URSI2022

XXXVII Simposio Nacional de la Unión Científica Internacional de Radio

Málaga, 5 a 7 de septiembre de 2022

LIBRO DE ACTAS

50 ANIVERSARIO

UNIVERSIDAD DE MÁLAGA

U.R.S.I.

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Bienvenida del comité Organizador

Recibe la más cordial bienvenida a la XXXVII edición del Simposio Nacional de la URSI, que se celebrará en formato presencial, organizado en Málaga, entre el 5 y el 7 de septiembre. Esta nueva edición recoge la tradición comenzada en 1980 que lo lleva a convertirse en el foro de referencia para investigadores y tecnólogos de universidades y empresas del sector TIC.

La URSI reúne anualmente a investigadores, profesionales y estudiantes del ámbito de las Tecnologías de la Información y las Comunicaciones, para presentar sus trabajos de investigación y desarrollo tecnológico. El objetivo es disponer de una plataforma en la que debatir, intercambiar experiencias y proporcionar posibilidades de colaboración entre los distintos grupos de trabajo en áreas TIC de la ingeniería y las ciencias experimentales.

A pesar de la situación actual y las incertidumbres que conlleva, queremos que no se pierda la cadencia anual del Simposio, tan importante para establecer sinergias entre los grupos de investigación de nuestro ámbito, y que es especialmente valioso como actividad de formación de nuestros jóvenes investigadores. Es por ello que te invitamos a visitar Málaga y participar activamente en un evento que reinventamos año a año.

Enrique Márquez Segura
Presidente del Comité Organizador

Comité organizador

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Universidad de Málaga

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José María Zamanillo Sainz de la Maza

Áreas Temáticas

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

Sesiones regulares

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

Sesiones especiales

- Antenas y Dispositivos de RF Basados en Nuevas Técnicas y Tecnologías de Fabricación
- Articial Intelligence in Beyond 5G/6G Networks
- Collaborative x-Wave Antenna Systems for Integrated Communication and Sensing Wireless Applications (x-Wave)
- Diseño de Capa Física Inalámbrica Basado en IA
- Metamateriales, Metasuperficies y otras Estructuras Periódicas
- Nuevas Tecnologías de Antenas para Aplicaciones de Ondas Milimétricas
- Recent advances in Small Satellites for Communications and Earth Observation
- Reflectarrays, Transmitarrays and Spatially-Fed Antennas
- Seguridad en Tecnologías 5G Avanzada y 6

Premio Jóvenes Científicos URSI 2022

La Unión Científica Internacional de Radio (URSI) concede un premio al mejor trabajo presentado por un investigador joven. Junto con este premio podrán otorgarse accésits tras la valoración del jurado.

Condiciones para optar al premio

Según lo acordado en la asamblea URSI celebrada en Leganés (7 de septiembre 2011), aquellos autores que deseen optar al Premio Jóvenes Científicos URSI 2022 deberán enviar el trabajo completo en inglés y cumplir las siguientes condiciones:

- Ser menor de 35 años a fecha de 1 de septiembre de 2022.
- Ser el primer autor de un trabajo remitido y aceptado en el Simposio.
- Solicitar la participación siguiendo las instrucciones correspondientes al envío de trabajos.

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

El jurado encargado de evaluar y seleccionar los artículos para la sesión especial en la que serán presentados para competir estará compuesto por un comité internacional de expertos, el presidente de URSI España y el presidente del comité organizador o personas en quienes deleguen.

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

Sede

Escuela Técnica Superior de Ingeniería de Telecomunicación

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

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

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

Universidad de Málaga

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

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

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

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

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

investigación de carácter nacional e internacional y en 2007 entra en la Red Española de Supercomputación con el Supercomputador Picasso.

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

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

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

(http://www.uma.es)

Conferencias plenarias

Conferencias plenarias

Conferencia plenaria 1 — Lunes, 05/09/2022, 11:30-12:30

Sobre el diseño de dispositivos pasivos de radiofrecuencia para aplicaciones espaciales.

Una visión GEA-ETSIT-UPM: 1982 – 2022

Jesús María Rebollar Machain

Universidad Politécnica de Madrid

Synopsis

El trabajo presenta una visión GEA-UPM del diseño de dispositivos pasivos de radiofrecuencia en sistemas de comunicaciones embarcados en satélites tanto comerciales como en sondas espaciales de investigación realizados en colaboración con el del entidades sector público y privado durante los últimos cuarenta años.

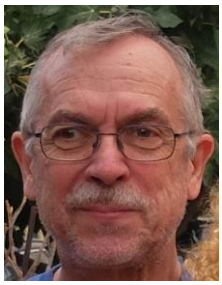
En la introducción se presentan los objetivos de estos sistemas de comunicaciones espaciales, sus bandas de frecuencia, los procedimientos y herramientas de diseño, las tecnologías de fabricación empleadas y las problemáticas específicas asociadas a los dispositivos que deben trabajar en el espacio, es decir en vacío.

A continuación, se realiza una descripción de las diferentes familias de dispositivos que han sido diseñados y que se encuentran embarcados en más de una treintena de satélites y sondas espaciales: polarizadores, rotadores, acopladores, redes de conformación de haz, filtros, diplexores, triplexores y ortomodos.

