reflector has applications in new multibeam antenna configurations for Ka-band satellites.

On the Performance of Advanced Reflectarray Configurations for Multibeam Satellite Communications

Tomás Ramirez[1], Daniel Martínez de Rioja[2], Eduardo Martínez de Rioja[3], Carlos Mosquera[1], José A Encinar[2]

[1]AtlanTTic Research Center, Universida de Vigo, España; [2]Information Processing and Telecomm. Center, Universidad Politécnica de Madrid, Madrid, España; [3]Dept. of Signal Theory and Communications, Universidad Rey Juan Carlos, Madrid, España

The performance of two multiple beam antenna configurations based on reflectarray technology is compared. Both cases, for two-colour and four-colour reuse schemes in satellite coverage, make use of two antennas on-board the satellite, which leads to more compact designs as opposed to more traditional four reflector deployments. The comparison is made in terms of the received signal-to-noise-ratio and signal-to-interference-noise-ratio. In addition, an initial spectral efficiency comparison is performed by assuming single user detection at the terrestrial terminals. The two-colour scheme offers better performance indicators, specially for higher power regimes. Furthermore, the performance of the two-colour scheme can be potentially increased with the application of interference mitigation techniques for those locations with high co-channel interference.

Lugar: Sala Virtual 2 Jueves, 03/09/2020: 11:00-12:00

Sesión 5.2. Sesión Especial: Arquitecturas amplificadoras de alta eficiencia y linealización de amplificadores

Presidente de la sesión: María José Madero Ayora, Teresa María Martín Guerrero

Incorporación de términos con envolvente de orden impar en la linealización de un PA de clase J

María José Madero Ayora, Carlos Crespo Cadenas, Juan A. Becerra
Dpto. de Teoría de la Señal y Comunicaciones. Universidad de Sevilla, España

En este trabajo se discuten algunas características de las técnicas de modelado y linealización, como la inclusión de términos con envolvente de orden impar en los modelos de comportamiento para un amplificador de potencia genérico. En particular, se realiza la deducción de estos términos bajo una perspectiva de serie de Volterra considerando la información del modelo circuital del dispositivo. Se muestra que el modelo generalized memory polynomial, incluyendo sus términos con la envolvente adelantada y retrasada con respecto a la señal, puede considerarse un caso particular del modelo de Volterra incluido en la demostración. Se demuestra experimentalmente la conveniencia de permitir los términos con envolvente de orden impar en la estructura del modelo para un amplificador de clase J, al que se aplica una señal 5G New Radio de 30 MHz, para un rango de más de 13 dB de niveles de potencia de salida. También se proporcionan resultados de la predistorsión digital del amplificador de clase J, que ilustran los beneficios de incluir estos términos con envolvente de orden impar en la estructura del modelo para las prestaciones en linealización.

Power adaptive modeling of wideband power amplifiers based on Volterra series

Juan Antonio Becerra González, Luis Álvarez López, María José Madero Ayora, Carlos Crespo Cadenas
Universidad de Sevilla, España

This work presents a novel power adaptive Volterra model for wideband power amplifiers (PAs). First, the model structure is derived by taking into account the input signal power level. Then, Volterra kernels are allowed to depend polynomially on the average power to achieve adaptability on this parameter. Simulation results show that the proposed model is able to represent the behavior of a commercial PA working in its saturation region in a power range of 6 dB compared against the traditional generalized memory polynomial model that describes the signal characteristics just in the power level where it has been regressed.

Extending a Dual-Band Model for Digital Predistortion of Power Amplifiers

Abraham Pérez Hernández, Juan Antonio Becerra González, María José Madero Ayora, Carlos Crespo Cadenas
Universidad de Sevilla, España

This paper proposes an extension for the two-dimensional generalized memory polynomial (2-D GMP) model for power amplifiers linearization. Based on multinomial theorem, the main blocks of a dual-band model are considered but new extensions are extracted. The linearizarion performance of this new model has been compared to a two-dimensional version of the GMP model. 5G New Radio signals have been used to generate the dual-band signal, which later was employed as input signal at the University of Chalmers' RF WebLab. Using the doubly orthogonal matching pursuit (DOMP) technique as component selection method, the chosen regressors are shown and the importance of the new extension is proven. Linearization results highlight the benefits of this proposal.

Modelado Nolineal de Diodo mediante Operador NFS y su Implementación en Herramienta CAD

Aarón García Luque[1], Teresa Mª. Martín Guerrero[1], Alberto Santarelli[2], Carlos Camacho Peñalosa[1]

[1]Universidad de Málaga, España; [2]University of Bologna, Italy

The characterization of active devices is fundamental point when developing system-level design techniques. To this aim, an automatic quasi-static (QS) nonlinear model extraction technique for solid state devices by using the Nonlinear Function Sampling (NFS) operator has been already developed and validated for GaN FET transistors. In this contribution, the adaptation of this technique to one-port devices is proposed and tested. An example has been designed, in which a commercial diode has been characterized by using a CAD (Computer-Aided Design) tool and its foundry model. It has been shown that equivalent nonlinear model extracted with NFS-based method offers good results when simulating the diode behaviour even under conditions not exactly the same as those employed in the characterization process.

Lugar: Sala virtual 3 Jueves, 03/09/2020: 11:00-12:00

Sesión 5.3. Telemática

Presidente de la sesión: Jasone Astorga Burgo, Pablo Corral González

Sistema Cíber Físico en Smart Campus: caso de uso para optimizar el consumo de agua

Sergio Barroso Ramírez, Pablo Bustos, Pedro Núñez
Universidad de Extremadura, España

In recent years, promising results have been achieved in the development of Smart Cities and Communities (S&CC) thanks to the breakthrough in the Internet of Things and Artificial Intelligence. One of the particular cases of the S\&CC are the SmartCampus, which represent a reduced version of the SmartCities while facilitating research on SmartX technologies. At the University of Extremadura, the SmartPoliTech project gives structure to a SmartCampus located at the Polytechnic School of Caceres by means of a network of sensors and a cyber-physical system (CPS) for the use of the data generated by the sensors. This paper presents the different components that make up SmartPoliTech's CPS, i.e., virtualization, persistence, service bus, and visualization tool, detailing some of its main features. In addition, a use case for this CPS is presented, in which the water consumption data collected by the sensors is used to obtain the most accurate estimate of consumption in the coming years

Transmisión inalámbrica multimedia coordinada con DASH-SAND

Román Belda Ortega, Ismael de Fez Lava, Juan Carlos Guerri Cebollada
Universitat Politècnica de València, España

The adoption of DASH (Dynamic Adaptive Streaming over HTTP) as a video transmission standard has introduced new challenges in environments with high density of Wi-Fi clients. Video players can incur playback problems (stalls, low playback quality...) in other players of the network, by ignoring their behavior. This paper proposes a collaborative playback technique based on DASH-SAND (MPEG's Server and Network Assisted DASH) that aims to reduce, in a collaborative way, the number of interruptions in the playback of multimedia content in Wi-Fi environments with high density of users. Results prove that the proposed solution reduces both the number and duration of stalls at the expense of decreasing the average representation of the playback.

Performance evaluation of expressive access control mechanisms for the IoT

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IoT applications are currently expanding to every business sector and are becoming the pillar of many business processes. Additionally, upcoming IoT scenarios are based on smart devices, which allow some kind of configuration or customization by different end users, attending to dynamic applications. In such a context, security and specially, access control mechanisms are crucial in order to ensure that only the intended end users are able to change the parameters of the protected IoT devices. Taking into account the resource constraints that characterize typical IoT devices, in this paper we present a performance evaluation of Hidra, a policy-based expressive access control system tailored to IoT devices. We assess the performance of Hidra in two devices with different storage, CPU and memory characteristics. Additionally, we evaluate two codification mechanisms to convey the access control policies to the protected devices: APBR, a binary codification mechanism designed for Hidra and CBOR, the reference standard solution for compressing security policies represented in JSON. The obtained results show that using Hidra with APBR encoding achieves shorter end-to-end delays and lower energy consumption. Additionally, it is concluded that the length of the policy affects more most constrained devices.

