URSI'19

XXXIV SIMPOSIUM NACIONAL DE LA UNIÓN CIENTÍFICA INTERNACIONAL DE RADIO

SEVILLA, 4 al 6 de septiembre de 2019

LIBRO DE RESÚMENES

U.R.S.I.

Escuela Técnica Superior de INGENIERÍA DE SEVILLA

UNIVERSIDAD DE SEVILLA

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ORGANIZAN

UNIVERSIDAD DE SEVILLA

Escuela Técnica Superior de INGENIERÍA DE SEVILLA

PATROCINAN

KEYSIGHT TECHNOLOGIES

ROHDE&SCHWARZ

puebla oliva

Índice general

1 | Bienvenida del Comité Organizador

BIENVENIDA DEL COMITÉ ORGANIZADOR

Es un gran placer y honor dar la bienvenida a todos los participantes en el XXXIV Simposio Nacional de la Unión Científica Internacional de Radio (URSI 2019) que se celebra en la Escuela Técnica Superior de Ingeniería de la Universidad de Sevilla. Esta edición ha sido organizada por el Grupo de Sistemas de Radiocomunicación, el Grupo de Ingeniería Biomédica, ambos pertenecientes al Departamento de Teoría de la Señal y Comunicaciones, y el Grupo de Microondas, perteneciente al Departamento de Electrónica y Electromagnetismo. Al igual que en ediciones previas, hemos pretendido que la URSI sea 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 son el electromagnetismo, los sistemas radiantes y de radiocomunicación, física e ingeniería electrónica, tratamiento digital de señales y/o ingeniería telemática, con el objetivo de constituirse en el foro técnico de referencia nacional para el sector de las telecomunicaciones, así como fomentar la colaboración entre investigadores y tecnólogos de las universidades y empresas del sector.

La presente edición de URSI es un reflejo del panorama tecnológico actual en su campo, que está marcado, por un lado, por la irrupción de la tecnología 5G y, por otro, por el impacto de las técnicas aditivas en la fabricación de componentes de alta frecuencia. Prueba de ello es el número de contribuciones recibidas que se centran en los nuevos estándares de comunicaciones inalámbricas desde diversas perspectivas, incluyendo las aportaciones a los sistemas radiantes, caracterización del canal en bandas milimétricas, o a gestión de redes 5G y, por otra parte, la aplicación de técnicas de impresión 3D para la implementación de componentes. El programa científico de URSI 2019 consta de 32 sesiones, en las que junto a áreas temáticas tradicionales como antenas, componentes y circuitos, comunicaciones móviles e inalámbricas, educación, fotónica y dispositivos ópticos, procesado de señal, telemática, etc, se han organizado sesiones especiales que atienden a temáticas como arquitecturas amplificadoras de alta eficiencia y linealización de amplificadores, electromagnetismo computacional, modelado y simulación de circuitos no-lineales, sensorización, procesado de señales cerebrales, reflectarrays, transmitarrays y estructuras periódicas, técnicas y tecnologías de fabricación para antenas y dispositivos de RF, y tecnologías en milimétricas y terahercios para comunicaciones. Dentro del sector espacial, URSI 2019 acoge la IV edición de la sesión especial Comunicaciones por Satélite, que contará con la participación de destacadas personalidades de la industria, y una sesión especial sobre componentes pasivos de alta frecuencia para aplicaciones espaciales. El programa se completa con la sesión de finalistas al Premio Jóvenes Científicos y tres ponencias plenarias a cargo de los profesores Almudena Suárez, Karu Esselle y Ángel Rodríguez Vázquez.

Quiero agradecer a los miembros del Comité Científico y del panel de revisores su trabajo y compromiso para la evaluación de las 192 contribuciones recibidas, a los presidentes de

sesión, a los organizadores de sesiones especiales y a los conferenciantes invitados por su dedicación y esfuerzo, y una mención particular a los autores por la calidad de sus trabajos. También agradecer a los patrocinadores la ayuda dispensada y especialmente a la dirección de la Escuela Técnica Superior de Ingeniería las muestras de apoyo y facilidades que nos ha dado en todo momento para acoger esta edición de URSI. Igualmente agradecemos el apoyo de la Universidad de Sevilla.

Para finalizar, es un inmenso placer daros la bienvenida a Sevilla como ciudad de acogida de URSI 2019. Esperamos que, a pesar de la intensidad de las jornadas científicas, los participantes puedan disfrutar de su historia, hospitalidad y actividad cultural. El programa social que se ha diseñado, que incluye visita guiada a los Reales Alcázares, pretende dar una buena muestra de ello. Os deseo una fructífera estancia en Sevilla que aliente el debate, permita el intercambio de experiencias y abra nuevas posibilidades de colaboración.

Saludos cordiales,

Javier Reina Tosina
Presidente del Comité Organizador de URSI 2019

2 | Organización

ORGANIZACIÓN

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Universidad de Sevilla

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INFORMACIÓN GENERAL

UNIVERSIDAD DE SEVILLA

La Universidad de Sevilla es una institución pública de educación superior con más de cinco siglos de historia. Su Estatuto fue aprobado en 2003 y en 2010 fue reconocida como Campus de Excelencia Internacional. En la actualidad su actividad se desarrolla a través de 133 departamentos universitarios y 32 centros universitarios, en los que se imparte docencia de 99 titulaciones de grado, 96 másteres de posgrado oficial y 32 programas de doctorado. Con un modelo de Campus integrado en la ciudad de Sevilla, se despliega en varias zonas urbanas, contribuyendo a la vertebración de la capital andaluza.

Con datos referidos al curso académico 2017-18, su comunidad universitaria está formada por más de 70000 personas, tamaño que representa la segunda posición en número de estudiantes y la cuarta en personal docente e investigador de las universidades públicas presenciales a nivel nacional.

Sede del Rectorado de la Universidad de Sevilla.

El Centro con mayor número de alumnos de la Universidad de Sevilla es la Escuela Técnica Superior de Ingeniería (ETSI), emplazada en el campus Cartuja, y sede de URSI 2019. Su actividad investigadora capta aproximadamente el 25% de la financiación de proyectos nacionales en la Universidad de Sevilla y más del 40% de la financiación de proyectos de I+D privados. Está ubicada en la Isla de la Cartuja, en el que fuera el pabellón de América durante la Exposición Universal de 1992. Se sitúa frente al Estadio Olímpico de Sevilla y junto al parque temático Isla Mágica, a unos 30 minutos a pie del centro de la ciudad, entrando por el puente de la Barqueta. Está comunicado por autobús con las líneas C1 y C2, que disponen de parada en la estación de Santa Justa, destino final del tren de alta velocidad (AVE) procedente de Córdoba, Madrid y Málaga. Situada a 16 minutos del aeropuerto de San Pablo. Todos los accesos por carretera confluyen en la ronda de circunvalación SE-30, que pasa por el puente del Alamillo, ya próximo a la Escuela.

ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA

Se crea en diciembre de 1963, por el Decreto Ley 3608/63 bajo el patrocinio de la Organización para la Cooperación y el Desarrollo Económico (OCDE). La Escuela se inauguró oficialmente en abril de 1967. En marzo de 1972 sale la primera promoción de la Escuela. El plan OCDE se declara a extinguir en el año 1976, adoptándose el plan de estudios 1964, vigente en las demás escuelas del país. En aquel entonces se otorgaban los títulos de Ingeniero Industrial, pudiéndose cursar las especialidades de Eléctrica, Mecánica, Organización y Química, y de Doctor Ingeniero Industrial.

En el Curso 1991-92, la Escuela comienza la impartición de los estudios de Ingeniería de Telecomunicación. En el curso 1994-95 se imparte por primera vez el segundo ciclo de esta titulación, pudiéndose cursar las especialidades o intensificaciones de señales y radiocomunicación, telemática, electrónica y control de procesos. En el año 2001 se comienza a impartir la titulación de Ingeniería Aeronáutica.

Edificio principal de la Escuela Técnica Superior de Ingeniería de Sevilla.

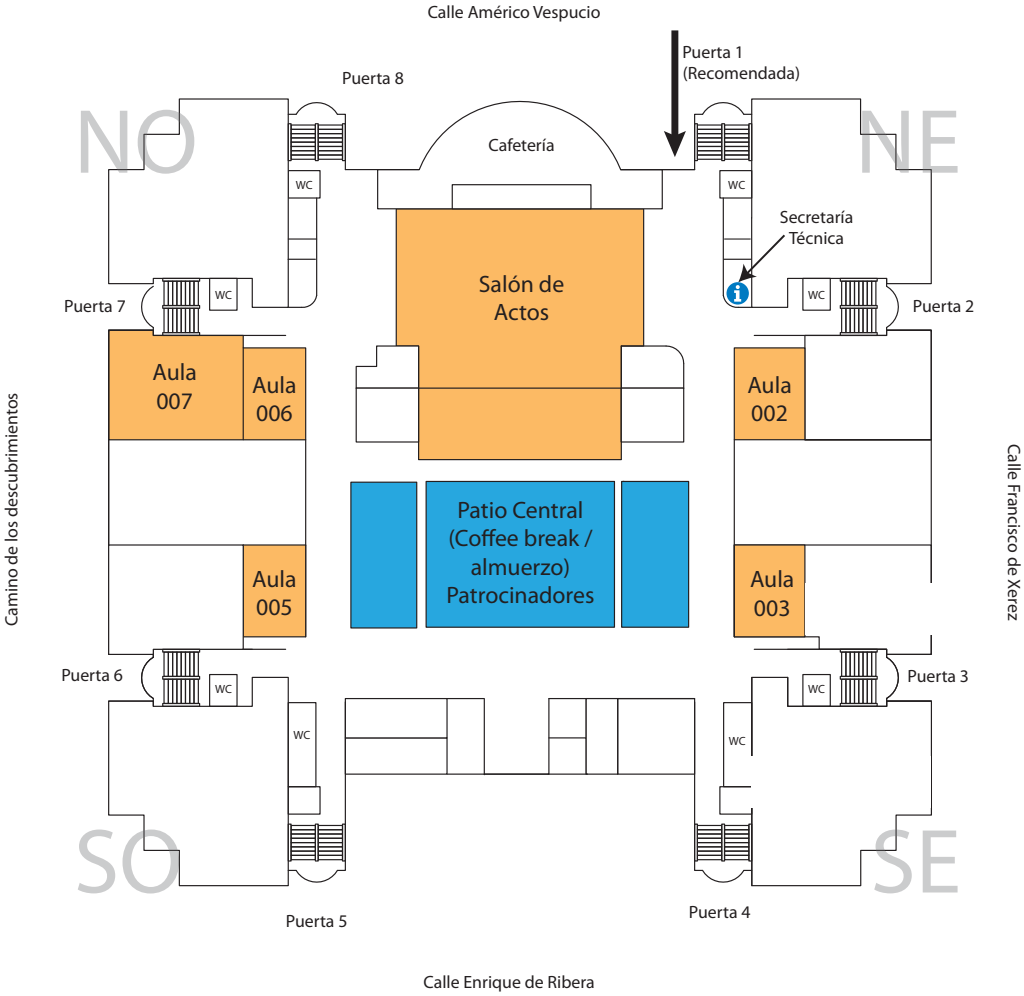
Actualmente se imparten 8 titulaciones de grado (Grado en Ingeniería de las Tecnologías Industriales, Grado en Ingeniería de las Tecnologías de Telecomunicación, Grado en Ingeniería Química, Grado en Ingeniería Aeroespacial, Grado en Ingeniería Civil, Grado en Ingeniería de la Energía, Grado en Ingeniería Electrónica, Robótica y Mecatrónica y Grado en Ingeniería de Organización Industrial), 11 titulaciones de máster (Máster en Ingeniería Industrial, Máster en Ingeniería de Telecomunicación, Máster en Ingeniería Química, Máster en Ingeniería Aeronáutica, Máster en Ingeniería de Caminos, Canales y Puertos, Máster en Sistemas de Energía Eléctrica, Máster en Electrónica, Robótica y Automática, Máster en Diseño Avanzado en Ingeniería Mecánica, Máster en Organización Industrial y Gestión de Empresas, Máster en Ingeniería Ambiental y Máster en Sistemas de Energía Térmica) y 4 programas de doctorado (Ingeniería Automática, Electrónica y de Telecomunicación, Ingeniería Energética, Química y Ambiental, Ingeniería Mecánica y de Organización Industrial y Sistemas de Energía Eléctrica).

A lo largo de sus más de 50 años de existencia la Escuela ha ido alcanzando su madurez, formando a los más de 13000 titulados que han salido de sus aulas, numerosos doctores, profesores, etc. Se han establecido cauces para la relación y colaboración con

otras universidades nacionales y extranjeras, tanto de profesores como de alumnos. Nuestra Escuela cuenta en la actualidad con más de 6000 alumnos, de los cuales egresan anualmente una media de 700, que son formados por 480 docentes. La calidad de la actividad desarrollada en este centro se pone de manifiesto en que trece áreas académicas con participación de la ETSI están consideradas en posiciones relevantes según el Ranking de Shanghai 2018, incluyendo Electrical and Electronic Engineering (entre las 150 primeras).

SEDE URSI 2019. EDIFICIO ETSI

La sede de URSI 2019 es la planta baja de la Escuela Técnica Superior de Ingeniería de la Universidad de Sevilla, ubicada en Camino de los Descubrimientos, s/n. 41092, Sevilla.


Calle Américo Vespucio
Puerta 1
(Recomendada)
Puerta 8
NO
NE
Cafetería
WC
Secretaría
Técnica
Salón de
Actos
Puerta 7
Puerta 2
Aula
007
Aula
006
Aula
002
Camino de los descubrimientos
Calle Francisco de Xerez
Patio Central
(Coffee break /
almuerzo)
Patrocinadores
Aula
005
Aula
003
Puerta 6
Puerta 3
SO
SE
Puerta 5
Puerta 4
Calle Enrique de Ribera

3 | Programa

Miércoles, 04/09/2019					
8:00 - 9:30	**Acreditación** *Acceso puerta 1 edificio ETSI*				
9:30 - 11:00	**Sesión 1.1**: Telemática *Aula 002*	**Sesión 1.2**: Sesión especial - Avances en el procesado de señales cerebrales *Aula 003*	**Sesión 1.3**: Sesión especial - Comunicaciones por Satélite (I) *Aula 005*	**Sesión 1.4**: Aplicaciones Biomédicas *Aula 006*	**Sesión 1.5**: Metamateriales *Aula 007*
11:00 - 11:30	**Pausa para Café** *Patio central planta baja edificio ETSI*				
11:30 - 11:50	**Acto de Apertura del Congreso URSI 2019** *Salón de Actos*				
11:50 - 12:40	**Conferencia Plenaria (Profª. Almudena Suárez)** *Salón de Actos*				
12:45 - 14:00	**Sesión 2.1**: Radiación, Dispersión y Radiopropagación (I) *Aula 002*	**Sesión 2.2**: Comunicaciones Móviles e Inalámbricas (I) *Aula 003*	**Sesión 2.3**: Sesión especial - Avances en modelado y simulación de circuitos no-lineales *Aula 005*	**Sesión 2.4**: Sesión especial - Electromagnetismo Computacional (I) *Aula 006*	**Sesión 2.5**: Sesión especial - Técnicas y tecnologías de fabricación para antenas y dispositivos de RF (I) *Aula 007*
14:00 - 15:30	**Almuerzo de Trabajo** *Patio central planta baja edificio ETSI*				
15:30 - 17:30	**Sesión 3.1**: Radiación, Dispersión y Radiopropagación (II) *Aula 002*	**Sesión 3.2**: Comunicaciones Móviles e Inalámbricas (II) *Aula 003*	**Sesión 3.3**: Sesión especial - Comunicaciones por Satélite (II) y Mesa Redonda *Aula 005*	**Sesión 3.4**: Sesión especial - Electromagnetismo Computacional (II) *Aula 006*	**Sesión 3.5**: Sesión especial - Técnicas y tecnologías de fabricación para antenas y dispositivos de RF (II) *Aula 007*

Jueves, 05/09/2019					
8:00 - 9:00	**Acreditación** *Acceso puerta 1 edificio ETSI*				
9:00 - 9:55	**Sesión Patrocinadores** *Aula 007*				
10:00 - 10:50	**Conferencia Plenaria (Prof. Karu Esselle)** *Salón de Actos*				
10:50 - 11:20	**Pausa para Café** *Patio central planta baja edificio ETSI*				
11:20 - 13:05	**Sesión 4.1**: Fotónica y Dispositivos Ópticos *Aula 002*	**Sesión 4.2**: Comunicaciones Móviles e Inalámbricas (III) *Aula 003*	**Sesión 4.3**: Radar y Radioastronomía *Aula 005*	**Sesión 4.4**: Premio Jóvenes Científicos URSI 2019 *Aula 006*	**Sesión 4.5**: Componentes y Circuitos Pasivos (I) *Aula 007*
13:10 - 14:00	**Asamblea Plenaria URSI** *Salón de Actos*				
14:00 - 15:30	**Almuerzo de Trabajo** *Patio central planta baja edificio ETSI*				
15:30 - 17:30	**Sesión 5.1**: Nuevas tendencias en IoT y Smart Spaces *Aula 002*	**Sesión 5.2**: Procesado de Señal: Voz, Imagen y Datos *Aula 003*	**Sesión 5.3**: Sesión especial - Tecnologías en Milimétricas y Terahercios para Comunicaciones y Sensorización *Aula 005*	**Sesión 5.4**: Antenas *Aula 006*	**Sesión 5.5**: Componentes y Circuitos Pasivos (II) *Aula 007*

Viernes, 06/09/2019				
8:00 - 9:00	**Acreditación** *Acceso puerta 1 edificio ETSI*			
9:00 - 10:30	**Sesión 6.1**: Sesión especial - Arquitecturas amplificadoras de alta eficiencia y linealización de amplificadores (I) *Aula 005*	**Sesión 6.2**: Sesión especial - Reflectarrays, Transmitarrays and Periodic Structures (I) *Aula 006*	**Sesión 6.3**: Sesión especial - Componentes pasivos de alta frecuencia para aplicaciones espaciales (I) *Aula 007*	**Sesión 6.4**: Educación: Nuevas Tecnologías y Herramientas *Aula 003*
10:30 - 11:15	**Pausa para Café** *Patio central planta baja edificio ETSI*			
11:15 - 12:45	**Sesión 7.1**: Sesión especial - Arquitecturas amplificadoras de alta eficiencia y linealización de amplificadores (II) *Aula 005*	**Sesión 7.2**: Sesión especial - Reflectarrays, Transmitarrays and Periodic Structures (II) *Aula 006*	**Sesión 7.3**: Sesión especial - Componentes pasivos de alta frecuencia para aplicaciones espaciales (II) *Aula 007*	
12:50 - 13:40	**Conferencia Plenaria (Prof. Ángel Rodríguez Vázquez)** *Salón de Actos*			
13:40 - 14:10	**Acto de Clausura del Congreso URSI 2019** *Salón de Actos*			
14:15 - 16:00	**Almuerzo de Trabajo** *Patio central planta baja edificio ETSI*			

4 | Conferencias Plenarias

Conferencia Plenaria

Análisis de circuitos innovadores basados en osciladores para radar, RFID y sistemas reconfigurables

Profª. Almudena Suárez Rodríguez
Grupo de Ingeniería de Microondas y Radiocomunicaciones
Universidad de Cantabria, España
Miércoles, 04/09/2019
Hora: 11:50 - 12:40. **Lugar**: Salón de Actos
Presidente de la sesión: Carlos Crespo Cadenas (Universidad de Sevilla)
Presidenta de la sesión: María José Madero Ayora (Universidad de Sevilla)

Almudena Suárez es la directora del grupo de investigación Ingeniería de Microondas y Radiocomunicaciones de la Universidad de Cantabria. Es “Fellow” del IEEE desde 2012 y fue “IEEE Distinguished Microwave Lecturer” en el periodo 2006-2008. Ha publicado 82 artículos en revistas del IEEE y 57 en IEEE T-MTT. Es autora del libro "*Analysis and Design of Autonomous Microwave Circuits*", Wiley-IEEE Press, 2009. Almudena Suárez fue coordinadora del área de Tecnología Electrónica y de Comunicaciones (TEC) de la Agencia Nacional de Evaluación y Prospectiva (ANEP) entre 2009 y 2013. Fue presidenta del congreso IEEE Topical Conference on Power Amplifiers (PAWR) en 2014 y 2015 y General TPC Chair de la European Microwave Week de 2018. Es miembro del Board of Directors (BoD) de la European Microwave Association (EuMA). Es actualmente “Publication Chair” de EuMA. Ha impartido numerosas conferencias invitadas en Europa, Estados Unidos y Asia y múltiples cursos cortos asociados al IEEE International Microwave Symposium y otros congresos de IEEE.

RESUMEN

En la presentación se mostrarán avances en el análisis y diseño de circuitos compactos y de bajo consumo para radar de bajo coste, RFID y sistemas reconfigurables. Las nuevas topologías aprovechan la capacidad de los circuitos osciladores de combinar la generación

de señal con otras funciones, como el mezclado de frecuencia o el desfasaje. Sin embargo, esta compactación de funciones incrementa la complejidad de operación, ya que deben satisfacerse simultáneamente varias condiciones matemáticas en un sistema de carácter autónomo. Entre los circuitos analizados se encuentra el radar auto-inyectado, en el que la señal transmitida por un oscilador es reflejada por un blanco en movimiento y reinyectada en el mismo oscilador con una modulación de fase, inducida por dicho movimiento. Se considerarán también lectores RFID compactos y de bajo costo. La señal del oscilador, controlada mediante un generador de rampa, es transmitida por la antena y la variación en la impedancia de carga equivalente, inducida por los resonadores que implementan la secuencia de bits de la etiqueta, da lugar a una modulación de frecuencia, fácilmente detectable. En la conferencia se presentará una nueva metodología de análisis de estos circuitos que utiliza un modelo de oscilador extraído de simulaciones de balance armónico y expresiones analíticas intuitivas para la descripción matemática de la interacción del oscilador con el entorno. Otro ejemplo de implementaciones compactas son las basadas en osciladores súper-regenerativos, capaces de reemplazar costosas cadenas amplificadoras en receptores utilizando los altos valores de ganancia que permite el crecimiento exponencial inicial de la oscilación. Se presentará un método de análisis basado en la extracción de una función de transferencia lineal y variante en el tiempo, definida en el dominio de la envolvente. Finalmente, se considerará el caso de los osciladores reconfigurables sin conmutador, con interés en sistemas de comunicación multibanda.

Conferencia Plenaria

Many names, many advantages – Are resonant cavity antennas the killer planar space-saving approach to get 15-25 dBi gain?

Prof. Karu Esselle
Macquarie University, Australia
Jueves, 05/09/2019
Hora: 10:00 - 10:50. **Lugar**: Salón de Actos
Presidente de la sesión: Rafael Rodríguez Boix (Universidad de Sevilla)
Presidente de la sesión: Francisco Medina Mena (Universidad de Sevilla)

Professor Karu Esselle, IEEE 'M (1992), SM (1996), F (2016), received BSc degree in electronic and telecommunication engineering with First Class Honours from the University of Moratuwa, Sri Lanka, and MASc and PhD degrees in electrical engineering from the University of Ottawa, Canada. He is a Professor of Electronic Engineering, Macquarie University, Sydney, Past Director of WiMed Research Centre and Past Associate Dean – Higher Degree Research (HDR) of the Division of Information and Communication Sciences. He has also served as a member of the Dean's Advisory Council and the Division Executive and as the Head of the Department several times. In 2018, he has been selected to chair the prestigious Distinguished Lecturer Program Committee of the IEEE Antennas and Propagation (AP) Society and in 2019 he was re-selected for the same position. After two stages in the selection process, Karu was also selected by this Society as one of two candidates in the ballot for 2019 President of the Society. Karu is also one of the three Distinguished Lecturers (DL) selected by the Society in 2016. Karu is also the Chair of the Board of management of Australian Antenna Measurement Facility, and was the elected Chair of both IEEE New South Wales (NSW), and IEEE NSW AP/MTT Chapter, in 2016 and 2017. He directs the Centre for Collaboration in Electromagnetic and Antenna Engineering. Karu was elevated to IEEE Fellow grade for his contributions to resonance-based antennas. He is also a Fellow of Engineers Australia.

Karu has authored approximately 600 research publications and his papers have been

cited about 8,000 times. He is the first Australian antenna researcher ever to reach Google Scholar h-index of 30 and his current i10 index (158 in May 2019) and h-index (41 in May 2019) is often among the top Australian antenna researchers. Since 2002, his research team has been involved with research grants, contracts and PhD scholarships worth over 18 million dollars, including 15 Australian Research Council grants. His research has been supported by many national and international organisations including Australian Research Council, Intel, US Air Force, Cisco Systems, Hewlett-Packard, Australian Department of Defence, Australian Department of industry, and German and Indian governments.

Karu is in the College of Expert Reviewers of the European Science Foundation (2019-22) and he has been invited to serve as an international expert/research grant assessor by several other research funding bodies as well, including European Research Council and national agencies in the Netherlands, Canada, Finland, Hong-Kong, Georgia, South Africa and Chile. He has been invited by Vice-Chancellors of Australian and overseas universities to assess applications for promotion to professorial levels.

Karu's awards include 2019 Motohisa Kanda Award for the most cited paper in IEEE Transactions EMC in the past five years, 2019 ARC Discovery International Award, 2017 Excellence in Research Award from the Faculty of Science and Engineering, 2017 Engineering Excellence Award for Best Innovation, 2017 Certificate of Recognition from IEEE Region 10, 2016 and 2012 Engineering Excellence Awards for Best Published Paper from IESL NSW Chapter, 2011 Outstanding Branch Counsellor Award from IEEE headquarters (USA), 2009 Vice Chancellor's Award for Excellence in Higher Degree Research Supervision and 2004 Innovation Award for best invention disclosure. His mentees have been awarded many fellowships, awards and prizes for their research achievements. Forty-eight international experts who examined the theses of his recent PhD graduates ranked them in the top 5% or 10%.

Karu has provided expert assistance to more than a dozen companies including Intel, Hewlett Packard Laboratory (USA), Cisco Systems (USA), Audacy (USA), Cochlear, Optus, ResMed and Katherine-Werke (Germany). He is an Associate Editor of IEEE Transactions on Antennas Propagation as well as IEEE Access.

ABSTRACT

No other antenna concept has more names. At present these antennas are known as Fabry-Perot cavity resonator antennas, Partial Reflector Surface (PRS) based antennas, Electromagnetic Band Gap (EBG) Resonator antennas (ERAs) and Two-Dimensional Leaky-Wave Antennas, and more names are forthcoming. Yet they all have more or less the same configuration consisting of a resonant cavity, formed between a partially reflecting superstructure and a fully reflecting (ground) plane. The resonant cavity is excited by a small feed antenna. Hence, they are referred to as resonant cavity antennas (RCAs) in this

presentation. Since the concept of using a “partially reflecting sheet array” superstructure to significantly enhance the directivity was disclosed by Trentini in 1956, it has been an attractive concept to several antenna researchers for several reasons, including its theoretical elegance, relationships to other well-researched area such as leaky-waves, EBG, frequency selective surfaces and metasurfaces, and practical advantages as a low-cost simple way to achieve high-gain (15-25 dBi) from an efficient planar antenna without an array, which requires a feed network. The RCA concept is one of the main beneficiaries of the surge of research on electromagnetic periodic structures in the last decade, first inspired by EBG and then to some extent by metamaterials. As a result, RCAs gained a tremendous improvement in performance in the last 10 years, in addition to other advantages such as size reduction. As an example, achieving 10% gain bandwidth from such an antenna with a PSS was a major breakthrough in 2006 but now there are prototypes with gain bandwidths greater than 50%. Until recently most RCAs required an area in the range of 25-100 square wavelengths but the new extremely wideband RCAs are very compact, requiring only 1.5-2 square wavelengths at the lowest operating frequency. Once limited to a select group of researchers, these advantages have attracted many new researchers to RCA research domain, and the list is growing fast, as demonstrated by the diversity of authors in recent RCA publications. RCAs have already replaced other types of antennas, for example as feeds for reflectors. Several methods have been developed to steer the beam of RCAs. Have they become the killer planar alternative to 3D antennas such as horns and small reflectors? What is the difference between RCS and lens antennas? Will RCAs make lens antennas redundant? Starting from historical achievements of RCA technology, this keynote presentation will take the audience through various aspects and developments of RCA technology, while attempting to answer aforementioned questions. It will conclude with a illustration of a new highly-efficient, low-cost method to steer the beam of an RCA over a wide angular range in both azimuth and elevation planes, which is applicable to not only RCAs but also any aperture-type medium- or high-gain antenna with a fixed beam.

Conferencia Plenaria

Time-based Smart Sensory Systems

Prof. Ángel Rodríguez-Vázquez
Universidad de Sevilla
Viernes, 06/09/2019
Hora: 12:50 - 13:40. **Lugar**: Salón de Actos
Presidente de la sesión: Javier Reina Tosina (Universidad de Sevilla)
Presidente de la sesión: Francisco Medina Mena (Universidad de Sevilla)

Ángel Rodríguez-Vázquez (IEEE Fellow, 1999) received the Ph.D. degree in Physics-Electronics (Universidad de Sevilla, 1982) with several awards, including the IEEE Rogelio Segovia Torres Award (1981). After stays in University of California-Berkeley and Texas A&M University he became a Full Professor of Electronics at the University of Sevilla in 1995.

He co-founded the Instituto de Microelectrónica de Sevilla, a joint undertaken of Consejo Superior de Investigaciones Científicas (CSIC) and Universidad de Sevilla, and started a Lab on Analog and Mixed-Signal Circuits for Sensors and Communications.

In 2001, he was the main promotor of AnaFocus Ltd. and served it as CEO until June 2009, when the company reached maturity as a worldwide provider of smart CMOS imagers. He also participated in the foundation of the Hungarian start-up AnaLogic Ltd. He has nine patents filed; AnaFocus was founded on the basis of his patents on vision chip architectures. He was recipient of the 1st Technology Transfer award of the University of Sevilla.

His R&D production includes three generation of vision chips, analog front-ends for XDSL MoDems, ADCs for wireless communications, ADCs for automotive sensors, complete MoDems for power-line communications, among many other mixed-signal SoCs. Many of these chips were state-of-the-art in their respective fields. Some of them entered massive production. He also produced teaching materials on data converters that were delivered to companies and got the Quality Label of EuroPractice.