Se presentan diferentes topologías de alimentadores para la realización de las aplicaciones de doble banda y simple/doble polarización tanto lineal como circular y en particular una nueva topología patentada por el GEA denominada AFENSAT para los sistemas doble banda simple polarización circular.

Como resultado de los desarrollos en dispositivos para espacio, se presenta un nuevo dispositivo denominado Quasi-Aislador-Recíproco-Sin-Pérdidas (QARSP) que permite obtener una notable mejora en el rendimiento de los sistemas de calentamiento por radiofrecuencia.

Biography



Ingeniero de Telecomunicación y Doctor Ingeniero por la E.T.S.I. Telecomunicación de la Universidad Politécnica de Madrid en los años 1975 y 1980 respectivamente. Desde 1976 ha trabajado en el Grupo de Electromagnetismo Aplicado de la Universidad Politécnica de Madrid, impartiendo docencia en temas relacionados con la Teoría Electromagnética y Microondas ocupando diversos puestos docentes. Desde el año 1988 es catedrático del Departamento de Electromagnetismo y Teoría de Circuitos y actualmente del Dpto. de Señales, Sistemas y Radiocomunicaciones de la Universidad Politécnica de Madrid.

Las áreas en las que se ha desarrollado investigación durante su vida académica se pueden sintetizar en:

- Osciladores de microondas a diodo Gunn
- Osciladores a FET de microondas
- Efectos Biológicos del campo electromagnético
- Caracterización de medios de transmisión homogéneos y no homogéneos
- Métodos Numéricos para análisis de problemas electromagnéticos
- Técnicas de Optimización
- Desarrollo de software para diseño de subsistemas de radiofrecuencia.
- Desarrollo de CAD para dispositivos pasivos de microondas.
- Estudio de medios de transmisión y dispositivos pasivos en la banda de THz.

Ha colaborado en un importante número de proyectos de I+D subvencionados tanto por organismos oficiales nacionales (CAICYT, CICYT, FIS, CAM, UPM, INTA, CIEMAT), internacionales (EURATOM, ESA) y empresas privadas nacionales (Telettra, ALCATEL, RYMSA, TRYO, ALCATEL-ESPACIO, THALES, EADS – CASA División Espacio, INDRA, AIRBUS) y extranjeras (EADS-ASTRIUM, PARATEK Inc., ROCKWELL-COLLINS, SPEAG, SIERRA MICROWAVE).

Ha participado en el diseño de un amplio grupo de dispositivos pasivos de microondas/milimétricas/THz tanto para equipos de tierra como embarcados en satélites, entre los que pueden destacarse: polarizadores mono/bi-banda mono/bi fase para antenas TT&C, filtros plano-E plano-H con ceros de transmisión y aouto-ecualizados, septum-OMT 's, multiplexores, OMT's, UMA's, Power Divider Networks, Beam Forming Networks, etc. Estos diseños han sido realizados en colaboración con la industria nacional e internacional y muchos de los componentes diseñados se encuentran en la actualidad en más de una veintena de satélites en órbita o han viajado embarcados en sondas espaciales (Rosetta, Bepi-Colombo etc).

Diversas aplicaciones de CAD desarrolladas han sido adquiridas por la industria y son utilizadas de forma regular en sus diseños.

Tiene diversas patentes en el ámbito de los componentes y dispositivos pasivos de Radiofrecuencia. Una publicación en el EUCAP-2014 con el tema de una de las patentes recibió el " Best student paper award" y el segundo premio de la convocatoria "HISPASAT 25 aniversario".

Conferencia plenaria 2 Martes, 06/09/2022, 10:00-11:00

Explorando el Universo: "De Antártida a las Estrellas"

José V. Siles

NASA Jet Propulsion Laboratory, USA

Synopsis

Have you ever wondered how the Solar System was formed? And the stars and planets? Do you think there could be life elsewhere in the Solar System? If so, maybe you have also wondered how one can find answers to all these questions. These are the kind of questions astrophysicists ask themselves to come up with a (simple) idea or hypothesis that eventually leads to a scientific mission and new discoveries. A simple scientific question often leads to a technology idea or concept that evolves until a mature cutting-edge scientific instrument (e.g. camera) is ready to explore the Universe and provide answers to these questions. Antarctica is one of the best places to look at the sky. This talk will explain this process through and actual exploration journey to Antarctica, to build and launch, from the bottom of the world, surrounded by ice and extreme cold, large far-infrared telescopes to study our Galaxy and other galaxies from the stratosphere. The talk will also discuss new enhancements in preparation for future far-infrared balloon missions, such as ASTHROS and potential future ASTHROS flights.

The Astrophysics Stratospheric Telescope for High-spectral Resolution Observations at Submillimeter-wavelengths, ASTHROS, is a 2.5-m (SOFIA-like size) balloon-borne observatory that will make the first detailed spectrally-resolved high spatial resolution 3D map of ionized gas in Galactic and extragalactic star forming regions via simultaneous observations of the 122µm (2.459 THz) & 205µm (1.461 THz) fine structure lines of ionized nitrogen.