Desarrollo de un Simulador de Nivel de Enlace del Estándard AFDX

Javier Villegas[1], Sergio Fortes[1], Carlos Baena[1], Eduardo Baena[1], Rafael Ortiz[2], Benjamín Colomer[2], Raquel Barco[1]

[1]Universidad de Málaga, España; [2]Aerospace & Defence Systems, Aertec Solutions

This paper presents a link level implementation of a system-level Avionics Full-Duplex Switched (AFDX) network simulator. The simulator features two main elements, the End-System and the AFDX switch. It is proposed as a tool for validation and optimization which would allow faster development of new network topologies, serving as well as a base for future simulation instruments.

Lugar: Sala Virtual 1 Jueves, 03/09/2020: 12:30-14:00

Sesión 6.1. Premio Jóvenes Investigadores

Presidente de la sesión: Francisco Medina Mena, Enrique Márquez Segura

Fully Metallic Fixed Beam Leaky-Wave Antennas with Tailored Radiation Patterns at mm-Waves

Oskar Zetterstrom[1], Qiao Chen[1], Pablo Padilla[2], Oscar Quevedo-Teruel[1]

[1]KTH Royal Institute of Technology, Suecia; [2]Universidad de Granada, Spain

In this article, we present four efficient leaky wave antennas (LWAs) with stable radiation pattern, operating at 60 GHz. The antennas are implemented in groove gap waveguide technology, which results in low losses. A metasurface prism-lens is employed to almost entirely cancel the frequency dispersion inherent in conventional LWAs. The leakage rate is tapered along the aperture to reduce the side lobe levels. Three different metasurfaces and leaky waveguides are designed. The four antennas are manufactured and the measurements corroborates the design procedure.

Characterization of THz radiation by collimated wavefront aperture raster scanning

Daniel Nuño[1], María Santos[1], Juan Sebastián Gómez-Díaz[2], Jordi Romeu[1], Lluís Jofre[1]

[1]Dept. of Signal Theory and Communications, Universitat Politècnica Catalunya, España; [2]Dept. of Electrical and Computer Engineering, University of California at Davis

We present measurements for characterization of the beam profile and polarization pattern of lens-coupled photoconductive antennas (PCAs) at THz frequencies using a setup with antennas at fixed positions and a movable aperture placed in between collimating THz lenses. The measured beam patterns for co-polar and cross-polar components reveal the expected Airy disc and quadrupole behavior, respectively. The temporal evolution of the polarization in the directions of maximum cross-polar component follows a single-cycle circle with opposite handedness at each side of the antennas line-of-sight (LOS). Results are consistent with those obtained with fiber-coupled movable antennas, while enjoying the simplicity of a free-space laser-PCA feed which does not require painstaking laser realignment for each beam direction measure.

Broadband Determination of the Propagation Constant of the Slot Mode of a Rectangular Waveguide

Alberto Hernández Escobar[1], Elena Abdo-Sánchez[1], Jaime Esteban[2], Teresa M. Martín-Guerrero[1], Carlos Camacho-Peñalosa[1]

[1]Universidad de Málaga, España; [2]Universidad Politécnica de Madrid, España

A broadband technique to extract the attenuation and phase constants of the slot mode in a rectangular waveguide from simulation or measurement results is proposed. The method is based on processing the values of the reflection coefficient of several slotted waveguides with different lengths and same termination and feeding. The accuracy of the method can be improved by increasing the number of simulated or measured waveguides. This technique is applied to the determination of the propagation constant of the slot mode by using the simulated data of a cavity-backed slot and validated using a two-port simulation. A realistic structure is proposed which can be used to obtain results from measurements. Simulation results from this structure are shown up to 10 GHz. The proposed method can be quite convenient to compute the propagation constants of leaky modes in leaky-wave antennas.

Reflectarray as plane wave generator for Compact Antenna Test Range in millimetre frequency band

Álvaro F. Vaquero, Manuel Arrebola, Marcos R. Pino
Universidad de Oviedo, España

In this work, a reflectarray is proposed to be used as a plane wave generator (PWG). The reflectarray works at 28 GHz and produces a uniform plane wave in a certain region of the Fresnel region of the antenna, reaching an ultra-compact structure. In a first approach, a far-field focused reflectarray is analyzed to create the plane wave. However, the size where the plane wave is considered uniform is not large enough for its use in compact antenna test ranges (CATR). The desired wave must satisfy tight requirements, both in amplitude and phase, to be considered as a uniform plane wave. The generalized Intersection Approach is used to improve the plane wave performances by doing a Phase-Only synthesis (POS) on the phase of the reflectarray elements. Simulations of the plane wave generated by the antenna before and after the optimization process are compared, showing an important enhancement on the uniformity of the wave. The obtained phase distribution is used to design and manufacture a reflectarray based on a three-parallel-dipoles cell. The prototype is measured in a planar range facility to evaluate the quality of the radiated plane wave. Measurements show a low ripple in both amplitude and phase, thus promising results are obtained.

A Deep Q-Network Approach for Radio Access Network Slicing

Irene Vilà, Jordi Pérez-Romero, Oriol Sallent, Anna Umbert
Universitat Politècnica de Catalunya, España

One of the key features of the 5G architecture is Network Slicing, which allows the simultaneous support of diverse service types with heterogeneous needs. In order to realise network slices in the Radio Access Network (RAN), it is required to devise mechanisms to efficiently distribute the available capacity among the different RAN slices. In this regard, this paper introduces a multi-agent reinforcement learning approach for capacity sharing, in which each agent implements a Deep Q-Network (DQN) algorithm. Results prove that the proposed approach achieves an efficient distribution of the capacity.

Additive Manufacturing of Circularly Polarized Waveguide Arrays at Ku and Ka bands

Eduardo García Marín[1], José Luis Masa Campos[1], Pablo Sánchez Olivares[2], Jorge A. Ruiz Cruz[1]
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In this contribution, a planar circularly polarized array with corporate feeding network in waveguide technology is presented. The antenna is divided in three layers: the radiating array and a two-stage feeding network. Given this intricate multilayer antenna design, successful manufacturing of a prototype is a challenge, especially at higher frequencies where power leakage can occur in between the layers. For this reason, this paper investigates the suitability of several manufacturing techniques and design strategies for the implementation of such complex antenna structures. The array is designed for Ku band applications, although the full waveguide design allows for easy scalability to other frequencies, in this case the Ka band.

Lugar: Sala Virtual 2 Jueves, 03/09/2020: 12:30-14:00

Sesión 6.2. Radiación, Radiopropagación y Radioastronomía

Presidente de la sesión: Eduardo Artal-latorre, Lorenzo Rubio Arjona

Diseño de software para análisis y reducción de datos radioastronómicos de la antena DSS 61 de PARTNeR

Antonio Vera Pérez[1], Pablo Corral González[2], Juan Ángel Vaquerizo Gallego[2], Miguel Aljaro Palacios[2], Guillermo de Scals Martín[2]

[1]PLD Space, España; [2]Universidad Miguel Hernández de Elche, España

After 35 intense years of work, NASA (National Aeronautics and Space Administration) decided to relieve all the functions of the DSS 61 antenna. Given the dilemma of its possible dismantling, the North American space agency inspired by the educational project GAVRT (Goldstone Apple Valley Radio Telescope), offered DSS 61 to Spanish society for its academic use. After several months of meetings of representatives of organizations associated with the space sector, a collaboration pre-agreement was reached in 2001 between NASA and the National Institute of Aerospace Technique (INTA) to carry out the Academic Radio Astronomy Project. After removing the antenna transmission module and adapting it to the new functionalities, in 2004 the PARTNeR project (Academic Project with the NASA Radio Telescope in Robledo) was created. This document provides information about the software designd for the analysys and reduction of radio astronomy data obtained by the PARTNER DSS 61 radio telescope.

Design and fabrication of a low cost corrugated horn antenna for UPNA's new radio telescope infrastructure to maximize G/T.

Iban Buldain Irurzun[1], Fernando Teberio Berdún[1], Xabier Francés Oiz[1], Jorge Teniente Vallinas[2]

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This paper presents the design and fabrication of a low cost corrugated horn antenna for the UPNA's new radio telescope infrastructure. The feedhorn design has been made taking into account easy fabrication techniques employing FDM 3D printers. For feedhorn design, the G/T ratio maximization has been the most important design parameter. To do so, a software tool to calculate the antenna temperature and G/T ratio of a ground station antenna has been developed for Anteral S.L. company during this project. The final feedhorn has been manually manufactured and prepared for outdoor conditions. It has only been S_{11} tested due to COVID-19 pandemic situation, but its result has been successful and the performance in the radio telescope is assumed to be also sucessful.