He has served and is currently serving as Editor, Associate Editor and Guest Editor for different IEEE and non-IEEE journals; he is in the committee of many international journals and conferences; and has chaired different international IEEE and SPIE conferences. Among others he has served as: TPC chair of IEEE ESSCIRC 1992 and 2010; General Chair of IEEE NDES 1996, IEEE CNNA 1996, IEEE ECCTD 2007 and IEEE ESSDERC-ESSCIRC 2010 and IEEE ICECS 2012. He served as VP Region 8 of IEEE CASS (2009-2012) and as Chair of the IEEE CASS Fellow Evaluation Committee (2010, 2012, 2013, 2014, and 2015). He has been appointed General Chairman of IEEE ISCAS 2020.

His publications have some 9,500 citations and several awards: the IEEE Guillemin-Cauer Best Paper Award, two Wiley's IJCTA Best Paper Awards, two IEEE ECCTD Best Paper

Awards, one IEEE-ISCAS Best Paper Award, one SPIE-IST Electronic Imaging Best Paper Award, the IEEE ISCAS Best Demo-Paper Award, and the IEEE ICECS Best Demo-Paper Award. He has been awarded the 2019 Mac Van Valkenburg award of IEEE-CASS and has been elected member of the Academia Europaea since 2019.

ABSTRACT

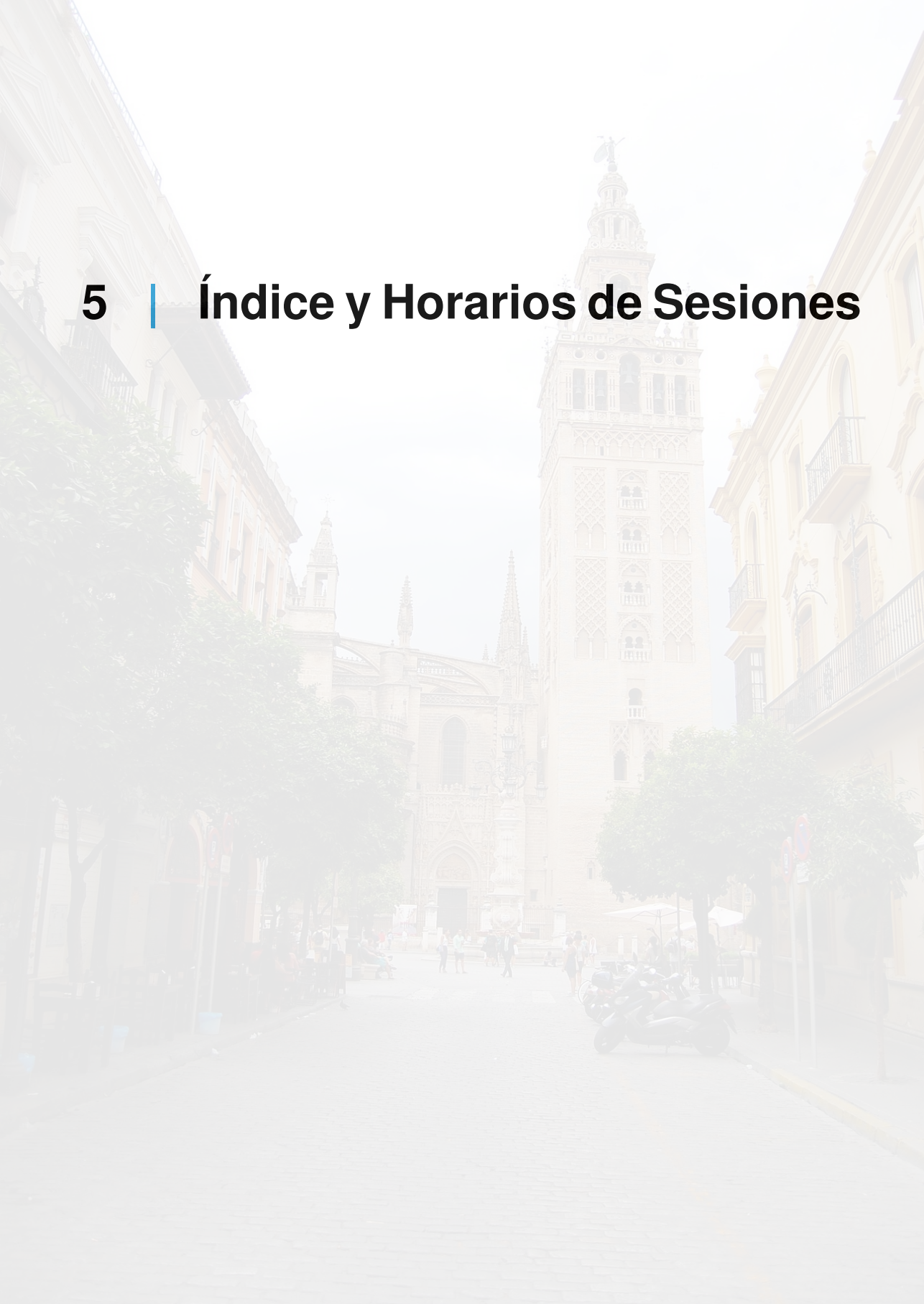
The seminal book of James Clerk Maxwell, "*A Treatise on Electricity and Magnetism*", first published in 1873, described how to emulate a resistor by using one capacitor and a set of switches controlled by a clock signal. This way, the resistance value happens to be directly proportional to the period of the clock, and inversely proportional to the capacitance. Roughly one century later, in the 1980s, this idea was a keystone for the accurate and robust implementation of miniaturized, sophisticated systems using micro-electronic circuits and technologies. Actually, this Maxwell's idea underlies the operation of high-fidelity audio reproduction systems, high-speed wireline communication modems, high-resilience automotive sensors, and high-resolution image sensors, among many other ITC wonders.

The main asset of Maxwell's idea emerges when one comes to the implementation of systems described by differential equations, as it is the case for most front-ends of modern micro-electronic systems. The operation of these systems as signal processors is controlled by time constants, which are primarily defined by the products of resistances and capacitances values. Because resistors and capacitors are fabricated using uncorrelated processes, RC products are subjected to large errors. However, if resistors are replaced by switched-capacitors, following Maxwell's idea, time constant values happen to be proportional to time, specifically to the period of a clock signal, and can hence be easily and accurately tuned. The precise implementation of dynamic equations is enabled this way. Also, systems based on capacitive-emulated resistors are more linear and more compact than other technological alternatives based on purely resistive v-i conversion.

This is just one example of many cases where the time variable is employed in smart sensory systems. For instance, time-coding, i.e. the representation of the information through time-related events, is today's employed to address challenges emerging due to the reduction of the dynamic range in deep-submicron micro-technologies. Also, time-coding is extensively employed by natural, information-processing systems; and these systems have evolved for some 4 billion years to develop extremely fast and energy-efficient sensory processing abilities. Furthermore, unveiling the intricate secrets of physics calls for systems capable to resolve events happening in the range of few psecs.

This lecture overviews some basic concepts, methods and applications related to the generation, control and applications of time in micro-electronic systems. Whenever possible and convenient, examples corresponding to accomplishments made by the research group of the lecturer will be used for illustration purposes.

5 | Índice y Horarios de Sesiones



SESIÓN 1 Miércoles, 04/09/2019 09:30 - 11:00

Sesión 1.1 Telemática

Lugar: **Aula 002**
Presidenta de la sesión: **Isabel Román Martinez** (Universidad de Sevilla)
Presidente de la sesión: **Antonio J. Sierra Collado** (Universidad de Sevilla)

Sesión 1.2 Sesión especial - Avances en el procesado de señales cerebrales

Lugar: **Aula 003**
Presidente de la sesión: **Sergio Cruces** (Universidad de Sevilla)
Presidente de la sesión: **Rubén Martín Clemente** (Universidad de Sevilla)

Sesión 1.3 Sesión especial - Comunicaciones por Satélite (I)

Lugar: **Aula 005**
Presidente de la sesión: **Miguel Calvo Ramón** (Universidad Politécnica de Madrid)
Presidente de la sesión: **Miguel A. Salas-Natera** (Universidad Politécnica de Madrid)

Sesión 1.4 Aplicaciones Biomédicas

Lugar: **Aula 006**
Presidenta de la sesión: **Carmen Serrano Gotarredona** (Universidad de Sevilla)
Presidente de la sesión: **David Naranjo Hernández** (Universidad de Sevilla)

Sesión 1.5 Metamateriales

Lugar: **Aula 007**
Presidente de la sesión: **Miguel Beruete Díaz** (Universidad Pública de Navarra)
Presidenta de la sesión: **Elena Abdo Sánchez** (Universidad de Málaga)

SESIÓN 2 Miércoles, 04/09/2019 12:45 - 14:00

Sesión 2.1 Radiación, Dispersión y Radiopropagación (I)

Lugar: **Aula 002**
Presidente de la sesión: **Lorenzo Rubio Arjona** (Universitat Politècnica de València)

Sesión 2.2 Comunicaciones Móviles e Inalámbricas (I)

Lugar: **Aula 003**
Presidente de la sesión: **José Ignacio Alonso Montes** (Universidad Politécnica de Madrid)
Presidenta de la sesión: **Matilde Sánchez Fernández** (Universidad Carlos III de Madrid)

Sesión 2.3 Sesión especial - Avances en modelado y simulación de circuitos no-lineales

Lugar: **Aula 005**
Presidenta de la sesión: **Almudena Suárez Rodríguez** (Universidad de Cantabria)
Presidente de la sesión: **Juan-Mari Collantes** (Universidad del País Vasco)

Sesión 2.4 Sesión especial - Electromagnetismo Computacional (I)

Lugar: **Aula 006**
Presidente de la sesión: **Valentín de la Rubia Hernández** (Universidad Politécnica de Madrid)
Presidente de la sesión: **Juan Manuel Rius Casals** (Universitat Politècnica de Catalunya (BarcelonaTECH))

Sesión 2.5 Sesión especial - Técnicas y tecnologías de fabricación para antenas y dispositivos de RF (I)

Lugar: **Aula 007**
Presidente de la sesión: **Pablo Padilla de la Torre** (Universidad de Granada)
Presidente de la sesión: **José Luis Masa Campos** (Universidad Autónoma de Madrid)

SESIÓN 3 — Miércoles, 04/09/2019 15:30 - 17:30

Sesión 3.1 Radiación, Dispersión y Radiopropagación (II)

Lugar: **Aula 002**
Presidente de la sesión: **Leandro Juan-Llácer** (Universidad Politécnica de Cartagena)
Presidente de la sesión: **Luis Mendo Tomás** (Universidad Politécnica de Madrid)

Sesión 3.2 Comunicaciones Móviles e Inalámbricas (II)

Lugar: **Aula 003**
Presidenta de la sesión: **Ana María Torres Aranda** (Universidad de Castilla-La Mancha)
Presidenta de la sesión: **Isabel de la Bandera Cascales** (Universidad de Málaga)

Sesión 3.3 Sesión especial - Comunicaciones por Satélite (II) y Mesa Redonda

Lugar: **Aula 005**
Presidente de la sesión: **Ramón Martínez Rodríguez-Osorio** (Universidad Politécnica de Madrid)
Presidente de la sesión: **Eduardo Martínez de Rioja** (Universidad Politécnica de Madrid)

Sesión 3.4 Sesión especial - Electromagnetismo Computacional (II)

Lugar: **Aula 006**
Presidente de la sesión: **Valentín de la Rubia Hernández** (Universidad Politécnica de Madrid)
Presidente de la sesión: **Juan Manuel Rius Casals** (Universitat Politècnica de Catalunya)

Sesión 3.5 Sesión especial - Técnicas y tecnologías de fabricación para antenas y dispositivos de RF (II)

Lugar: **Aula 007**
Presidente de la sesión: **Oscar Quevedo Teruel** (KTH Royal Institute of Technology)
Presidente de la sesión: **José Luis Masa Campos** (Universidad Autónoma de Madrid)

SESIÓN 4

Jueves, 05/09/2019 11:20 - 13:05

Sesión 4.1 Fotónica y Dispositivos Ópticos

Lugar: **Aula 002**
Presidente de la sesión: **Gonzalo Wangüemert Pérez** (Universidad de Málaga)
Presidente de la sesión: **Oswaldo González Hernández** (Universidad de La Laguna)

Sesión 4.2 Comunicaciones Móviles e Inalámbricas (III)

Lugar: **Aula 003**
Presidente de la sesión: **Jesús Grajal de la Fuente** (Universidad Politécnica de Madrid)
Presidente de la sesión: **Pablo Aguilera Bonet** (Galgus)

Sesión 4.3 Radar y Radioastronomía

Lugar: **Aula 005**
Presidente de la sesión: **Mateo Burgos García** (Universidad Politécnica de Madrid)
Presidente de la sesión: **Eduardo Artal Latorre** (Universidad de Cantabria)

Sesión 4.4 Premio Jóvenes Científicos URSI 2019

Lugar: **Aula 006**
Presidente de la sesión: **Francisco Medina Mena** (Universidad de Sevilla)
Presidenta de la sesión: **Almudena Suárez Rodríguez** (Universidad de Cantabria)

Sesión 4.5 Componentes y Circuitos Pasivos (I)

Lugar: **Aula 007**
Presidenta de la sesión: **Angela Coves Soler** (Universidad Miguel Hernandez de Elche)
Presidente de la sesión: **Jesús Martel Villagrán** (Universidad de Sevilla)

SESIÓN 5 — Jueves, 05/09/2019 15:30 - 17:30

Sesión 5.1 Nuevas tendencias en IoT y Smart Spaces

Lugar: **Aula 002**
Presidente de la sesión: **Jorge Calvillo Arbizu** (Universidad de Sevilla)
Presidente de la sesión: **Sergio Fortes Rodríguez** (Universidad de Málaga)

Sesión 5.2 Procesado de Señal: Voz, Imagen y Datos

Lugar: **Aula 003**
Presidenta de la sesión: **Begoña Acha Piñero** (Universidad de Sevilla)
Presidenta de la sesión: **Adriana Dapena Janeiro** (Universidade da Coruña)

Sesión 5.3 Sesión especial - Tecnologías en Milimétricas y Terahercios para Comunicaciones y Sensorización

Lugar: **Aula 005**
Presidente de la sesión: **Lluís Jofre Roca** (Universitat Politècnica de Catalunya)
Presidente de la sesión: **Jose-Maria Molina-Garcia-Pardo** (UPCT)

Sesión 5.4 Antenas

Lugar: **Aula 006**
Presidente de la sesión: **Mariano Baquero Escudero** (Universitat Politecnica de Valencia)
Presidente de la sesión: **Carlos Camacho Peñalosa** (Universidad de Málaga)

Sesión 5.5 Componentes y Circuitos Pasivos (II)

Lugar: **Aula 007**
Presidente de la sesión: **Enrique Márquez Segura** (Universidad de Málaga)
Presidente de la sesión: **Juan Francisco Valenzuela Valdés** (Universidad de Granada)

SESIÓN 6 Viernes, 06/09/2019 09:00 - 10:30

Sesión 6.1 Sesión especial - Arquitecturas amplificadoras de alta eficiencia y linealización de amplificadores (I)

Lugar: **Aula 005**
Presidente de la sesión: **José Ángel García García** (Universidad de Cantabria)
Presidente de la sesión: **Gabriel Montoro López** (Universitat Politècnica de Catalunya)

Sesión 6.2 Sesión especial - Reflectarrays, Transmitarrays and Periodic Structures (I)

Lugar: **Aula 006**
Presidente de la sesión: **Manuel Arrebola Baena** (Universidad de Oviedo)
Presidente de la sesión: **Eduardo Carrasco** (Universidad Politécnica de Madrid)

Sesión 6.3 Sesión especial - Componentes pasivos de alta frecuencia para aplicaciones espaciales (I)

Lugar: **Aula 007**
Presidente de la sesión: **Juan Hinojosa Jiménez** (Universidad Politécnica de Cartagena)
Presidente de la sesión: **Miguel Ferrando Bataller** (Universitat Politècnica de València)

Sesión 6.4 Educación: Nuevas Tecnologías y Herramientas

Lugar: **Aula 003**
Presidente de la sesión: **Manuel Sierra Pérez** (Universidad Politécnica de Madrid)
Presidenta de la sesión: **Teresa M. Martín Guerrero** (Universidad de Málaga)

SESIÓN 7

Viernes, 06/09/2019 11:15 - 12:45

Sesión 7.1 Sesión especial - Arquitecturas amplificadoras de alta eficiencia y linealización de amplificadores (II)

Lugar: **Aula 005**
Presidente de la sesión: **Gabriel Montoro López** (Universitat Politècnica de Catalunya)
Presidente de la sesión: **José Ángel García García** (Universidad de Cantabria)

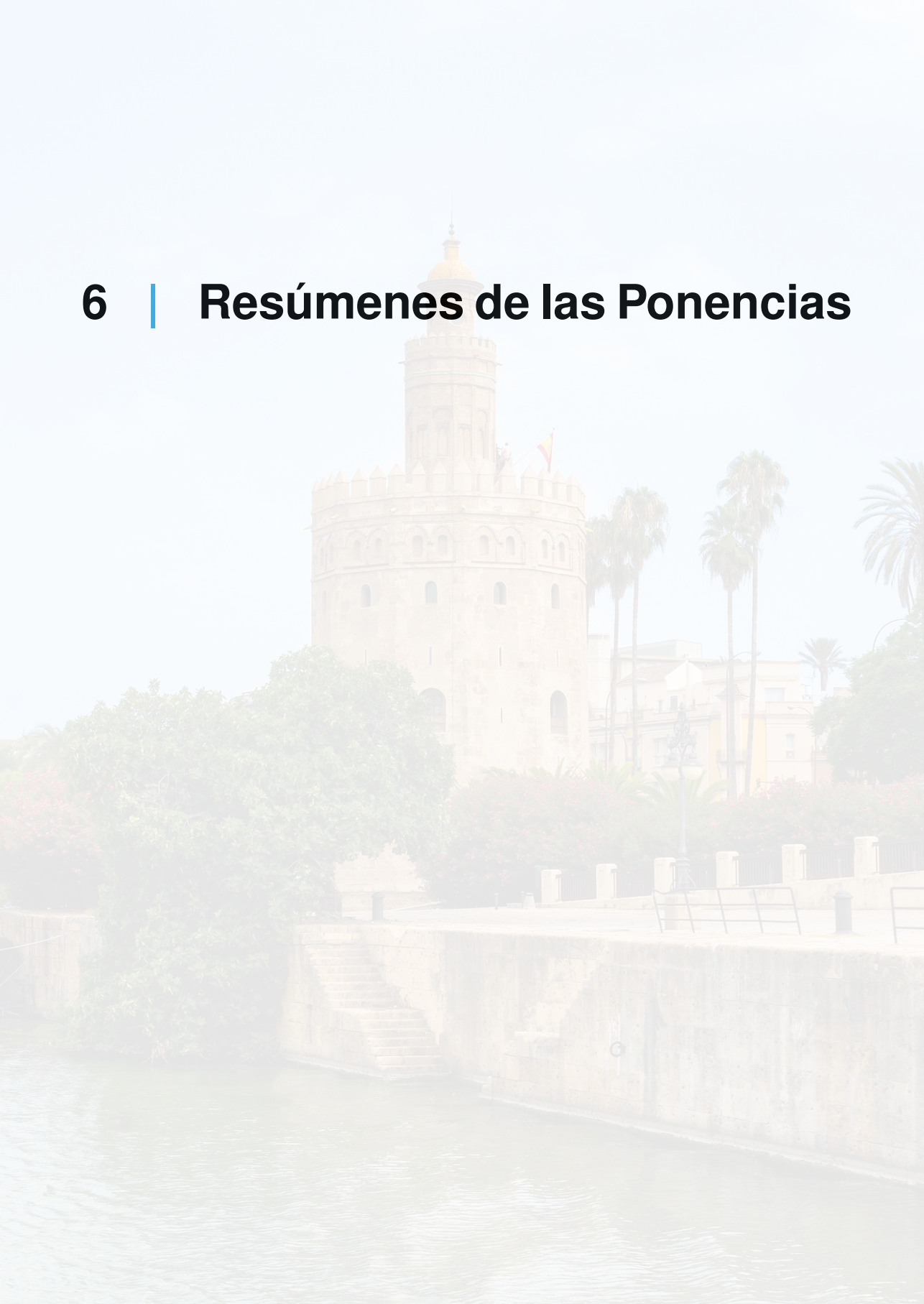
Sesión 7.2 Sesión especial - Reflectarrays, Transmitarrays and Periodic Structures (II)

Lugar: **Aula 006**
Presidente de la sesión: **Manuel Arrebola Baena** (Universidad de Oviedo)
Presidente de la sesión: **Eduardo Carrasco** (Universidad Politécnica de Madrid)

Sesión 7.3 Sesión especial - Componentes pasivos de alta frecuencia para aplicaciones espaciales (II)

Lugar: **Aula 007**
Presidente de la sesión: **Fernando Daniel Quesada Pereira** (Universidad Politécnica de Cartagena)
Presidente de la sesión: **Eva Rajo Iglesias** (Universidad Carlos III de Madrid)

6 | Resúmenes de las Ponencias



Sesión 1.1
Telemática

Miércoles, 04/09/2019
Hora: **09:30 - 11:00**. Lugar: **Aula 002**

09:30 - 09:45 Estimación de métricas de vídeo streaming para ”network slicing”

Baena, Carlos; Fortes, Sergio; Baena, Eduardo; Barco, Raquel
Universidad de Málaga, España

The use of multimedia content has hugely increased in recent times, becoming one of the most used and important service for the users of mobile networks. Consequently, network operators struggle to optimize their infrastructure to support the best video service-provision to the end user. As an additional dimension, 5G introduces the concept of Network slicing as a new paradigm that presents a completely different view of the configuration and optimization of the network. In this, "slices", this means, specific sets of resources allocated for certain type of users and services, are agreed between the infrastructure operator and the “verticals” (direct providers of service to end-users), based on different target end-user requirements. A main challenge of this scheme is to establish which specific resources can provide the agreed quality of service. To do so, the present article presents a system for the estimation of Video Streaming Key Quality Indicators (KQIs) based on network low-layer configuration and metrics.

09:45 - 10:00 Comparación de servicios de vídeo streaming de YouTube

Jiménez Pérez, Luis Roberto; Solera Delgado, Marta; Toril Genovés, Matías
Dpto. de Ingeniería de Comunicaciones, Universidad de Málaga, España

YouTube is one of the most popular services on the Internet, enabling easy streaming of a video (conventional or live) with acceptable video quality. In March 2015, YouTube added 360º video streaming service which provides users with panoramic view and allows them to freely control their viewing direction during video playback. At present, the most important service in mobile networks is video streaming, which is expected to generate 82% of all IP traffic volume by 2021. Thus, understanding YouTube video and its features is of the utmost importance for network operators. In this paper, a comparative study between the conventional and live YouTube streaming service is presented, which includes the 360º video. The analysis covers both protocol messages and application behavior. To that end, different combinations of client type (mobile phone or PC) and video service type (conventional or live) are tested. For each combination, a short video streaming session is established, where all HTTP messages (request/response) are captured and decrypted between the YouTube client and server in the video playback sequence.

10:00 - 10:15 Statistical characterization of the chunk size distribution in DASH

Vaca-Rubio, Cristian Jesús; Gómez, Gerardo; Aguayo-Torres, M. Carmen; López-Martínez, F. Javier
Dpto. Ingeniería de Comunicaciones, Universidad de Málaga, España

We present a statistical characterization of the segment size distribution of video streaming services based on dynamic adaptive streaming over HTTP (DASH). We first obtain the empirical distributions from traffic captures of available data sets encoded with different quality and segment size duration. Then, we determine the distributions that provide a better fit to the empirical data. We show that Weibull and truncated logistic distributions are adequate to modeling the chunk size distributions for a wide range of video qualities and segment size duration. Results are used to develop a source model for DASH traffic, implementing a synthetic generator of DASH-like video traces.

10:15 - 10:30 Throughput-based quality adaptation for DASH in 5G mobile networks

Aguilar Armijo, Jesús; Vaca Rubio, Cristian Jesús; **Gómez Paredes, Gerardo**; Aguayo Torres, Mari Carmen; Entrambasaguas Muñoz, José Tomás
Universidad de Málaga, España

Video streaming in mobile networks is currently the most widely used service and its usage is expected to grow exponentially in the next years. Due to the changing conditions of the radio interface, techniques likes Dynamic Adaptive Streaming over HTTP (DASH) allows the user equipment to request the video coding rate that better matches the instantaneous network capacity. There are three types of algorithms to select the appropriate video coding rate based on different types of quality of service metrics: throughput-based, buffer-based and hybrid. In this paper we present three different versions of a throughput-based algorithm, comparing their performance in terms of mean and mode of the video quality index as well as the number of overlapping video chunks. We focus on the end-user quality of experience to evaluate which is the implementation that optimizes the performance.

10:30 - 10:45 Optimización de señalización en el canal común descendente para el estándar LTE-LAA

Baena Martínez, Eduardo; **Fortes Rodríguez, Sergio**; Baena González, José Carlos; Barco Moreno, Raquel
Universidad de Málaga, España

The use of unlicensed bands is one of the most promising features envisaged to increase capacity in cellular networks. However, this poses multiple challenges associated to the operation of LTE based standards with coexisting networks, such as WiFi. Previous coexistence analyses have been focused on the user-plane data-related transmissions and mainly based on abstract models. Meanwhile, the effects of the in-band signaling defined by the standards have been mainly disregarded, particularly for ultra-dense scenarios. This paper performs an assessment of how the different in-band signaling mechanisms influence the performance of the coexisting technologies. Based on this analysis, an optimized signaling solution is envisaged to additionally enhance the service provision in these scenarios.

10:45 - 11:00 Computación en la nube para la docencia práctica en asignaturas de Ingeniería

Ternero, Juan A.; **Sierra Collado, Antonio J.**; Román Martínez, Isabel; Ariza, María Teresa
Universidad de Sevilla, España

La computación en la nube se está utilizando actualmente en diversos ámbitos de la docencia, como en sistemas de gestión del aprendizaje, repositorios de recursos docentes, entre otros. En este trabajo se exponen 3 metodologías diferentes utilizadas para la realización de las prácticas en la asignatura de ingeniería, Diseño de Bases de Datos, mostrando la evolución desde el uso de equipos independientes, hasta la computación en la nube, pasando por un servidor central en el Departamento. La experiencia de la aplicación de la computación en la nube en la docencia práctica conlleva diversas mejoras que se muestran en este trabajo.

Sesión 1.2

Sesión especial - Avances en el procesado de señales cerebrales

Miércoles, 04/09/2019
Hora: **09:30 - 11:00**. Lugar: **Aula 003**

09:30 - 09:50 Assessing the influence of cognitive reserve in EEG signals through Alzheimer's Disease progression

Rodríguez, Víctor [1]; Poza, Jesús [1]; Gómez, Carlos [1]; Tola-Arribas, Miguel Ángel [2]; Cano, Mónica [2]; Hornero, Roberto[1]
[1] *Grupo de Ingeniería Biomédica, Universidad de Valladolid, España;* [2] *Hospital Universitario Río Hortega, Valladolid, España*

Alzheimer's Disease (AD) has a high economical, social, and clinical impact in our society, especially in most developed world. It has been proven that its progression is influenced by many factors such as age, gender, genetics of cognitive reserve (CR). In the case of the latter, its influence in neural signals during AD progression has been scarcely studied. To understand how CR influences brain activity, electroencephalographic (EEG) recordings were analysed as a function of the CR by using spectral and nonlinear methods. The database was composed by 160 subjects divided in 3 groups (controls, mild cognitive impairment subjects, and AD patients) and 2 CR levels (low and high). Results showed that the spectral and nonlinear EEG parameters are influenced by CR. Also, it has been observed using cognition, memory, and functional disability tests that a high CR provides more resilience against AD progression, but also a faster decline in the later AD stages. We conclude that CR has a remarkable influence in AD progression, which can be observed by analysing neurophysiological signals.

09:50 - 10:10 Análisis de la actividad neuronal obtenida por la técnica del registro óptico en la carpa dorada

González-Santalla, Francisco Javier [(1)]; Puntas, Tamara del Águila [(2)]; Madrid Pulgarín, David [(2)]; **Pérez-Carrasco, José-Antonio**[(1)]
[(1)] *Dpto. de Teoría de la Señal y Comunicaciones, Universidad de Sevilla, España;* [(2)] *Laboratorio de Psicobiología, Dpto. de Psicología Experimental, Universidad de Sevilla, España*

One of the main topics in neuroscience is the analysis of the functional connectivity between different areas of the brain. Currently, the techniques for recording neural activity by means of VSDI (voltage-sensitive dyes imaging) offer the highest spatial and temporal resolution. The present work consists in the analysis of images of neuronal activity of the Carassius auratus telencephalon (golden carp) by means of a signal processing tool to analyze the functional connectivity between the different areas of the brain. The analysis tool described in this work has proven to be very useful in the study of the spatio-temporal patterns of brain activation. The automation of the process to obtain the results, the easily accessible graphic interface, and the intuitive graphic representation of the correlation between the different ROIs have considerably accelerated and make it easier the access to the information and the interpretation of the results.

10:10 - 10:30 Estudio de la DFT deslizante para clasificación de estados oculares con bajo retardo

Laport, Francisco; Vazquez-Araújo, Francisco J.; Castro, Paula M.; **Dapena, Adriana**
Universidade da Coruña, España

Los estudios realizados en los últimos años han demostrado el enorme potencial del uso de señales de encefalografía en aplicaciones que van más allá del diagnóstico clínico. En particular, en este trabajo presentaremos un sistema de detección de estados oculares, diseñado por los autores, para el que desarrollamos también algoritmos que reducen el retardo producido entre la adquisición de señal y la toma de decisión del sistema. Este sistema ha sido diseñado con un bajo número de electrodos para facilitar su uso por usuarios finales. Distintas experimentos realizados en entornos reales muestran que la integración del hardware propio con los algoritmos propuestos permite trabajar con alta precisión y retardos inferiores a 2 s, lo que representa un retardo muy bajo considerando la baja diversidad proporcionada cuando se dispone de una única señal de encefalografía.

10:30 - 10:50 A Technique for Artifact Attenuation in Motor-Imagery BCI

Olías, Javier; Martín Clemente, Rúben; Sarmiento-Vega, Mª. Auxiliadora; Cruces, Sergio
Universidad de Sevilla, España

Artifact is a term used in the biomedical field to make reference to a kind of signal distortion that is produced by non-biological process and that are not inherent of the system. In Brain Computer Interfaces (BCI) they are usually produced by a person's movement like blinking or breathing. Although most of the artifacts are of a short duration and sporadic, their effects can disrupt the whole system.
We have found that the new method that we have recently presented in the field of Motor-Imagery BCI (MI-BCI) to estimate the trial covariance matrices, is a very powerful tool to palliate the effects of these artifacts. This algorithm normalizes the underlaying EEG sources by weighting the samples of each trial before computing the covariance matrix. In this work we explain this technique and we show how by using it, we are also establishing a robust penalty to the samples that were contaminated by artifacts, without using any extra parameters or specific training.