ASTHROS builds on the success of heterodyne instruments on Herschel, SOFIA and STO-2, providing a low-risk low-cost steppingstone for future heterodyne missions. A 21-day Antarctic flight in 2023/24 will focus on mapping two template Galactic star forming regions and the entire disk of the M83 barred spiral galaxy at high angular resolution, complementing existing datasets from SOFIA, WISE, Herschel, Spitzer and HST. ASTHROS will be capable of tuning to nearby spectral lines (OH, HDO, HF, HD, CO) for Target of Opportunity observations. One compelling target is the HD 112µm (2.674 THz) line that traces the gas mass in protoplanetary disks. ASTHROS' angular resolution of 12" at 122 µm and 20" at 205 µm corresponds to 0.2 pc and 0.35 pc at 122µm and 205µm, respectively, for a source 4 kpc from the Sun. This high angular resolution will enable us to resolve structures ~750 times smaller than the typical size of star forming regions (~150 pc). Combined with large-scale mapping, we will begin to understand how different stellar feedback mechanisms affect ionized gas over a wide range of spatial scales in the Milky Way and the M83 galaxy.

ASTHROS payload will consists of a 4-pixel dual band cryogenic superconducting heterodyne array camera for high-spectral resolution imaging at 1.4-1.5 THz and 2.4-2.7 THz. The instrument design features a straightforward receiver architecture, simple optical layout, and subsystems that have high degree of flight heritage, pedigree, and proven performance through suborbital and space missions such as STO-2 and Herschel. ASTHROS will fly for the first time a 4-K class low-power cryocooler and thus will not require liquid helium. A cryocooler will enable extended lifetime missions, and its use will serve as a pathfinder for future NASA missions.

Biography

Dr. Jose V. Siles received the M.Sc. and Ph.D. degrees in telecommunication and electrical engineering from the Technical University of Madrid, Madrid, Spain, in 2003 and 2008, respectively. In 2002, he joined the Signal, Systems and Radiocommunications Department of the Technical University of Madrid as a Research Fellow supported by a fellowship from the Spanish Ministry of Education, working on the physics-based modeling of semiconductor devices for terahertz applications. Part of this research was performed at the University of Rome "Tor Vergata", Italy, and at the Observatory of Paris-LERMA, France. In 2008 and 2010, he was a Post-Doctoral Fellow with the Observatory of Paris-LERMA participating in several programs funded by the CNES, the European Space Agency and the European Commission. In September 2010, he joined the Submillimeter-Wave Advanced Technology Group at NASA's Jet Propulsion Laboratory, California Institute of Technology, Pasadena CA, USA, as a Fulbright Post-Doctoral Fellow. He has participated in several programs to develop terahertz technology, including frequency multiplied sources and receivers, for the French space agency (CNES), the European Space Agency (ESA), the European Commission and NASA/JPL. He is an experienced terahertz component and circuit designer, having designed and tested terahertz sources and mixer circuits up to 3 THz, all of them exhibiting world-record performances. His current research interests involve the design, development and test of ultra-compact solid-state power-combined multiplied local oscillator sources and receivers for high resolution multi-pixel heterodyne cameras at submillimeter-wave and terahertz frequencies for radio-astronomy, planetary science, Earth science, communications, and radar applications. He was the recipient of a Fulbright Postdoctoral Research Award at JPL for the period 2010-2012, sponsored by the U.S. Department of State and the J. Fulbright Program. In 2015/16 and 2016/17, he was responsible for the delivery, assembly and I&T in Antarctica of the of the first multi-pixel terahertz local oscillator system for NASA's Stratospheric Terahertz Observatory (STO-2), successfully launched from Antarctica on Dec.2016. He is Principal Investigator of several NASA funded tasks to develop the next-generation of high-spectral resolution submillimeter-wave instruments for Astrophysics and Planetary Science. Dr. Siles was the recipient of the 2012 NASA/JPL Outstanding Postdoctoral Research Award and the 2014 NASA Outstanding Group Achievement Award for the Development of Compact Multi-Pixel Receivers for Planetary Science. He was awarded in 2016 with the U.S. Antarctic Service Medal. In 2018, he received the prestigious JPL Lew Allen Award for Excellence.

Jose is a senior member of IEEE, vice chair of the Metro LA Chapter of IEEE/MTT-S and President of the LA Chapter of the Fulbright Association.

He enjoys playing soccer, swimming, travelling, salsa dancing and flying airplanes. He is an experienced instrument rated private airplane pilot. He has spent a total of 5 months on the ice during two Antarctic scientific balloon campaigns in 2015 and 2016.

He is currently the Project Manager and technical lead of the "The Astrophysics Stratospheric 2.5-m Telescope for High Spectral Resolution Observations at Submillimeter-wavelengths" (ASTHROS) NASA balloon mission, scheduled to launch from Antarctica on December 2023.

Education:

- Ph.D. in Electrical Engineering, Technical University of Madrid, Spain (2008)
- Advanced Studies Diploma in Signal Theory and Communications, Technical University of Madrid, Spain (2006)
- M.Sc. in Telecommunication Engineering, Technical University of Madrid, Spain (2003).