Diseño del acoplamiento microstrip de detectores de inductancia cinética

Eduardo Artal Latorre, Luisa de la Fuente Rodríguez, Beatriz Aja Abelán

Universidad de Cantabria, España

Coupling of Kinetic Inductance Detectors (KIDs) to a microstrip feedline for the readout system is a critical issue in the design of radio astronomy receivers based on this technology. A design method proposes a step by step procedure to achieve a goal of coupling value in the case of microstrip lines. This method uses the mutual inductance equivalent circuit of asymmetric coupled lines connected to a series resonant circuit. Taking into account network symmetry properties, the problem is reduced to a 1-port network analysis. Simulated values are obtained from a microwave circuit analysis software. The proposed method is applied to the coupling design of an absorption Kinetic Inductance Detector resonator in the frequency range around 500 MHz.

Evaluación de modelos de duración de desvanecimientos para enlaces satelitales en las bandas Ka y Q

Alejandro Pérez Aguilera, Domingo Pimienta del Valle, José Manuel Riera
ETSI Telecomunicación, Universidad Politécnica de Madrid, España

The atmosphere has great impact in the propagation of electromagnetic waves. Particularly, in satellite communications, signals suffer fading effects due to its path through the atmosphere. Moreover, at the frequencies studied (20-40 GHz) and presented in this paper, meteorological effects produce the most important fades, with rain being the main attenuation phenomenon. The fading dynamics are characterized, according to the ITU (International Telecommunications Union), by some statistics such as fade duration. This paper is focused on fade duration, more specifically, on the assessment and optimization of fade duration models and attenuation level, in Ka and Q bands. The experimental data collected for the study was gathered from: ITU, GTIC and several European research groups. The experimental distributions were compared with the models and, subsequently, optimized with adjustment methods based on minimizing the errors. Model comparison and the statistical results are presented.

Modelado de las pérdidas de propagación en un escenario de oficinas en bandas de milimétricas

Lorenzo Rubio Arjona[1], Bernardo Bernardo[1], Vicent M. Rodrigo-Peñarrocha[1], Juan Reig[1], José-María Molina-Garcia-Pardo[2], Jesús R. Pérez[3], Rafael P. Torres[3], Herman Fernández[4], Luis Valle[3], José Basterrechea[3], Marta Domingo[3]
[1]Universitat Politècnica de València, España; [2]Universidad Politécnica de Cartagena, España; [3]Universidad de Cantabria, Santander. España; [4]Universidad Pedagógica y Tecnológica de Colombia, Sogamoso. Colombia

En este trabajo se presentan los resultados en términos de pérdidas de propagación de una campaña de medidas realizada en un escenario típico de oficina. Las medidas se han realizado en la banda de 25 a 40 GHz utilizando una sonda de canal en el dominio de la frecuencia. Se han considerado condiciones de propagación con visión directa entre la antena transmisora y receptora, junto con la posibilidad de bloqueo de la componente directa debido al mobiliario. En el trabajo se han modelado las pérdidas de propagación a partir de los modelos propuestos en el proyecto europeo WINNER-II y adoptados por el 3GPP para la banda de milimétricas. Estos modelos son: FI (single-frequency floating-intercept model), CI (single-frequency close-in free space reference distance model), ABG (multi-frequency Alpha-Beta-Gamma model) y CIF (close-in free space reference distance with frequency path loss exponent model). El valor medio de los parámetros de los modelos, junto con los intervalos de confianza al 95%, ha sido obtenido a partir de las medidas utilizando técnicas de regresión y optimización.

Caracterización electromagnética de materiales mediante medidas de alta precisión en espacio libre

Borja Plaza Gallardo[2], Ignacio Muñoz Rebate[1], David Ramos Somolinos[1], David Poyatos Martinez[1]
[1]INTA, España; [2]Consultor Externo para INTA. ISDEFE, ESPAÑA

Aerospace or automotive industries employ novel composite or 3D printed materials in their manufacturing processes to improve performance and reduce costs. Obtaining the electromagnetic (EM) characterisation of these materials or a combination of them is essential to ensure safety and EM compatibility. In this paper, the development of a test bench with polyrod antennas for measurements in free space is presented. A complete design is described, from simulation analysis to validation measurements. The aim is to achieve flexible measurements that permit the electromagnetic characterization of very diverse samples and materials, and high accuracy measurements that allow to know the exact behavior of these materials.

Lugar: Sala virtual 3 Jueves, 03/09/2020: 12:30-14:00

Sesión 6.3. Comunicaciones Móviles, Inalámbricas e IoT IV

Presidente de la sesión: Leandro Juan-Llácer

A Stochastic Channel Intra-Wagon Railway Model by Ray-Tracing Software

Maria A. Serrano, José I. Alonso
Information Processing and Telecommunications Center. Universidad Politécnica de Madrid

This article presents analytical results of a stochastic channel modelling of the interior of a railway wagon, based on ray-tracing (RT) simulation. The 3D railway wagon model is constructed. According to 3rd Generation Partnership Project (3GPP), RT simulations are then conducted at 26 GHz with 500 MHz bandwidth. The large and small-scale channel parameters are extracted and modelled. The proposed approach overcomes the challenges associated with the deployment of 5G technology in millimetre-bands through reliable and accurate propagation models obtained by RT simulation. Stochastic model obtained can be successfully incorporated into link-level simulators to carry out a fast and reliable deployment of mobile 5G communications systems and Wi-Fi standards (802.15.3c and 802.11ad) in millimetre-band 3D scenarios.

Fusion of LTE and UWB ranges for trilateration

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Universidad de Málaga, España

High precise indoor positioning is the spotlight for the new mobile generation 5G. Ultra-Wide Band (UWB) technology stands out as the creditable preference for locating the user in indoor scenarios. The principal limitation of this technology appears in the coverage area that reaches a few tens of meters. In our case of study, we have simulated a conceivable real environment with UWB and Long Term Evolution (LTE) base stations for positioning users. In this scenario, users have been tracked by an Extended Kalman Filter (EKF), a memory state filter to predict the movement of the user that improves the performance of the system. In regions that receivers only track isolated UWB stations we make use of this information in order to improve the location provided by mobile networks. Essentially, when performing trilaterion using the data offered by LTE, we also include the data of UWB in case that this information do not serve to position by itself. In this manner, the coverage area by at least one UWB station augments and accuracy of the system improves in those regions where only LTE previously provided location.

An enhancement Software Defined Radio Platform for evaluation of Decode-and-Forward Relay Nodes

Randy Verdecia-Peña, José A. Campoy Doallo, José I. Alonso
Universidad Politécnica de Madrid, España

Recently, Relay Nodes (RNs) are haven special attention as radio access technology to overcome channel fading and to improve channel capacity on high-speed and vehicle density environments. RNs have been an object of standardization by the 3GPP, but this process hasn't been accompanied for a hardware development that allows evaluating their advantages. The Software Defined Radio (SDR) has emerged as a promising technology that allows implementing the concept of RN at a low cost. In this paper, we propose to develop and implement significant improvements in the capabilities of an SDR platform for Decode-and-Forward Relay Node developed in [1]. These improvements consist of using two NI-USRP-2944R with a better benefit in hardware than the previous ones. Besides, it is introduced the Multi-Input Multi-Output (MIMO) antenna technique. In tests conducted they were considered scenarios LOS (Light-of-Vision) and NLOS (Non-Light-of-Vision) showing the capabilities of the platform developed. The measured performances of several types of modulation schemes are compared under the same conditions. Results show downlink performance increased with a 2x2 MIMO technique.

Evaluation of MIMO and beamforming techniques in HSR with TDD In-band Relay Nodes

Randy Verdecia-Peña, José I. Alonso
Universidad Politécnica de Madrid

There is a growing demand for Internet access by wireless devices, such as smartphones, tablets or personal computers, in high-speed and vehicle-density scenarios. A promising technology proposed by 3GPP would consist of the use of Relay Nodes (RNs), which can provide significantly improved throughput and coverage. In this paper, a performance study of an LTE communications architecture for High-Speed Railways (HSRs), based on the usage of Mobile Relay Nodes (MRNs) with beamforming and MIMO capabilities, is presented. It will be shown that railway communication systems using MRNs with beamforming and 2x2 MIMO capabilities offer significant improvements in the throughput that user on-board the train can get. In addition, the performance of macro users located in cells through which the train moves are presented. The numerical results indicate that the use of relaying technologies, if they also have beamforming and MIMO capabilities, show substantial improvements in the throughput of on-board users.