Sesión 1.3

Sesión especial - Comunicaciones por Satélite (I)

Miércoles, 04/09/2019
Hora: **09:30 - 11:00**. Lugar: **Aula 005**

09:30 - 10:10 From large platforms at GEO to small satellites at LEO for Satellite Communications

Abad, Antonio [1]; Pintó Marín, Pedro [2]; Salas-Natera, Miguel A. [2]
[1] *Hispasat S.A., España.;* [2] *Grupo de Radiación, Universidad Politécnica de Madrid, España*

It has been under analysis and development the enabling technologies for the future scenarios including satellite communication systems based on the growth of the information society. During last decade, a constant increase in data capacity requirement and consumption of audiovisual content, plus actual demand for higher quality and freedom of movement has pushed up the development of actual HTS and future VHTS systems. This scenario gives an excellent position to consolidate the satellite relevant and competitive role in the market stage. Besides, new agents from different areas powering a “NewSpace” and “NewSky” era have demonstrated that the need to expand the field of vision to new approaches is more important than ever. Once all the barriers about viability in economic or regulatory terms have been passed, new and unimplemented ideas are just to be consolidated if the new technology developments as well as new-radio (5G) enable these novel system concepts. This means that new concept such as LEO satellites for satellite communication became to be a real solution for the space access.

10:10 - 10:25 Coverage optimization for the preliminary design of multibeam satellite systems using regular and irregular beams

Ortiz Gomez, Flor G. [(1)]; Salas-Natera, Miguel A. [(1)]; Martínez Rodríguez-Osorio, Ramón [(1)]; Landero-Ayala, Salvador [(2)]
[(1)] *Universidad Politécnica de Madrid, España;* [(2)] *Universidad Nacional Autónoma de México, México*

VHTS has been designated by users, satellite operators and manufacturers to play a key role in future 5G networks to complement terrestrial networks. In addition, VHTS satellite systems suppose a uniform traffic requested by beam, but it is anticipated that future traffic demands will be very uneven in the service area. The uniform distribution of traffic capacity means that some beams are overstretched, while others may not have enough resources. This results in real HTS systems not fully utilizing their capacity advantage, which will be more inefficient for VHTS systems. Therefore, the design of the new generation of satellite payloads must be able to have a flexible allocation of resources. The optimization of the coverage is an intermediate step and too important in the design of the flexible payload. In this sense, this article presents a preliminary analysis for the optimization of coverage.

10:25 - 10:40 New challenges in the operation and control of SatCom Flexible Payloads

Godino Llani, Elena; Juliana Quirós, Gregorio; Honold, Pablo
GMV, España

In today's highly competitive satellite communications market (SatCom), the flexible payloads satellites appears as one of the most promising solutions that can boost the SATCOM business. This document describes the new challenges that must be addressed by a satellite operator with a flexible payload satellite in comparison to the traditional fixed missions in order to maximize the revenue that the new payload capabilities can provide. The first part of the document describes the characteristics, new applications and main differences of flexible payloads versus the traditional ones. Later the challenges and main issues that must be taken into account for the point of view of payload control and operations are described. And finally, GMV solution for flexible payloads fleets together with the expected evolution in the ground segment is presented.

10:40 - 10:55 Novel dichroic cell for multiband reflector antenna system for satellite communications

Salas-Natera, Miguel A. [1]; Garrote Moreno, Roberto [1,2]; Carrasco, Eduardo [1]; Encinar Garcinuño, José Antonio [1]; Martínez, Ramón [1]
[1] *Universidad Politécnica de Madrid, España;* [2] *Universidad Autónoma de Madrid, España*

This work presents a novel dichroic cell for multi-band reflector antenna systems that has two different configurations using a novel resonant element formed by rings connected with tuning stubs. The case study presented shows the design of a symmetrical cell using two resonant elements in both faces of the dichroic cell, and the design of a non-symmetrical cell using one novel resonant element in one face of the cell and a single ring in the other face. These two configuration allows to perform different topologies of dual band feeds.

Sesión 1.4

Aplicaciones Biomédicas

Miércoles, 04/09/2019
Hora: **09:30 - 11:00**. Lugar: **Aula 006**

09:30 - 09:45 Sistema no invasivo basado en microondas para detección de tumores mamarios

Blanco Angulo, Carolina; Antillano Fernández, Mariela; García Martínez, Héctor; Gutiérrez Mazón, Roberto; Vicente Samper, José María; Sabater Navarro, José María; Ávila Navarro, Ernesto
Universidad Miguel Hernández de Elche, España

In this work, a non-invasive system based on 16 broadband Vivaldi antennas in the range of microwaves for detection of tumour tissue in breast cancer is presented. For tissue models, a mixed procedure based on measures and simulations has been developed in order to calculate the dielectric properties of the materials. Following this method, a breast model has been made. The complete system has been automated by means of a computer, that manages a microcontroller for switching the antennas and performs the signal processing of the reflections received by each antenna and offers an image of the analysed tissue. The proposed system has been tested in several practical cases with good results, being able to detect tumours with volume less than 0.5 ml.

09:45 - 10:00 An evaluation of segmentation and classification strategies on melanomas

Vélez Núñez, Paulina Andrea; Acha Piñero, Begoña; Serrano Gotarredona, María del Carmen
Universidad de Sevilla, España

According to AiM at Melanoma Foundation, Melanoma represents the 1% out of all types of cancer, having the highest mortality rate. Therefore, early melanoma detection is crucial for increasing the rate of survival.
In this paper, a segmentation and two classification strategies based on Convolutional Neural Networks (CNN) to classify melanoma versus non-melanoma are proposed.
A semantic segmentation has been successfully developed by using a SegNet. In order to train, validate and test the segmentation network, the ISIC 2017 Database was used, and finally applied to ISIC 2018 database. Moreover, in order to classify dermoscopy images into Melanoma and Non-Melanoma lesions, different strategies based on Convolutional Neural Networks (CNN) are proposed.
From the segmentation process, the best results were: DICE of 0.75 and 0.6350 as Jaccard. Furthermore, the best classification results were AUC of 0.7978 with 84% of accuracy.

10:00 - 10:15 Chaleco inteligente para la supervisión de pacientes con EPOC durante los ejercicios de mantenimiento

Naranjo Hernández, David [1]; Reina Tosina, Javier [1]; Roa Romero, Laura M. [1]; Barbarov Rostán, Gerardo [1]; Talaminos-Barroso, Alejandro [1]; Cejudo-Ramos, Pilar [2]; Márquez-Martín, Eduardo [2]; Ortega-Ruiz, Francisco [2]
[1] *Universidad de Sevilla, España;* [2] *Hospital Universitario Virgen del Rocío, Sevilla, España*

El entrenamiento muscular es una componente fundamental de los programas de rehabilitación respiratoria en pacientes con enfermedad pulmonar obstructiva crónica (EPOC). Una vez concluido el programa de entrenamiento es común la pérdida de las mejoras alcanzadas por falta de adherencia y motivación de los pacientes en los programas de mantenimiento. Este trabajo muestra una primera aproximación a un chaleco inteligente para la supervisión y motivación de pacientes con EPOC durante los ejercicios de mantenimiento respiratorio en su propio domicilio. El chaleco inteligente incorpora capacidades de sensorización y de procesado para evaluar el número de repeticiones de los ejercicios prescritos, el gasto metabólico asociado a las actividades realizadas y los parámetros respiratorios del usuario durante los tiempos de reposo entre ejercicios. Los datos son transmitidos de forma inalámbrica a un teléfono inteligente que realiza un segundo procesado, y sirve de interfaz con el usuario y de pasarela de comunicaciones para la gestión remota de la información. El consumo de energía asociado a las comunicaciones se disminuye mediante un preprocesado basado en el reconocimiento de la forma de onda. Los resultados obtenidos en unos primeros experimentos en un entorno controlado con voluntarios sanos ponen de manifiesto la viabilidad técnica de la solución propuesta.

10:15 - 10:30 Imagen de tejidos duros por resonancia magnética de bajo campo

Borreguero Morata, Jose [1]; Algarín Guisado, Jose Miguel [1]; Díaz Caballero, Elena [2]; Grau Ruiz, Daniel [2]; Rigla Pérez, Juan Pablo [2]; Galve Conde, Fernando [1]; Benlloch Baviera, Jose Maria [1]; Alonso Otamendi, Joseba [1]
[1] *Consejo Superior de Investigaciones Científicas, España;* [2] *Tesoro Imaging S.L., Valencia, Spain*

En este trabajo presentamos los resultados que hemos alcanzado usando un sistema de resonancia magnética con bajo campo (0.33 T) para obtener imágenes de un diente humano, como ejemplo de tejido biológico duro. Para la obtención de las imágenes se ha hecho uso de la secuencia PETRA (Pointwise Encoding Time Reduction with Radial Acquisition), cuya validez hemos verificado por primera vez a bajo campo. Además hemos logrado hacer una reconstrucción 3D de gran resolución de un canino humano a partir de la señal de resonancia magnética recogida.

10:30 - 10:45 Segmentación multietiqueta para delimitación de estructuras musculares y óseas en volúmenes TAC

Pérez-Carrasco, José-Antonio; Acha, Begoña; Serrano, Carmen
Dpto. de Teoría de la Señal y Comunicaciones, Universidad de Sevilla, España

Segmentation of muscle and bone structures in CT volumes is a complicated task for physicians and surgeons due to the similarity of Hounsfield values with those within surrounding organs among other factors. The lack of efficient and automatic tools for this task and the lack of generality make that most physicians and surgeons prefer to segment bone and/or muscle tissue manually rather than to work with different tools focused in one kind or tissue or a particular area of the body. In this work an automatic tool for the joint segmentation of muscle and bone structures is described. A public database of CT volumes have been used to assess the algorithm and the results provided outperform recent methods using the same public database.

Sesión 1.5
Metamateriales

Miércoles, 04/09/2019
Hora: **09:30 - 11:00**. Lugar: **Aula 007**

09:30 - 09:45 Labyrinth metasurface absorber for high-sensitivity thin film sensing

Jáuregui López, Irati [1,2]; Rodríguez Ulibarri, Pablo [1]; Urrutia, Aitor [3]; Kuznetsov, Sergei A. [4]; Beruete, Miguel [1,2,3]
[1] *Antennas Group - TERALAB, Electric and Electronic Engineering Department, Public University of Navarra, Spain;* [2] *Multispectral Biosensing Group, Navarrabiomed, Complejo Hospitalario de Navarra, Universidad Pública de Navarra;* [3] *Institute of Smart Cities, Public University of Navarra, Spain;* [4] *Novosibirsk State University, Pirogova, Novosibirsk, Russia. Rzhanov Institute of Semiconductor Physics SB RAS, Novosibirsk Branch "TDIAM.", Novosibirsk, Russia*

In this work a so-called labyrinth metasurface sensor working in the terahertz (THz) band is presented. The intricate geometry of the design leads to a high electric field confinement in all the structure surface, leading to ultrasensitive performance for thin-film sensing applications. The structure is coated with extremely thin analytes with thicknesses varying from ha = 24 nm to ha = 345 nm of tin dioxide (SnO2) and its sensing capabilities are numerically and experimentally evaluated. Increasing the analyte thickness leads to a maximum redshift of 8 GHz of the resonant reflection dip. An average measured sensitivity of 12744.4 GHz/mm · RIU and a measured average FOM of 606.9 $(\text{mm}\cdot\text{RIU})^{-1}$ are obtained, improving previous results found in the literature for designs fabricated with the same manufacturing techniques. This excellent performance can have an impact in other types of sensing applications, where samples in a thin-film form become essential, such as biological sensing.

09:45 - 10:00 Novel all-dielectric chiral metamaterial based in crank structures

García Collado, Ángel Joaquín [1]; Molina Cuberos, Gregorio José [2]; Barba García, Ismael [3]; Margineda Puigpelat, José [2]
[1] *Universidad Católica de Murcia, España;* [2] *Universidad de Murcia;* [3] *Universidad de Valladolid*

In this work, we present a novel path for the fabrication of chiral metamaterials based on structures with chiral geometry implemented in dielectric media, without metal insertions and with low losses. By using 3D printing techniques or CNC machining it is possible to manufacture metamaterials with complex designs and at reduced cost, this is the clue to obtain satisfying results. A fundamental aspect is the dielectric permittivity of the material where the imaginary part of the permittivity has to be minimized. Preliminary results seem to confirm this method as a valid tool for producing chiral media, thus opening up a wide range of possibilities material design.

10:00 - 10:15 Propagación TE en guía biplaca con altura arbitraria mediante uso de metasuperficie de Huygens

Abdo-Sánchez, Elena [1]; Epstein, Ariel [2]; Eleftheriades, George V. [3]
[1] *Universidad de Málaga, España;* [2] *Technion - Israel Institute of Technology, Israel;* [3] *University of Toronto, Canadá*

In this communication, we explore transversal electric (TE) propagation through a parallel-plate waveguide with below-cutoff height by replacing the top plate by a Huygens' metasurface. We use the already-developed theoretical formulation to transform the guided mode into a leaky mode by means of a Huygens' metasurface but, in this case, we make the leakage factor tends to zero, so avoiding radiation. Through electromagnetic simulation of a metasurface design, we demonstrate that the formulation is valid and a TE mode can be fully guided through the metasurface-based waveguide with arbitrary height.

10:15 - 10:30 La partícula Omega conjugada y su versatilidad en el control de la polarización

Fernández Fernández, Óscar; Gómez Gómez, Álvaro; Vegas García, Ángel
Universidad de Cantabria, España

In this communication, the authors present different chiral metamaterial structures that reflect the versatility of the conjugated Omega particle. This particle produces electro-magnetic or magneto-electric coupling depending on the mutual orientation between the incident electric field and the particle.
In this communication three variations of the conjugated omega are presented. These structures provide different mechanisms to control the polarization of an incident wave. The first two structures provide a static response and behaves as a polarization rotator or polarization converser. The third structure integrates PIN diodes presenting a switchable response among different possibilities.

10:30 - 10:45 Beam steering using active artificial magnetic conductors: A 10-degree steep controlled steering

Vásquez Peralvo, Juan Andrés [(1)]; Fernández González, José Manuel [(1)]; Rigelsford, Jonathan M. [(2)]
[(1)] *Universidad Politécnica de Madrid, España;* [(2)] *University of Sheffield, United Kingdom*

An Active Artificial Magnetic Conductor (AAMC) to beam steer a printed dipole radiation pattern is presented. The AAMC consist of a square loop Active Frequency Selective Surface (AFSS), a ground plane and the DC feeding system. To vary the AFSS properties, an array of varactor diodes, model SMV2020, is placed between the metallic sheets and exited by a DC feeding system. The printed dipole is placed a quarter wave length above the AAMC and fed by a 50-ohm line. Simulation results show that by varying the capacitance of each column of the array a more controlled beam steering can be accomplished. The overall beam steering is about 60 degrees with a step size of 10 degrees with minor side lobes. All the simulations were achieved by CST Microwave Studio and its optimization tool.

10:45 - 11:00 Design of a stacked array of leaky wave antennas in groove gap waveguide technology

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

The design of an array of leaky wave antennas made in groove gap waveguide technology is presented in this paper. The antennas are stacked one on top of the other to create the array. To achieve maximum directivity enhancement, and to avoid side effects that would reduce the efficiency of the design, the distance between the elements of the array is studied. For the feeding of the array, a single waveguide port is used to feed one element, and then the energy is coupled equally to the others through a feeding network. The aiming band is that of 92-96 GHz, and the directivity enhancement using an array of four stacked leaky wave antennas is +10.6 dB, reaching 30.5 dB, in comparison to the single antenna directivity of 19.9 dB.

Sesión 2.1

Radiación, Dispersión y Radiopropagación (I)

Miércoles, 04/09/2019
Hora: **12:45 - 14:00**. Lugar: **Aula 002**

12:45 - 13:00 Doppler spectrum analysis in three-dimensional 5G millimeter-wave channel models

Cerezo Barranco, Antonio; Ruiz Vega, Fernando Jesús; Aguayo Torres, María del Carmen
Universidad de Málaga, España

This article is contextualized in the mobile communications systems where there are multiple factors to consider: mobility, frequency, obstacles, reflectors, etc. In this paper, it is presented an evaluation of the Doppler spectrum in a Three-Dimensional (3D) channel model for different frequencies, UserTerminal (UT) directions and UT speeds. To commence, it introduces the channel model that is used for the simulations, then the Classic Doppler Spectrum frequently used in Two-Dimensional (2D) channel models is entered. Finally, it tries the Doppler spectrum for the some typical 5G frequencies, for speeds from 0 to 500 km/h and for the motion direction in the 3D space.

13:00 - 13:15 Contribución a la caracterización del canal radio interior en la banda de 3 a 4 GHz

Pérez López, Jesús Ramón [(1)]; Torres Jiménez, Rafael Pedro [(1)]; Rubio Arjona, Lorenzo [(2)]; Gonzáles Illera, Jorge [(1)]; Basterrechea Verdeja, José [(1)]; Domingo Gracia, Marta [(1)]; Rodrigo Peñarrocha, Vicent Miquel [(2)]; Reig Pascual, Juan [(2)]
[(1)] *Universidad de Cantabria, España;* [(2)] *Universitat Politècnica de València, España*

Este trabajo presenta una contribución a la caracterización del canal radio en interiores en la banda 3-4 GHz, incluyendo los resultados obtenidos en una campaña de medida que permiten extraer conclusiones sobre las pérdidas de propagación, la dispersión temporal y la selectividad en frecuencia del canal. Estos parámetros adquieren de nuevo una relevancia importante, a considerar en la planificación de los nuevos sistemas de comunicaciones móviles 5G.
La banda de frecuencias elegida está en línea con los planes puestos en marcha en Europa, donde la banda 3.4-3.8 GHz ya se ha reservado para dichos sistemas y, en España, ya se ha adjudicado la banda 3.4-3.6 GHz y se está completando la liberación de la banda 3.6-3.8 GHz.

13:15 - 13:30 Estudio dosimétrico para entornos interiores de transporte de autobuses urbanos

Celaya-Echarri, Mikel [1]; Azpilicueta, Leyre [1]; López-Iturri, Peio [2]; **Picallo, Imanol** [2]; Aguirre, Erik [2]; Ramos, Victoria [3]; Falcone Lanas, Francisco [1]
[1] *Tecnológico de Monterrey, Mexico;* [2] *Universidad Pública de Navarra;* [3] *Instituto de Salud Carlos III*

The advent of context aware environments within the implementation of Smart Cities and Smart Regions is supported by communication systems integrated within elements such as Intelligent Transportation Systems. In this paper, the impact of wireless communication system integration within public transportation buses will be analyzed, in order to assess regulatory compliance as well as to identify potential issues such as hot-spot location due to user density and wireless system usage.

13:30 - 13:45 Caracterización del canal radio en un entorno de oficinas a 26 GHz

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

En este trabajo se analizan las pérdidas de propagación y la dispersión temporal del canal radio en un escenario de oficinas en la banda de 26 GHz, con aplicabilidad al diseño y despliegue de las futuras redes 5G. A partir de una campaña de medidas en banda ancha, implementada en condiciones LOS (Line-of-Sight) y OLOS (Obstructed LOS), se obtienen los parámetros de los modelos de pérdidas de propagación CI (Close-In) y FI (Floating-Intercept). Las características de dispersión temporal del canal radio se analizan en base al valor cuadrático medio del delay-spread y del ancho de banda de coherencia. Los resultados mostrados permiten tener un mejor conocimiento de la propagación en esta banda de frecuencias y en este tipo de escenarios.

13:45 - 14:00 Medición de las pérdidas de propagación en interiores en las bandas milimétricas para 5G de 26 y 39 GHz

Hernández Sáenz, Sergio; Pimienta del Valle, Domingo; Mendo Tomás, Luis; García del Pino, Pedro; Riera Salís, José Manuel
Universidad Politécnica de Madrid, España

Nowadays the saturation of the radio spectrum has caused the need of working with higher frequencies that are less likely to be in use. The new 5G wireless communication standard has defined a wide range of millimetric-wave frequency bands to be analyzed in order to fulfil all the requirements of this new standard. In this paper, empirical results of indoor propagation in the bands of 26 and 39 GHz are presented. The experiments have been carried out in a corridor of the Universidad Politécnica de Madrid for line-of-sight (LOS) and non-line-of-sight (NLOS) conditions. With that data, the propagation losses have been obtained and compared with other models using regression fittings, providing similar and coherent results.

Sesión 2.2

Comunicaciones Móviles e Inalámbricas (I)

Miércoles, 04/09/2019
Hora: **12:45 - 14:00**. Lugar: **Aula 003**

12:45 - 13:00 Selección automática de características para una gestión proactiva eficiente de redes 5G

Mendoza, Jessica; Palacios, David; de la Bandera, Isabel; Barco, Raquel
Universidad de Málaga, España

The growth in the number of services, functionalities and users expected with the arrival of the 5th Generation (5G) of mobile communications networks will produce an increase in the complexity of the network management tasks. These tasks should be adapted to meet the requirements of zero latency and great bandwidth presented by 5G new services. Thus, traditional management reactive approach should evolve to a proactive one. In this context, prediction techniques will become an essential tool. At the same time, 5G management algorithm will use both internal (network information) and external (context information) information sources. Thus, 5G management tasks should handle large amounts of data. The use of large dataset to generate prediction models can lead to the lack of precision of these models, due to the sparsity suffered by the data. In this paper, the use of feature selection techniques to improve prediction models is proposed.

13:00 - 13:15 Optimización conjunta de la gestión de la movilidad y la capacidad en redes 5G

Ramírez-Arroyo, Alejandro [1]; **Valenzuela Valdés, Juan Francisco** [1]; Carmona Murillo, Javier [2]; Luna Valero, Francisco [3]; Valenzuela Valdés, Antonio [1]; Padilla de la Torre, Pablo [1]
[1] *Universidad de Granada, España;* [2] *Universidad de Extremadura, España;* [3] *Universidad de Málaga, España*

Es necesario un desarrollo de tecnología para satisfacer las demandas de tráfico por parte de los usuarios. Del año 2017 al año 2022, el crecimiento del tráfico global anual se cifra en un 220%. Este crecimiento anual conlleva a su vez el aumento del número de usuarios conectados a redes IP, pasando de 2,4 a 3,6 dispositivos conectados por persona. Estos datos muestran la importancia del desarrollo de una infraestructura donde este tráfico pueda mantenerse. Actualmente, las redes 4G son capaces de gestionar esta carga. Sin embargo, se hace visible la necesidad de la aparición de redes 5G en un corto periodo de tiempo, que se espera para el año 2020. En este trabajo, se presenta un estudio preliminar de la optimización de varios parámetros del sistema 5G. Se presenta la configuración de los distintos parámetros básicos del sistema, se describen los distintos planes de asignación de cada uno de los usuarios a cada una de las estaciones base y se optimiza la potencia transmitida por la estaciones base para obtener mejoras simultáneamente en la capacidad del sistema, el consumo global de las estaciones base y el coste de señalización en diferentes protocolos de movilidad. Es decir, por primera vez se presenta una optimización conjunta para varios niveles de red.

13:15 - 13:30 Mejora de la calidad de experiencia en redes LTE multi-portadora

Gijón Martín, Carolina; Toril Genovés, Matías; Luna Ramírez, Salvador; Marí Altozano, María Luisa
Universidad de Málaga, España

In multi-tier cellular networks, effective handover schemes are required to assign users to the most adequate layer. In this paper, a data-driven strategy for traffic steering is proposed to improve the overall Quality of Experience (QoE) in multi-carrier Long Term Evolution (LTE) networks. Unlike classical approaches, traffic steering is tackled by tuning Reference Signal Received Quality (RSRQ)-based inter-frequency handover margins. The tuning process is driven by a novel indicator derived from connection traces showing QoE changes in the vicinity of handovers. Method assessment is carried out in a dynamic system-level simulator implementing a real multicarrier LTE scenario. Results show that the proposed algorithm significantly improves QoE figures from the initial operator solution.

13:30 - 13:45 Massive MIMO beamforming with grid-less angle information

Jamali, Vahid [(1)]; Llorca, Jaime [(2)]; Sánchez-Fernández, Matilde [(3)]; Tulino, Antonia [(4)]
[(1)] *University of Erlangen-Nuremberg, Alemania;* [(2)] *Nokia Bell Labs, EEUU;* [(3)] *Universidad Carlos III de Madrid, España;* [(4)] *DIETI Department, University of Napoli, Federico II, Italia*

Wireless propagation channels carry very relevant information that array processing techniques can reveal by in order to optimize system performance. Angle of arrival (AoA) is one of the key parameters whose knowledge has straightforward applications to future communication systems that use large antenna arrays. A full dimensional characterization of AoA is mandatory to provide user spatial orthogonality for interference control and customized services, robust angle information beamforming, low cost hybrid beamforming design, or the provisioning of location-aware and tracking services. In this work we focus on extracting AoA multi-dimensional propagation parameters exploiting the sparse nature of signal measurements in massive MIMO systems to provide robust angle information beamforming. The approach undertaken is based on the atomic l_0 norm that allows grid-less resolution of the AoA with arbitrary 3D antenna structures.

13:45 - 14:00 Analysis of mobile relay node architectures for vehicular scenarios in millimeter wave bands

Oliva Sánchez, José David; Alonso Montes, José Ignacio
Universidad Politécnica de Madrid, España

Vehicular scenarios are under thorough examination for future mobile communications. In this article, a two-hop relay architecture which implements Mobile Relay Nodes (MRNs) in millimeter wave (mmWave) bands is presented for two unique scenarios: a High-Speed Train (HST) in a rural scenario and a city bus in an urban scenario. A Multiple-Input Multiple-Output (MIMO) channel is established between the Donor-eNB (DeNB) and the Users Equipment (UE) to enhance channel capacity. Furthermore, two types of MRNs are analyzed —Amplify-and-Forward (AF) and Decode-and-Forward (DF). Finally, performance analysis is studied and discussed by means of a link-level simulator which uses various channel models.

Sesión 2.3

Sesión especial - Avances en modelado y simulación de circuitos no-lineales

Miércoles, 04/09/2019
Hora: **12:45 - 14:00**. Lugar: **Aula 005**

12:45 - 13:00 Análisis de estabilidad y oscilaciones en circuitos y sistemas complejos

Ramírez, Franco; Pontón, Mabel; Sancho, Sergio; Suárez, Almudena
Universidad de Cantabria, España

Advances in the stability and oscillation analysis of complex circuits and systems, containing multiple active elements, is presented. For the stability analysis, the system is decomposed in a number of stable blocks. This stability is verified through the pole-zero identification of each component. In these conditions, the characteristic determinant will not contain any poles on the right-hand side to the complex plane, so the Nyquist criterion can be applied to determine the stability properties of the full system. In this manner, all the system blocks are globally considered, so there is no need to test different locations of the complex system. Additionally, a methodology to analyze the oscillatory states of a multi-oscillator system is presented. This is based on an analytical formulation of the system, in which the oscillator components are described through numerical models, extracted from harmonic-balance simulations. The method is applied to a system of wireless-coupled oscillators in synchronized operation, with interest in sensor networks.

13:00 - 13:15 Análisis de estabilidad de amplificadores de potencia usando Vector Fitting

Collantes, Juan-Mari [(1)]; Mori, Libe [(2)]; Anakabe, Aitziber [(1)]; Lizarraga, Ibone [(1)]; Otegi, Nerea [(1)]; Armengaud, Vincent [(3)]; Soubercaze-Pun, Geoffroy [(3)]
[(1)] *Universidad del País Vasco, España;* [(2)] *Mondragon Unibertsitatea;* [(3)] *CNES*

Pole-zero identification is becoming a standard for the stability analysis of microwave power amplifiers. In this work we present the recent advances in the field that are driven by the use of Vector Fitting algorithms as identification tool. A residue analysis derived from a partial fraction representation of the transfer function is used to quantify the sensibility of the identification obtained at a particular circuit location. This is of paramount importance to detect the best nodes and branches for efficient circuit stabilization. In addition, this residue analysis combined with a Multiple-Input Multiple-Output identification can also be used to minimize the problem of over-modeling. Examples of the two applications of the residue analysis are given.

13:15 - 13:30 Análisis de estabilidad global mediante intersección de contornos

Hernández, Silvia; Suárez, Almudena
Dpto. de Ingeniería de Comunicaciones, Universidad de Cantabria, España

A new methodology to obtain the bifurcation loci that delimit the stable operation regions of nonlinear circuits, in terms of two relevant parameters, is presented. The method, intended to be used in combination with harmonic balance, is based on the calculation of an admittance function under a small-signal excitation, which should be equal to zero at the bifurcation points. The zeroes of the admittance function are calculated obtaining two surfaces, corresponding to the real and imaginary parts of the function, and detecting the intersection points of the respective zero-value contours. The main advantage is the capability to exhaustively detect bifurcation points in multivalued bifurcation curves and even disconnected curves, without continuation techniques. An extension of the method, based on the calculation of the admittance function under a large-signal excitation, allows tracing multi-valued solution curves versus an analysis parameter. It has been applied to obtain the bifurcation loci of a power amplifier and trace the solution curves of a subharmonic injection-locked oscillator of a high order.

13:30 - 13:45 Extracción de modelos casi-estáticos para dispositivos no-lineales a partir de medidas en el dominio de la frecuencia

Pérez Parras, Sergio; **Martín Guerrero, Teresa M.**; Baños Polglase, Janie D.; Camacho Peñalosa, Carlos
Universidad de Málaga, España

In this contribution an extraction method already proposed by authors and suitable for FET-type devices that could be represented by a quasi-static model is illustrated. For the first time, the method is applied to a FET embedded in a parasitic elements environment and fed at each port with sources that include internal impedances. The main impact of adding these elements is that intrinsic voltages that control the nonlinear current and charge sources of the model to be extracted are not ideal monochromatic signals. The results show that the extraction method works with these more realistic control voltages at the expense of an important reduction of the range of control voltages with respect to the ideal case. The dependence of the results on the input power level is also assessed. Results demonstrate that the method is still valid under realistic conditions and it is ready to be applied to experimental results.