Conferencia plenaria 3 Miércoles, 07/09/2022, 12:30-13:30

Understanding the exponential power of quantum computing

Ginés Carrascal de la Heras

IBM, Quantum Ambassador

Synopsis

Quantum computing is a reality that presents challenges to engineering students and practitioners.

Quantum physics is far from intuitive. Since its discovery, which changed the way we understand our universe, quantum mechanics has become an accurate and experimentally consistent scientific theory. Quantum computing is the act of performing computation by making use of quantum mechanics. By using quantum physical effects, such as entanglement or superposition, quantum computers can perform calculations that are not viable in the classical world. These capabilities provide quantum computers with a powerful advantage over classical computers.

Therefore, the creation of a large-scale quantum processor would be a revolutionary event. Achieving large-scale computers will require a large amount of work in diverse fields, including developing more reliable quantum devices, designing computer architecture and designing quantum algorithms and error correction codes.

The quantum representation of information has some powerful advantages over its classical counterpart. Quantum mechanical systems can exist in different states since physical properties can take discrete values. Particle energy levels, the polarization of a photon or other properties such as the spin of an electron are examples of such states. By assigning logical values to different states, it is possible to perform calculations using quantum mechanics. Logical operations can be represented by transitions between these states.

Although quantum systems present discrete states, simultaneously they can be in a superposition of them. Also, when multiple qubits become entangled, then the states of the individual qubits involved depend on each other. Therefore, the information is not only stored in each qubit, there is additional information in the relationship created between them.

Biography

GINES CARRASCAL was born in Salamanca, Spain in 1975. He received the M.Sc. degree in physics from the University of Salamanca (Spain) in 1999.

From 2000 he has been working as Architect at IBM Consulting Spain, getting involved with quantum computing from 2017, now acting as Quantum Technical Ambassador and Qiskit Advocate. He has become IBM Certified Associate Developer - Quantum Computation using Qiskit v0.2X in 2021. Since 2014 he has been an Adjunct Professor of computer science at Universidad Carlos III de Madrid and since 2018, Adjunct Professor at Universidad Complutense de Madrid at the computer science departmental section of the Mathematics Faculty. His research interest includes Artificial Intelligence and the application of Quantum Computing to optimization problems, specially but not only in the field of Banking and Financial Services.

Prof. Ginés Carrascal has received two Outstanding Technical Achievement Awards (OTAA), the highest IBM technical award in 2012 and 2016.

Programa

Programa

XXXVII Simposium Nacional de la Unión Científica Internacional de Radio

Fecha: Lunes, 05/09/2022

8:30 - 9:30	**ACL: Acreditación lunes** Lugar: **1.0.1.B**			
9:30 - 10:30	**L.1.1: Circuitos y dispositivos activos de microondas (I)** Lugar: **Ío - 1.0.2.A** Presidente: **Teresa María Martín-Guerrero**, Universidad de Málaga, España	**L.1.2: Componentes y circuitos pasivos de microondas (I)** Lugar: **Europa - 1.0.2.B** Presidente: **Miguel Ángel Gómez Laso**, Universidad Pública de Navarra (UPNA), España Presidente: **Ángela Coves Soler**, Universidad Miguel Hernández de Elche, España	**L.1.3: Comunicaciones por satélite** Lugar: **Calisto - 1.0.1.C** Presidente: **Luis Enrique García Muñoz**, Universidad Carlos III de Madrid, España	**L.1.4: Aplicaciones biomédicas (I)** Lugar: **Ganímedes - 2.0.1.A** Presidente: **Javier Reina Tosina**, Universidad de Sevilla, España
10:30 - 11:00	**IN: Inauguración** Lugar: **Salón Júpiter - Salón de Actos**			
11:00 - 11:30	**CFL: Pausa para el café - Lunes**			
11:30 - 12:30	**P1: Sesión Plenaria - Lunes** Lugar: **Salón Júpiter - Salón de Actos** Dr. José V. Siles (NASA Jet Propulsion Laboratory)			
12:30 - 14:00	**L.2.1: Antenas (I)** Lugar: **Ío - 1.0.2.A** Presidente: **Carlos Camacho Peñalosa**, Universidad de Málaga, España Presidente: **José Luis Gómez Tornero**, Universidad Politécnica de Cartagena, España	**L.2.2: Componentes y circuitos pasivos de microondas (II)** Lugar: **Europa - 1.0.2.B** Presidente: **Miguel Ángel Gómez Laso**, Universidad Pública de Navarra (UPNA), España Presidente: **Ángela Coves Soler**, Universidad Miguel Hernández de Elche, España	**L.2.3: Sesión Especial: Artificial Intelligence in Beyond 5G/6G Networks (I)** Lugar: **Calisto - 1.0.1.C** Presidente: **Oriol Sallent**, Universitat Politècnica de Catalunya, España Presidente: **Raquel Barco Moreno**, Universidad de Málaga, España	**L.2.4: Aplicaciones biomédicas (II)** Lugar: **Ganímedes - 2.0.1.A** Presidente: **Rafael Verdú Monedero**, Universidad Politécnica de Cartagena, España
14:00 - 16:00	**AL: Almuerzo lunes** Lugar: **Jardín Botánico de la Universidad de Málaga**			
16:00 - 17:30	**L.3.1: Sesión Especial: Nuevas tecnologías de antenas para aplicaciones de ondas milimétricas** Lugar: **Ío - 1.0.2.A** Presidente: **Eva Rajo Iglesias**, Universidad Carlos III de Madrid, España Presidente: **José Ignacio Herranz Herruzo**, Universitat Politècnica de València, España	**L.3.2: Electromagnetismo** Lugar: **Europa - 1.0.2.B** Presidente: **Jaime Esteban Marzo**, Universidad Politécnica de Madrid, España Presidente: **Francisco Mesa**, Universidad de Sevilla, España	**L.3.3: Sesión Especial: Artificial Intelligence in Beyond 5G/6G Networks (II)** Lugar: **Calisto - 1.0.1.C** Presidente: **Raquel Barco Moreno**, Universidad de Málaga, España Presidente: **Oriol Sallent**, Universitat Politècnica de Catalunya, España	**L.3.4: Telemática: IoT, interfaces de comunicación (I)** Lugar: **Ganímedes - 2.0.1.A** Presidente: **Isabel de la Bandera Cascales**, Universidad de Málaga, España Presidente: **Emil Jatib Khatib**, Universidad de Málaga, España