Analysis and Characterization of Wireless Communication Systems at 2.4 GHz in Conditioned Forest Environments

Imanol Picallo[1], Hicham Klaina[2], Peio Lopez-Iturri[1,3], Erik Aguirre[1,3], Mikel Celaya-Echarri[4], Leyre Azpilicueta[4], Alejandro Eguizábal[1], Francisco Falcone[1,3], Ana Alejos[4]
[1]Universidad Pública de Navarra, España; [2]Universidade de Vigo, España; [3]Institute of Smart Cities, Universidad Pública de Navarra, España; [4]Tecnologico de Monterrey, México

This work analyzes the communication of a sensor network taking into account that it is obstructed by a tree and is affected by the vegetation that surrounds it. In order to validate device-to-device communication, both measurements and simulations by means of an in-house developed 3D Ray Launching algorithm have been performed at 2.4 GHz. The measurements have been taken in the Orgi Forest, located in Navarre. The validation of the measurements together with the analysis of the path loss and multipath leads to the conclusion that there are two zones in the wave propagation along with the communication link. A scattering zone near to the tree affected by multipath propagation and an obstructed line of sight zone far from the tree.

Reconstrucción del Entorno Radio para Comunicaciones en Agrupaciones de Vehículos

Sandra Roger, Carmen Botella, Juan José Pérez-Solano, Joaquin Perez
Universitat de València, España

Vehicle platoons are groups of vehicles that travel together, maintaining a constant distance from each other. Platoons generally require robust and reliable wireless communications to keep their structure and perform coordinated maneuvers. When the platoon is assisted by the infrastructure through a cellular vehicle to anything (V2X) communication, one of the critical factors is reducing the communication latency. In this paper, the use of a spatial interpolation technique, namely Ordinary Kriging, is explored as a mechanism to reduce signaling overhead in the channel information acquisition stage, which can impact in practice over reducing latency. Specifically, its potential to reconstruct the radio environment map of the platoon from a limited number of available channel values is evaluated. This analysis allows to establish optimal patterns of vehicles with access to channel information in order to obtain a high accuracy reconstruction.

Lugar: Sala virtual 4 Jueves, 03/09/2020: 12:30-14:00

Sesión 6.4. Sesión Especial: Aplicaciones en ingeniería biomédica

Presidente de la sesión: Javier Reina Tosina, David Naranjo Hernández

Plataforma de rehabilitación domiciliaria basada en IoT

Jorge Calvillo Arbizu[1,2], Pablo Romero Escot[1], Isabel Román Martínez[2], Javier Reina Tosina[1,3]

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The Internet of things (IoT) paradigm means an opportunity for new healthcare models both at home and in hospital settings where sensor devices can play a significant role in the monitoring of the patient's vital signs, context or activity. However, the continuous monitoring of patients' health status may result in massive amounts of information that can be unfeasible to be managed and supervised by human. Thus, monitoring platforms require processing tools to automatically filter data in real time in order to identify and alert about potential risk events. This paper presents a proof of concept of an IoT-based home rehabilitation platform (by using FIWARE tools) for patients with chronic obstructive pulmonary disease. Events are processed in real time and a set of rules allow to identify situations that may result in patient harm. Conditions established in rules about data from sensors may trigger alerting or corrective actions automatically.

Estudio del comportamiento dieléctrico de tejidos mamarios y diseño de antena UWB para usos médicos

Elizabeth Fernandez, Patricia Castillo Araníbar, Vicente Gonzales Posadas, Daniel Segovia Vargas

Universidad Carlos III, España

In this work, we present a study for the dielectric behavior of the breast. This will help in the detection of differences in dielectric properties of breast tissues and tumors. The use of a computational design with the help of the High Frequency Structure Simulator (HFSS) software will result in a full electromagnetic analysis. A broadband monopole antenna working in the range between 2-6 GHz will be used as radiating element., This antenna has a size of 35x35mm and has been fabricated on a FR-4 PCB board with a thickness of 1.5 mm, copper thickness 17 microns and a dielectric constant of 4.4.

Modelos computacionales bioelectromagnéticos para optimizar la focalidad espacial en las técnicas tDCS

Pablo Franco Rosado[1,2,3], María Amparo Callejón Leblic[3], Javier Reina Tosina[3], Laura María Roa Romero[3], Juan Francisco Martín Rodríguez[1,2,4], Pablo Mir Rivera[1,2]

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The purpose of this study is to apply electromagnetic computational modeling techniques to evaluate the optimization of cortical stimulation in non-invasive neurostimulation techniques, particularly in transcranial direct current stimulation (tDCS). Using the location of the electrodes as a mechanism to control the direction of the electric field, an alternative arrangement (P3F3) for the stimulation of the sensorimotor region is compared to the classic one (C3Fp2) in terms of volumetric focality, a parameter that evaluates the relative stimulated volume of a region. The results conclusively show that the proposed arrangement improves the volumetric focality of the electric field in the region of interest with respect to the conventional one. More extensive analyzes will be necessary to establish a relationship between these results and those obtained in neurophysiological studies.

Dispositivo inteligente de espectroscopía de bioimpedancia adaptado al proceso de trasplante renal

David Naranjo-Hernández[1], Javier Reina-Tosina[1], Laura M. Roa[1], Miguel Ángel Pérez-Valdivia[2,3], Mercedes Salgueira-Lazo[4,3,1], Rafael A. Medina-López[2,3]

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The present work describes a first approximation to a bioimpedance spectroscopy device adapted to the kidney transplantation process in order to provide an objective measurement of the graft viability before transplantation. Since bioimpedance depends on the particular characteristics of the medium through which the electric current circulates, it is possible to apply bioimpedance technology in the characterization and estimation of the composition, physiological, morphological and structural conditions of the kidney during transplantation. The device is capable of performing bioimpedance measurements of a kidney at multiple configurable frequencies, processing the data to obtain the modulus and phase of bioimpedance at each of the frequencies, and wirelessly transmit the processed information. Some of the design requirements have been low-cost, precision, sterilizable, innocuousness, immunity against electromagnetic interference, portability, wireless and small size. The results obtained show the feasibility of the proposed technology towards its clinical transfer in the context of kidney transplantation.

Influencia de la presencia de glaucoma en la diferencia de CDR de ambos ojos de un mismo paciente usando retinografías de RIMONEr3

Mayka Montalbán Gómez[1], Rafael Verdú Monedero[1], Juan Morales Sánchez[1], Inmaculada Sellés Navarro[2]

[1]Universidad Politécnica de Cartagena; [2]Servicio de Oftalmología del Hospital General Universitario Reina Sofía, Murcia

Una de las enfermedades principales que afectan al nervio óptico es el glaucoma, que provoca un daño progresivo e irreversible que reduce el campo visual del paciente. Un indicador para el diagnóstico de esta enfermedad es la relación copa-disco (CDR) que se basa en la morfología del nervio óptico. En este trabajo se analiza la diferencia de los valores de CDR de ambos ojos de pacientes sanos y pacientes con glaucoma o sospechosos de padecerlo para caracterizar la influencia de esta diferencia entre ambos ojos como indicador diagnóstico de glaucoma. En el estudio se ha utilizado la base de datos RIMONEr3 que contiene retinografías junto con la segmentación manual del disco óptico y la excavación realizada por dos expertos. A partir de las segmentaciones, se ha evaluado la asimetría como la diferencia en valor absoluto del CDR de ambos ojos, obteniendo parámetros estadísticos de media y varianza para el grupo de pacientes sanos y con glaucoma o sospecha. Los resultados sobre el conjunto de pacientes de la base de datos indican que existe diferencia en el valor medio de la asimetría entre los pacientes sanos y con glaucoma, pero es necesario aumentar el número de pacientes para reducir la varianza y así esta caracterización pueda ser útil como indicador diagnóstico de glaucoma.