13:45 - 14:00 Behavioral frequency domain model formulations for accurate nonlinear microwave circuit design

Fernández Barciela, Mónica [1]; Moure Fernández, Rocío [1]; Peláez Pérez, Ana [2]; Casbon, Michael [3]; Tasker, Paul J. [3]
[1] *Universidad de Vigo, España;* [2] *Televés S.A., España;* [3] *Cardiff University, United Kingdom*

Frequency domain nonlinear behavioral models have demonstrated in the last ten years its potential as a tool for nonlinear microwave circuit design. Different formulations and extraction procedures have been proposed, in order to extend or improve the model predictions. Their main advantage is rooted in their ability to provide less time consuming and more accurate nonlinear device predictions than compact models in realistic design environments, where power levels and multi-harmonic terminal impedances may change during design optimization. This is crucial, for example, in new efficient power amplifier architectures, where bias and/or load impedances may dynamically change, and a precise control of the signals time domain waveforms at the transistors ports is required. In this paper we will discuss aspects related to travelling wave and V-I domain behavioral formulations, with respect to their extraction, frequency scalability, optimum complexity and suitability for analytical guiding the first steps in nonlinear circuit design.

Sesión 2.4

Sesión especial - Electromagnetismo Computacional (I)

Miércoles, 04/09/2019
Hora: **12:45 - 14:00**. Lugar: **Aula 006**

12:45 - 13:00 Aceleración de problemas periódicos finitos mediante bases desacopladas y slot-FFT

Landesa Porras, Luis; Serna, Alberto; Taboada, José M.
Universidad de Extremadura, España

A new set of macrobasis functions are developed and its use for 3D-dielectrtic periodic problems is very efficient with the slot-FFT method. The main properties of this new macrobases are orthonormal, power decoupled, and, especially, only a few macrobases can model perfect the radiation of the scatter independently of the incident field. Because macrobasis are defined in the same manner in a periodic problem its use to this kind of problems are very powerful.

13:00 - 13:15 Análisis de problemas de elevado tamaño eléctrico mediante IE-DDM

Martín Martínez, Víctor Francisco; Larios Benítez, David; **Taboada Varela, José Manuel**; Landesa Porras, Luis
Universidad de Extremadura, España

A tear-and-interconnect surface integral equation (SIE) domain decomposition (DD) preconditioner is applied to the electromagnetic solution of realistic large-scale problems including multi-scale features. The paper focuses especially on complex, realistic radiation problems and composite penetrable objects, such as those found in the context of electromagnetic compatibility (EMC) studies or in the field of nanoplasmonic applications. A set of well-posed numerical examples will demonstrate the ability of this approach to improve, or even enable, convergence in such kind of realistic applications.

13:15 - 13:30 Mesh-robust implementation of the PMCHWT formulation for the electromagnetic scattering analysis of penetrable objects

Ubeda, Eduard; Sekulic, Ivan; **Rius, Juan Manuel**
CommSensLab, Universitat Politècnica de Catalunya, España

The conventional schemes of discretization with the method of moments for the scattering analysis of homogeneous dielectric targets rely on edge-based basis functions. This restricts the modelling of targets to conformal meshes, with all adjacent facets sharing one single edge. Edge-based schemes require the execution of edge search algorithms in order to establish the set of interior edges of the mesh. However, flaws in the mesh generation may give rise to an incomplete identification of the interior edges and a wrong modelling of the currents. Recently introduced facet-based schemes of discretization of surface integral equations, with volumetric testing, have exhibited improved accuracy in the analysis of penetrable targets with geometric singularities. Since facet-based schemes ignore by definition edges, they are better suited than edge-based schemes for the robust analysis of slightly defective meshes, e.g. with unconnected vertices or misaligned edges.

13:30 - 13:45 Discretizaciones de alto orden para la Ecuación Integral de Campo Magnético

Conde-Pumpido, Fernando; Gil, José María
Information Processing and Telecommunications Center, Universidad Politécnica de Madrid, España

Higher-order curl and div-conforming basis functions are applied to the discretization of the Magnetic-Field Integral Equation. Two canonical examples are used to test the convergence of the method and its improvement against the Electric-Field Integral Equations for some applications.

13:45 - 14:00 Análisis de lentes metálicas mediante modos característicos

Ferrando Bataller, Miguel [1]; Santillán Haro, Daniel [2]; Antonino Daviu, Eva [1]; Cabedo Fabrés, Marta [1]; Vico Bondía, Felipe [1]; Rius Casals, Juan Manuel [3]
[1] *Universitat Politècnica de València, España;* [2] *Universidad Nacional de Chimborazo, Ecuador;* [3] *Universitat Politècnica de Catalunya, España*

Se presenta un método de análisis de lentes metálicas con geometría circular. Las lentes se analizan mediante la formulación de los Modos Característicos. Se han diseñado lentes planas de una sola capa con directividades de 15 dBi y 19 dBi, con un ancho de banda de 1.5 GHz a frecuencias de milimétricas. El procedimiento propuesto permite diseñar rápidamente otros prototipos en las bandas de microondas y milimétricas. Los diseños son de bajo perfil.

Sesión 2.5

Sesión especial - Técnicas y tecnologías de fabricación para antenas y dispositivos de RF (I)

Miércoles, 04/09/2019
Hora: **12:45 - 14:00**. Lugar: **Aula 007**

12:45 - 13:00 Implementación de circuitos planares de microondas mediante técnicas aditivas

García Martínez, Héctor; **Torregrosa Penalva, Germán**; Ávila Navarro, Ernesto; Coves Soler, Ángela; Bronchalo, Enrique
Universidad Miguel Hernández de Elche, España

En este artículo presentamos diferentes circuitos de microondas que funcionan hasta 10 GHz, que se han implementado siguiendo un proceso de fabricación aditiva 3D de bajo coste. Se muestra cómo se puede usar esta tecnología para proponer topologías y estructuras de circuitos que no pueden ser implementadas mediante tecnologías convencionales (como circuitos planares en sustratos comerciales, guías de ondas o tecnología SIW ...). Se han diseñado, simulado, fabricado y caracterizado tres circuitos diferentes: un filtro paso bajo de saltos de impedancia, un diplexor que satisface las frecuencias de las aplicaciones GSM y WLAN, y un filtro paso banda EBG en guía de onda rectangular. Las medidas presentadas muestran unas respuestas adecuadas y acordes con las simulaciones.

13:00 - 13:15 Diseño de filtros multicapa mediante técnicas de fabricación aditiva.

García Martínez, Héctor; Candel Marti, Alfredo; Ávila Navarro, Ernesto; Torregrosa Penalva, Germán
Universidad Miguel Hernández de Elche, España

En este artículo se presenta el diseño y la fabricación de filtros multicapa utilizando técnicas de fabricación aditiva. Se realiza el análisis del coeficiente de acoplamiento y el factor de calidad, y se describe el proceso de fabricación de la estructura multicapa, basado en una impresora 3D de bajo coste y filamento estándar. Finalmente, se han diseñado y fabricado dos filtros de líneas acopladas multicapa, uno para reducir la ocupación del área y el otro para obtener el máximo ancho de banda en el rango de RF. Los filtros diseñados se han simulado y medido con buenos resultados, lo que demuestra la posibilidad de utilizar impresoras 3D de bajo coste en el diseño de filtros multicapa.

13:15 - 13:30 Implementation of a 3D printed microwave waveguide using plated PLA

Nova Giménez, Vicente [(1)]; Bachiller Martin, María Carmen [(1)]; Sánchez Marín, Juan Rafael [(1)]; Marín García, María Luisa [(2)]; Boria Esbert, Vicente Enrique [(1)]
[(1)] *Instituto de Telecomunicaciones y Aplicaciones Multimedia, Universitat Politècnica de València;* [(2)] *Instituto de Tecnologia Quimica, Universitat Politècnica de València*

This manuscript presents a new technique for manufacturing lightweight low-cost waveguides by using 3D printing technology. A WR-75 standard waveguide is manufactured through fused deposition modelling (FDM) of polylactic acid with bronze (PLA). The 3D printed waveguide is firstly plated by using an electroless plating process in order to achieve a highly strongly adhesion of the copper coated. Then, thanks to this first copper layer, the waveguide can be plated again by using an electroplating process in order to achieve a smoother copper surface. The measured frequency response is in good agreement with the simulated one, it has an average insertion loss per length unit less than 0.04 dB/cm and a minimum return loss of 22.6 dB within the operation range of frequencies (from 9 GHz to 15 GHz). Since 3D printed technology allows developing arbitrary hollow structures, this technique provide a low cost and flexible approach for manufacturing lightweight microwave devices.

13:30 - 13:45 Millimetre and sub-millimetre wave electronic circuit manufacture with micron precision by means of photolithography techniques

Teniente Vallinas, Jorge [1,2]; Melero Frago, Marta [1]; Biurrun Quel, Carlos [1]; Torres García, Alicia [1]; Pérez Escudero, José Manuel [1]
[1] *Dpto. de Ingeniería Eléctrica, Electrónica y de Comunicación. Universidad Pública de Navarra, España;* [2] *Instituto de Smart Cities (ISC), Universidad Pública de Navarra, España*

This paper presents the manufacture procedure employed at ISC/UPNA for mm-wave and sub-millimetre wave high accuracy electronic circuit.
The method employed is based on photolithography process and is explained in detail so as to be reproduced in similar conditions by other research groups.
The method proposed obtains higher accuracy results than common laser machining techniques available nowadays for the scientific community and it can be developed in a research lab for a fraction of the price of such laser machining methods.
Common substrate properties used for mm-wave and sub-millimetre wave electronic circuit manufacture are also given in the paper highlighting the properties of some of the substrates and also their manufacture difficulties.
Some examples of successful manufactured circuits are also given to demonstrate the advantages of using this manufacture method.

13:45 - 14:00 Estudio comparativo sobre la supresión del modo común en imagen por resonancia magnética

Bosch Esteve, Rubén; Algarín Guisado, José Miguel; Pallás Lodeiro, Eduardo; Alonso Otamendi, Joseba; Benlloch Baviera, José María
Consejo Superior de Investigaciones Científicas (CSIC), España

En este trabajo, comparamos dos métodos para rechazar la corriente de modo común inducida en la malla de los cables coaxiales empleados en los experimentos de imágenes por resonancia magnética. En un primer enfoque, usamos un cable coaxial enrollado con forma toroidal sintonizado a la frecuencia de resonancia deseada por medio de un condensador entre las vueltas extremas del blindaje de tierra del cable coaxial. En el segundo enfoque, utilizamos una trampa de cable flotante que consta de dos cilindros conductores coaxiales, donde un extremo está en cortocircuito y el otro extremo está sintonizado a la resonancia, formando un cuarto de filtro de longitud de onda. Fabricamos ambas trampas de cable para rechazar corrientes de modo común a 65.2 MHz, correspondientes a la frecuencia de 1H Larmor de un escáner de imagen de resonancia magnética de 1.5 T. La trampa de cable flotante tiene un mejor rendimiento debido a la reducción del acoplamiento magnético a una carga. Su factor de calidad es, por consiguiente, también mejor.

Sesión 3.1

Radiación, Dispersión y Radiopropagación (II)

Miércoles, 04/09/2019
Hora: **15:30 - 17:30**. Lugar: **Aula 002**

15:30 - 15:45 Cálculo teórico-experimental de las pérdidas de inserción acústicas de paneles monolíticos para comunicaciones submarinas

Pardo Quiles, Domingo [1,2]; Rodríguez, José-Víctor [1]; Lozano Giménez, Rubén [1]
[1] *ETSIT - Universidad Politécnica de Cartagena, España;* [2] *Dpto. de Ingeniería, Navantia S.A*

En este trabajo se calculan y miden teóricamente en función de la frecuencia y el ángulo de incidencia las pérdidas de inserción acústicas (IL) en paneles monolíticos e isotrópicos utilizados comúnmente en aplicaciones submarinas. Específicamente, la IL se midió en una piscina calibrada de agua dulce en el rango de frecuencias de 10 kHz a 60 kHz, y en los ángulos de incidencia de 0º a 80º.
Posteriormente, se compararon con los resultados simulados con el programa software desarrollado por los autores (SAILOR), basado en la formulación propuesta por Brekhovskikh y G.Roche para la estimación de IL en materiales monocapa o multicapa, con ángulos de incidencia normal y oblicuo. De esta manera, el presente trabajo también tiene la intención de verificar empíricamente dicha formulación en el rango mencionado de frecuencias y ángulos de incidencia medidos.

15:45 - 16:00 Method to delimit near-field effects of wind turbines on terrestrial radio links

de la Vega, David; Angulo, Itziar
Universidad del País Vasco (UPV/EHU), España

Potential impact on telecommunication services is an increasing concern in wind farms deployment. The evaluation of the potential disturbance of a planned wind farm requires accurate and unbiased criteria applied in a comprehensive impact study. Near-field effects of wind turbines on microwave radio links is one of the less analyzed disturbances. In this paper, new theoretical based criteria and a calculation procedure are proposed. Results of the method are in form of constraint masks, easy to apply by wind farm promoters in the layout design, by telecommunications operators in the evaluation of the potential impact, and by administrations involved in license tasks. The proposed method is evaluated in real cases of wind farms located close to radio links facilities, and compared to current criteria. The method has been recently agreed by CEPT to be published in a CEPT ECC Report.

16:00 - 16:15 Estudio experimental de la atenuación por dispersión en árboles en la banda de 1 a 40 GHz

Martínez-Inglés, María Teresa [(1)]; Molina García-Pardo, José María [(2)]; **Juan-Llácer, Leandro** [(2)]; Pascual-García, Juan [(2)]; Rodríguez, José-Víctor [(2)]
[(1)] *Centro Universitario de la Defensa, Ministerio de defensa, España;* [(2)] *Universidad Politécnica de Cartagena, España*

In the scope of propagation in agriculture applications, this work presents the experimental results on dispersion attenuation when waves propagate though trees (bonsáis), in the frequency band from 1 GHz to 40 GHz. Depending on the position of the Tx antenna, different dispersion patterns are measured. The power delay profile (PDP) with the presence of the tree is delayed and attenuated respect to the PDP without tree. The dispersion attenuation due to the presence of the tree increases in frequency up to 10 dB.

16:15 - 16:30 Análisis radioeléctrico para el despliegue de sistemas inalámbricos a 2.4 GHz en entornos para la práctica de baloncesto

Picallo, Imanol [(1)]; Lopez-Iturri, Peio [(1,2)]; Aguirre, Erik [(1)]; Azpilicueta, Leyre [(3)]; Celaya-Echarri, Mikel [(3)]; Astrain, José Javier [(4)]; Villadangos, Jesús [(4)]; Falcone, Francisco [(1,2)]
[(1)] *Dpto. Ingeniería Eléctrica, Electrónica y de Comunicación, Universidad Pública de Navarra;* [(2)] *Institute of Smart Cities, Universidad Pública de Navarra;* [(3)] *School of Engineering and Sciences, Tecnológico de Monterrey, Mexico;* [(4)] *Dpto. Estadística, Informática y Matemáticas, Universidad Pública de Navarra*

The implementation of wireless communication systems in basketball environments could change radically the experience of both players and spectators. This work presents preliminary radio propagation results at 2.4 GHz by means of an in-house developed deterministic simulation tool: the 3D Ray Launching (3D RL) algorithm. The 3D RL has been applied to a real basketball court and pavilion and has been validated with a campaign of measurements within the real environment. The presented methodology can lead to optimized deployments of wireless communication-based solutions within this kind of environments.

16:30 - 16:45 Development of measurement system and procedures to characterize NLOS channels

Castiella Fernández, Marta; Velasco de la Fuente, Pedro; Pérez Peña, Santiago; Burgos García, Mateo
Universidad Politécnica Madrid, España

Over the Horizon Communications Measurement and Modeling is a project launched by the Facebook Connectivity Research Department, which goal is delivering internet connectivity to the more than 3.8 billion people who are not yet online by exploring new communications models and technologies and implementing them to the internet infrastructure.
According to Facebook studies, there are many practical situations in which it is necessary to surpass mountains with low diffraction angles to establish communication. However, the existing propagation models are very pessimistic as they are based on higher diffraction angles measurements. Therefore, NLOS channels should be analyzed in depth.
The project aims to design and build a Channel Sounder, accomplish a campaign of measurements to obtain relevant results and derive new propagation models for NLOS Channels.

16:45 - 17:00 Estudio de diversidad en tiempo para radioenlaces satelitales en las bandas Ka y Q

Pimienta del Valle, Domingo; Riera Salís, José Manuel; García del Pino, Pedro
Universidad Politécnica de Madrid, España

One of the available propagation impairment mitigation techniques (the methods used to counteract the adverse effects to the signal in the satellite communication channel) is time diversity (TD). This technique relies on resending the information a conveniently chosen time after, in order to obtain a diversity gain when a fade event occurs. TD analysis can be carried out when experiments with high availability and for a relatively long period of time are available. Since the GTIC-Radiocommunication Research Group has excess attenuation data with a very high availability (higher than 97%) collected from two satellite beacon receivers, one receiving the 20 GHz signal coming from KA-SAT and the other receiving the 40 GHz signal coming from Alphasat, for a four-year period, a TD analysis have been carried out, which is presented here. Results are also compared with four available models: Matriccini, the Joint Probability, Greece and ONERA, giving very good approximations for both bands.

17:00 - 17:15 Monitorización en tiempo real del contenido de agua de una vid mediante THz

Quemada Mayoral, Carlos [(1)]; Iriarte Galarregui, Juan Carlos [(1,2)]; Marín Ederra, Diana [(3)]; Miranda Jiménez, Carlos [(3)]; Gonzalo García, Ramón [(1,2)]; Santesteban García, Luis Gonzaga [(3)]; Ederra Urzainqui, Íñigo [(1,2)]
[(1)] *Dpto. Ingeniería, Eléctrica Electrónica y de Comunicación, Universidad Pública de Navarra, España;* [(2)] *Instituto de Smart Cities, Universidad Pública de Navarra, España;* [(3)] *Dpto. Agronomía, Biotecnología y Alimentación, Universidad Pública de Navarra, España*

This paper presents an innovative real-time monitoring system that enables the continuous water content estimation of a grapevine by means of reflectivity measurements on the plant's trunk at the terahertz band. Since outdoor conditions, such as temperature and lighting, have a noticeable influence on the plant's hydration level, the whole setup has been settled inside a growth chamber where both magnitudes can be modified at will. In order to monitor the plant's water content, the electromagnetic power level reflected by the trunk has been correlated with variations of the three most important environmental parameters, such as lighting conditions, temperature and irrigation, using both time domain and frequency domain measurement techniques. These results have been contrasted with long-established techniques, such as a dendrometer and a humidity probe, obtaining a high level of correlation.

Sesión 3.2

Comunicaciones Móviles e Inalámbricas (II)

Miércoles, 04/09/2019
Hora: **15:30 - 17:30**. Lugar: **Aula 003**

15:30 - 15:45 Algoritmo de detección de huecos de cobertura usando información de redes sociales

Bejarano Luque, Juan Luis [(1)]; Toril, Matías [(1)]; Fernández Navarro, Mariano [(1)]; Acedo Hernández, Rocío [(2)]; García, Antonio Jesús [(1)]
[(1)] *Universidad de Málaga, España;* [(2)] *Blue Telecom Consulting, España*

One of the main problems that an operator faces in the process of planning and organizing a cellular network is the distribution of people in the coverage area. Usually, network operators do not have information about the coordinates of the connections occurred in the network, so their position has to be estimated. Traditionally, position of users has been estimated using two main techniques, first one based on the Angle of Arrival (AoA) and the Time of Arrival (ToA), and second one based on the measured RSRP by the terminal. In this paper, a method to detect poor performance areas in a live Long Term Evolution (LTE) network is proposed based on real data obtained from connection traces and public information from Social Networks.

15:45 - 16:00 Reparto de tráfico basado en métricas de rendimiento en escenarios con multiconectividad

Burgueño Romero, Jesús; de la Bandera Cascales, Isabel; Palacios Campos, David; Barco Moreno, Raquel
Universidad de Málaga, España

Multi-connectivity (MC) is one of the most relevant features to be introduced in 5G networks, allowing users to simultaneously aggregate radio resources from several network nodes to improve both reliability and data rates. Until now, no policies have been defined to determine the amount of traffic to be held by each of the Component Carriers (CCs) provided by the different serving nodes. This paper shows how a traffic split, which is dependent of user and network performance metrics, allows the benefits of MC to be further enhanced in terms of throughput when compared to a homogeneous traffic split among the CCs provided by several serving nodes. To that end, several simulations have been carried out with different user distributions.

16:00 - 16:15 Modelado de indicadores de calidad de servicio para la gestión de red extremo a extremo

Herrera García, Ana; Fortes, Sergio; Baena, Eduardo; Mendoza, Jessica; Barco, Raquel
Universidad de Málaga, España

The evolution of cellular telecommunication networks is enabling providers to deploy a wide range of services. In this sense, end-to-end (E2E) performance analysis and optimization will be one of the key features in the management of the new 5G systems. However, estimating the end-user experience is not an easy task for network operators. The amount of end-user performance information that the operators can really measure from the network is limited, complicating this approach. In this line, the present work develops on the calculation of service metrics (known as Key Quality Indicators) from classic low-layer measurements and configuration parameters using machine learning (ML) techniques. To assess the approach, the proposed system is implemented and evaluated in a real cellular network testbed.

16:15 - 16:30 Procesado masivo y automático de trazas en redes celulares

Anaya López, Gonzalo Javier [(1)]; Guerra Melgares, Noelia [(2)]; Cárdenas Angelat, Carlos [(2)]; Aguayo Torres, María del Carmen[(1)]; Baños Polglase, Juana [(2)]
[(1)] *Dpto. Ingeniería de Comunicaciones, Universidad de Málaga, Málaga, España;* [(2)] *DEKRA Testing and Certification S.A.U., Málaga, España*

The introduction of new services in mobile communications usually requires extensive evaluation campaigns. Even though new services and devices may have undergone conformance testing, it is important to ensure they do properly work in real live networks, where some parameters, signalling procedures or timer values may differ from those used in conformance testing. It is also important to diagnose error sources. This paper describes a tool that automatically analyses traces captured by the mobile terminal. Its design addresses two main challenges: the efficient handling of the large amount of information captured by the terminal and the extraction of relevant information from traces generated by different sources.

16:30 - 16:45 Método de análisis temporal para root cause analysis en redes móviles

Luo-Chen, Hao Qiang; J. Khatib, Emil; Suárez, José R.; Barco, Raquel
Universidad de Málaga, España

Troubleshooting encompasses a variety of processes required for the solution of mobile network degradations. These netwoks usually operate correctly, thanks to automatized processes of configuration and optimization, but such degradations may happen due to diverse unpredicted reasons and their impact is negative from the user perspective, since the service quality degrades. For that, Root Cause Analysis (RCA) is the step which accomplishes the task of searching the origin of those degradations. In this paper, an automatic RCA method based on temporal analysis of the general behavior of network elements and its correlation with individual counters is presented.

16:45 - 17:00 Optimización de la calidad de experiencia en redes LTE mediante el reparto de tráfico

Marí-Altozano, María Luisa; Luna-Ramírez, Salvador; Toril, Matías; Gijón, Carolina
Universidad de Málaga, España

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 traffic steering a key use case. Traditionally, traffic steering aims to balancing the traffic among adjacent cells, although it has also been used to balancing QoE among cells in a LTE network. Nevertheless, these techniques may fail when pursuing maximum user QoE. In this work, a novel traffic steering algorithm is proposed to reach maximum QoE in a realistic LTE network with a file download service.

17:00 - 17:15 Análisis y recomendaciones para la optimización de la red LTE de Orange en la ciudad de Cuenca

Torres Aranda, Ana María; Márquez Rosero, Marcelo; Mateo Sotos, Jorge
Universidad de Castilla-La Mancha, España

En el presente trabajo se ha realizado un estudio de la red LTE de la operadora Orange en la ciudad de Cuenca para a partir del mismo realizar una serie de recomendaciones que permiten optimizar y mejorar la cobertura y calidad de la red LTE.
En el estudio llevado a cabo se ha destacado su arquitectura, interfaz radio y capa física. A partir de aquí, se han utilizado dispositivos móviles con el software Qualipoc permitiendo realizar recorridos dentro de la ciudad con el que ha sido posible obtener la información necesaria para el análisis. Una vez evaluada esta información se ha determinado el estado actual de la red de LTE en la ciudad de Cuenca y se ha identificado las zonas con problemas de cobertura y calidad de acuerdo a ciertos parámetros de RF. Por último y utilizando el software de simulación Atoll como soporte y MapInfo como sistema de información geográfica, se han realizado recomendaciones para mejorar la cobertura y calidad de la misma dentro de la ciudad.

17:15 - 17:30 Optimización de la calidad de experiencia en escenarios de multiconectividad

de la Bandera Cascales, Isabel; Palacios, David; Burgueño, Jesús; Barco, Raquel
Universidad de Málaga, España

The vertiginous evolution of mobile communications networks is affecting not only the complexity and size of them, but also the way that these new networks have to be managed. Nowadays, the network management, and specially network optimization, is focused on improving users' quality of experience instead of network performance. This new approach will be essential in next fifth generation new radio (5G NR) networks where different services with different requirements have to coexist. This work is focused in one of the main features from 5G NR networks, multi-connectivity. This functionality allows a user to connect to more than one node by using multiple component carriers simultaneously. This paper proposes an automatic method to assign component carriers with the objective of optimizing the users' quality of experience.

Sesión 3.3

Sesión especial - Comunicaciones por Satélite (II) y Mesa Redonda

Miércoles, 04/09/2019
Hora: **15:30 - 17:30**. Lugar: **Aula 005**

15:30 - 15:45 A compact antenna design with simultaneous X/Ka-band and dual-sense polarization (LHCP/RHCP) for SatCom applications

Rocha Peñalosa, Borja [(1)]; Galocha Iragüen, Belén [(2)]; Besada Sanmartin, José Luis [(2)]; Alonso Fernández, Yaiza [(1)]; Ruíz Dou, José Luis [(1)]; Zarzuelo Torres, Carlos [(1)]
[(1)] *Indra Sistemas, España;* [(2)] *Universidad Politécnica de Madrid, Grupo de Radiación*

A dual X/Ka Band antenna system capable of generating both senses of circular polarization (RHCP/LHCP) is presented in this article. The feed system provides simultaneous operability in X-band (DL: 7.25-7.75 GHz UL: 7.9-8.4 GHz) and military Ka-band (DL: 20.2-21.2 GHz, UL: 30-31 GHz) offering broadband links required in the military missions. The antenna is formed by a dual band self-supported feed-chain based on a coaxial structure that illuminates a main reflector surface of 60 cm diameter. An axial ratio lower than 0.6 dB and 0.8 dB at X Band and Ka band ports respectively and antenna efficiencies up to 70% have been obtained.
This article shows predicted performance of compact antenna terminal computed with electromagnetic simulation tools such as CST MW Studio and TICRA software.

15:45 - 16:00 Optimization of smart gateway diversity systems for VHTS considering ground segment cost

Massanet Ginard, Michel; **Martínez Rodríguez-Osorio, Ramón**
Universidad Politénica de Madrid, España

This paper addresses an optimization problem on the design of gateway diversity for very high throughput satellites. GW diversity has converted into a critical requirement on the achievement of high throughputs due to extreme rain attenuation implicated in the increase of frequency. The GW diversity allocation is based on outage probability contour levels computed using Rec. ITU-R P.1815-1 which depend on the GW antenna diameter. The proposed approach aims to reduce the antenna diameters and terrestial fiber network in the same feeder spot beam while improving the link connection availability of the system. Simulations in Q/V-band and real GW positions are presented together with a comparison with non-diversity schemes. Results show the comprise between the backup GW site and its antenna diameter in the deployment cost using the outage probability contour levels. The optimization shows cost savings up to 200 K€.

Sesión 3.4

Sesión especial - Electromagnetismo Computacional (II)

Miércoles, 04/09/2019
Hora: **15:30 - 17:30**. Lugar: **Aula 006**

15:30 - 15:45 Nueva técnica de ecuación integral para el análisis de discontinuidades capacitivas entre guías de onda rectangulares que incluyen postes diélectricos y/o metálicos de forma arbitraria

Quesada Pereira, Fernando Daniel [1]; Gómez Molina, Celia [1]; Álvarez Melcón, Alejandro [1]; Boria Esbert, Vicente Enrique [2]; Guglielmi, Marco [2]
[1] *Dpto. de Tecnologías de la Información y las Comunicaciones, Universidad Politécnica de Cartagena, Cartagena.;* [2] *Instituto de Telecomunicaciones y Aplicaciones Multimedia, Universidad Politécnica de València, Valencia*

In this contribution, we propose a novel and efficient integral equation technique that allows the analysis of capacitive step discontinuities between rectangular waveguides. The numerical method models accurately the influence of a given number of arbitrarily shaped conducting and/or homogeneous posts in the vecinity of the step discontinuity. The formulation is based on the Surface Equivalence Principle, using the parallel plate Green's functions as the kenel of the integral equation, to take into account for the boundary conditions at the walls of the rectangular waveguides forming the step. This formulation, written in the spectral-spatial domains, takes advantage of the capacitive symmetry of the problem under analysis, reducing its original 3D nature to a 2.5D one. The numerical technique has been validated with two different examples, namely a plain step discontinuity and a practical lowpass filter design. The simulation results have been compared to those obtained by using a commercial Finite Elements Method (FEM) software tool (ANSYS HFSS), showing in all cases very good agreement with higher computational efficiency.

15:45 - 16:00 Modelado de superficies selectivas en frecuencia apiladas mediante un método híbrido numérico-analítico

Mesa Ledesma, Francisco [1]; Rodríguez Berral, Raúl [1]; García Vigueras, María [2]; **Medina Mena, Francisco** [1]
[1] *Universidad de Sevilla, España;* [2] *Institut National des Sciences Appliquées de Rennes, Rennes, France*

This contribution proposes a method that combines numerical full-wave calculations with an appropriate circuit model to accurately characterize a variety of stacked frequency selective surfaces (FSS's). The numerical data are obtained with the help of a commercial solver for some elementary structures whose combination gives place to the global, much more complex, stacked structure. The method is specially useful when the number of stacked FSS's is relatively high and the distance between them is relatively small, in such a way that higher-order Floquet-harmonic interactions play an essential role. The approach is based on the existence and properties of an equivalent Π-network for each pair of coupled FSS's involved in the structure under analysis. The proposed solution of the complete problem of N stacked FSS's only involves full-wave simulations of a single FSS. Three situations have to be considered where the surface is either standalone, or backed by perfect electric/magnetic conductors. Several illustrating examples are provided to validate the proposed methodology.