Fecha: Martes, 06/09/2022

8:30 - 9:00

ACM: Acreditación martes
Lugar: **1.0.1.B**

9:00 - 10:00

M.1.1: Sesión Especial: Patrocinadores 1
Lugar: **Ío - 1.0.2.A**
Keysight Technologies / Rohde & Schwarz / Pro Málaga

M.1.2: Sesión Especial: Patrocinadores 2
Lugar: **Europa - 1.0.2.B**
DHV Technologies / Indra / Mathworks

10:00 - 11:00

P2: Sesión Plenaria - Martes
Lugar: **Salón Júpiter - Salón de Actos**
Profesor Jesús María Rebollar Machain (Universidad Politécnica de Madrid)

11:00 - 11:30

Pausa para el café - Martes

11:30 - 13:00

M.2.1: Sesión Especial: Premio Jóvenes Científicos
Lugar: **Ío - 1.0.2.A**
Presidente: **Francisco Medina Mena**, Universidad de Sevilla, España
Presidente: **Mónica Fernández Barciela**, Universidad de Vigo, España

M.2.2: Sesión Especial: Antenas y dispositivos de RF basados en nuevas técnicas y tecnologías de fabricación (I)
Lugar: **Europa - 1.0.2.B**
Presidente: **José Luis Masa Campos**, Universidad Autónoma de Madrid, España
Presidente: **Pablo Padilla de la Torre**, Universidad de Granada, España

M.2.3: Comunicaciones móviles e inalámbricas (I)
Lugar: **Calisto - 1.0.1.C**
Presidente: **Matilde Sánchez Fernández**, Universidad Carlos III de Madrid, España
Presidente: **Lorenzo Rubio Arjona**, Universitat Politècnica de València, España

M.2.4: Radiación, dispersión y radiopropagación
Lugar: **Ganímedes - 2.0.1.A**
Presidente: **José María Molina García-Pardo**, Universidad Politécnica de Cartagena, España

13:00 - 14:00

PU: Asamblea Plenaria URSI
Lugar: **Amaltea - Sala de Grados C**

14:00 - 16:00

AM: Almuerzo martes
Lugar: **Jardín Botánico de la Universidad de Málaga**

16:00 - 17:30

M.3.1: Antenas (II)
Lugar: **Ío - 1.0.2.A**
Presidente: **Daniel Segovia Vargas**, Universidad Carlos III Madrid, España
Presidente: **Miguel Ferrando Bataller**, Universitat Politècnica de València, España

M.3.2: Sesión Especial: Metamateriales, metasuperficies y otras estructuras periódicas
Lugar: **Europa - 1.0.2.B**
Presidente: **Miguel Camacho Aguilar**, Universidad de Sevilla, España
Presidente: **Dayan Pérez Quintana**, Universidad Pública de Navarra, España

M.3.3: Comunicaciones móviles e inalámbricas (II)
Lugar: **Calisto - 1.0.1.C**
Presidente: **Leandro Juan Llácer**, Universidad Politécnica de Cartagena, España
Presidente: **José Ignacio Alonso Montes**, Universidad Politécnica de Madrid, España

M.3.4: Radioastronomía
Lugar: **Ganímedes - 2.0.1.A**
Presidente: **Eduardo Artal Latorre**, Universidad de Cantabria, España
Presidente: **Luisa de la Fuente**, University of Cantabria, España