Comparison of Sliding Transforms and Discrete Wavelet Transforms to Detect Eye States

Adriana Dapena[1], Francisco Laport[2], Francisco J. Vazquez-Araujo[3]

[1]Universidad de A Coruña, España; [2]Universidad de A Coruña, España; [3]Universidad de A Coruña, España

This paper deals with the detection of open eyes and closed eyes from the Electroencephalography (EEG) signals acquired by a system with one or two sensors. We propose two different approaches to extract the features of the signals: complex-valued transforms applying to sliding windows and discrete wavelet transforms. We combine these transforms with two well-known and widely applied classifiers: Linear Discriminant Analysis and Support Vector Machine. Several experimental results are presented to compare the performance obtained with these methods using real EEG signals acquired by our own EEG prototype.

Lugar: Sala Virtual 1 Viernes, 04/09/2020: 09:00-10:30

Sesión 7.1. Sesión Especial: Collaborative x-Wave Antenna Systems for Integrated Communication and Sensing Wireless Applications I

Presidente de la sesión: Jose-Maria Molina-Garcia-Pardo, Lluís Jofre Roca

Optical beam steering network with multiband capability

Sara Vega, Daniel Nuño, María Santos

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A multiwavelength (MW) optical true time delay Network (OTTDN) to feed a phased array antenna (PAA) is presented. Beam steering capabilities can be demonstrated when applying MW tuning. A Dual Electrode Mach Zehnder Modulator (DE-MZM) as radio frequency (RF) modulating stage allows to tune the operative band avoiding severe Chromatic Dispersion (CD) fading to obtain a flattened response. A working example simulation of a 4 elements array at 8 GHz shows the RF multiband spectral flat response potential of the technique, as well as the network conditions needed for beam steering with free-lobe operation.

Beamforming Antenna System for Underground Railway mmWave Communications

Cristian García[1], Germán Ramírez[1], Christian Ballesteros[1], José María Molina-García-Pardo[2], Jordi Romeu[1], Lluis Jofre-Roca[1]

[1]Universitat Politècnica de Catalunya, España; [2]Universidad Politécnica de Cartagena

Public Transportation Systems (PTS) are going to be even more important in future societies, and among current PTS, underground networks are essential in big cities. The growing demand of PTS arises some special capacity and reliability requirements tightly coupled to security and safety issues. This makes 5G to be a suitable candidate to support such robust communications systems. Many functionalities such as remote train control, remote video surveillance control, or infotainment for the users should be enabled. In this work, a propagation analysis at mmWave frequencies in an underground scenario between two stations is performed. From this initial scenario assessment, losses up to 35 dB are observed towards both ends of the tunnel, compensation techniques like transmitter power profiling and antenna beamforming are proposed and tested to equalize received power along the train trajectory with satisfactory results.

Vehicular mm-Wave Array for Smart Handover

Bharath-Reddy Ganugapanta[1], Germán Augusto Ramírez Arroyave[1], Jaime Molins Benlliure[2], Miguel Ferrando-Bataller[2], Jordi Romeu[1], Lluís Jofre[1]

[1]Universitat Politecnica de Catalunya; [2]Universidad Politecnica de Valencia

The emergence of new technologies such as autonomous vehicles and high data rate 5G networks requires more advanced antenna types that are capable of fulfilling requirements for highly demanding wireless communication links. Micostrip-fed slot antenna array is one such type that provides low return loss and good transient behaviour for broadband applications. A compact size coupled-fed slot antenna element and its phased array is proposed in this paper. Two different substrates Rogers TMM4 and Green TapeTM 951 Low Temperature Co-Fired Ceramic (LTCC) are considered for the fabrication of microstrip feedline. The feedline is fabricated on the respective substrates and then mounted on the Rogers RT5880 substrate. Ground planes are used on both the front and backside of the antenna array. The antenna is operating in a range of 24.25 GHz - 29.5 GHz. A Smart Array is proposed in this paper which has a good performance in terms of antenna gain and scanning property for 5G application in Smart handovers.

Millimeter-wave MIMO Array Measurement System for Imaging and Channel Characterization

Christian Ballesteros Sánchez[1], Luca Montero Bayo[1], Germán Augusto Ramírez Arroyave[1], Mayco Mariano Dagatti[1], José Antonio Solano Pérez[2], José María Molina García-Pardo[2], Jordi Romeu Robert[1], Lluis Jofre Roca[1]

[1]Universitat Politècnica de Catalunya, España; [2]Universidad Politécnica de Cartagena, España

Millimeter-wave band offer unique characteristics to obtain good spatial position and resolution of certain type of targets. The aim of this paper is to study a near-field focusing technique applied to the imaging of different geometries, from an analytical, numerical and experimental point of view. Millimeter-wave band scattering simulations are performed and compared with imaging reconstruction of experimental measurements, using a particular set-up and scenario. This work is a first step to contribute to the growing need of sensing the environment and surrounding objects of moving devices, such as new generation vehicles, in a clear and robust way with respect to other forms of sensing.

Lugar: Sala Virtual 2 Viernes, 04/09/2020: 09:00-10:30

Sesión 7.2. Sesión Especial: Tecnologías de voz y habla, música y otras señales sonoras y de audio

Presidente de la sesión: Ana María Barbancho Pérez, Rafael Verdú Monedero

Automated music generation based on dice game

Carlos Samuel Villalba Bastida, Antonio Jurado Navas
Universidad de Málaga, España

In this paper, we present an automated simple music generator based on Markov chains. Basic harmonic standards and many other particular features are also included depending on the style selected by the user. The algorithm here presented generates pieces of music (also the sheet music) from different parameters provided by the user. In addition, we offer some psychoacoustic results that can contribute to the evaluation of the musical pieces and to a future self-learning of the algorithm.

Mitigación del ruido del tráfico con tapas difractoras sobre barreras acústicas para un rango de frecuencia extendido

Domingo Javier Pardo Quiles, José Víctor Rodríguez Rodríguez
Universidad Politécnica de Cartagena, España

The key goal of noise barriers is to protect residential areas from annoying noise caused by road traffic. In order to improve the performance of noise barriers while aesthetics of the surroundings is kept, the coupling of additional elements of different shapes or 'caps' to the top of barriers can be a suitable tool to increase the global insertion losses. In this work, an extensive study of the performance of single and double caps of different shapes attached on top of conventional barriers is accomplished by computing their insertion losses through a uniform theory of diffraction (UTD)-based formulation. Moreover, this study is performed for an extended frequency band of up to 10 kHz, which, to the best of the authors' knowledge, has not previously been studied. The results show that the Y-shaped single and double barrier caps are, in general, the most effective at increasing acoustic losses for noise mitigation.

An automatic tool for the analysis of musical tempo based on audio-to-score alignment

Antonio Jesús Muñoz-Montoro, Juan Torre-Cruz, Pedro Vera-Candeas, Julio José Carabias-Orti
Universidad de Jaén, España

This paper proposes the use of an offline alignment system to estimate the time in the audio of the occurrence of each beat time from a MIDI file. For this purpose, we require both the MIDI of the composition and a pre-trained dictionary of isolated notes of solo instrument recordings for each instrument in the mixture of the audio file. We evaluate this approach by focusing on the task of analysing the variation of tempo of different interpretations from the same musical piece. Particularly, the experimental evaluation is carried out using the Chopin Mazurkas collection provided by the Mazurka Project. In this database, the manual annotations of beat times in the audio for almost 3000 recordings of 49 mazurkas are available. We demonstrate that the proposed approach based entirely on an automatic process obtains hierarchical correlation plots similar to that obtained using manual annotations. This result gives room for the development of automatic analysis of musical interpretations.