16:00 - 16:15 Improved cross-polarization performance in reflectarray antennas by direct optimization of the XPD and XPI parameters

Prado, Daniel R. [1]; **Arrebola, Manuel** [2]; Pino, Marcos R. [2]; Goussetis, George [1]
[1] *Heriot-Watt University, Reino Unido;* [2] *Universidad de Oviedo, España*

Current satellite missions for communications demand a high polarization purity, with figures of merit such as the crosspolar discrimination (XPD) better than 33 dB. In order to accomplish these values, some kind of optimization must be carried out to improve cross-polarization performance. The most common approach is to minimize the crosspolar component of the radiation pattern in the region of interest. Nevertheless, this strategy produces suboptimal results since the figure of merit for cross-polarization performance is optimized indirectly. Thus, it is proposed to directly optimize the XPD to improve the polarization purity of reflectarrays for satellite missions. For that purpose, the generalized Intersection Approach algorithm is employed to optimize a very large shaped-beam reflectarray for a direct broadcast satellite application with a European coverage. It is shown that directly optimizing the cross-polarization figure of merit provides better results than the usual approach of minimizing the crosspolar pattern.

16:15 - 16:30 Formulación eléctrica de red multimodal equivalente aplicada al análisis de circuitos impresos multicapa encapsulados

Gómez Molina, Celia [1]; Quesada Pereira, Fernando [1]; Álvarez Melcón, Alejandro [1]; Boria Esbert, Vicente [2]; Guglielmi, Marco [2]
[1] *Universidad Politécnica de Cartagena;* [2] *Universidad Politècnica de València*

The Multimode Equivalent Network formulation has proved to be a very efficient and accurate numerical technique for the analisis of waveguide and single-layer boxed coupled lines microstrip filters. The aim of this contribution is to extend the electric zero-thickness MEN formulation to the analysis of multilayer boxed microstrip circuits that are based on arbitrary rectangular elements and include ports in the transverse plane. For this purpose, the MEN approach is used to model each metal interface in the multilayer circuit through its equivalent network. Then, the equivalent networks are conveniently cascaded to obtain the final equivalent network that characterizes the whole circuit. To validate the theory, a trisection filter composed of two metallization levels is analyzed and discussed in this contribution.

16:30 - 16:45 Técnica híbrida para un análisis eficiente y preciso del canal V2X en escenarios de tráfico urbano

Lozano, Lorena [1]; Somolinos, Álvaro [2]; González, Iván [1]; Cátedra, Felipe [1]
[1] *Dpto. Ciencias de la Computación, Universidad de Alcalá, España;* [2] *newFASANT, Guadalajara, España*

In order to satisfy the demand of the automotive industry to analyses the vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) radio-wave channel in urban traffic scenarios, this paper proposes the development of a new hybrid technique combining Method of Moments (MoM), Physical Optics (PO) and Geometrical Theory of Diffraction (GTD). Obtaining an efficient and accurate technique to solve multiscale problems that appear in this kind of analysis. Results and validations for simple cases and real urban scenarios are presented.

16:45 - 17:00 Verificación numérica mediante MoM de modelos estocásticos de valores propios en billares de microondas.

Villar, Jorge M.; Bautista, Lucía; Castro, Inmaculada T.; Taboada, José M.; Landesa Porras, Luis
Universidad de Extremadura, España

The distribution of the eigenvalues in large closed cavities can be described using random matrix hypothesis of Wigner. The distance between eigenvalues can be predicted by Random Matrix theory (RMT) using a Gaussian Orthogonal Ensemble (GOE) of matrices. For the numerical evaluation of the eigenvalues, the Method of Moments can be used; in fact, resonances inside the cavity perturbs outer numerical solutions of the Method of Moments for electromagnetic problem computations. Using this fact, we calculate the eigenvalue distribution for several billiards, and we verify for much of them that this distribution matchs very well the Wigner surmise.

17:00 - 17:15 Extracting design information from computational electromagnetics

Carrasco de Jaureguizar, Belén; de la Rubia Hernández, Valentín
Universidad Politécnica de Madrid, España

In this work, extraction of design information from full-wave electromagnetic analysis of microwave circuits is detailed. Global eigenmode representation does not actually provide handy information other than describing the actual frequency response of the device under analysis. A more insightful representation is preferred to extract meaningful design information out of the electromagnetic analysis. A local mode representation basis is used to describe the electromagnetic behavior of the microwave circuit, where all electromagnetic couplings among the different local resonating cavities and the input and out ports are identified. This approach provides design information since the actual state of the circuit is detailed in a straightforward local design parameter arrangement. Different devices will show the possibilities of the proposed approach.

Sesión 3.5

Sesión especial - Técnicas y tecnologías de fabricación para antenas y dispositivos de RF (II)

Miércoles, 04/09/2019
Hora: **15:30 - 17:30**. Lugar: **Aula 007**

15:30 - 15:45 Dispositivo desfasador mecánico en tecnología de guía de onda gap

Sánchez Escuderos, Daniel; Herranz Herruzo, José Ignacio; Ferrando Rocher, Miguel; Valero Nogueira, Alejandro
Universitat Politècnica de València, España

This paper describes a new mechanical phase shifter in gap waveguide technology to be used in ground terminals of Ka-band satellite on-the-move applications. The new device is divided into two main parts: the bottom part, a power divider connected to concentric groove-gap waveguides (GGW); and the upper part, the output ridge-gap waveguides. The coupling between both parts is done through a slot on a metallic plane between the bottom and the upper parts. A small gap is inserted between this plane and the bed of nails of the GGW to allow the bottom part to be rotated. The use of a bed of nails in the bottom GGW prevents from leakage of waves through the gap. Results show a constant phase shift between contiguous output RGW ports, with a good insertion and return loss levels within the operating frequency band, 29.5-30.5 GHz.

15:45 - 16:00 Fabricación aditiva de atenuadores variables de veleta rotatoria en guía de onda

Márquez Segura, Enrique [1]; Otter, William J. [2]; Lucyszin, Stepan [2]; Ridler, Nick [3]
[1] *Universidad de Málaga, España;* [2] *Imperial College London, Reino Unido;* [3] *National Physical Laboratory, Teddington, Reino Unido*

Rotary Vane Attenuator is considered an industry standard in precision waveguide attenuators. These atenuattors exhibit high accuracy, repeatability and reliability. In this paper the design and fabrication of a rotary vane atenuattor using addditive manufacturing is presented. The use of several material to fabricate the lossy septum is discussed. ABS has been used to design all mechanical and waveguide parts. Waveguide parts has been metallised using a dual component spraying technology. Measurements has assessed the validity of the manufacturing process.

16:00 - 16:15 Aplicación de técnicas de impresión 3D al diseño y fabricación de superficies selectivas en frecuencia

Muñoz Rebate, Ignacio [1]; **Plaza Gallardo, Borja** [2]; Martín Iglesias, Santiago [1]; Poyatos Martínez, David [1]
[1] *Instituto Nacional de Técnica Aeroespacial (INTA), España;* [2] *Ingeniería de Sistemas para la Defensa (ISDEFE), España*

This paper presents the application of 3D printing (or additive manufacturing) to the design and fabrication of a frequency selective surface (FSS). In particular, the periodic structure has been created using fused deposition modeling (FDM) technology. Along the paper, a complete development method is described, starting from the electromagnetic (EM) characterization of available materials and the selection of the most suitable one, followed by the design, analysis and optimization of the geometry via EM simulations. Finally a test specimen is implemented and measured in an anechoic chamber. In this case, an innovative material is used: a graphene filled thermoplastic that is able to conduct electricity. The measurement results agree with the simulations, validating the approach and encouraging the use of this 3D printing technique for the manufacturing of radiofrequency devices.

16:15 - 16:30 Fused filament fabrication of low-cost high-performance horn antennas

Ortiz de Saracho Pantoja, Irene [1]; Montejo Garai, José Ramón [2]; Ruiz Cruz, Jorge [3]; Rebollar, Jesús [2]
[1] *Microdata Telecom AB, Suecia;* [2] *Grupo de Electromagnetismo Aplicado, Information Processing and Telecommunications Center, Universidad Politécnica de Madrid, España;* [3] *Escuela Politécnica Superior, Universidad Autónoma de Madrid, España*

This paper presents the development of three low-cost high-performance horn antennas in Ku band, fabricated with the Fused Filament Fabrication (FFF) technology, included among the Additive Manufacturing (AM) techniques. The horn antennas have been designed, printed, metallized and measured in order to assess their suitability for communication applications. They are light and robust structures, quickly manufactured and for a very low price, which makes them available for small labs with reduced budget or academic purposes. Besides, they include some challenging shapes very difficult to achieve with traditional manufacturing. Despite all the restrictions, there is an excellent agreement between simulations and experimental results, which validates the approach to obtain competitive 3D printed Ku band horns in plastic.

16:30 - 16:45 Low-dispersive 60 GHz leaky-wave antennas

Quevedo-Teruel, Óscar [1]; Dahlberg, Oskar [1]; Chen, Qiao [1]; Padilla de la Torre, Pablo [2]; Pucci, Elena [3]
[1] *KTH Royal Institute of Technology, Suecia;* [2] *Universidad de Granada, España;* [3] *Ericsson AB, Suecia*

The fifth generation of communications (5G) will start being implemented in 2019. One of the bands that is being considered for 5G is from 56 GHz to 62 GHz. In this frequency range, highly-efficient and directive antennas are needed. Here, we propose a low-dispersive leaky-wave antenna for 5G point-to-point communications. Leaky-wave antennas are dispersive in nature; however, it has been recently demonstrated that a dispersive prism can compensate for the original dispersion of leaky-wave antennas. Here, we propose two implementations of low-dispersive leaky-wave antennas in gap-waveguide. The first implementation uses a prism made of bed-of-nails. The second solution uses a glide-symmetric holey structure. Both solutions are compared in terms of bandwidth, performance and manufacturing difficulties.

16:45 - 17:00 Diffusion-bonded circularly polarized W-band monopulse array antenna

García Marín, Eduardo; Masa Campos, José Luis; Sánchez Olivares, Pablo
Universidad Autónoma de Madrid, España

A W-band circularly polarized antenna array with monopulse capability has been designed and fabricated by diffusion bonding of copper plates. The antenna is presented as a proof of concept for a space debris radar project. A waveguide monopulse beamforming network provides monopulse operation in the two main radiation planes. The feeding network is implemented in waveguide technology as well, with corporate topology and amplitude tapering to ensure adequate radiation patterns for the monopulse system. Circular polarization is straightforwardly achieved by hexagonal-shaped radiating cavities. Experimental results validate diffusion bonding for complex multilayer antenna fabrication at W-band, providing a bandwidth over 10 % for axial ratio under 3 dB, impedance matching under -10 dB and total efficiency over 75 %.

17:00 - 17:15 Estudio de tolerancias en un array en banda V fabricado mediante estereolitografía (SLA) y metalizado

Palomares-Caballero, Ángel [1,2]; Alex-Amor, Antonio [1,3]; Taha El-Khorassani, Mohamed [2]; Valenzuela-Valdés, Juan [2]; Padilla de la Torre, Pablo [2]
[1] *Universidad de Málaga, España;* [2] *Universidad de Granada, España;* [3] *Universidad Politécnica de Madrid, España*

The manufactured effects on a V-band antenna array based on gap-waveguide technology has been studied. The array is composed by multiple layers that implement a feeding network and aperture antenna elements. Stereolithography (SLA) with a subsequent metal coating has been chosen as the manufacturing technique. A tolerance study has been carried out to determine the affected parameters in the array fabrication process. The metal thickness and the gap size between layers have been the analyzed parameters. These parameters influence the manufactured array. The values of them have been worked out by means of comparisons between measurements and simulations with different tolerances values.

Sesión 4.1

Fotónica y Dispositivos Ópticos

Jueves, 05/09/2019
Hora: **11:20 - 13:05**. Lugar: **Aula 002**

11:20 - 11:35 Discretización de la etapa de salida en sistemas de comunicación óptica no guiada en el visible

González Hernández, Oswaldo; Ayala Alfonso, Alejandro; Rodríguez Pérez, Silvestre; Rodríguez Mendoza, Beatriz
Universidad de La Laguna, España

White light-emitting diodes (WLEDs) are optimized for being used in conmutation (on/off). Simultaneously, many high spectral-efficiency communication systems, such as the orthogonal frequency-division multiplexing (OFDM) technique, require the generation of continous waveforms which conflicts with optimal WLED operation. Therefore, we evaluate the performance degradation due to the discretization of WLED output signals when OFDM is chosen as modulation technique. Two schemes are proposed to enhance system performance as compared with linear discretization: compansion previous to linear discretization and non-linear discretization. Simulation results show that both proposals allow the system to work under the forward error correction bit error rate (BER) limit of $3{,}8 \cdot 10^{-3}$ for 16-QAM when a 4-bit discretization is applied while standard linear discretization system incur in an irreducible BER. However, if greater modulation schemes, such as 64-QAM, are invoked, at least 6-bit discretization is required to make the system operate under that BER limit and no advantange is observed by using both methods as compared to the simpler linear discretization technique, even the latter showing a better performance trend at high signal-to-noise (SNR) ratios.

11:35 - 11:50 Ultra-narrowband subwavelength based Bragg filter for silicon photonics biosensing

Pérez Armenta, Carlos [1]; Molina Fernández, Íñigo [1,2]; Cheben, Pavel [3]; Čtyroký, Jiří [4]; Wangüemert Pérez, J. Gonzalo [1,2]
[1] *Dpto. de Ingeniería de Comunicaciones, Universidad de Málaga, Málaga, España;* [2] *Bionand Centre for Nanomedicine and Biotechnology, Málaga, España;* [3] *National Research Council Canada, Ottawa, Ontario, Canada;* [4] *Institute of Photonics and Electronics, Prague, Czech Republic*

Recently, a new architecture of Bragg filters using subwavelength grating (SWG) waveguides and loading segments was proposed. It enables ultra-narrowband spectral responses while still being manufacturable. Because of the high sensitivity of the SWG waveguides and the reduced bandwidth (and consequently limit of detection), this device could have great potential for biosensing. In this paper, its performance as biosensor is evaluated in a 2D scenario, resulting in a sensitivity of 681 nm/RIU and an intrinsic limit of detection of $4{,}1 \cdot 10^{-4}$ RIU for bulk sensing. For surface sensing, a sensitivity of 0.85 nm/nm and an intrinsic limit of detection of 0.33 nm were achieved. These results are quite competitive with the state-of-the-art photonic biosensors.

11:50 - 12:05 Modelling the limit of detection of coherent photonic biosensors

Torres Cubillo, Antonia [1]; Leuermann, Jonas [1,2]; Molina Fernández, Íñigo [1,2]; Halir, Robert [1,2]
[1] *Universidad de Málaga, España;* [2] *Bionand Centre for Nanomedicine and Biotechnology*

Photonic biosensing is an emerging application of integrated optics, enabling quantitative and label-free detection of biomolecules. The performance of such biosensors depends on both their sensitivity and output noise and should thus be evaluated from a system perspective. In this work, a practical photonic biosensing system is studied, modelled and simulated. Accurate models for different noise sources are proposed. High-level simulations show that the presence of mechanical vibrations can limit sensor performance and should be highly prioritized for optimization purposes. Simulated and experimental results are comparable under equivalent conditions, obtaining a limit of detection in the order of 10^{-7} RIU.

12:05 - 12:20 Homodyne detector based quantum random number generator

Troncoso Costas, Marcos [1]; Álvarez Outerelo, David [2]; Díaz Otero, Francisco Javier [2]
[1] *University of Vigo;* [2] *Dept. of Signal Theory and Communications, University of Vigo Telecommunications*

Quantum random number generators give the opportunity to, in theory, obtain completely unpredictable numbers only perturbed by the noise in the measurement. The obtained data can be digitalized and processed so that it gives as a result a uniform sequence of binary random numbers without any relation with the classical noise in the system. In this work we analyze the performance of a homodyne detector with two different arrangements: Measurement of vacuum fluctuations, and measurement of Amplified Spontaneous Emission (ASE) from an EDFA. The raw data from the experiments is processed using a Toeplitz extractor, giving as a result sequences of binary numbers capable of passing the NIST Statistical Test Suite.

12:20 - 12:35 Diseño de filtros ópticos integrados con respuesta espectral arbitraria en tecnología de silicio sobre aislante

Pereira-Martín, Daniel [1]; Wangüemert-Pérez, J. Gonzalo [1]; Molina-Fernández, Íñigo [1]; Luque-González, José Manuel [1]; Cheben, Pavel [2]; Schmid, Jens H. [2]; Ye, Winnie N. [3]; Čtyroký, Jiří [4]; Ortega-Moñux, Alejandro [1]
[1] *Dpto. de Ingeniería de Comunicaciones, Universidad de Málaga, Málaga, Spain;* [2] *National Research Council Canada, Ottawa, Canada;* [3] *Department of Electronics, Carleton University, Ottawa, Canada;* [4] *Institute of Photonics and Electronics, Prague, Czech Republic*

Silicon photonics is one of the most promising technologies nowadays, with myriads of potential applications in communications and sensing. Many of these applications require spectral filters synthesizing arbitrary frequency responses. However, the high refractive index contrast of the platform makes the design quite challenging. In this work, we propose to use a Bragg grating topology based on a silicon waveguide with evanescently coupled loading segments whose separation can be changed to accurately modify its strength. By using the layer-peeling algorithm to find the Bragg apodization profile, a filter with 20 transmission peaks located at arbitrary wavelengths has been designed.

12:35 - 12:50 Statistical channel impulse response modeling for optical wireless communication in turbid waters

Boluda-Ruiz, Rubén [1,2]; Rico-Pinazo, Pedro [1]; Castillo-Vázquez, Beatriz [1]; García-Zambrana, Antonio [1]; Qaraqe, Khalid [2]
[1] *Universidad de Málaga, España;* [2] *Texas A&M University at Qatar, Doha, Qatar*

Underwater optical wireless communication (UOWC) systems support high-speed, reliable and cost-effective implementations that are demanded for extending the telecommunication networks to oceans. UOWC systems suffer from attenuation and scattering processes. Particularly, the scattering process can change the direction of the emitted photons, especially in turbid waters. In this way, quantifying the signal attenuation and the time dispersion produced by absorption and scattering is a crucial work. Hence, we propose a new closed-form solution for modeling the channel impulse response for UOWC systems in turbid water that is validated through Monte Carlo simulations and can be used for system design and optimization purposes.

Sesión 4.2

Comunicaciones Móviles e Inalámbricas (III)

Jueves, 05/09/2019
Hora: **11:20 - 13:05**. Lugar: **Aula 003**

11:20 - 11:35 Desvelando la ocupación real: Caracterización de las dinámicas del canal WiFi usando software-defined radios

Salvago Duarte, Fernando; Candelario Elías, Julio; Aguilera Bonet, Pablo
Galgus

This paper addresses the problem of characterizing channel occupation in WiFi unlicensed bands. In order to design better radio resource optimization methods, it is fundamental to guarantee that channel occupation is correctly reported by the drivers of commercial WiFi devices. In our study, we run several experiments in real-world deployments, attacking the wireless network with different types of WiFi and non-WiFi interference. The data is processed in real time by using Software-Defined Radios in the 2.4 GHz band where the devices operate. The analysis of the data trends allows us to design better resource allocation algorithms in order to improve the performance of the WiFi network in high-density of users deployments with a high demand of multimedia services, and especially in presence of spurious interference that are out of our control.

11:35 - 11:50 Simulation tool of IEEE 802.11ac wireless networks propagation in indoor environments

Molina Galán, Alejandro; **Corral González, Pablo**; Vidal Pérez, Jesús; Aljaro Palacios, Miguel; de Scals Martín, Guillermo
Universidad Miguel Hernández de Elche, España

This research pretends to be useful for the future deployment of the wireless network of the Universidad Miguel Hernández, specifically at the campus of Elche. In terms of capacity, in short term we will need more capacity in the wireless network, for this reason we are testing some aspects of the protocol IEEE 802.11ac (Wi-Fi 5). This protocol works in the 5 GHz band and provides us more channels and capacity with channel bonding and MIMO. Before the deployment of the wireless network, we need to know the propagation model of the signal in different scenarios and conditions. We analyse the results obtained by a developed software tool capable of representing different measurements of the signal strength with LOS and NLOS scenarios and comparing with indoor propagation models. For measuring the signal level we have used an emitter 3x4 MIMO and a receiver 3x3 MIMO, both compatible with Wi-Fi 5.

11:50 - 12:05 Radio interference analysis tool based on GNU Radio

Yébenes Gálvez, José Antonio [(1)]; Martos Naya, Eduardo [(1)]; Aguayo Torres, María del Carmen [(1)]; Cárdenas Angelat, Carlos [(2)]; Baños Polglase, Janie [(2)]
[(1)] *Dept. of Communication Engineering, Universidad de Málaga.;* [(2)] *DEKRA Testing and Certification, S.A.U. Málaga*

Avoiding interference is one of the main challenges in radio communications. Interference hunting is usually done with costly instruments. In this work, it is described a cost efficient portable tool for interference analysis that is based on software defined radio. A generic radio module implements the RF front end, while flexible signal processing is carried out on a personal computer. The proposed tool analyses spectrum characteristics spanning from 70 MHz to 6 GHz band, detects radio interference signals and helps to identify the type of radio technology used by the source transmitter.

12:05 - 12:20 Implementation and evaluation of decode and forward relay nodes using software defined radio

Marín García, José Antonio; Romero Franco, Cristina; Alonso Montes, José Ignacio
Information Processing and Telecommunications Center. E.T.S.I. Telecomunicación. Universidad Politécnica de Madrid, España

Relay Nodes (RNs) are being currently studied as a solution for mobile communications in scenarios where the propagation conditions are challenging. This could include high-mobility scenarios, low coverage areas or outdoor to indoor situations. Several types of Relay Nodes are proposed in the literature and by standardization organisms such as 3GPP. In this paper, a proof of concept of an LTE Decode-and-Forward (D&F) Relay Node using Software Defined Radio (SDR) is presented. The developed SDR platform implements LTEs Physical Layer (PHY), Medium Access Control Layer (MAC) and some Radio Link Control (RLC) features. Two USRP-2901 will be used to obtain empirical channel data of an outdoor to indoor scenario. The objective is to evaluate the viability of using RNs and demonstrate the improvements on the users' throughput.

12:20 - 12:35 On the random power availability in wireless power transfer systems with nonlinear energy harvesting

Matez-Bandera, José Luis [1,2]; Peña Martín, Juan Pedro [1]; López-Martínez, F. Javier [2]
[1] *Dpto. Tecnología Electrónica, Universidad de Málaga, España;* [2] *Dpto. Ingeniería de Comunicaciones, Universidad de Málaga, España*

In this paper, we characterize the distribution of the instantaneous harvested power in practical wireless power transfer systems. Specifically, we investigate the impact of fading on the wireless power link, together with the inherent nonlinear nature of energy harvesting (EH) devices. We obtain exact closed-form expressions for the probability density function and the cumulative distribution function of the available power at the output of the EH devices in different scenarios, which are useful to determine the impact of a line-of-sight condition and the fading severity on the harvested power. We see that wireless channel variability due to fading, combined with EH nonlinearity, can be sometimes beneficial for system performance operation.

12:35 - 12:50 On the effect of random power availability in wireless power transfer systems with physical layer security

Tarrías-Muñoz, Antonio [1,2]; Romero-Jerez, Juan Manuel [1]; Lopez-Martínez, F. Javier [2]
[1] *Dpto. Tecnología Electrónica, Universidad de Málaga, España;* [2] *Dpto. Ingeniería de Comunicaciones, Universidad de Málaga, España*

In this paper, we evaluate the performance of wireless powered communication systems from a physical layer security perspective. Our aim is to determine under which conditions the random power availability due to wireless power transmission using a dedicated power beacon impacts the maxi- mum secrecy rate, compared to its deterministic counterpart. We also investigate the effect of line-of-sight condition on the system performance. Analytical expressions are derived for some specific scenarios, which are combined with Monte Carlo simulations. We see that under a moderate line-of-sight condition in the wireless power transfer link, the secrecy performance is barely affected.

12:50 - 13:05 Medidas de canal en un entorno interior de 1-40 GHz

Martínez Inglés, María Teresa [1]; **Pascual García, Juan** [2]; Gaillot, Davy P. [3]; Sanchis Borras, Concepción [4]; Molina García-Pardo, José María [2]
[1] *Centro de Defensa, CUD, Base Aérea de San Javier, Ministerio de Defensa-Universidad Politécnica de Cartagena, España;* [2] *Universidad Politécnica de Cartagena, España;* [3] *Universidad de Lille, Francia;* [4] *Universidad Católica San Antonio de Murcia, España*

This work presents a multidimensional measurement campaign from 1 GHz to 40 GHz in an indoor environment. MIMO channel transfer functions were obtained using a Vector Network Analyzer and Optical-Radio transceivers. One of the main novelties in this contribution is the channel sounder, where a full bandwidth of 39 GHz is measured, without distance limitation due to use of a fiber optical link. The total relative received power, the Path Loss, the RMS delay spread and the K factor were computed from measured data. The Path Loss and RMS delay spread were computed also for different sub-bands at 2, 10, 20, 30 y 40 GHz using a bandwidth of 2 GHz.

Sesión 4.3

Radar y Radioastronomía

Jueves, 05/09/2019
Hora: **11:20 - 13:05**. Lugar: **Aula 005**

11:20 - 11:35 Radar monopulso activo con escaneo en frecuencia basado en dispositivos Bluetooth Low Energy usando un array de dos antenas leaky planares

Poveda García, Miguel; Gómez Alcaráz, Antonio; Gil Martínez, Alejandro; Hidalgo Sánchez, Pedro; Cañete Rebenaque, David; Martínez Sala, Alejandro; Gómez Tornero, José Luis
Universidad Politécnica de Cartagena, España

En este trabajo se presenta un sistema de detección de ángulo de llegada de señales recibidas por un dispositivo Bluetooth Low Energy (BLE). El sistema está basado en técnicas de radar monopulso en amplitud. Gracias al inherente escaneo en frecuencia de las antenas leaky, varias funciones monopulso pueden ser sintetizadas para aumentar el campo de visión o Field of View del sistema sin perder resolución angular. El sistema hace uso de la información proporcionada por el campo RSSI (Received Signal Strenght Indicator), que se incluye en el receptor en las tramas BLE y que indica la potencia recibida de la señal emitida por el dispositivo BLE. Al ser un sistema basado en escaneo en frecuencia en lugar de escaneo electrónico o mecánico como en otras propuestas, es más idóneo para aplicaciones dentro del marco del Internet of Things, dado que tiene costes más reducidos y es de menor complejidad y tamaño.

11:35 - 11:50 Red de sensores radar pasivos para detección de drones en entornos urbanos

Blázquez-García, Rodrigo; Muñoz Miguel, Lourdes; **Burgos-García, Mateo**
Universidad Politécnica Madrid, España

Recently, the increase in the usage of consumer drones due to their low cost and simple use has posed new security threats. For this reason, new surveillance systems should be developed against their malicious or negligent use. With the aim of detecting and classifying these targets, this paper presents a passive radar sensor network based on the use of the downlink signal of the LTE communication system as the illumination of opportunity. Each sensor node is implemented by using a two-channel software-defined radio to obtain the reference and surveillance signals. The signal processing is based on the range-Doppler cross-correlation between the reconstructed reference signal and the surveillance signal, after a direct-signal and multipath cancellation process that removes the echoes due to static clutter. The centralized data processing fuses the detections through a multilateration algorithm and tracks the targets. In this way, this sensor network can be deployed in urban environments to detect and classify drones.

11:50 - 12:05 uRAD: Open source radar system to boost new educative models and applications

Maestrojuán Biurrun, Itziar; Torres Landívar, Victor; Gastón Beraza, Diego
Anteral, España

uRAD is a tiny shield for Arduino or Raspberry Pi that transforms both boards into a completely functional microwave radar. Operating in the free emission 24 GHz ISM frequency band, uRAD has four different operation modes that are ease programmed with Arduino IDE or Python. You will be able to measure distance, velocity and other magnitudes of your surrounding world with great accuracy. Moreover, uRAD only needs 2 pins of your Arduino or Raspeberry Pi which does not limit your connections and facilitate integration with other sensors creating more complete and complex projects. Connect uRAD and unleash the power of radar systems in your Arduino or Raspberry Pi.

12:05 - 12:20 Detectores de fase para un receptor interferométrico de 10 a 20 GHz

Martín Abelenda, Irene; **Artal Latorre, Eduardo**; Aja Abelán, Beatriz; de la Fuente Rodríguez, Luisa
Dpto. de Ingeniería de Comunicaciones, Universidad de Cantabria, España

Phase detectors are key components in any interferometer receiver, because the phase shift between waves arriving to two separated antennas is an essential magnitude to apply interferometry techniques. Two types of phase detectors, based on double balanced mixers, are used and experimentally tested for an interferometer system covering two sub-bands in a 10 to 20 GHz receiver demonstrator for radio astronomy applications. The selected phase detector scheme is an IQ mixer, or IQ demodulator, combining two double balanced mixers. Amplitude and phase imbalances of such phase detector are extracted from measurements. A calibration method is proposed for systematic errors correction in a receiver covering 10 to 14 GHz and 16 to 20 GHz sub-bands.

12:20 - 12:35 Optimización de HERA: Herramienta de Reducción de datos RadioAstronómicos

Vera Pérez, Antonio [1]; **Corral González, Pablo** [2]; Vaquerizo Gallego, Juan Ángel [3]; Aljaro Palacios, Miguel [2]; De Scals Martín, Guillermo [2]
[1] *PLD Space, Elche, España;* [2] *Universidad Miguel Hernández de Elche, España;* [3] *Centro de Astrobiología CSIC-INTA, Torrejón de Ardoz, España*

Este documento proporciona información sobre el software desarrollado en LabVIEW para la reducción de datos radioastronómicos obtenidos por el radiotelescopio DSS 61 de PARTNeR. Aprovechando los avances producidos en las últimas décadas en las ciencias de la computación, esta versión software proporciona una amplia gama de herramientas de análisis y visualización de datos, como el uso de filtrado parametrizable por Transformada Wavelet, diferentes métodos de estimación de la temperatura de sistema o almacenamiento automático de resultados en una base de datos, entre otros. De esta forma, con este nuevo programa y el software de control de la antena, es posible ofrecer al estudiante un conjunto de herramientas profesionales que permitan llevar el estudio del universo a cualquier ordenador personal.

12:35 - 12:50 Diseño de una lente compacta como alternativa a las bocinas de paredes corrugadas para aplicaciones de astronomía

Polo-López, Lucas [1]; Pisano, Giampaolo [2]; Ruiz-Cruz, Jorge A. [1]; Córcoles, Juan [1]
[1] *RFCAS, Escuela Politécnica Superior, Universidad Autónoma de Madrid, España;* [2] *AIG, School of Physics and Astronomy, Cardiff University, Reino Unido*

This work presents the design of a compact lenslet, based on engineered materials, for astronomy applications in the W-band.
The lenslet, which is fed directly by a waveguide, produces a Gaussian beam with good sidelobe (-10 dB/-15 dB) and cross-polarisation (below -20 dB) levels. The main advantange of the designed device is that its length is significantly reduced in comparison with that of a conventional corrugated horn for astronomy applications.
The key aspects of this novel lenslet are described, along with an explanation of the design process. Finally, a numerical example is provided in order to demonstrate the capabilities of these kind of devices.