Fecha: Miércoles, 07/09/2022

8:30 - 9:00	**ACX: Acreditación miércoles** Lugar: **1.0.1.B**			
9:00 - 10:45	**X.1.1: Sesión Especial: Reflectarrays, Transmitarrays and Spatially-fed Antennas** Lugar: **Ío - 1.0.2.A** Presidente: **Alvaro Fernández Vaquero**, Universidad de Oviedo, España Presidente: **José Daniel Martínez de Rioja del Nido**, Universidad Politécnica de Madrid, España	**X.1.2: Sesión Especial: Antenas y dispositivos de RF basados en nuevas técnicas y tecnologías de fabricación (II)** Lugar: **Europa - 1.0.2.B** Presidente: **Pablo Padilla de la Torre**, Universidad de Granada, España Presidente: **Jose Luis Masa Campos**, Universidad Autonoma de Madrid, España	**X.1.3: Procesado de señal: voz, imagen y datos** Lugar: **Calisto - 1.0.1.C** Presidente: **Ana M. Barbancho Pérez**, Universidad de Málaga, España Presidente: **Pedro Núñez Trujillo**, Universidad de Extremadura, España	**X.1.4: Telemática: IoT, interfaces de comunicación (II)** Lugar: **Ganímedes - 2.0.1.A** Presidente: **Sergio Fortes Rodríguez**, Universidad de Málaga, España
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11:30 - 12:30	**X.2.2: Metamateriales** Lugar: **Ío - 1.0.2.A** Presidente: **Rafael Rodríguez Boix**, Universidad de Sevilla, España	**X.2.3: Sesión Especial: Recent advances in Small Satellites for Communications and Earth Observation** Lugar: **Europa - 1.0.2.B** Presidente: **Adriano Camps**, Universitat Politecnica de Catalunya, España	**X.2.4: Fotónica y comunicaciones ópticas** Lugar: **Calisto - 1.0.1.C** Presidente: **Luis Landesa Porras**, University of Extremadura, España	**X.3.3: Aplicaciones matemáticas: modelado y simulación** Lugar: **Ganímedes - 2.0.1.A** Presidente: **María José Madero Ayora**, Universidad de Sevilla, España
12:30 - 13:30	**P3: Sesión Plenaria - Miércoles** Lugar: **Salón Júpiter - Salón de Actos** Ginés Carrascal de la Heras (IBM, Quantum Ambassador)			
13:30 - 14:00	**CLX: Acto de clausura** Lugar: **Salón Júpiter - Salón de Actos**			
14:00 - 16:00	**AX: Almuerzo miércoles** Lugar: **Jardín Botánico de la Universidad de Málaga**			

Índice y horario de sesiones

Índice y horario de sesiones

Sesión L.1 Lunes, 05/09/2022: 09:30-10:30

Lugar: sala Ío (1.0.2.A)

L.1.1. Circuitos y dispositivos activos de microondas (I)

Presidente de la sesión: Teresa María Martín-Guerrero

Lugar: sala Europa (1.0.2.B)

L.1.2. Componentes y circuitos pasivos de microondas (I)

Presidente de la sesión: Miguel Ángel Gómez Laso, Angela Coves Soler

Lugar: sala Calisto (1.0.1.C)

L.1.3. Comunicaciones por satélite

Presidente de la sesión: Luis Enrique García Muñoz

Lugar: sala Ganímedes (2.0.1.A)

L.1.4. Aplicaciones biomédicas (I)

Presidente de la sesión: Javier Reina Tosina

Sesión L.2 Lunes, 05/09/2022: 12:30-14:00

Lugar: sala Europa (1.0.2.B)

L.2.1. Antenas (I)

Presidente de la sesión: Carlos Camacho Peñalosa, José Luis Gómez Tornero

Lugar: sala Ío (1.0.2.A)

L.2.2. Componentes y circuitos pasivos de microondas (II)

Presidente de la sesión: Miguel Ángel Gómez Laso, Angela Coves Soler

Lugar: sala Calisto (1.0.1.C)

L.2.3. Sesión Especial: Artificial Intelligence in Beyond 5G/6G Networks (I)

Presidente de la sesión: Oriol Sallent, Raquel Barco Moreno

Lugar: sala Ganímedes (2.0.1.A)

L.2.4. Aplicaciones biomédicas (II)

Presidente de la sesión: Rafael Verdú Monedero

Sesión L.3 Lunes, 05/09/2022: 16:00-17:30

Lugar: sala Ío (1.0.2.A)

L.3.1. Sesión Especial: Nuevas tecnologías de antenas para aplicaciones de ondas milimétricas

Presidente de la sesión: Eva Rajo Iglesias, José Ignacio Herranz Herruzo

Lugar: sala Europa (1.0.2.B)

L.3.2. Electromagnetismo

Presidente de la sesión: Jaime Esteban Marzo, Francisco Mesa

Lugar: sala Calisto (1.0.1.C)

L.3.3. Sesión Especial: Artificial Intelligence in Beyond 5G/6G Networks (II)

Presidente de la sesión: Raquel Barco Moreno, Oriol Sallent

Lugar: sala Ganímedes (2.0.1.A)

L.3.4. Telemática: IoT, interfaces de comunicación (I)

Presidente de la sesión: Isabel de la Bandera Cascales, Emil Jatib Khatib

Sesión M.2 Martes, 06/09/2022: 11:30-13:00

Lugar: sala Europa (1.0.2.B)

M.2.1. Sesión Especial: Premio Jóvenes Científicos

Presidente de la sesión: Francisco Medina Mena, Mónica Fernández Barciela

Lugar: sala Ío (1.0.2.A)

M.2.2. Sesión Especial: Antenas y dispositivos de RF basados en nuevas técnicas y tecnologías de fabricación (I)

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

Lugar: sala Calisto (1.0.1.C)

M.2.3. Comunicaciones móviles e inalámbricas (I)