Síntesis Sonora a Partir de la Voz Usando Formantes y un Método Adaptativo

Daniel Hernan Molina Villota, Isabel Barbancho, Antonio Jurado Navas
Universidad de Málaga, Francia

Abstract- This is an interactive project for the generation of sounds using the human voice, the formants and a sample library. Our project is focused on the use of formants, f synthesis via the Fourier transform for the modification of sounds (from a library or another voice) to give then a formant spectrum. The project helps the automatic generation of sounds using the voice itself and the formants filters acting as an extension of the human voice. Also, it is allow the transformation of the voice through adaptative method using a MIDI controller. Furthermore, this project can help to change the texture of the sounds of a library, to give them a vowel sound, and vary sounds using midi notes and an adaptative use of the human voice for the control. This capacity can be also used in the modification of another input of human voice or any sound instead of the sounds of the library

Detección y segmentación del disco óptico mediante morfología matemática y contornos activos en retinografías de RIMONEr3

Mayka Montalbán Gómez, Rafael Verdú Monedero, Juan Morales Sánchez
Universidad Politécnica de Cartagena, España

Este artículo describe un método robusto y eficiente para la detección y segmentación del disco óptico en retinografías. El método se basa en la detección eficaz del disco óptico mediante operadores de morfología matemática y una posterior segmentación más precisa mediante una implementación eficiente de contornos activos. Para comprobar la validez del método propuesto, se ha evaluado con la base de datos RIMONEr3 que contiene 159 retinografías, y al compararlo con la segmentación de un experto se ha obtenido un valor medio del coeficiente Sorensen-Dice de 0.891.

Lugar: Sala virtual 3 Viernes, 04/09/2020: 09:00-10:30

Sesión 7.3. Sesión Especial: Inteligencia Artificial para Comunicaciones Celulares I

Presidente de la sesión: Raquel Barco Moreno, Sergio Fortes Rodríguez

Sonda experimental de monitorización de redes móviles para eventos.

Alejandro Antonio Moreno Sancho, Eduardo Baena Martínez, Sergio Fortes Rodríguez, Raquel Barco Moreno
UMA, España

No solo el alto incremento de personas usando redes móviles, sino la acumulación durante eventos como conciertos o partidos de fútbol, ha causado problemas con la administración de dichas redes, causando una reduccion de la calidad en el usuario. En este artículo exponemos los efectos de estos eventos y los enlazamos con la calidad final del usuario en diferentes experimentos que también serán explicados. Analizando los datos de ciertos nodos LTE localizados en el estadio Lerkendal en Noruega, hemos sido capaces de analizar los problemas. Reconocer cuando se causa el problema y como se comporta es el primer paso para hacer una solución que mejore la situación.

Time-dependent KPI generation based on Copula

Hao Qiang Luo-Chen, Carlos S. Álvarez-Merino, Emil J. Khatib, Raquel Barco
Universidad de Málaga, España

New generations of mobile networks are developed to serve the increasing user and devices connected to the networks. However, the management of these networks has a need of automation, due to the also growing complexity. Self-Organizing Network (SON) was conceived to fulfil the automation of network management, within which troubleshooting is located under Self- Healing (SH). The current tendency is the use of Artificial Intelligence (AI) algorithms that are trained using Machine Learning (ML). This training requires a considerable amount of data. Anyway, the reluctance of operators to sharing their data with the research community causes a scarcity of data representing degradations that can be used for the development and training of ML algorithms. In this paper a method to solve this data sample limitation is proposed. In the first place, the method divides the data into time categories to create models which preserve the time characteristics. Afterwards, it applies statistical copulas to adapt the models into new ones maintaining statistical relationships. Finally, the method returns synthetic data that can be an input for ML. As an example, the data from a real mobile network is processed.

End-to-end transparent user identification using touchscreen biometrics

Michal Krzeminski[1], Javier Hernando[2]
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We study the touchscreen data as behavioral biometrics. The goal was to create an end-to-end system that can transparently identify users using raw data from mobile devices. The touchscreen biometrics was researched only few times in series of works with disparity in used methodology and databases. In the proposed system data from the touchscreen goes directly, without any processing, to the input of a deep neural network, which is able to decide on the identity of the user. No hand-crafted features are used. The implemented classification algorithm tries to find patterns by its own from raw data. The achieved results show that the proposed deep model is sufficient enough for the given identification task. The performed tests indicate high accuracy of user identification and better EER results compared to state of the art systems. The best result achieved by our system is 0.65% EER.

Análisis del efecto del número de beams sobre un escenario 5G

Antonio Tarrias, Sergio Fortes, Eduardo Baena, Raquel Barco
Universidad de Málaga, España

5G has been presented as the most revolutionary generation in the mobile network paradigm. With regard to the RAN part, the main achieved improvements in comparison with its predecessor are based on the use of mmWaves. To overcome the high propagation losses that are inherent to mmWaves, beamforming scheme usage becomes essential. In this scope, theaimofthispaperistoprovideafirstapproachregarding the effect of the beamforming configuration in these radio networks. To do so, a complete scenario has been simulated in ns-3, enabling the evaluation of the signal-to-interference-plus-noise ratio (SINR) received by a UE under different number of configured beams.

Adquisición de métricas en cloud gaming

Oswaldo S. Peñaherrera-Pulla[1], Carlos Baena[1], Sergio Fortes[1], Eduardo Baena[1], Mai Tranle[2], Raquel Barco[1]
[1]Universidad de Málaga, España; [2]Vodafone Group, Madrid, España

This document presents a Cloud Gaming review and how it works in contrast with the traditional Gaming scenario.Then several platforms that can be used to implement this serviceare described. Next, it's exposed the way how Cloud Gaming is qualified by "gamers" in terms of Quality of Experience through some specific parameters such as Bit Rate, Network Latency, video resolution, frame rate, etc. In order to measure these parameters, a testbed was developed. This experiment is designed in a Server-Client architecture which embed Moonlight-Stream platform with Python Scripts to analyze temporal client logs and extract metrics, automatize human actions as mouse and keyboard events. Testbed was probed over WLAN for an objective resolution of 1080p. To maintain an objective criterion, several iterations were executed over the same network, simulated human actions were used. Results show that Cloud Gaming comply with theorical limits in previous studies explained in first sections.

Lugar: Sala virtual 4 Viernes, 04/09/2020: 09:00-10:30

Sesión 7.4. Componentes y Circuitos Pasivos de Microondas

Presidente de la sesión: José Ramón Montejo Garai, Miguel Ángel Gómez Laso

Diseño de un divisor de potencia 1 a 4 en tecnología SIW para frecuencias de 5G

Alfonso Gómez García, Jesús Rubio Ruiz, Rafael Gómez Alcalá, Yolanda Campos Roca

Universidad de Extremadura, Escuela Politécnica de Cáceres, España

Este trabajo presenta el proceso de diseño de un divisor de potencia 1 a 4 en banda K, realizado en tecnología de guía de onda integrada en sustrato, para aplicaciones 5G. La geometría del divisor, basada en un pentágono regular, se detalla en este trabajo, así como las ecuaciones utilizadas para obtener las dimensiones iniciales. Se estudiará la contribución sobre la respuesta en amplitud de los parámetros geométricos del diseño. También se determinará el efecto de añadir distancia extra entre los puertos de alimentación y el centro del dispositivo para obtener una respuesta en fase concreta. Una vez confirmado que la respuesta en amplitud y fase son ajustables, se seleccionará un rango de frecuencias para aplicaciones 5G, y ajustaremos el diseño para obtener una buena respuesta para la banda escogida.

Balanced Dual-Band Bandpass Filter Based on Multilayer Open-Loop Resonators with Magnetic Coupling

Jose Luis Medrán del Río[1], Aintzane Lujambio[2], Armando Fernández-Prieto[1], Alejandro Javier Martínez-Ros[3], Jesús Martel[4], Francisco Medina[1]

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A printed dual-band balanced bandpass filter (BPF) using multilayer technology is proposed in this contribution. The filter is based on the use of two pairs of magnetically coupled open-loop resonators in order to achieve good common-mode suppression without the need of adding additional components to the differential filter. The lower differential passband, centered at the GPS L1 frequency, 1.575 GHz, is created by means of two coupled resonators etched in the middle layer of the structure, while the upper differential passband, centered at 2.4 GHz Wi-Fi frequency, is associated with the resonators printed on the top layer. The use of magnetic coupling provides an intrinsic common-mode rejection mechanism leading to 39 dB insertion loss for the common mode within the lower passband and 33 dB within the upper passband. A prototype has been fabricated and measured that verifies the usefulness of the reported design.