Sesión 4.4

Premio Jóvenes Científicos URSI 2019

Jueves, 05/09/2019
Hora: **11:20 - 13:05**. Lugar: **Aula 006**

11:20 - 11:35 Full-metal K-Ka dual-band shared-aperture array antenna fed by combined ridge-groove gap waveguide

Ferrando-Rocher, Miguel; Herranz-Herruzo, José Ignacio; Valero-Nogueira, Alejandro
Universitat Politècnica de València, España

This paper presents an 8 x 8 dual-band shared-aperture array antenna operating in K (19.5-21.5 GHz) and Ka-band (29-31 GHz) using Gap Waveguide technology. Radiating elements consist of circular apertures located on the top plate of the antenna and excited by two stacked cavities with different diameters for dual-frequency operation. A waffle grid is used on top to increase the effective area of apertures and reduce grating lobes. Each stacked cavity is fed by its appropriate corporate-feeding network: the upper feeding layer operates at 20-GHz band and the lower one at 30-GHz band. As a result, the antenna presents two ports, one for each band, which radiate a directive farfield pattern with linear polarization, orthogonal to each other. Experimental results show impedance and radiation pattern bandwidths larger than 1.5 GHz in both bands.

11:35 - 11:50 Design of multibeam parabolic reflectarray for high throughput satellites in Ka-band

Martínez-de-Rioja, Daniel [1]; Encinar, Jose A. [1]; Pino, A. [2]; Rodríguez-Vaqueiro, Y. [2]; Arias, M. [2]
[1] *Universidad Politécnica de Madrid, España;* [2] *Universidade de Vigo, España*

This contribution describes the design and simulation results of a parabolic reflectarray antenna to produce multiple spot beams from a geostationary satellite, which generates two adjacent beams per feed in orthogonal circular polarization (CP), separated 0.56 degrees, simultaneously at 19.7 and 29.5 GHz. The parabolic reflectarray uses a unit cell that introduces a progressive phase shift of opposite sign in each CP by applying the variable rotation technique independently at Tx (19.7 GHz) and Rx (29.5 GHz) frequencies. The proposed antenna can be suitable for multiple spot beam satellites in Ka-band since it allows a reduction by a 50 % in the number of antennas and feeds needed to provide the multi-spot coverage.

11:50 - 12:05 Design and characterization of a pure phase modulator based on TNLC

Pérez Aguilar, Lorena; Puerta Notario, Antonio; Garrido Balsells, José María; del Castillo Vázquez, Miguel
Universidad de Málaga, España

In this work, we present a complete process to obtain a pure phase modulator based on a twisted nematic liquid crystal display (TNLCD). We first describe a simple technique for measuring the physical parameters of each cell of this device with no ambiguities, and we use them to build a simplified model of the display based on the Jones matrix theory. Then, after selecting a proper optical system for pure phase modulation, an optimal configuration of the system is searched using a numerical algorithm. This procedure drastically reduces the voluminous experimental stage this task normally requires. The presented method is verified through experimental results, finding an excellent agreement between the measurements and the predicted data.

12:05 - 12:20 Conical-beam travelling-wave array antenna based on slotted circular waveguide at Ku-band

Sánchez Olivares, Pablo; Masa Campos, José Luis; Escalona Moreno, David; García Marín, Eduardo
Grupo de Radiofrecuencia, Circuitos, Antenas y Sistemas, Universidad Autónoma de Madrid, España

A high-gain conical-beam travelling-wave array antenna based on a slotted circular waveguide is designed at the higher part of Ku-band (16-18 GHz). The single radiating element is formed by a ring of equally spaced slots fed by a circular waveguide. The excitation of the TM_{01} mode provides a uniform feeding distribution to each slot, generating an omnidirectional radiation performance. Thus, an array antenna formed by 48 rings of slots is proposed following the conventional design rules of travelling-wave arrays. Every ring is optimized to achieve a uniform power distribution and consequently maximum directivity for the array antenna performance. The distance between elements is also adjusted to obtain the better input matching response and mitigate the grating lobe appearance, generating a high-gain conical-beam radiation performance suitable for satellite communications. The proposed design has been manufactured by using a 3D printing process. Input matching under -15 dB, high-gain values around 13.5 dB or total efficiency higher than 98% have been achieved for the whole frequency band.

12:20 - 12:35 Using the outphasing technique with switching-mode power converters for visible light communication

Rodríguez Méndez, Juan; González Lamar, Diego; García Aller, Daniel; Fernández Miaja, Pablo; Sebastián Zúñiga, Javier
Universidad de Oviedo, España

A technique that provides variable output voltage from the output voltage ripple of a Switching-Mode Power Converter (SMPC) is explained in this work. The generated variable voltage is used to reproduce the communication signal of a Visible Light Communication (VLC) transmitter, thus avoiding the use of power inefficient Linear Power Amplifiers (LPAs). The proposed method uses the outphasing technique, which has been widely studied for switching-mode radiofrequency power amplifiers, with a SMPC that is responsible for both biasing the High-Brightness LEDs (HB LEDs) and reproducing the communication signal.

12:35 - 12:50 Dual reflectarray configurations for multibeam satellite antennas in Ka-band

Martínez de Rioja, Eduardo [(1)]; Encinar, José A. [(1)]; Pino, Antonio [(2)]; González-Valdés, Borja [(2)]; Rodríguez-Vaqueiro, Yolanda [(2)]; Arias, Marcos [(2)]
[(1)] *Universidad Politécnica de Madrid, España;* [(2)] *Universidade de Vigo, España*

This contribution proposes the use of dual reflectarray (RA) configurations to provide multi-spot coverage in Ka-band from a geostationary satellite, using a smaller number of apertures and feeds than conventional reflector systems. A dual-RA configuration formed by a parabolic main RA and a flat RA subreflector has been designed to produce two spot beams in orthogonal circular polarization (CP) from a single feed in dual linear polarization (LP). The flat RA subreflector provides the required angular separation between the beams by implementing a different phase distribution in each LP, while the parabolic main RA performs the conversion from dual-LP into dual-CP. The simulated results show the feasibility of the proposed configuration and its potential to be used for multiple beam applications in Ka-band.

12:50 - 13:05 Electrically tunable phase shifter based on liquid crystal and 3D-printed gap waveguide at W band

Tamayo-Domínguez, Adrián; Fernández-González, José Manuel
Universidad Politécnica de Madrid

This paper presents the design of an electrically tunable phase shifter embedded in a gap waveguide structure at W band. The design takes advantage of two new manufacturing technologies for millimeter-wave devices that are growing rapidly in the radio-frequency and antenna sector. These technologies are additive manufacturing and the use of liquid crystal for the design of reconfigurable devices. Several prototypes manufactured using additive manufacturing are shown to validate the technology. The proposed phase shifter design provides a phase-shifting of around 34^{o}/mm between 85 and 100 GHz in simulation.

Sesión 4.5

Componentes y Circuitos Pasivos (I)

Jueves, 05/09/2019
Hora: **11:20 - 13:05**. Lugar: **Aula 007**

11:20 - 11:35 Diseño de un acoplador direccional diferencial en guía de onda coplanar de doble cara

Martel Villagrán, Jesús [1]; Fernández-Prieto, Armando [2]; Medina Mena, Francisco [2]
[1] *Dpto. Física Aplicada II, Universidad de Sevilla;* [2] *Dpto. de Electrónica y Electromagnetismo, Universidad de Sevilla*

In this work we present a rigorous approach for the design of a differential coupled-lines directional coupler (DCLDC) implemented in a double-side CPW structure. We take the advantage of the double symmetry of this structure to obtain in a simple and efficient way the values of the coupling and the characteristic impedance at the ports of the coupler. In addition, the broadside coupling between the involved differential CPW lines leads to cover a wide range of values of the coupling (included very strong coupling) in such a way that this technology can be potentially used in several applications. Design curves relating the geometrical parameters of the structure with the electrical parameters of the DCLDC are provided and a 3-dB coupler with an impedance of 50 ohms at the terminal ports has been designed. Good agreement between the results from EM simulation and from transmission lines models have been found. We also expect present experimental results at the time of the meeting.

11:35 - 11:50 Diseño y fabricación de un divisor de potencia Wilkinson en tecnología Empty Substrate Integrated Coaxial Line

Merello Giménez, José Manuel; Bachiller Martín, María Carmen; Nova Giménez, Vicente; Boria Esbert, Vicente
Universitat Politècnica de València, España

This project presents the design and manufacture of a Wilkinson power divider in Empty Substrate Integrated Coaxial Line technology (ESICL), for C-band applications. The manufactured devices in this transmission technology have great bandwidth performance, as well as excellent integrability and power management, in addition to low weight, volume and loss. Due to the special structure of the Wilkinson power divider, its implementation in coaxial transmission technology presents great difficulties that involve a thorough study and planification. Moreover, in order to achieve reliable measurements, a TRL calibration kit has been developed to eliminate the spurious effects of connectors and feeding lines. In this way, two devices have been manufactured and their experimental results are in good agreement with the simulated designs.

11:50 - 12:05 Metodología de síntesis para el diseño de filtros en escalera, duplexores y multiplexores en tecnología acústica

Silveira Taboadela, Patricia; Verdú Tirado, Jordi; Triano Notario, Ángel; **de Paco Sánchez, Pedro**
Universitat Autònoma de Barcelona, España

The user segment of wireless communication systems takes profit of the outstanding performance of filtering devices based on acoustic resonators. With a spectrum more and more overcrowded the design of filters and duplexers for mobile devices is becoming a challenging task. The major reasons are stringent transmission response and a very restrictive technology. This work presents a methodology that provides a systematic synthesis procedure for the design of ladder filters and duplexers based on acoustic wave resonators.

12:05 - 12:20 Fabricación e integración de resonador reconfigurable con cristal líquido en tecnología SIW

Bachiller Martín, María Carmen; Sánchez Marín, Juan Rafael; Nova Giménez, Vicente; Boria Esbert, Vicente Enrique
Universitat Politècnica de València, España

This paper presents the manufacturing and integration process of a novel continuously tunable microwave resonator based on Liquid Crystal (LC) material. The reconfigurable device is implemented with integrated technologies in Decoupled Empty Substrate Integrated Waveguide (DESIW). DESIW technology allows both magnetic and electric DC (or low frequency) biasing of the LC. The technical challenges of using and polarizing LC inside the resonator have been solved. The resonator is tunable in a range of 600 MHz, achieving a tunability range of 8.5% around a centre frequency of 7 GHz. Moreover, the measured insertion loss of the reconfigurable device is between 4.3 dB and 6.8 dB, thus obtaining a Q-factor of 190-172.

12:20 - 12:35 Filtro pasobanda en guía de onda evanescente con inserciones impresas con forma de Split Ring Resonators (SRR)

Pertusa Gutiérrez, Gabriel; Álvarez Melcón, Alejandro; Quesada Pereira, Fernando Daniel
Universidad Politécnica de Cartagena, España

This work proposes a new bandpass filter combining an evanescent waveguide section with printed Split Ring Resonators (SSRs), located in the transverse plane. The concept allows to easily adjust couplings between resonators, while the resonant frequencies can be controlled with the geometry of the rings. Effects of the ring width and orientation on the couplings are also investigated. A first filter prototype using the proposed concept has been demonstrated, leading to a very compact structure. Results show the feasibility and interest of the novel concept proposed for the development of high performance bandpass filters.

12:35 - 12:50 Microstrip BPFs with DRs with novel feeders and a novel mechanical tuning to control I/O coupling

Espinosa Adams, David [1]; Llorente Romano, Sergio [1]; Gómez-Chacón Camuñas, Rubén [2]
[1] *Universidad Carlos III de Madrid, España;* [2] *Thales Alenia Space Spain*

This work contributes to enhance microstrip filters performance, limited by a low quality factor Q and high insertion losses IL. In order to achieve this aim, cylindrical ceramic dielectric resonators (DRs) are introduced in the equation, widely used for space applications. Therefore, our approach proposes a novel solution in the state of the art of satellite communications, where bulky structures based on cavities with DRs present several deviation variables, such as DRs allocation, feeds positions, size and shape of each cavity, mass or distance limitation between walls and DRs. Our proposal is focused on reducing the number of unknowns (yield analysis advantage), minimizing costs which let use those filters in low-cost satellite constellations without degrading so much the Q which structures based on cavities present, reducing the manufacturing complexity and mass, important limitation factor in payload system. $TE_{01\delta}$ is fed inside the DR to maximize the Q, and remain stable the resonance frequency to implement filters which operate independent of the physical side walls dimensions. Several charts have been simulated to analyze a 4th order band-pass filter (BPF), which is centered at 11.88 GHz. The bandwidth maximization presents an important challenge, based on the feeder shape and the way which the resonant mode is fed. For I/O coupling, an asymmetric double curved surface shunt stub configuration (bandwidth limitation) is analyzed. Known the behavior, a differential feeder is presented as baseline solution. Finally, a novel filter solution is designed and simulated. It implements a novel differential mode feeder and a novel I/O coupling tuning to control the maximum energy which pass through the input DR.

12:50 - 13:05 Comparative study of filters based on periodic structures in SIW technology

Martínez Gil, Javier [1]; Coves Soler, Ángela [1]; Bronchalo Bronchalo, Enrique [1]; Bozzi, Maurizio [2]
[1] *Universidad Miguel Hernandez de Elche, España;* [2] *University of Pavia, Italy*

In this work, the study of two different topologies of S-band band-pass filters based on periodic structures in substrate integrated waveguide (SIW) technology is theoretical and experimentally addressed. The first topology consists of periodic rectangular perforations of the SIW substrate. In this filter topology, the lower cutoff frequency is determined by the cutoff frequency of the first Floquet mode of the periodic structure, while the upper cutoff frequency and the rejection band are conditioned by its first band-gap. The second topology consists of a periodic array of square complementary split-ring resonators (CSRRs) etched on the waveguide surface. In this case, the use of subwavelength resonators with evanescent-wave transmission leads to a much smaller filter, given that the pass-band is below the cutoff frequency of the waveguide. The effect of the different dimensions of the unit cell in the filters characteristics (lower cutoff frequency, pass-band, and rejection-band associated to the first band-gap of the periodic structure) is analyzed through the dispersion diagram of the periodic cell. A band-pass filter based on each topology has been designed and built, showing in both cases good matching and low insertion loss in the pass-band, and a deep rejection band.

Sesión 5.1

Nuevas tendencias en IoT y Smart Spaces

Jueves, 05/09/2019
Hora: **15:30 - 17:30**. Lugar: **Aula 002**

15:30 - 15:45 Advanced IoT cybersecurity for human beings

Sanz, Ane [1]; Astorga, Jasone [1]; Huarte, Maider [1]; Jacob, Eduardo [1]; Uriarte, Mikel [2]
[1] *Dpto. de Ingeniería de Comunicaciones, Universidad del Pais Vasco, España;* [2] *Nextel S.A.*

Security, and access control in particular, is one of the main drawbacks to the broad adoption of IoT solutions, as traditional solutions cannot be directly used in IoT environments due to the significant resource constraints of the targeted devices. Among security solutions specifically tailored to IoT, the Hidra access control mechanism stands out as an efficient approach to bring to the IoT world the flexibility and expressiveness achieved in traditional computing environments. This is fulfilled by the definition of complex security policies and their codification using a specific policy language. Unfortunately, the resulting system becomes complex and difficult to use by non-security experts, hindering its broad adoption. Therefore, this paper presents some enhancements to make powerful security mechanisms usable by human beings whatever their expertise: a user- friendly mechanism to create and manage security policies, and an encoder/decoder module to convert security policies from human-friendly to machine-friendly format and vice versa.

15:45 - 16:00 Sistema IoMT para la comunicación distribuida y descentralizada de sensores en redes de área personal

Talaminos Barroso, Alejandro [(1)]; Reina Tosina, Javier [(1)]; Roa Romero, Laura M. [(1)]; Naranjo Hernández, David [(1)]; Barbarov Rostán, Gerardo [(1)]; Cejudo Ramos, Pilar [(2)]; Márquez Martín, Eduardo [(2)]; Ortega Ruiz, Francisco [(2)]
[(1)] *Grupo de Ingeniería Biomédica, Dept. de Teoría de la Señal y Comunicaciones, Universidad de Sevilla, Sevilla;* [(2)] *Unidad Médico Quirúrgica de Enfermedades Respiratorias, Hospital Universitario Virgen del Rocío, Sevilla*

Este trabajo presenta el diseño, implementación y validación de un sistema IoMT que facilita la comunicación distribuida de sensores inalámbricos en redes de área personal. El sistema IoMT propuesto permite que diferentes terminales móviles compartan información generada por distintos sensores corporales a través de una red peer-to-peer (P2P) con la tecnología Wi-Fi Direct y sin necesidad de conectarse a un punto de acceso o red inalámbrica. Los datos son distribuidos a nivel de aplicación utilizando el estándar Data Distribution Service (DDS), sin intermediarios en la comunicación. Como caso de uso se presenta la comunicación y gestión descentralizada de varias camisetas inteligentes que portan sensores de monitorización respiratoria y actividad física. El sistema IoMT propuesto puede ser de utilidad para entornos de comunicación sin acceso a Internet donde se requiera una monitorización en tiempo real in-situ descentralizada y con requisitos de baja latencia, tolerancia a fallos, alta disponibilidad sin puntos únicos de fallo y cifrado de la información.

16:00 - 16:15 Líneas ambientales, de enseñanza e investigación de la iniciativa Smart-Campus de la Universidad de Málaga

Fortes, Sergio [(1)]; Santoyo-Ramón, José Antonio [(2)]; Palacios, David [(1)]; Baena, Eduardo [(1)]; Mora-García, Rocío [(2)]; Medina, Miguel [(2)]; Mora, Patricia [(2)]; Barco, Raquel [(1)]
[(1)] *Dpto. de Ingeniería de Comunicaciones, Universidad de Málaga, Málaga, España;* [(2)] *Vicerrectorado de Smart-Campus, Universidad de Málaga, Málaga, España*

In the past years, the concept of Smart City has been a main paradigm for public ICT 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. 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 of the Smart City concept. In this way, the present paper presents the main lines and approaches followed by the Smart-Campus initiative of University of Málaga, SmartUMA, detailing its general framework, ICT infrastructures, ongoing activities and results, as well as describing the lessons learned and guidelines for other initiatives in the field.

16:15 - 16:30 Armonización ISO/IEEE 11073 - IoT en la monitorización de actividad física

Calvillo Arbizu, Jorge [1,2]; Román Martínez, Isabel [2]; Roa, Laura M. [1,3]; Reina Tosina, Javier [1,3]
[1] *Grupo de Ingeniería Biomédica, Universidad de Sevilla, España;* [2] *Dpto. de Ingeniería Telemática, Universidad de Sevilla, España;* [3] *Dpto. de Teoría de la Señal y las Comunicaciones, Universidad de Sevilla, España*

The irruption of Internet of things (IoT) technologies in different sectors such as smart cities and industry is popularizing the use of sensors and actuators. In the health domain, sensors are widely applied (e.g., remote patient monitoring, ICU scenarios); however, the IoT paradigm is far from being widespread. A proper application of IoT platforms in health demands conforming health standards and dealing with the specific requirements of this domain.
This work approaches the harmonization of a physical activity recognition system based on the ISO/IEEE 11073:10441 standard and a general-purpose and open IoT platform (FIWARE). Results show that harmonization is feasible and needed in order to translate the advantages of IoT to the health domain. However, several issues remain to be addressed such as managing and storing real-time data (requiring big data technologies) and efficient integration of data into the electronic health record of the monitored subject.

16:30 - 16:45 Módulos para la docencia de comunicaciones en vehículos e IoT

Romero Romero, José Manuel; Márquez Segura, Enrique
Universidad de Málaga, España

The automotive industry is evolving dramatically nowadays with the advent of autonomous driving, and connectivity. New communications inside the vehicles demand management of a growing volume of data. The different systems available in the vehicle exchange information related to its functionality while it is processed by other systems to decide and act on the vehicle. The CanBus is the most used bus and is present compulsory in manufactured vehicles. In this work a development board is presented based on Arduino DUE that allows the combination of the internal information inside the vehicle with the exterior through GPS and the Sigfox network. The main application of this board is education of vehicle communications and diagnosis and communication with internet of things networks.

16:45 - 17:00 Monitorización de vehículos conectados sobre la plataforma IoT FIWARE

Ariza, Teresa; Sierra Collado, Antonio J.; Martínez, Luis
Universidad de Sevilla, España

Este artículo propone un sistema para la monitorización de sensores en el ámbito del coche conectado. La aplicación permite la monitorización de los parámetros de conducción y posicionamiento usando componentes Fiware para el almacenamiento, procesamiento y representación de los datos.

17:00 - 17:15 Smartphone-based traffic estimation in smart cities

Jatib Khatib, Emil; Martín Carrasco, Juan; Lázaro Legaz, Pedro; Barco Moreno, Raquel
Universidad de Málaga, España

Measuring traffic in real time is one of the main functionalities of Smart Cities. To reduce the costs of deployment and operation, traffic measurement with mobile devices has been widely studied. In this paper, a traffic monitoring system using mobile devices is proposed. The proposed algorithm has the advantage of having a very low computational cost, allowing most of the preprocessing being done in the mobile device and therefore making possible the centralized collection of a massive number of measurements.

Sesión 5.2

Procesado de Señal: Voz, Imagen y Datos

Jueves, 05/09/2019
Hora: **15:30 - 17:30**. Lugar: **Aula 003**

15:30 - 15:45 Descomposición de señales de audio mediante un algoritmo de conjunto activo con $\alpha\beta$-divergencias

Sarmiento Vega, Auxiliadora; Durán-Díaz, Iván; Fondón García, Irene; Cruces Álvarez, Sergio
Universidad de Sevilla, España

This article considers the decomposition of a non-negative signal into a non-negative linear combination of the contributions of pre-specified atomic units, which are also non-negative. This model, referred as compositional model, is evident in the time-frequency characterizations of audio signals, where the sound can be viewed as a blending of spectral patterns of the component sounds that are present simultaneously. The algorithm proposed in this article obtains the activation vector of the atoms through an active-set Newton algorithm that employ the $\alpha\beta$-divergence between the observed signal and the decomposition. This divergence family has been proved to be more efficient than other more common divergences, such as the generic Kullback-Leibler divergence in various audio signal processing applications. We have evaluated the proposed algorithm in two scenarios: a signal separation application of polyphonic music and for the separation of speech signals from music.

15:45 - 16:00 Nuevos métodos para el análisis de las resonancias de Schumann medidas en Sierra Nevada

Rodríguez Camacho, Jesús [1]; Gómez Lopera, Juan Francisco [1]; Salinas, Alfonso [2]; Fornieles Callejón, Jesús [2]; Portí, Jorge [1]; Blanco, David [1]; Carrión, María del Carmen [1]; Navarro Camba, Enrique [3]
[1] *Dpto. de Física Aplicada, Universidad de Granada;* [2] *Dpto. de Electromagnetismo y Física de la Materia, Universidad de Granada;* [3] *Dpto. de Informática, Universidad de Valencia*

Las medidas de las resonancias de Schumann ofrecen información global sobre eventos eléctricos y otros parámetros atmosféricos. En la mayoría de trabajos publicados acerca de medidas de estas resonancias solo se analiza la evolución temporal a largo plazo de sus frecuencias centrales y sus amplitudes, sin prestar atención a otra información complementaria para el seguimiento de fenómenos atmosféricos que puede obtenerse de las medidas, como son los eventos transitorios detectados en las medidas, la identificación y clasificación de los espectros que presentan alguna particularidad, el porcentaje de saturación de la señal en los distintos intervalos temporales o el seguimiento de los intervalos para los que se obtienen valores inaceptables para los parámetros de las resonancias. En este trabajo se indica de qué forma puede utilizarse esta información para complementar el análisis de las variaciones regulares de las resonancias de Schumann.

16:00 - 16:15 Clasificación de texturas mediante textones basados en Análisis en Componentes Independientes (ICA)

Hornillo Mellado, Susana; Acha Piñero, Begoña; Serrano Gotarredona, María del Carmen
Universidad de Sevilla, España

Una estrategia a la hora de caracterizar texturas es considerar que están compuestas por estructuras fundamentales o textones. En procesado de imagen, estos textones suelen obtenerse a partir de un conjunto de filtros 2D empleando filtros invariantes a la rotación, caracterizados por tener simetría circular o por combinar filtros con distintas orientaciones y escalas.
En este trabajo, exploramos el uso de los filtros ICA para la obtención de textones y clasificación de un conjunto de imágenes de texturas que han sido tomadas en diferentes condiciones de iluminación y orientación. Los filtros ICA se obtienen realizando un Análisis en Componentes Independientes (ICA) de las texturas. ICA es una técnica estadística y computacional ampliamente utilizada para extraer características independientes subyacentes en un conjunto de datos observados. La particularidad de los filtros ICA es que se adaptan a las imágenes que se desea analizar. Por este motivo, y a diferencia de los filtros invariantes a la rotación, los textones obtenidos representan con mayor precisión las estructuras básicas presentes en las texturas, dando lugar a mejores porcentajes de clasificación correcta.

16:15 - 16:30 Creación simplificada de mosaicos a partir de fotos aéreas

Martín Rodríguez, Fernando; Mojón Ojea, Orentino
Universidad de Vigo, España

Esta comunicación es sobre un método simplificado para construir mosaicos de imágenes a partir de imágenes aéreas. Los mosaicos de gran exactitud proyectados ortonormalmente (ortomosaicos) construidos a partir de imágenes aéreas (principalmente de aviones no tripulados) son hoy en día un estándar. Esta técnica utiliza las llamadas aplicaciones de "Fotogrametría".
Sin embargo, las aplicaciones de fotogrametría son software propietario normalmente costoso (a pesar de algunas opciones open-source que son de menos calidad y difíciles de usar) y, además, la creación de ortomosaicos es normalmente un proceso lento.
En este trabajo tratamos de desarrollar un método fácil que sea capaz de crear un mosaico simplificado que puede ser útil para algunas aplicaciones (principalmente aplicaciones de visión por computadora donde no sean necesarias medidas geoméricas precisas).
Además nuestro sistema es mucho más rápido que la fotogrametría clásica. El método está basado en algoritmos utilizados (entre otras aplicaciones) para sintetizar imágenes panorámicas: los puntos de control se deducen automáticamente utilizando el algoritmo SURF y después se utilizan para calcular transformaciones geométricas que permiten hacer coincidir las regiones solapadas de las imágenes y así crear el mosaico final.
El artículo describe el método así como sus resultados. Además, se describe el diseño de una carga útil (sistema de captura) específica que diseñamos, fabricamos y probamos embarcada en un drone real.

16:30 - 16:45 Non proper complex-valued Gaussian process for regression: A widely non-linear approach

Murillo Fuentes, Juan José; **Boloix Tortosa, Rafael**
Universidad de Sevilla, España

In this paper we develop the formulation of the Gaussian process for regression (GPR) to deal with complex-valued outputs. Previous solutions for kernels methods usually assume a complexification approach, where the real-valued kernel is replaced by a complex-valued one. However, based on the results in complex-valued linear theory, we prove that both a kernel and a pseudo-kernel are to be included in the solution. This is the starting point to develop the new formulation for the complex-valued GPR. We include an experiment where we first propose a kernel and pseudo-kernel lo later show that the novel solution, denoted as widely non-linear complex GPR (WCGPR), outperforms a complex GPR where a pseudo-kernel is not included.

16:45 - 17:00 Aplicabilidad de la transformada Wavelet al análisis de las descargas parciales para la prognosis en componentes eléctricos

Guerra Pereda, David [1]; Gil Abaunza, Unai [1]; Martínez Cancela, Luis [2]; Pujana Goitia, Ainhoa [2]; Perea Olabarria, Eugenio [2]
[1] *Universidad del País Vasco / Euskal Herriko Unibertsitatea, España;* [2] *Corporación Tecnalia Research & Innovation*

The continuous monitoring of the components of power lines and facilities is to play a key role in the real-time diagnosis and prognosis expected from Industry 4.0. The analysis of the so-called partial discharges in high voltage and medium voltage components is the right tool for such a monitoring. Unfortunately the measured signals in such harsh environments are polluted by unwanted difficult-to-remove disturbances. Signal processing by means of the Wavelet transform can help in this matter. In this paper the state of the art has been analysed in order to provide some guidelines about the optimization of the processing of measured partial discharges, by means of the Wavelet transform. Amongst them, a collection of the most appropriate mother wavelets to be applied is provided.

17:00 - 17:15 Study of the effect of frame sampling on video signal processing on neural networks learning

Vaquero, Rafael; Simois, Francisco J.
Dpto. Teoría de la Señal y Comunicaciones, Escuela Técnica Superior de Ingeniería, Universidad de Sevilla.

Video signal processing is one of the most compute-intensive activities in data analysis, especially when neural networks are involved. Our purpose is to find out how the learning process of a neural network is affected by the amount of available data. We will sample the video input provided to the network by different quantities and we will evaluate the network performance using loss and accuracy. Our results show that the effect of frame sampling is not very significant, i.e., network metrics are little influenced by the amount of provided data. Therefore, the computational savings could largely compensate in many cases for the slight reduction of the performance.

Sesión 5.3

Sesión especial - Tecnologías en Milimétricas y Terahercios para Comunicaciones y Sensorización

Jueves, 05/09/2019
Hora: **15:30 - 17:30**. Lugar: **Aula 005**

15:30 - 15:45 On the use of mm-wave FMCW radar IF signals in the bi-focusing multi-frequency imaging algorithm

Solano Pérez, José Antonio [(1)]; Ballesteros, Christian [(2)]; **Molina-García-Pardo, José-María** [(1)]; Rodríguez, José-Víctor [(1)]; Jofre, Lluís [(2)]; Mateo Aroca, Antonio [(1)]
[(1)] *Universidad Politécnica de Cartagena, España;* [(2)] *Universitat Politècnica de Catalunya*

Frequency Modulated Continuous Wave (FMCW) radars are part of the new sensing devices installed in vehicles in order to explore the surroundings. Millimetric wave frequency band provides enough information to apply imaging algorithm. The imaging bi-focusing multi-frequency algorithm in W-band using FMCW radar has a direct applicability in enhancing detection of concealed weapons, as proximities sensors, to avoid collisions and pedestrian detection in vehicles. This paper assesses the feasibility of using the Intermediate Frequency (IF) signal provided by homodyne FMCW radar operating in 77 GHz as input to millimetric wave bi-focusing monostatic-bistatic multi-frequency algorithm from a theoretical point of view and by means of simulation. Additionally, the bi-focusing multi-frequency algorithm results using FMCW radar are compared with the obtained using the theoretical calculation of the scattered field, equivalent to the parameter S_{21} obtained from a Vector Network Analyzer (VNA).