Presidente de la sesión: Matilde Sánchez Fernández, Lorenzo Rubio Arjona

Lugar: sala Ganímedes (2.0.1.A)

M.2.4. Radiación, dispersión y radiopropagación

Presidente de la sesión: José María Molina García-Pardo

Sesión M.3 Martes, 06/09/2022: 16:00-17:30

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M.3.1. Antenas (II)

Presidente de la sesión: Daniel Segovia Vargas, Miguel Ferrando Bataller

Lugar: sala Europa (1.0.2.B)

M.3.2. Sesión Especial: Metamateriales, metasuperficies y otras estructuras periódicas

Presidente de la sesión: Miguel Camacho Aguilar, Dayan Pérez Quintana

Lugar: sala Calisto (1.0.1.C)

M.3.3. Comunicaciones móviles e inalámbricas (II)

Presidente de la sesión: Leandro Juan Llácer, José Ignacio Alonso Montes

Lugar: sala Ganímedes (2.0.1.A)

M.3.4. Radioastronomía

Presidente de la sesión: Eduardo Artal Latorre, Luisa de la Fuente

Sesión X.1 Miércoles, 07/09/2022: 09:00-10:45

Lugar: sala Ío (1.0.2.A)

X.1.1. Sesión Especial: Reflectarrays, Transmitarrays and Spatially-fed Antennas

Presidente de la sesión: Álvaro Fernández Vaquero, José Daniel Martínez de Rioja del Nido

Lugar: sala Europa (1.0.2.B)

X.1.2. Sesión Especial: Antenas y dispositivos de RF basados en nuevas técnicas y tecnologías de fabricación (II)

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

Lugar: sala Calisto (1.0.1.C)

X.1.3. Procesado de señal: voz, imagen y datos

Presidente de la sesión: Ana M. Barbancho Pérez, Pedro Núñez Trujillo

Lugar: sala Ganímedes (2.0.1.A)

X.1.4. Telemática: IoT, interfaces de comunicación (II)

Presidente de la sesión: Sergio Fortes Rodríguez

Sesión X.2 Miércoles, 07/09/2022: 11:30-12:30

Lugar: sala Ío (1.0.2.A)

X.2.2. Metamateriales

Presidente de la sesión: Rafael Rodríguez Boix

Lugar: sala Europa (1.0.2.B)

X.2.3. Sesión Especial: Recent advances in Small Satellites for Communications and Earth Observation

Presidente de la sesión: Adriano Camps

Lugar: sala Calisto (1.0.1.C)

X.2.4. Fotónica y comunicaciones ópticas

Presidente de la sesión: Luis Landesa Porras

Sesión X.3 Miércoles, 07/09/2022: 11:30-12:30

Lugar: sala Ganímedes (2.0.1.A)

X.3.3. Aplicaciones matemáticas: modelado y simulación

Presidente de la sesión: María José Madero Ayora

Resúmenes de las ponencias

Resúmenes de las ponencias

Lugar: sala Ío (1.0.2.A) Lunes, 05/09/2022: 09:30-10:30

L.1.1. Circuitos y dispositivos activos de microondas (I)

Presidente de la sesión: Teresa María Martín-Guerrero

Generación de Diente de Sierra de RF para una Cavidad Multi-Armónica en la Instalación HIE-ISOLDE del CERN

Laura Medina Gomez[1], Pedro J. González[1], Ibon Bustinduy[1], Juan Luis Muñoz[1], Arash Kaftoosian[1], Ismael Martel[2], Tomás Fernández[3], José Ángel García[3]

[1]Consorcio ESS Bilbao, España; [2]Universidad de Huelva, España; [3]Universidad de Cantabria, España

En este trabajo, se propone un sistema de control digital de radiofrecuencia de bajo nivel (LLRF), junto con un sistema amplificador, para la generación, regulación y amplificación de formas de onda de diente de sierra, como lo requiere una cavidad buncher multiarmónica (MHB) para un acelerador de partículas. En la práctica, el perfil ideal del campo eléctrico en diente de sierra se logra con una suma de funciones sinusoidales más simples como en la expansión de las Series de Fourier. En esta comunicación se estudian amplificadores de banda ancha para la forma de onda de diente de sierra compuesta o varios amplificadores de banda estrecha, uno por cada componente armónico. La cavidad MHB, así como el sistema de RF para alimentarla, se utilizará en la instalación ISOLDE del CERN.

Experimental Performance of Quasi-Static versus Nonquasi-Static Nonlinear Diode Model

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

[1]Telecommunication Research Institute (TELMA), Universidad de Málaga, Spain; [2]Department of Electrical, Electronic and Information Engineering (DEI), Università di Bologna, Italy

Accurate active device modeling is becoming essential for the development of novel system-level RF-design prototypes. For this purpose, an automatic nonlinear model extraction technique for quasi-static (QS) and first-order nonquasi-static (NQS) diodes from direct large-signal single-tone measurements has been introduced. Both equivalent circuit strategies, which rely on the Nonlinear Function Sampling (NFS) operator and have been already numerically tested, are now experimentally evaluated with a commercial Schottky diode. The step-by-step CAD-tool integration and some early promising experimental results allow for optimism in the full large-signal validation under more realistic and challenging conditions.