Estructuras de gap Electromagnético (EBG) de altas prestaciones en tecnologías microstrip y coplanar

Clara Máximo Gutiérrez, Alejandro Álvarez Melcón, Félix L. Martínez Viviente, Juan Hinojosa Jiménez

UNIVERSIDAD POLITÉCNICA DE CARTAGENA, España

In this paper, a design technique of high-performance low-pass filters based on electromagnetic bandgap structures (EBG) in microstrip and coplanar (CPW) technology is introduced. The proposed design technique consists of a stepped impedance synthesis, using Chebyshev functions and circular patterns etched in the ground planes of the microstrip and CPW lines. This approach improves the return loss and reduces the ripple in the passband of the traditional EBG- and DGS-based wide stop-band filters. Two fifth-order low-pass filters have been designed, simulated and measured in microstrip and CPW technologies. Both filters were manufactured on a Roger 6010 substrate. A good agreement between simulated and measured results was obtained for these designed filters. Moreover, high-performance in both passband and stopband, and compact size compared with other reported EBG- and DGS- based low-pass filters were obtained.

Divisor de potencia en tecnología microstrip con distribución de amplitud reconfigurable mediante diodos varactores

Carlos Verdejo Dávila, Pablo Sánchez Olivares, Jose Manuel Fernández González
ETSI Telecomunicaciones, UPM, España

A design of a 2-way tunable power divider in microstrip technology is proposed in this contribution. It is formed by two pairs of diode varactors controlled by two independent DC sources. The equivalent capacitance value of the diode can be tuned by controlling its reverse voltage. Every output microstrip line of the power divider is connected to the input line by means of a pair of diodes. Besides, by adjusting the equivalent capacitances of the varactor diodes different power distribution can be achieved, creating a tunable power divider. The proposed design can be used to modify the radiation pattern of an array antenna, reducing the side lobe level or the 3dB beamwidth. An example of some possible configurations in an 8-element array antenna at S-band is also analyzed.

Highly Sensitive Phase Variation Permittivity Sensor Based on a Step Impedance Transmission Line

Jonathan Muñoz-Enano[1], Paris Vélez[1], Marta Gil[2], Ferran Martín[1]
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El artículo presenta un sensor de modo reflexivo altamente sensible útil para mediciones de constantes dieléctricas. El sensor se basa en red de un puerto que consta de una línea de transmisión de 50 Ω de longitud un cuarto de longitud de onda (λ/4) acabada en circuito abierto (línea de detección), en cascada con una sección de línea de transmisión con una impedancia característica menor. El área de detección comprende la línea de transmisión abierta λ/4, con una longitud eléctrica sensible a la presencia de un material de prueba (MUT) encima de esta línea (debido a los efectos de la constante dieléctrica en la velocidad de fase de la línea). La variable de salida es la fase del coeficiente de reflexión a la entrada. En el presente artículo se demuestra que la sensibilidad se optimiza escogiendo la longitud eléctrica de la sección de la línea de transmisión de baja impedancia igual a 90º. Además, la sensibilidad aumenta al reducir la impedancia de dicha línea. Un dispositivo prototipo ha sido diseñado y fabricado. La sensibilidad medida se mejora sustancialmente en comparación con la de una línea uniforme con una longitud y área de detección idénticas.

Highly sensitive dielectric resonator sensor for liquid characterization

Mahdieh Gholami Mayani, Francisco Javier Herraiz Martínez, Javier Matanza Domingo, Romano Giannetti
Comillas Universidad Pontificia, España

This article describes a novel 2 GHz dielectric resonator sensor (DRS). The dielectric resonator is made of ceramic material and is fed by a microstrip transmission line, using the aperture-feeding method. The sensor shows a high quality factor (Q-factor) with an associated high resolution. As a test, the sensor is used in an application for the characterization of liquid solvents such as Glucose and Ethanol at different concentrations.

Lugar: Sala Virtual 1 Viernes, 04/09/2020: 11:00-12:00

Sesión 8.1. Sesión Especial: Collaborative x-Wave Antenna Systems for Integrated Communication and Sensing Wireless Applications II

Presidente de la sesión: Jose-Maria Molina-Garcia-Pardo, Lluís Jofre Roca

Aplicabilidad de modelos teóricos de propagación para entorno urbano en la estimación de las pérdidas a 3.5 GHz en plantaciones de cítricos

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Agriculture 4.0 represents a considerable increase in the number of sensors, as well as the appearance of new wireless technologies, which will mean the need to efficiently planning radio communication systems in agricultural environments. In this work, the applicability of the Walfisch-Bertoni and the Ikegami propagation models that have been used to estimate propagation losses in urban environments, has been studied in citrus plantations. The similarities and differences of the profiles between the transmitter and the receiver, have been analyzed to identify the dominant propagation mechanisms in each case: buildings, in urban environments, and trees, in citrus plantations, assuming that the height of the transmitter is above the height of the trees and the height of the receiver below them. The propagation losses estimated by the models have been compared with the measurements carried out at the 3.5GHz frequency (one of the 5G bands) in a lemon plantation after the fruit was collected. Under these conditions, it has been observed how the slope of the regression line of the measurements has a value of 2.7, far from that obtained by the Walfisch-Bertoni model and closer to the one estimated by the Ikegami model. Furthermore, when analyzing the error between the theoretical and the measured losses, a standard deviation of 6.39dB is observed for the Walfisch-Bertoni model and 4.91dB for the Ikegami model.

R-Band Scale Imaging for Sub-6 GHz Vehicular Antenna Signature Analysis

José Antonio Solano-Pérez[1], María-Teresa Martínez-Ingles[2], José-María Molina-Garcia-Pardo[1], Christian Ballesteros Sánchez[3], Lluís Jofre-Roca[3], Jordi Romeu[3], José-Víctor Rodríguez[1], Antonio Mateo-Aroca[4]

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Next generation of connected and autonomous vehicles will be equipped with high numbers of antennas operating in a wide frequency range for communications and sensing the environment. The study of the 3D spatial angular responses and radiation pattern modified by the vehicular structure will allow a better integration of communication and sensing antennas. The use of near-field monostatic focusing technique, jointly with frequency-dimension scale translation is applied for imaging using the concept of differential imaging to obtain the differential currents. The aim of this paper is to research the capability of obtaining the induced currents using near-field monostatic focusing system, from an analytical and experimental point of view. Measurements, using reference target, were performed in terahertz band, from 220 to 330 GHz. The results show that the induced currents are estimated using this methodology and the influence of the bandwidth is assessed.

Eficiencia de Radiación en Antenas tipo Chip para aplicaciones IoT en 5G

Jaime Molins Benlliure[1], Marta Cabedo Fabrés[1], Eva Antonino Daviu[1], Miguel Ferrando Bataller[1], Jordi Romeu Robert[2], Lluís Jofre Roca[2]

[1]Universitat Politècnica de València; [2]Universitat Politècnica de Catalunya

Se ha realizado un análisis del impacto del tamaño y forma del plano de masa de una PCB sobre la eficiencia de radiación de una antena de pequeño tamaño. Además se aborda la influencia de la posición de la antena como también de las diferentes configuraciones disponibles. Para el análisis se ha diseñado una antena tipo chip para ser fabricada en tecnología LTCC, colocándola en una PCB (FR4). Este estudio trata los puntos clave para poder obtener la máxima eficiencia de radiación en dispositivos de tamaño muy reducido donde se utilizan antenas de pequeño tamaño para las nuevas bandas 5G de IoT (600 MHz-USA, 700 MHz-Europa) y las bandas ISM (868 MHz-Europa, 915 MHz-USA).

Embedded Sensor Transmission Optimization with a X-Wave mini-Anechoic Chamber

Miquel Sellés Valls, Giselle González López, Luis Jofre Roca

Universitat Politècnica de Catalunya, España

The electromagnetic and mechanical design of a measurement set up intended to operate as a X-Wave (microwave, millimeter-wave and terahertz) miniaturized anechoic chamber for small antenna system and embedded device measurement is presented. The transmission coefficient equation between a Reference Antenna (RA) and an Antenna Under Test (AUT) is optimized for the considered scenario. Target applications include but are not limited to measurement of embedded RFID sensors for operation in different ISM bands and mmWave antenna measurement. The design and validation of two RAs, with resonance frequencies 0.892 GHz and 50 GHz is presented, along with a proposed AUT. Numerical validation of the proposed set up is provided by means of analytic and EM simulations at 0.892 GHz and 50 GHz.