15:45 - 16:00 Broadband circular polarization "diamond" antenna implemented in gap waveguide technology for 5G millimeter-wave communications

Pérez Quintana, Dayan [1,2]; Beruete, Miguel [1,2]; Ederra, Iñigo [1,2]
[1] *Universidad Pública de Navarra, España;* [2] *Institute of Smart Cities, Public University of Navarra*

In this paper a simple diamond-shaped slot antenna with circular polarization (CP) working in the 5G millimeter-wave band (60 GHz), with high radiation efficiency and broadband performance both in matching and axial ratio is presented. The antenna is implemented in Ridge Gap Waveguide technology, a part of the Gap Waveguide (GW) to overcome the limitations of standard technological solutions, as GW does not require electrical contact and can be produced by layers simplifying the manufacturing process. The feeding system is based on a carefully designed miniaturized transition from V-Band standard waveguide (WR-15) to RGW. A broadband matching with reflection coefficient magnitude below -10 dB ($|S_{11}|$ <-10 dB) is achieved from approximately 59 to 68 GHz (>9 GHz). The CP operation coincides with the aforementioned band where it meets the applied axial ratio criterion (AR < 3 dB), giving as a result a broad fractional bandwidth of 14.52%. The maximum gain of the system is around 6.94 dB, with a radiation efficiency close to 98%.

16:00 - 16:15 Sub-6 GHz vs Ka band multi-antenna indoor scattering characterization

Ballesteros Sánchez, Christian [1]; Dumre, Kushal [1]; Bouazza, Badr [1]; Martínez-Inglés, María-Teresa [2]; Rodríguez, José-Víctor [2]; Molina García-Pardo, José María [2]; Romeu Robert, Jordi [1]; Jofre Roca, Luis [1]
[1] *Signal Theory and Communications Department, Universitat Politècnica de Catalunya, Barcelona, Spain;* [2] *Dpto. Tecnologías de la Información y las Comunicaciones, Universidad Politécnica de Cartagena, Murcia, Spain*

In this paper, sub-6 GHz and millimeter-wave (mmW) band channel scattering characterization are performed and imaging reconstruction is obtained by using a 2-D scatterer mapping technique based on Multi-frequency Bi-focusing (MF-BF). The simulated data matrix is also processed to obtain its eigenvalues and eigenvectors. A relation between the eigenvalues and the number of scatterers and the eigenvectors and the scatterers spatial localization is obtained.

16:15 - 16:30 Glide-symmetric PIN phase shifter implemented in gap-waveguide technology

Palomares-Caballero, Ángel [1,2]; Alex-Amor, Antonio [1,3]; Valenzuela-Valdés, Juan [2]; Luna, Francisco [1]; Padilla de la Torre, Pablo [2]
[1] *Universidad de Málaga, España;* [2] *Universidad de Granada, España;* [3] *Universidad Politécnica de Madrid, España*

This paper presents a compact and low-loss waveguide phase shifter based on a pin lattice in glide-symmetric configuration. There is a significant increase in provided phase shift when using a glide-symmetric pin distribution instead of a non-glide-symmetric configuration. A prototype has been manufactured to validate the simulated results of both phase shifters: non-glide-symmetric and glide-symmetric designs. Gap-waveguide technology has been implemented for low-cost manufacturing. The measurement results demonstrate the higher performance and compactness of the glide-symmetric phase shifter. For the same phase shifter length, the glide-symmetric design provides around 80 degrees more of phase shifting compared to the non-glide-symmetric phase shifter. Both phase shifters have a good impedance matching between 46 and 60 GHz (less than -10 dB) and an insertion loss lower than 1 dB.

16:30 - 16:45 V2I millimeter-wave MIMO vs beamforming capacity analysis

Balleteros, Christian [1]; Ramírez Arroyave, Germán Augusto [1,2]; Romeu, Jordi [1]; Egea-López, Esteban [3]; Pascual-García, Juan [3]; Molina, Jose María [3]; **Jofre, Lluís** [1]
[1] *Universitat Politècnica de Catalunya;* [2] *Universidad Nacional de Colombia;* [3] *Universidad Politécnica de Cartagena*

This paper presents the comparison of capacity enhancement by means of advanced antenna techniques in vehicular to infrastructure communications for the Line-of-Sight and non Line-of-Sight cases. The analysis is based on ray tracing simulation at the 5.9 and 28 GHz frequency bands. Realistic antenna models are considered to validate the impact of a 4×4 MIMO compared to a beam-forming mMIMO application.

16:45 - 17:00

On wafer test results of a preliminary design Low Noise Amplifier MMIC at 250 GHz manufactured using a 130-nm BiCMOS technology at EUROPRACTICE

Teniente Vallinas, Jorge [1,2]; Chocarro Álvarez, Javier [1]; Melero Frago, Marta [1]; del Río Orduña, David [3]; Gurutzeaga Zubillaga, Iñaki [3]
[1] *Dpto. de Ingeniería Eléctrica, Electrónica y de Comunicación. Universidad Pública de Navarra, España;* [2] *Instituto de Smart Cities (ISC). Universidad Pública de Navarra, España;* [3] *CEIT-IK*[4]*, San Sebastián, España*

This paper presents the test results of a preliminary design of a Low Noise Amplifier (LNA) at 250 GHz. The design was prepared for IHP technology SG13G2 SiGe: C Bipolar/Analog from the European manufacturer IHP, available in the EUROPRACTICE program.
The manufactured MMIC includes two amplifier configurations, a common emitter and a common base, both with only one stage. The manufactured MMIC also contains several standards for calibration.
Thirty five MMICs were manufactured at EUROPRACTICE and twenty of them were tested showing consistency between measured results. Several difficulties appeared during testing of the MMICs but most of them were solved. 5 dB gain was obtained in common base configuration but 0 dB gain in common emitter configuration. This results belong to a preliminary design, future designs expect to improve the presented results.

17:00 - 17:15 Characteristic mode analysis of planar dual-port static and reconfigurable antennas

Ramírez Arroyave, Germán Agusto [1,2]; Peñafiel, Carlos Ramiro [3]; Araque Quijano, Javier Leonardo [2]; Cabedo-Fabres, Marta [3]; Romeu, Jordi [1]; Ferrando-Bataller, Miguel [3]; **Jofre, Lluís** [1]
[1] *Universitat Politècnica de Catalunya;* [2] *Universidad Nacional de Colombia;* [3] *Universitat Politècnica de València*

This paper presents the analysis and validation by means of the Characteristic Mode Analysis (CMA) technique of two compact dual-port antennas designed by means of a custom implementation of Method of Moments efficiently coupled to a Genetic Algorithm with the objectives of I) Good input match at each port and high inter-port isolation, II) Port diversity in a set of frequencies. Those antennas can be useful in advanced communications techniques such as full-duplex communications, cognitive radio and multiple-input multiple-output systems.
As a contribution to a better understanding the output of the optimization process, which can provide inputs for new optimization tasks, the CMA reveals that the framing structure has two orthogonal resonant modes at 2.46 GHz which can be exploited by properly locating the excitation ports.

17:15 - 17:30 Conversor de polarización circular ultra-delgado de alta eficiencia en THz basado en metasuperficies

Moreno Peñarrubia, Alexia [1]; Kuznetsov, Sergei A. [2]; Beruete, Miguel [1]
[1] *Universidad Pública de Navarra, España;* [2] *Novosibirsk State University*

In this work, the design and simulation of a half-wave plate based on a zigzag bi-layered metasurface, working in the THz range is presented. The device thickness is less than $\lambda/20$ at the operation frequency and the transmission efficiency obtained is larger than 90%. The cross-polarization discrimination is around 30 dB, ensuring an axial ratio near to 1 at the output. A numerical study of the robustness with respect to possible misalignments between layers is done by simulating two additional devices with the maximum possible shifts between layers along x and y axis. The results show very high robustness for the x-shift case and a frequency shift behavior for the y-case, keeping in both cases an excellent performance as a half-wave plate.

Sesión 5.4
Antenas

Jueves, 05/09/2019
Hora: **15:30 - 17:30**. Lugar: **Aula 006**

15:30 - 15:45 Filtro-divisor a 30 GHz en tecnología gap waveguide

Baquero Escudero, Mariano; Ferrando Rocher, Miguel; Sánchez Escuderos, Daniel
Universitat Politècnica de València, España

En este artículo se presenta un filtro paso banda de tercer orden con un divisor de potencia de uno a dos que funciona entre 29.5 GHz y 31 GHz en tecnología Gap Waveguide. Este filtro será parte de un diplexor integrado en terminales terrestres de los futuros sistemas de comunicaciones por satélite en movimiento (SatCom on-the-move). Un poste rebajado ha sido escogido como resonador. El acoplamiento entre resonadores se controla con la distancia de los postes rebajados. Una guía de onda rectangular estándar, WR28, ha sido elegido como puerto de entrada, y una ventana de acoplamiento se utiliza para alimentar el primer resonador. El último resonador está acoplado a un Groove Gap Waveguide (GGW), que finalmente alimentará a los subarrays. Para medir la respuesta del Filtro-divisor, antes de integrarse en la antena, una transición entre la GGW y la guía WR28 se ha diseñado.

15:45 - 16:00 Design of triangular-latticed subarray antenna fed by hexagonal radial line for K-band applications

Muriel Barrado, Alfonso Tomás; Pla Terrada, Óscar Alberto; Sierra Pérez, Manuel
Universidad Politécnica de Madrid, España

A circularly polarized double-stacked patch subarray antenna fed by a hexagonal radial line with internal circular coupling patches is proposed. The antenna works at K band (19.7 GHz – 20.2 GHz) with LHCP. On the one hand, the design approach consists of a coupling study based on the simulation of a periodic parallel-plate waveguide as a first approximation of the radial line. On the other hand, a phase compensation method by rotation is applied in order to adjust the radiating phase of each element of the subarray, which are separated $0.7\lambda_0$. Thus, the subarray is uniformly fed in terms of amplitude and phase. An axial ratio below 1 dB is achieved for the entire frequency band, with a gain of 24 dB and a total efficiency of 87%. The radial line has been modelled as a hexagon to perform this analysis in larger arrays in future design steps.

16:00 - 16:15 Ranura de banda ancha en doble T sobre cavidad para arrays alimentados en serie

Hernández Escobar, Alberto; Abdo Sánchez, Elena; Camacho Peñalosa, Carlos
Universidad de Málaga, España

A previous radiating element for series-fed arrays proposed by the authors and based on a Cavity-Backed Slot (CBS) is modified to improve its bandwidth. In order to do that, the slot is modified to reduce its resonance frequency so the slot starts radiating at lower frequencies. The modification consists in increasing the effective length of the slot by bending it towards its sides. The concept is proved through the simulation of an already proposed structure with and without the modification. This method successfully reduces the resonance frequency of the slot about 1 GHz in the 5 GHz band, increasing the working bandwidth by this amount. The radiation properties of the element are not altered by this modification.

16:15 - 16:30 Análisis de arrays de antenas microstrip situadas en cavidades integradas en substrato

Gómez García, Alfonso [(1)]; Gónzalez de Aza, Miguel Á. [(2)]; Rubio, Jesús [(1)]; Gómez Alcalá, Rafael [(1)]; Campos-Roca, Yolanda [(1)]
[(1)] *Dpto. Tecnología de Computadores y Comunicaciones, Universidad de Extremadura, Cáceres, España.;* [(2)] *Dpto. de Señales, Sistemas y Radiocomunicaciones, Universidad Politécnica de Madrid, España.*

Este trabajo presenta un estudio preliminar en el uso del menor número de perforaciones metalizadas para simular un efecto de pared metálica en un array de antenas de parche apoyadas sobre cavidad metálica. El estudio se realiza sobre una agrupación de 7x7 y 11x11 antenas de parche circulares clásicas, alimentadas con una sonda coaxial.
El array es analizado utilizando una metodología full-wave, basada en una descomposición directa en dominios del dispositivo en términos de modos esféricos y cilíndricos, y utilizando los teoremas de rotación y traslación para dichos modos.

16:30 - 16:45 Antena MIMO para estación base 5G interior

Molins Benlliure, Jaime [1]; Llanga Vargas, Aníbal [2]; Park, Dong Kook [3]; Ferrando Bataller, Miguel [1]; Cabedo Fabrés, Marta [1]
[1] *ITEAM, Universitat Politècnica de València, València, Spain;* [2] *G-RESEARCH, Universidad Nacional de Chimborazo, Riobamba, Ecuador;* [3] *Dept. of Electronics & Electrical Information Eng., Korea Maritime and Ocean University, Busan, Republic of Korea*

A broadband high efficiency cavity-backed antenna with independent beams is presented. The design is milled in a metallic box and capacitively fed by 4 coaxial cables. Matching is accomplished with the use of an impedance transformer created by the extension of the coaxial inner conductor. This antenna is a compact, and low-cost solution which can be easily manufactured to be mounted as a 5G indoor base station antenna providing MIMO behaviour due to its four independent beams. The operating frequency band ranges from 3 GHz to 5 GHz (50%), covering the early deployment 5G low band. The results of the simulations show a total efficiency greater than 67%. By properly feeding the ports, the antenna can be configured to radiate with horizontal polarization, vertical polarization or circular polarization. The overall dimensions of the antenna are $\lambda_c \times \lambda_c \times 0,2$.

16:45 - 17:00 Diseño de antenas Vivaldi con polarización cruzada para estaciones base de 5G

Fernández-Martínez, Paula; Martín-Antón, Sergio; Segovia-Vargas, Daniel
Universidad Carlos III de Madrid, España

In this paper an ultra-wide band cross-polarized Vivaldi antenna will be designed. This antenna covers the 1.4-3.8 GHz 5G mobile communications band providing return losses below -14 dB and isolation between ports of <-30dB. The cross polarization is achieved by overlapping two Vivaldi antennas and placing them creating a 45º according to the horizontal plane. Finally, the antenna is placed above a metallic ground plane which collimates the radiation patterns obtaining beamwidths from 65º to 95º. The results of the simulation of the cross polarized antenna over the ground plane and the measurement of a single manufactured Vivaldi antenna in FR4 substrate will be shown.

17:00 - 17:15 Characteristic mode analysis of two resonant parallel loops in the near-field

Abderrazak, Ferdaous [1,2,3]; Antonino-Daviu, Eva [1]; Hayouni, Mohamed [2]; Ferrando-Bataller, Miguel [1]; Choubani, Fethi [2]
[1] *ITEAM, Universitat Politècnica de València, Valencia, Spain;* [2] *Innov'COM Lab/Sup'Com, University of Carthage, Tunis, Tunisia;* [3] *National Engineering School of Tunis, University of Tunis El Manar, Tunis, Tunisia*

Using two identical parallel loop antennas, their resonances are analyzed based on the Theory of Characteristic Modes in the near-field region. This study analyses the resonance frequency shift of the main characteristic modes in the frequency range from 1 to 4 GHz in terms of the separation between the antennas. The simulation results demonstrate that the coupling effects differently on characteristic modes depending on the position of the antennas. Furthermore, the coupled mode theory elucidates the resulting conducts. We explore the performance of the currently proposed wire antennas for the practical applicability and suggest directions for further studies.

17:15 - 17:30 Measurement and characterization of 3D-printed horn at 240 GHz

Biurrun Quel, Carlos [1,2]; del Río, Carlos [1,2]
[1] *Dept. of Electrical, Electronic and Communication Engineering, Public University of Navarra, Pamplona;* [2] *Institute of Smart Cities (ISC), Public University of Navarra, Pamplona*

This work provides a validation of the 3D-printing technology for manufacturing horn antennas working at sub-THz frequencies (240 GHz centre frequency). The high propagation and attenuation losses present at the unlicensed band from 200 to 330 GHz require the use of highly-directive antennas in order to be overcome. In this work, a 12 dBi choke horn, manufactured by SLA 3D printing technology, is presented. The horn was designed to serve as the feeder of a parabolic reflector, providing a gain above 50 dBi. Additionally, the measurement processes for both Far- and planar Near-Field measuring techniques is detailed. Within the measurement campaign, a novel dynamic, software-controlled method was included, which allows the automatic adjustment of the time-domain gating on every step.

Sesión 5.5

Componentes y Circuitos Pasivos (II)

Jueves, 05/09/2019
Hora: **15:30 - 17:30**. Lugar: **Aula 007**

15:30 - 15:45 Estudio de la capacidad de configuración del ancho de banda de rechazo en filtros basados en secciones dieléctricas alternas

Sánchez Marín, Juan Rafael; **Bachiller Martín, María Carmen**; Nova Giménez, Vicente; Boria Esbert, Vicente Enrique
Universitat Politècnica de València, España

A study for the out-of-band rejection behaviour in the novel Alternating Dielectric Line Sections (ADLS) topology is presented in this paper. ADLS filtering structure consists of alternating sections of Substrate Integrated Waveguides (SIW) and Empty Substrate Integrated Waveguides (ESIW), i.e. sections of integrated waveguides with and without dielectric filling. By using this topology, a band-pass filter response with a rejection bandwidth up to $2f_0$, can be implemented by selecting the dielectric permittivity of the substrate. In this paper, an out-of-band width and depth study is done for two filters with different orders and material permittivity values. Both filters have been manufactured and measured as hypothesis validators.

15:45 - 16:00 Diseño analítico de filtros multibanda con líneas de transmisión multiconductoras y stubs en abierto

Pérez Escribano, Mario; Márquez Segura, Enrique; Sánchez Martínez, Juan José
Universidad de Málaga, España

A new topology for implementing multiband bandpass filters is presented in this paper. Two identical short-circuited multiconductor transmission lines (MTL) and several shunt open stubs are interconnected to achieve the desired frequency response. Using this configuration, zeros are forced in the passband of the MTL, creating a multiband bandpass filter. As both, the MTLs and the stubs are distributed elements, spur-line band-stop filters are added in order to mitigate the first replicas of the structure. To assess the developed theory, a prototype consisting of a 4 fingers-MTL and two shunt open stubs is simulated, showing a good agreement between analytical and simulated results. Furthermore, it is possible to establish a design criterion that allows to synthesize multiband responses, varying just some parameters of the MTLs and the stubs.

16:00 - 16:15 Estudio de la sintonización electrónica en tecnología guía de onda a temperaturas criogénicas para un detector de axiones de materia oscura

García Barceló, Jose María [1]; Lozano Guerrero, Antonio [1]; Álvarez Melcón, Alejandro [1]; Gimeno Martínez, Benito [2]; Navarro Martínez, Pablo [1]; Díaz Morcillo, Alejandro [1]; Arguedas Cuendis, Sergio [3]; Döbrich, Babette [3]; Wuensch, Walter [3]; Golm, Jessica [3]; Malbrunot, Chloe [3]; Cogollos Triviño, Cristian [4]; G. Irastorza, Igor [5]; Redondo Martín, Javier [5]; Gallego, Juan Daniel [6]; Peña Garay, Carlos [7]
[1] *Universidad Politécnica de Cartagena, España;* [2] *Universidad de Valencia, España;* [3] *European Organization for Nuclear Research (CERN), Suiza;* [4] *Universidad de Barcelona, España;* [5] *: Universidad de Zaragoza, España;* [6] *: Centro Astronómico de Yebes (Observatorio Astronómico Nacional), España;* [7] *: Laboratorio Subterráneo de Canfranc, España*

In this work, the progress on the possibilities of electrical tuning for improving the performance of the RADES (Relic Axion Detector Exploratory Setup) axion searcher structures is described. A first prototype splitted into two halves has been manufactured providing a tuning range of 700 MHz at room temperature. To improve the design, several ideas and simulation results with ferroelectric materials varying the dielectric permittivity are discussed. Considerations for the meshing of the structure with a commercial software are presented, in order to deal with problems of materials with high dielectric permittivity in such electromagnetic code. A small protoype of two cavities together with a ferroelectric material will be manufactured in the near future in order to be measured by a Vector Network Analyzer at cryonegic temperatures.

16:15 - 16:30 Design and manufacturing of a compact stripline lowpass filter to be integrated into panel antennas

Álvarez Mellado, Ana; Zarzuelo Torres, Carlos
Indra, España

En este artículo se presenta el diseño, la fabricación y las medidas de un filtro de muy bajas pérdidas realizado en tecnología stripline y que por su estructura permite su integración en un panel de antenas. Es un filtro que se ha diseñado para actuar como filtro de armónicos de un sistema de radiofrecuencia. Se presentan tanto simulaciones electromagnéticas como medidas del prototipo fabricado.

16:30 - 16:45 Sensibilidad de la respuesta en frecuencia en filtros diseñados con funciones α-spline

Raposo Sánchez, Miguel Ángel; Sáez Landete, José; Cruz Roldán, Fernando
Universidad de Alcalá, España

The type of α-spline functions, defined in the frequency domain, presented at the XXX National Symposium of the International Scientific Radio Union held in 2015 is rewritten in this work in order to give a clearer and more elegant formulation. Previous work showed the application of spline functions (β-spline and α-spline) to generate transition bands over ideal filters. They determined, from a particular way of choosing the samples belonging to these spline functions, both the spline order and the semi-order necessary to design digital filters with predefined characteristics. An alternative method of sample selection is herein presented providing filters that outperform previous designs. The sensitivity of the frequency response with regard to the γ parameter is also shown.

16:45 - 17:00 Optimized shield for common mode chokes in EMI filters for aeronautical applications

Domínguez-Palacios, Carlos [(1)]; González-Vizuete, Pablo [(1)]; Bernal, Joaquín [(2)]; Martín-Prats, María Ángeles [(1)]
[(1)] *Dpto. de Ingeniería Electrónica, Universidad de Sevilla, España;* [(2)] *Dpto. de Física Aplicada III, Universidad de Sevilla, España*

This work analyzes the effect of conducting bands placed close to a common mode choke on the attenuation provided by an electromagnetic interference filter where the common mode choke is mounted. The main aim was to determine whether the response of the common mode choke can be modified and to clearly identify and quantify the physical mechanism responsible for the changes found in the attenuation of the common mode choke and the electromagnetic interference filter.
This study has allowed us to devise an optimum shield for a common mode choke that can significantly improve the attenuation to differential mode noise of an electromagnetic interference filter at high frequencies, where parasitic effects usually undermine the performance of the filter.The technique described here can be applied easily and it does not result in an increase of the weight, volume or cost of the filter.

17:00 - 17:15 Techniques to optimize performance of the output filter of an aeronautic DCDC converter

González, Pablo; Bernal, Joaquín; Martín Prats, María Ángeles
Universidad de Sevilla, España

In this work we analyze the impact of output filter design techniques aimed to reduce conducted emissions at the output of an isolated DCDC power converter for power transfer between a high voltage DC bus and a 28VDC bus, intended for the power distribution system of a modern 'more electrical aircraft'.
By measuring common and differential mode emissions of a real DCDC power converter we demonstrate that symmetrization techniques are effective to reduce conducted emissions at the output of a power converters with a high voltage step, in which high common mode currents flow in the low voltage side. Since the proposed techniques provide reduction of conducted emissions with no increase of the number of filter components, they are specially suitable for aerospace applications, where usually high power density is an important requirement.

Sesión 6.1

Sesión especial - Arquitecturas amplificadoras de alta eficiencia y linealización de amplificadores (I)

Viernes, 06/09/2019
Hora: **09:00 - 10:30**. Lugar: **Aula 005**

09:00 - 09:15 Amplificador de envolvente clase G de alto rendimiento para técnicas de linealización de transmisores

Patiño Gómez, Moisés; Ortega González, Francisco Javier
Universidad Politécnica de Madrid, España

En este trabajo se presenta el diseño, simulación e implementación un amplificador de envolvente con una topología de tensión de alimentación multinivel clase G (de cuatro niveles) que puede ser usado en técnicas de linealización de amplificadores de potencia de radiofrecuencia de alto rendimiento. El principal objetivo de este proyecto consiste en comprobar los niveles de linealidad y ancho de banda que se pueden lograr con este tipo de topología. El prototipo desarrollado presenta un rendimiento del 60% con una potencia de salida de 12 W de pico y sobre un ancho de banda de 10 MHz para una señal de prueba basada en una modulación digital 64-QAM.
Además se ha evaluado el desempeño de un sistema EER (envelope elimination and restoration) formado por un amplificador de potencia en banda S y por el amplificador de envolvente implementado, consiguiendo un 43% de rendimiento con una potencia de salida de 9.4 W de pico. Los niveles de linealidad que se han obtenido son 4.68% de EVM (error vector magnitude) y 34 dB de ACPR (adjacent channel power ratio), sin aplicar técnicas para corregir la distorsión.

09:15 - 09:30 Amplificador de potencia clase-E/F2 de alta eficiencia en un amplio rango de cargas resistivas en la banda UHF

Vegas Bayer, David; Pérez-Cisneros, José R.; Ruiz, M. Nieves; **García, José Á.**
Universidad de Cantabria, España

This paper presents the design of a load-insensitive class-E/F2 power amplifier at UHF frequency band. Among all the modes described in the continuum of class-E in terms of the second harmonic reactive termination, class-E/F2 is selected due to its potential to reduce the impact of real device loss mechanisms under variable resistance operation. The proposed drain terminating network, which consists of lumped elements, synthesizes the optimal load modulating trajectory therefore approximating the zero voltage switching (ZVS) condition along a wide range of resistive loads. The implemented PA at 700 MHz maintains an efficiency as high as 70% up to an output power below 5.4% (-12.7 dB) of its peak value. An outphasing scheme based on this PA has been also implemented providing an efficiency higher than 60% up to 13 dB below of its peak value. It is possible to linearly reproduce a 10 MHz LTE signal with a PAPR higher than 12 dB has been linearly reproduced with an average efficiency greater than 45%.

09:30 - 09:45 Utilizando técnicas de mejora de rendimiento de amplificadores de potencia de RF en comunicaciones por luz visible

Sebastián, Javier; G. Aller, Daniel; Rodríguez, Juan; F. Miaja, Pablo; G. Lamar, Diego
Universidad de Oviedo, Grupo de Sistemas Electrónicos de Alimentación

As very well known, modern communications need linear and efficient RF Power Amplifiers (RFPAs). Classical Class A and Class B RFPAs exhibit extremely low efficiency when amplifying signals with high Peak-to-Average Power Ratio (PAPR). In order either to increase the efficiency of linear RFPAs or to achieve linear behaviour in the case of efficient (but not linear) Switching-Mode RFPAs, several techniques can be applied. These techniques can be divided in two categories: a) those based on the use of Switching-Mode DC-to-DC converters and, b) those based on combining the operation of several RFPAs. Although the expanding of these techniques is mainly due to the mobile (cellular) telephony, they can be used in other progressing telecom scenario: the Visible Light Communication (VLC). Thus, this paper tries to show how the aforementioned techniques can help us to develop more efficient VLC transmitters.

09:45 - 10:00 Amplificadores de potencia GaN de banda ultra ancha: Diseño con simulación EM

Barrutia Inza, Iban; Herrera Guardado, Amparo
Universidad de Cantabria, España

When designing GaN amplifiers up to millimeter wave frequencies in monolithic microwave integrated circuit (MMIC) format, fabricated circuit's measurement results can significantly depart from simulations relying purely on library elements from supplied foundry PDK. Even EM simulations, if inappropriately parameterized, can play havoc in the design's outcome. The purpose of this paper is to help GaN power MMIC designers by pointing out several issues that raise when designing and simulating high frequency active and passive structures and giving hints for a correct EM simulation setup to obtain trustable results.

10:00 - 10:15 Transmisores VLC basados en la suma de intensidades lumínicas

G. Aller, Daniel; F. Miaja, Pablo; **G. Lamar, Diego**; Rodríguez, Juan; Sebastián, Javier
Universidad de Oviedo, Grupo de Sistemas Electrónicos de Alimentación

In this work two high efficiency LED drivers for Visible Light Commnunication are presented. The proposal takes advantage of the light by adding the signals in their light form instead of electrically, which leads to a reduction on the complexity of the design. The first design is based on the Outphasing technique in which an amplitude and phase modulated signal is generated by the sum of two phase modulated constant envelope signals. The transmitter is made up of two Class E RFPAs. The second design is based on the linear-assisted technique when a Class E amplifier is combined with a linear stage. The errors introduced by the phase modulation of the class E are corrected by means of this linear stage.

Sesión 6.2

Sesión especial - Reflectarrays, Transmitarrays and Periodic Structures (I)

Viernes, 06/09/2019
Hora: **09:00 - 10:30**. Lugar: **Aula 006**

09:00 - 09:15 Broadband shaped-beam reflectarray optimization using support vector machines

Prado, Daniel R. [1]; López-Fernández, Jesús A. [2]; **Arrebola, Manuel** [2]; Pino, Marcos R. [2]; Goussetis, George [1]
[1] *Heriot-Watt University, Reino Unido;* [2] *Universidad de Oviedo, España*

In this work, SVMs are employed to accelerate the optimization of a 1-meter contoured-beam reflectarray antenna for direct broadcast satellite application in a 15% bandwidth in dual-linear polarization. A method of moments based on local periodicity is used to obtain samples to train the SVMs for each frequency. The surrogate model is then used for a design at central frequency, that is later used as starting point for a broadband optimization procedure that is accelerated more than an order of magnitude without a significant loss of accuracy. The minimum copolar gain in the coverage zone is improved more than 10 dB at the upper frequency while maintaining a computationally efficient design procedure.

09:15 - 09:30 Resistively loaded FSS for suppressing antenna backscatter on spacecraft platforms

Gonçalves Machado, Gabriel; Cahill, Robert; Fusco, Vincent; Conway, Gareth
Queen's University Belfast, Reino Unido

This paper reports on a simple, cost-effective and novel approach for electromagnetically decoupling antennas from spacecraft platforms. This is achieved by deploying a very thin metal backed resistively loaded Frequency Selective Surface (FSS) to suppress the scattering of linear polarised (LP) or circularly polarised (CP) waves from the metal structure. The microwave absorber is similar in construction as commercial available multi-layer insulator (MLI) material and therefore can easily be integrated into the top surface to provide enhanced radio frequency (RF) performance in conjunction with thermal control and protection of the payload instruments. Full wave electromagnetic simulations are used to demonstrate the effectiveness of this concept by modelling the radiation pattern of a CP dipole antenna which was designed to work at 10 GHz and is placed a distance of $\lambda/2$ above the metal surface of a 10 cm^3 CubeSat. This arrangement represents the worst-case scenario where destructive interference produces a null on boresight and crosspolar levels which are higher than the reference polarisation. However, the numerical results show that the shape of the undistorted radiation pattern of the antenna in isolation is almost fully restored in the forward hemisphere when the surface of the CubeSat is covered with a 2D periodic array of resistively loaded hexagonal patches which are printed on a 1.12 mm ($\lambda/25$) thick film of Polyethylene Terephthalate (PET).

09:30 - 09:45 Implementation of the spectral domain MoM with edge singularity basis functions for the analysis of a large class of multilayered periodic structures

Camacho Aguilar, Miguel [1]; **Rodríguez Boix, Rafael** [2]; Medina Mena, Francisco [2]
[1] *University of Pennsylvania, Philadelphia, USA;* [2] *Universidad de Sevilla, España*

The spectral domain Method of Moments (SD-MoM) is applied to the analysis of a wide variety of multilayered structures containing either periodic arrays of apertures or periodic arrays of patches. Basis functions accounting for edge singularities are used in the approximation of the magnetic/electric current density on the apertures/patches, which makes it possible a fast convergence of the SD-MoM with respect to the number of basis functions. Since the two dimensional Fourier transform (2-D FT) of the basis functions cannot be obtained in closed form, these 2-D FT are numerically computed by means of the Nonuniform Fast Fourier Transform (NUFFT) algorithm. The numerical results obtained indicate that the SD-MoM based on NUFFT is 80 times faster than commercial software CST, and only 15% slower than the conventional SD-MoM used in those cases where the 2-D FT of the basis functions is available in closed-form.

09:45 - 10:00 Multi-beam circular polarized reflectarray on parabolic reflector by VRT

Somolinos, Álvaro [1]; **Florencio Díaz, Rafael** [2]; González, Iván [2]; Cátedra, Felipe [2]; Encinar, José Antonio [3]
[1] *newFASANT, Guadalajara, España;* [2] *Universidad de Alcalá, España;* [3] *Universidad Politécnica de Madrid*

Easy technique to compute the required phase to tilt a pencil beam to the desired direction is proposed. This require phase is added to the reflected fields by the variable rotation technique (VRT) in reflectarrays printed on parabolic surfaces fed by a single dual circular polarized (CP) horn. The proposed reflectarray cell for VRT is made of a conductive cross printed on a grounded dielectric. To demonstrate the multibeam capacity a 1.8-meter offset parabolic reflectarray has been designed to generate six beams in circular polarization with three dual-CP feed-horns, with very promising results for multi spot beam satellite antennas in Ka-band.

10:00 - 10:15 A receiving DTH reflectarray antenna with mechanically scanned beam

Pirinoli, Paola [1]; Lohrey, Thomas [2]; Orefice, Mario [1,3]; Beccaria, Michele [1]; Dassano, Gianluca [1]
[1] *Politecnico di Torino, Italia;* [2] *Eutelsat S.A., Paris, France* (retired)*;* [3] *IEIIT- CNR, Politecnico di Torino, Italy*

In this paper, the possibility of designing a Direct-To-Home (DTH) system using, as receiving antenna, a planar Reflectarray (RA) with mechanical beam steering capabilities is discussed: the preliminary results on the numerical analysis and experimental characterization of the designed prototype are promising, confirming the feasibility of proposed antenna configuration.

Sesión 6.3

Sesión especial - Componentes pasivos de alta frecuencia para aplicaciones espaciales (I)

Viernes, 06/09/2019
Hora: **09:00 - 10:30**. Lugar: **Aula 007**

09:00 - 09:15 Full-metal polarizers employing 3D cells conceived from a circuit perspective

Molero Jiménez, Carlos; García Vigueras, María
INSA Rennes, Francia

An original linear-to-circular polarizer based on a frequency selective surface with three-dimensional architecture is presented in this manuscript. The frequency selective surface is a full-metal periodic structure whose typical unit cells can be identified with conventional square waveguides. The structure is illuminated with a plane wave linearly polarized slanted 45^{o} with respect the axis of the structure. The particular design of the unit cell allows for an independent treatment of the orthogonal components of the incident field. Equivalent circuits will be employed in all cases with the aim of reducing the complexity of the problem and the difficulty at interpreting the phenomenology associated with the structure. Two different designs are proposed, exhibiting bandwidths of 5.8% and 14% respectively. The feasibility of the equivalent circuit is validated by comparing with a full-wave simulator.

09:15 - 09:30 Diseño de filtros de banda ultra ancha (UWB) en tecnología E-SIW en banda satelital Ku

Máximo Gutiérrez, Clara; Álvarez Melcón, Alejandro; Hinojosa Jiménez, Juan
Universidad Politécnica de Cartagena, España

Se presenta el diseño de un filtro de banda ultra ancha implementado en tecnología E-SIW en la banda frecuencial Ku, usada para aplicaciones espaciales. Estos filtros se han diseñado mediante la síntesis de saltos de impedancia usando funciones de Chebyshev. El diseño se ha llevado a cabo introduciendo tramos de sustrato dieléctrico en la cavidad vacía de la guía E-SIW. Se realizan en esta contribución varias comparaciones mostrando en ellas varios diseños implementados con diferentes tipos de inversores y a diferentes frecuencias de corte. Finalmente se muestra la mejoría, en cuanto a pérdidas de inserción, del uso de la guía E-SIW al ascender en frecuencia comparando el diseño realizado con otro similar llevado a cabo en guía SIW.

09:30 - 09:45 Improving corona discharge breakdown thresholds in microstrip bandpass filters

Morales Hernández, Aitor; Sánchez Soriano, Miguel Ángel; Marini, Stephan
Universidad de Alicante, España

In this work, corona discharge breakdown threshold in microstrip bandpass filters is studied. If a gas is subjected to strong electric fields, gas breakdown may occur with severe consequences for microwave devices. The objective of this paper is to propose a solution for the mentioned problem for a hairpin microstrip filter, through the implementation of dielectric material covers over the open-circuit terminations of the resonators forming the filter, where the voltage magnification is maximum. A parametric study of covers' dimensions for an open-ended resonator is presented, and it is analyzed how the maximum electric field strength and the unloaded quality factor are modified. Finally, the aforementioned study is applied to the design of a fifth order bandpass filter centered at 1.6 GHz. Numerical results show that by using this strategy, the power handling capability of microstrip filters can be considerably enhanced without degrading the filter response performance.

09:45 - 10:00 Filtro evanescente en banda Ku de tercer orden resintonizable de forma continua con diodos Varicap

Romera Pérez, Antonio [(1)]; Pons Abenza, Alejandro [(1)]; Quesada Pereira, Fernando D. [(1)]; Álvarez Melcón, Alejandro [(1)]; Arche Andradas, Lara [(2)]
[(1)] *Universidad Politécnica de Cartagena, España;* [(2)] *Thales Alenia Space Spain*

This paper presents a novel solution to introduce electronic tuning to a bandpass waveguide filter. The structure is based on evanescent mode resonators which are implemented as elliptical cylinders attached to the side wall of the evanescent waveguide section. These posts are not in contact with top and bottom walls, where a capacitive effect is produced due to the air gap. The idea is to employ the produced capacitance to include varactor diodes which are capable of shifting the resonant frequency of the structure. The feeding network for the proper operation of the varactor diodes is implemented using a Substrate Integrated Waveguide (SIW) structure acting as the top and bottom walls of the waveguide. Moreover, a third order Ku-band waveguide filter is designed, using the proposed strategy for the electronic tuning of the resonators. The baseline configuration is designed with centre frequency f_c = 12.6 GHz and bandwidth BW = 120 MHz (a fractional bandwidth of 0.94%). By changing the corresponding capacitors, the filter passband can be shifted down to a central frequency of 11.85 GHz without showing a large degradation in terms of return losses. The proposed structure is capable to operate between 11.85 GHz and 12.67 GHz, thus leading to an 820 MHz (6.9%).

10:00 - 10:15 Space Mapping para la sintonización de filtros

Melgarejo Lermas, Juan Carlos; Guglielmi, Marco; Cogollos, Santiago; Boria, Vicente E.
Universitat Politècnica de València, España

Space Mapping techniques are widely used for the optimized design of waveguide filters. In this work we propose a linear mapping between the tuning elements of a real waveguide filter implementation and the geometrical design parameters of its counterpart without tuning elements, which will help to hugely accelerate the tuning process of microwave filters.

10:15 - 10:30 Reducción de tamaño en filtros evanescentes empleando técnicas de modelado geométrico 3D

Pons Abenza, Alejandro [(1)]; Romera Pérez, Antonio [(1)]; Álvarez Melcón, Alejandro [(1)]; Quesada Pereira, Fernando Daniel [(1)]; Arche Andradas, Lara [(2)]
[(1)] *Universidad Politécnica de Cartagena, Región de Murcia, España;* [(2)] *Thales Alenia Space España, Tres Cantos, Madrid, España*

In this work, a novel shaping technique for the footprint reduction in evanescent waveguide filters is presented. This shaping technique consists on employing smooth width transitions of the evanescent waveguide side walls in order to control the coupling level between two metallic post resonators. Traditionally, the coupling levels between two evanescent resonators have been controlled by the separation between them. With the proposed shaping, it is possible to reduce the physical distance between contiguous resonators and modify the shaping degree to control the inter-resonator coupling. This leads to an effective footprint reduction of the filter, as the evanescent resonators can be placed closer. The proposed concept is validated with the design of 5th order in-line filters with different degrees of shaping. Results show that the obtained footprint reduction is more significant as the shaping becomes more aggressive. As a result of the applied shaping, the resonators unloaded quality factor (Qu) is slightly reduced, but the spurious free range (SFR) of the designed filters is significantly improved. The proposed concept can be applied to other evanescent resonator technologies, where their footprint could also be reduced using these 3D geometrical modelling techniques.

Sesión 6.4

Educación: Nuevas Tecnologías y Herramientas

Viernes, 06/09/2019
Hora: **09:00 - 10:30**. Lugar: **Aula 003**

09:00 - 09:15 Instalación, configuración y empleo de un Receptor GNSS para docencia en Ingeniería de Telecomunicación

García Luque, Aarón; Martín Guerrero, Teresa M.
Universidad de Málaga, España

The need to efficiently manage a huge volume of real-time data has motivated the development of GNSS (Global Navigation Satellite Systems) for assisted navigation, localization and industrial tools that require instantaneous and accurate range calculation. Due to this demand, our Research Group has acquired a multisystem receiver that fixes its position by means of different satellite constellations. In this contribution, the start-up of the device in the workplace to be used in research and teaching laboratories is detailed. Installation's process, its possibilities of use and Matlab® simulations based on GPS (Global Positioning System) are presented and used to compare real performance with simulated results. Finally, the design of a dedicated structure to hold the receiver antenna is included.

09:15 - 09:30 RFLabSuite: prácticas online de electrónica de radiofrecuencia

Cobo Rodríguez, Germán; Morán Moreno, Jose Antonio; Monzo Sánchez, Carlos; Santamaría Pérez, Eugènia; García Solórzano, David
Universitat Oberta de Catalunya, España

Learning analogue electronics in undergraduate and post-graduate education requires learners to carry out specific laboratory activities so that they can acquire relevant practical skills belonging to this field. In online universities, teaching radio-frequency electronics with real hardware involves the implementation of remote control systems with the aim that learners can remotely control the devices the practical activity requires to handle. In the present article, we present the RFLabSuite system, which allows designing, implementing and remotely carrying out such practical activities in an environment where users (i.e. teachers and learners) can work without having to be concerned with how the physical connections between the different devices involved in the practice can be remotely modified (i.e. as in a traditional face-to-face laboratory).

09:30 - 09:45 Radio and mobile communication concepts demonstrated by means of spectrograms

Mendo Tomás, Luis
Universidad Politécnica de Madrid, España

This paper shows how to use spectrograms to illustrate theoretical concepts related to wireless propagation, radio and mobile communication systems. Using a digital oscilloscope and a computer, spectrograms at different scales are generated. The obtained representation is very interactive, and can be used in classroom demonstrations. Some examples are given.

09:45 - 10:00 Herramienta colaborativa para la evaluación de una asignatura tecnológica en máster

Castro, Paula M.; Dapena, Adriana; Laport, Francisco; Fresnedo, Óscar
Universidade da Coruña, España

In this work we propose a wiki as a collaborative tool for work and evaluation of an activity traditionally done through a written document using a text editor that does not motivate the student and that is very far from its social reality in the XXI century. The student will be responsible for the entire process, from the preparation of the rubric as an assessment tool, the implementation of the wiki on a freely chosen content in collaboration with colleagues also of their choice, until its assessment by a committee composed of students and the teacher according to that rubric.

10:00 - 10:15 Docencia de antenas basada en proyectos

Sierra Pérez, Manuel; Fernández Gonzalez, Jose Manuel; Sierra Castañer, Manuel
Universidad Politécnica de Madrid, España

Durante varios años el Curso de Antenas en el cuarto año del programa de grado en Ingeniería de Telecomunicación se ha basado en proyectos de diseño de antenas. El conjunto de alumnos se distribuye en grupos de trabajo para realizar un proyecto específico de antenas basado en un sistema real de comunicaciones o de control. El trabajo se distribuye en tres fases: Diseño de la antena; elaboración de software de análisis y análisis final de la antena con un software comercial. Este artículo presenta la experiencia de cinco años de enseñanza, la evaluación personal de resultados y recomendaciones para la implementación de esta forma de docencia.

10:15 - 10:30 Implementación de una herramienta gráfica para el estudio de comunicaciones digitales

Fresnedo Arias, Óscar; Laport López, Francisco; **Castro Castro, Paula M.**; Dapena Janeiro, Adriana
Universidade da Coruña, España

In this paper, we present a software tool which can be used to improve the learning process of the students in a subject of digital communications. This computer application has a graphical user interface which allows the students to test a set of features related to the theoretical concepts of the subject in a simple way. Using this tool, the students can also observe the impact of the different design parameters of a communication system on its performance in terms of the bit error rate, transmission rate or energy consumption. The additional data and pictures provided by the tool in the different steps during the digital encoding, transmission and decoding of the source information help them to connect the theoretical dimension to the actual implications of the main ideas which are explained in the regular lectures. Finally, the use of this tool avoids that the students waste their time by implementing the features of interest by themselves and using some programming language. Hence, they can leverage this time on working with the developed tool and achieving deeper learning.

Sesión 7.1

Sesión especial - Arquitecturas amplificadoras de alta eficiencia y linealización de amplificadores (II)

Viernes, 06/09/2019
Hora: **11:15 - 12:45**. Lugar: **Aula 005**

11:15 - 11:30 A method for selecting online the coefficients to be updated in a DPD for PA linearization

Pham, Quynh Anh [1]; **Montoro López, Gabriel** [1]; López Bueno, David [2]; Gilabert Pinal, Pere L. [1]
[1] *Universitat Politècnica de Catalunya, España;* [2] *Centre Tecnològic de Telecomunicacions de Catalunya, España*

This paper presents a technique for selecting online the coefficients to be updated in a digital predistorter (DPD) based on direct learning. The proposed method, which is based on a combination of matching pursuit (MP) and least squares (LS) techniques (and is therefore named MP-LS method) allows to improve the PA linearization performance of a fixed number of DPD coefficients, due to the fact that at each DPD iteration the coefficients to be updated are properly chosen. The proposed technique is compared to a conventional LS estimation, and experimental results demonstrate that the MP-LS method can provide a performance improvement in relation to a DPD with fixed-preselected coefficients. The method could be especially useful in DPD systems that have hardware restrictions in the resources to be used by the update subsystem in the feedback path. That is the case of DPDs based on FPGA devices implementing a QR algorithm in the programmable logic (PL) side.

11:30 - 11:45 Procedimiento de linealización de amplificadores de alta eficiencia operando cerca de saturación

Madero Ayora, María José; Crespo Cadenas, Carlos; Becerra, Juan A.
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Este trabajo presenta una técnica de linealización para un amplificador clase J operando en la región de compresión. El procedimiento de predistorsión se basa en añadir una función estática como un nuevo regresor al modelo de Volterra en banda base. Gracias a él se supera la inestabilidad inherente de la respuesta polinómica cuando se opera cerca de saturación, a la vez que es posible aplicar técnicas estándar para el diseño de predistorsionadores digitales con reducción de parámetros. Para validar el enfoque se han realizado experimentos con un amplificador clase J diseñado con el dispositivo CGH35015F de Cree, un HEMT encapsulado de GaN y 15 W, con señales 5G New Radio de 20 MHz. Se muestran las prestaciones alcanzadas con la salida linealizada en términos de relación de potencia en el canal adyacente, error cuadrático medio normalizado y magnitud del vector error.

11:45 - 12:00 Evaluación y linealización de transmisores MIMO sobre enlaces RoF

Mateo Pérez, Carlos; **García Dúcar, Mª. Paloma**; de Mingo Sanz, Jesús; Valdovinos Bardají, Antonio; Hernández Solana, Ángela
Universidad de Zaragoza, España

Radio-over-Fiber (RoF) is a suitable technology for efficiently developing the cloud-RAN concept in Long Term Evolution Advanced (LTE-A) deployments. Multiple-Input Multiple-Output (MIMO) structures are used in LTE-A deployments to increase the transmission data rate. Usually, distortion coming out from the radiofrequency (RF) power amplifier and from the optical segment should be taken into account in order to achieve the desired performance at the base station. In this paper, the crosstalk introduced by a MIMO architecture is also taken into account. A 2x2 MIMO memory polynomial predistorter to improve the transmitter linearization is proposed including the crosstalk MIMO. The experimental obtained results show that the proposed method of RoF linearization (2x2 MIMO MPM-DPD) reaches an improvement of and 2,5 dB regarding to the ACPR and a reduction of 2% in the EVM value respect to a classical memory polynomial predistorter (MPM-DPD).

12:00 - 12:15 Linealización digital de transmisores mediante redes neuronales no lineales

López Bueno, David [1,2]; Anh Pham, Quynh [2]; Montoro, Gabriel [2]; Gilabert, Pere L. [2]
[1] *Centre Tecnològic de Telecomunicacions de Catalunya, España;* [2] *Universitat Politècnica de Catalunya*

This paper presents an overview on how the artificial neural networks (ANN) are applied to digitally linearize modern transmitters. The use of nonlinear ANNs is intended to either assist or replace the traditional crest factor reduction (CFR) and digital predistortion (DPD) building blocks, and benefit from their inherently good approximation capabilities and reduced hardware complexity when targeting complex transceiver scenarios such as those present in 5G. There is not a universal procedure to set up the best ANN given a specific application. However, in this paper some design considerations which have been experimentally validated in the literature will be summarized both considering single-antenna and multi-antenna transmitters. Finally, some principles in the selection of ANN parameters for nonlinear modeling will be showcased by using a simulation test bench that employs measured data from a strongly non-linear GaN PA operated with wideband signals.

12:15 - 12:30 Linealización usando bases de Bernstein de unidades radio remotas en sistemas 5G-NR con fronthaul óptico

Carro Ceballos, Pedro Luis; García Ducar, Paloma; de Mingo Sanz, Jesús; Valdovinos, Antonio; Hernández, Ángela; Gutiérrez, Fernando
Universidad de Zaragoza, España

Digital Predistortion (DPD) is a well-known method to reduce nonlinear distortion in power amplifiers (PA) and Radio over Fiber, which is an important issue in the 5G-NR transmission. Their waveforms are based on multicarrier techniques and spectral regrowth may decrease performances. In this paper, we present an evaluation on the performance of a linearization technique with 5G-NR signals with different numerologies based on a bounded coefficient and more robust digital predistorter using Bernstein polynomials.

Sesión 7.2

Sesión especial - Reflectarrays, Transmitarrays and Periodic Structures (II)

Viernes, 06/09/2019
Hora: **11:15 - 12:45**. Lugar: **Aula 006**

11:15 - 11:30 Improved capabilities in reflectarray elements based in SIW technology

Carrasco, Eduardo [1]; Zang, Jiawei [2]; Tomé, José [1]; Álvarez Melcón, Alejandro [3]; Gómez-Díaz, Juan S. [4]
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The design of aperture-coupled reflectarray elements based in Substrate Integrated Waveguide (SIW) technology is presented as an alternative to microstrip delay lines. The element combine the advantages of metallic rectangular waveguides, but with the low cost, low profile and manufacturing advantages of planar technology. In addition, the proposed topology simplifies the multi-stack structure by eliminating one dielectric layer in the design. The inherent shielding provided by the SIW cancels undesirable back radiation, which is difficult to control in the microstrip counterpart. An improved bandwidth for the element is presented by increasing the number of resonant elements, and at the same time optimizing the coupling between all the components of the element. This optimization can also be used to implement sharp frequency selectivity of the reflecting element. Finally, the proposed radiating element can be also used for dynamically control the phase when the waveguide is loaded with a varactor diode.

11:30 - 11:45 Full-wave evaluation of a 40 dBi transmit-array for Ka-band SoTM

Matos, Sérgio [1]; Costa, Jorge [1]; Naseri, Parinaz [2]; Lima, Eduardo [3]; Fernandes, Carlos [3]; Fonseca, Nelson [4]
[1] *Instituto de Telecomunicações, Instituto Universitário de Lisboa, Lisbon, Portugal;* [2] *University of Toronto, Faculty of Applied Science & Engineering, Toronto, Ontario, Canada;* [3] *Instituto de Telecomunicações Instituto Superior Técnico, Universidade de Lisboa, Lisbon, Portugal;* [4] *ESA Antenna and Sub-Millimeter Wave Section, Noordwijk, The Netherlands*

Transmit-array (TA) antennas have been shown to be a cost-effective solution for the new generation of satellite communications. These antennas are usually composed by thousands of fine-tuned subwavelength unit-cells. Therefore, full-wave evaluations become quite challenging as the required gain increases, constraining the antenna design and optimization. This is aggravated by the fact that, when beam scanning is required, higher gains cannot be obtained by simply scaling a given design. In fact, for a F/D ratio, the maximum gain of the TA is limited by the scanning aberrations. Recently, we have proposed a new phase compensation law for the TA, designated as the bifocal correction, that allows to overcome the usual gain/scanning tradeoff limit. However, due to the lack of computational resources, we were only able to demonstrate this concept for a 40 dBi TA using PO/GO methods. In this communication we present the full-wave performance of this 40 dBi bifocal TA design using a new efficient numerical evaluation method, properly validated with a smaller 30 dBi TA.

11:45 - 12:00 Periodic glide-symmetric corrugated double-sided lines with controlable stopband

Padilla de la Torre, Pablo [1]; Palomares Caballero, Ángel [2,1]; Alex Amor, Antonio [2,3]; Valenzuela Valdés, Juan [1]; Quevedo Teruel, Óscar [4]
[1] *Universidad de Granada, España;* [2] *Universidad de Málaga;* [3] *Universidad Politécnica de Madrid;* [4] *KTH Royal Institute of Technology*

In this work, we demonstrate that it is possible to tune the dispersion properties of double-sided printed lines by adding glide symmetry. Glide-symmetric periodicities are created by adding corrugations in both strips of the printed lines. Glide symmetry eliminates the stopband between first and second propagation modes and is able to increase the propagation constant, increasing its linearity with respect to the frequency, i.e. increasing its bandwidth. Thus, the periodic glide-symmetric line can be designed to possess higher equivalent effective refractive index in an wide range of frequencies. These properties are numerically and experimentally validated. We also show that this glide-symmetric structure can be used for filtering purposes by breaking the symmetry.

12:00 - 12:15 Structural stability of plasmonic periodic nanostructures in flow-through operation

Escobedo, Carlos [1]; Gómez-Cruz, Juan [1,2]; Carrasco, Eduardo [3]
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Periodic arrays of subwavelength apertures support surface plasmon resonance, have an intrinsic small footprint and can be arranges in collinear optics, which has motivated their use as sensors. In flow-through operation, the nanoapertures may experience pressures differences across the substrate in which they are fabricated, which may impose the risk for structural failure. This work presents an investigation of the deflection and structural stability of nanoplasmonic subwavelength aperture-based sensors operating in flow-through mode. The analyses was approached using both experiments and FEA using simulations through FEM. Both, experimental and simulation results, suggest that the periodic nanostructures can safely operate under trans-membrane pressures of up to 20 psi.

Sesión 7.3

Sesión especial - Componentes pasivos de alta frecuencia para aplicaciones espaciales (II)

Viernes, 06/09/2019
Hora: **11:15 - 12:45**. Lugar: **Aula 007**

11:15 - 11:30 Diseño sistemático de filtros comb-line doblados en tecnología guiada

San-Blas, Ángel A. [1]; **Martínez, Andrea** [1]; Boria, Vicente E. [2]; Guglielmi, Marco [2]
[1] *Dpto. de Ingeniería de Comunicaciones, Universidad Miguel Hernández de Elche;* [2] *Dpto. de Comunicaciones, iTEAM, Universitat Politècnica de València.*

En este trabajo se presenta un procedimiento sistemático para el diseño eficiente de filtros comb-line doblados implementados en tecnología guiada. La estrategia propuesta se basa en dividir el proceso de diseño en etapas más sencillas, con el objetivo de reducir el número de variables a optimizar en cada paso del proceso. La respuesta eléctrica de una red circuital equivalente del componente en guía considerado en cada etapa se ha empleado como respuesta objetivo. Asimismo, se presenta un método para obtener un valor inicial para algunas dimensiones clave del filtro. La técnica de diseño propuesta se ha validado con éxito mediante el diseño práctico de un filtro comb-line doblado de seis polos que opera en banda S.

11:30 - 11:45 Avances en el diseño de filtros en guía de ondas mediante la técnica del slope parameter

Ruiz Garnica, Jesús; Soto Pacheco, Pablo; Sánchez Escuderos, Daniel; Boria Esbert, Vicente
Universitat Politècnica de València, España

La técnica del slope parameter ha sido empleada desde hace muchos años para obtener las dimensiones iniciales de filtros de microondas en guías de onda, empleando normalmente el valor teórico del slope parameter del resonador. Sin embargo, y gracias a la disponibilidad de potentes simuladores comerciales, es posible refinar la estimación teórica para mejorar la precisión del diseño inicial obtenido. En este trabajo, se propone un nuevo procedimiento mejorado de diseño de filtros en guía de onda basado en una obtención más precisa del slope parameter de cada resonador. Para validar la nueva técnica, se ha diseñado un filtro en línea en guía de onda rectangular, comparándose las dimensiones de la estructura sintetizada mediante diferentes técnicas.

11:45 - 12:00 Nuevo modelo del efecto multipactor para guías rectangulares parcialmente rellenas de dieléctrico

Berenguer Alonso, Andrés [(1)]; Coves Soler, Ángela [(1)]; Mesa Ledesma, Francisco [(2)]; Bronchalo Bronchalo, Enrique [(1)]; Gimeno Martínez, Benito [(3)]
[(1)] *Universidad Miguel Hernández de Elche;* [(2)] *Universidad de Sevilla;* [(3)] *Universidad de Valencia*

In this work it is shown a new model for the analysis of multipactor effect in partially dielectric-loaded rectangular waveguides. For this purpose, a CAD software has been developed which solves the dynamics of the electron inside this waveguides, taking into account the RF electromagnetic fields and the DC electric field that appears because of the charging of the dielectric surfaces. This electrostatic field is obtained by computing the electric potential produced by an arbitrary charge distribution on the dielectric surface, which has been particularized to a waveguide loaded with a thin dielectric layer. The electron trajectory is then found by numerically solving the equations of motion.

12:00 - 12:15 Filtros paso banda basados en saltos de impedancia con alta selectividad

Calero, Ibai [(1)]; Teberio, Fernando [(1)]; Martín-Iglesias, Petronilo [(1,2)]; Miranda, Luis [(1)]; **Arregui, Iván** [(1)]; Arnedo, Israel [(1)]; Percaz, Jon Mikel [(1)]; Santiago, David [(1)]; Lopetegi, Txema [(1)]; Benito, David [(1)]; Laso, Miguel A. G. [(1)]
[(1)] *Universidad Pública de Navarra, España;* [(2)] *European Space Agency, Holanda*

Rectangular waveguide stepped-impedance filters have been recently proposed to achieve band-pass frequency responses. In this work, a novel method is presented to enhance their selectivity. The design technique preserves the advantages of the baseline filter while allowing the inclusion of transmission zeros in its band-pass response. This is achieved by introducing $\lambda_g/4$-stubs in some of the filter sections following a modular design process which implies a redesign of only the sections affected. The inclusion of the transmission zeros does not alter the good in-band behavior of the original filter and the method avoids cumbersome optimization processes. The technique has been tested by designing a Ku-band filter with two transmission zeros, one on either side of the passband. A prototype has been fabricated to validate the proposed example.

12:15 - 12:30 Técnicas numéricas avanzadas para el cálculo del campo electrostático en guías de onda rectangulares con dieléctrico

Berenguer Alonso, Andrés [(1)]; Coves Soler, Ángela [(1)]; Bronchalo Bronchalo, Enrique [(1)]; Mesa Ledesma, Francisco [(2)]; Gimeno Martínez, Benito [(3)]
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The resolution of the Green's function for obtaining the electrostatic potential generated by the charges located in the dielectric layer of a rectangular waveguide requires efficient integration techniques. Due to the characteristics and the oscillatory nature of the function to be integrated, the use of the Filon's method together with a convergence analysis is adequate. However, the application of this numerical integration technique can lead to numerical instabilities in the result. For this reason, in this research work we have presented two different methods to deal with these numerical errors of integration: SSA and GPR. In this way, it is possible to clean the electrostatic potential avoiding subsequent errors in the calculation of the electrostatic field.

12:30 - 12:45 Implementación de dispositivos de resonadores acoplados mediante algoritmos ASM

García Lampérez, Alejandro
Universidad Carlos III de Madrid, España

Existen numerosos métodos de síntesis basados en matrices de acoplamientos para el diseño de filtros y, en menor medida de multiplexores. Sin embargo, un paso del proceso de diseño resulta todavía problemático, e incluso en algunos casos no está resuelto: la implementación de la estructura física que corresponde a los coeficientes de la matriz de acoplamientos. Este problema se resuelve habitualmente mediante optimización, pero el alto coste computacional en ocasiones lo hace el proceso poco práctico o inviable. Este artículo presenta un algoritmo para llevar a cabo ese paso de implementación. Para ello, se considera que el modelo electromagnético y la matriz de acoplamientos son dos modelos con distintas precisiones. El problema se transforma entonces no tanto en encontrar los parámetros óptimos del modelo físico, como en alinear ambos modelos. Como resultado, el número de simulaciones requeridas se puede reducir sustancialmente. El método se ilustra con dos ejemplos, un filtro de cavidades acopladas y un multiplexor compacto en tecnología SIW.

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