Lugar: Sala Virtual 2 Viernes, 04/09/2020: 11:00-12:00

Sesión 8.2. Procesado de Señal: Voz, Imagen, Datos y Comunicaciones

Presidente de la sesión: Fernando Martín Rodríguez, Francisco Javier Hernando Pericas

Ensemble Methods and Input Alternatives for Acoustic Scene Classification Using Convolutional Neural Networks

Sergi Perez-Castanos[1], Javier Naranjo-Alcazar[1,2], Pedro Zuccarello[1], Maximo Cobos[2], Francesc J. Ferri[2]

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Acoustic scene classification (ASC) has been approached in the last years using deep learning techniques such as convolutional neural networks or recurrent neural networks. Many state-of-the-art solutions are based on image classification frameworks and, as such, a 2D representation of the audio signal is considered for training these networks. Finding the most suitable audio representation is still a research area of interest. In this paper, different log-Mel representations and combinations are analyzed. Experiments show that the best results are obtained using the harmonic and percussive components plus the difference between left and right stereo channels, (LR). On the other hand, it is a common strategy to ensemble different models in order to increase the final accuracy. Even though averaging different model predictions is a common choice, an exhaustive analysis of different ensemble techniques has not been presented in ASC problems. In this paper, geometric and arithmetic mean plus the Ordered Weighted Averaging (OWA) operator are studied as aggregation operators for the output of the different models of the ensemble. Finally, the work carried out in this paper is highly oriented towards real-time implementations. In this context, as the number of applications for audio classification on edge devices is increasing exponentially, we also analyze different network depths and efficient solutions for aggregating ensemble predictions.

Detección de Plástico Flotante en Imágenes de Sentinel 2

Fernando Martín Rodríguez

Universidad de Vigo, España

Esta comunicación describe una investigación preliminar sobre la detección de grandes masas de plástico flotante (basura marina) en los océanos y mares usando EO (Earth Observation), esto es: imagen satélite. Usaremos imágenes públicas del satélite Sentinel 2 (proyecto Copernicus). Para desarrollar un reconocedor de plástico, comenzamos con imágenes de un lugar donde podemos encontrar una gran acumulación (plástico "no flotante"): Almería. Hicimos una prueba utilizando índices diferenciales de teledetección, pero obtuvimos resultados mucho mejores utilizando todas las longitudes de onda disponibles (trece bandas de frecuencia) y aplicando redes neuronales a esos vectores de características. Los resultados se utilizarán en el proyecto BEWATS (programa Pleamar 2019, Fundación Biodiversidad, Ministerio de Transición Ecológica y Reto Demográfico) que pretende combinar información tomada en las playas, tanto a pie como con imagen de dron con imagen de satélite e información de corrientes para detectar origen y destino de la contaminación plástica.

Estudio de Robustez en la Identificación de Sensores de Imagen Basada en PRNU

Fernando Martín Rodríguez
Universidad de Vigo, España

En el campo de las imágenes forenses, es importante poder extraer una "huella digital del sensor" de una o un pequeño conjunto de imágenes que sabemos fueron obtenidas por la misma cámara. Idealmente, esa huella digital se usaría para identificar una cámara individual. La huella digital de la cámara se basa en cierto tipo de ruido aleatorio presente en todos los sensores de imagen debido a imperfecciones de fabricación y, por lo tanto, único e imposible de evitar. PRNU (Photo-Response Non-Uniformity) se ha convertido en el método más utilizado para SCI (Source Camera Identification). En esta comunicación, diseñamos un conjunto de "ataques" a un sistema SCI basado en PRNU y medimos el éxito de cada método. Entendemos un método de ataque como cualquier procesamiento que altera mínimamente la calidad de la imagen y que esté diseñado para engañar a los detectores de PRNU (o, en general, cualquier detector de huellas digitales de la cámara). El sistema SCI basado en PRNU se tomó de una referencia destacada que, además, es de dominio público: *http://dde.binghamton.edu/download/camera_fingerprint/*

Experimental Study of the Phase Noise in K-band ARoF systems for Low Complexity 5G receivers

Javier Pérez Santacruz[1,2], Simon Rommel[1], Antonio Jurado Navas[2], Ulf Johannsen[3], Idelfonso Tafur Monroy[1]
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In this paper, an experimental analysis of the phase noise in an OFDM ARoF setup at 25 GHz for beyond 5G is presented. The configuration of the setup allows to gradually scale the final phase noise level of the system. Moreover, an OFDM phase noise mitigation method with low complexity and delay is proposed and explained. The proposed method is an advanced version of the LI-CPE algorithm. The advanced LI-CPE version avoids the one OFDM symbol delay of its antecedent. In addition, the yields of using both methods are shown under different phase noise levels and with different subcarrier spacings. Finally, it is experimentally proven that the proposed method performs better than its previous version.

Sesión 8.3. Sesión Especial: Inteligencia Artificial para Comunicaciones Celulares II

Presidente de la sesión: Raquel Barco Moreno, Sergio Fortes Rodríguez

Sistema de Compensación de Eventos Sociales en Redes Celulares Basado en Balanceo de Carga

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Las redes celulares avanzadas utilizan indicadores clave de rendimiento para resolver problemas bajo el paradigma de las redes auto-organizadas. Sin embargo, debido al entorno dinámico y la movilidad de los usuarios en los escenarios con eventos sociales (por ejemplo, eventos deportivos, conciertos, etc.), para que la red mantenga la calidad de la experiencia del usuario no es suficiente administrarla sobre la base para el análisis de datos entregados por la red celular y el uso de métodos de optimización reactiva. El trabajo presentado es un caso de uso de un sistema de compensación de los efectos generados por eventos sociales basados en parámetros de conciencia de contexto con el objetivo de equilibrar la carga de las celdas de la red a partir de la información sobre el evento. Para su evaluación, se obtienen resultados comparativos entre algoritmos basados exclusivamente en parámetros de red celular y agregando la información de contexto, demostrando las capacidades del sistema y los métodos propuestos.

Una visión basada en QoE para algoritmo MRO en redes LTE

María Luisa Marí Altozano[1], Stephen Mwanje[2], Salvador Luna-Ramírez[1], Matías Toril[1], Carolina Gijón[1]
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Due to the huge increase in traffic and services in mobile networks, network management has changed its main focus from Quality of Service (QoS) to a Quality of Experience (QoE) perspective. In addition, SON (Self organization Networks) techniques have been developed to automate network management, being Mobility Robustness Optimization a key use case. Traditionally, Mobility Robustness Optimization aims to improving Handover performance by reducing too-early, too-late and ping-pong handovers. Nevertheless, these techniques may fail when pursuing maximum user QoE at cell edge. In this work, a novel Mobility Robustness Optimization algorithm is proposed to reach maximum QoE at cell edge in a realistic LTE network with a file download service.

Predicción de métricas de red celular basada en información social

Javier Villegas, Sergio Fortes, Eduardo Baena, Raquel Barco
Universidad de Málaga, España

Recent years have seen a massive increase of mobile network users, which can overwhelm the network capacities if an unexpectedly large amount of devices connect to it at the same time, resulting in lower quality of service. Thus, this makes useful the application of forecasting mechanisms for cellular network management activities. Vast cellular demands and social events are strongly correlated, and these events can be rapidly gathered from Internet sources. Therefore, this paper proposes a model to exploit these resources to make long-term cellular demand prediction.

Estimación de capacidad en redes LTE mediante aprendizaje supervisado

Carolina Gijón Martín, Matías Toril Genovés, Salvador Luna Ramírez, Juan Luis Bejarano Luque, María Luisa Marí Altozano

Universidad de Málaga, España

Network dimensioning is a critical task for cellular operators to avoid degraded user experience and unnecessary upgrades of network resources with changing mobile traffic patterns. For this purpose, smart network planning tools require accurate cell and user capacity estimates. In these tools, throughput is often used as a capacity metric due to its close relationship with user satisfaction. In this work, a comprehensive analysis is carried out to compare different Supervised Learning (SL) algorithms for estimating cell and user throughput in the Down Link (DL) in busy hours from radio measurements collected on a cell basis in the Operation Support System (OSS). To this end, a dataset with the most relevant performance indicators is collected from a Long Term Evolution (LTE) network. Results show that SL algorithms outperform classical multi-variable linear regression approach, achieving an average relative error lower than 10%from only 5 network indicators. kNN and RF show the best results for cell and uses throughput estimation, respectively, when considering the trade-off between model accuracy and storage capacity.

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