GaN-based Class J and Doherty Hybrid Power Amplifiers for C-band Communications

Diego Aguiar Armada, Ainhoa Morales Fernandez, Monica Fernandez Barciela, Fernando Isasi Vicente, Fernando Martín Rodríguez

atlanTTic Research Center, Universidade de Vigo, 36310 Vigo

Gallium Nitride (GaN) is nowadays the leading semiconductor technology for the design of transmitters with high RF power at microwave and millimeter wave frequency bands. This paper describes the design, assembly and validation of Class J and Doherty Power Amplifiers (PA) for C-band communications using GaN HEMTs and hybrid technology. The RF performance of each fabricated prototype is assessed and compared to simulations. In

simulation, the Class J PA provided at 5.8 GHz 37.7 dBm output power, 14 dB power gain and 53% PAE (Power Addded Efficiency) at 3 dB compression. The measured RF performance achieved 36 dBm output power, 12 dB gain and 47% PAE at a slightly lower frequency in C band. On the other hand, the simulated Doherty PA (DPA) achieved at 5.8 GHz a drain efficiency (η) greater than 50\% in the Doherty regime (ranging from 34 to 40 dBm of output power), while providing between 10 and 11.8 dB of gain in the same 6 dB range. The DPA prototype showed lower measured performance than in simulation, providing 9 dB of gain and 39 dBm of Pout in C band.

Híbrido en Cuadratura como Combinador No Aislado para Arquitecturas Outphasing

José Angel García García[1], M. Nieves Ruiz Lavín[1], David Vegas Bayer[1], Laura Catalina Medina Gómez[2], Tomás Fernández Ibáñez[1]

[1]Universidad de Cantabria, España; [2]Consorcio ESS Bilbao, España

Esta contribución analiza la utilización de un híbrido en cuadratura como parte de un combinador no aislado en arquitecturas de transmisión de alta eficiencia tipo outphasing o Chireix. Mediante una terminación reactiva apropiada de la puerta aislada respecto a la de salida, es posible rotar las trayectorias de modulación mutua de la impedancia de carga de los amplificadores, en añadido al papel ofrecido por las susceptancias de compensación. Se presentan las ecuaciones que describen la evolución de las admitancias de carga con el ángulo de desfase, resultados de su evaluación, así como el grado de libertad que ofrece la inyección de corriente por dicha puerta con una etapa de amplificación auxiliar. Se incluyen finalmente ejemplos de implementación de un esquema outphasing y de un esquema outphasing con rango extendido de control de potencia, que integran amplificadores clase-E/F_2 GaN HEMT en la banda de 700 MHz.

Lugar: sala Europa (1.0.2.B) Lunes, 05/09/2022: 09:30-10:30

L.1.2. Componentes y circuitos pasivos de microondas (I)

Presidente de la sesión: Miguel Ángel Gómez Laso, Ángela Coves Soler

CSRRs modificados en tecnología SIW para la mejora del ancho de banda de filtros

Javier Martínez Gil[1], Angela Coves Soler[1], Angel A. San Blas Oltra[1], Enrique Bronchalo Bronchalo[1], Maurizio Bozzi[2]

[1]Dpto. de Ingeniería de Comunicaciones-I3E, Universidad Miguel Hernández de Elche, Elche (Alicante); [2]Department of Electrical, Computer and Biomedical Engineering, University of Pavia, Italy

In this paper, a substrate integrated waveguide (SIW) loaded with three pairs of modified complementary split-ring resonators (CSRRs) is presented, in which the subwavelength waveguide passband can be significantly increased due to the appearance of new electromagnetic couplings between the different resonators. The obtained results are compared to those provided by a more classical topology based on CSRRs periodically etched along the waveguide wall, showing a significant bandwidth improvement, while maintaining a good matching level. A prototype of this new wideband filter has been fabricated and measured, and the simulations and measurements show a very good agreement, thus validating the proposed design.

Filtro paso banda en tecnología groove gap waveguide con altura de pines reducida para facilitar su fabricación

David Santiago Arriazu, Miguel Ángel Gómez Laso, Txema Lopetegui Beregaña, Iván Arregui Padilla

Instituto de Smart Cities (ISC), Dpto. de Ing. Eléctrica, Electrónica y de Comunicación. Univ. Pública de Navarra (UPNA), Pamplona, España

In this work, a novel topology of groove gap waveguide (GGW) technology is presented to facilitate the fabrication process by Computer Numerical Control (CNC) milling. GGW has been proposed as an interesting alternative to the rectangular waveguide for the design of microwave and millimeter-wave components. This technology consists of two parallel metal plates, where one of them has a $\lambda/4$-height pin bed that provides a high impedance condition at the plane over the pins, avoiding electrical contact requirement with the upper plate and hence facilitating the fabrication requirements. However, the manufacture by CNC milling of the pins may be troublesome, especially for devices operating at high frequency. A way to facilitate this process is achieved by using pins with reduced height. Moreover, the proposed configuration allows us to maintain the standard dimension ports of the equivalent rectangular waveguide and the operation in its corresponding bandwidth. A comparison with other GGW topologies has been presented and a bandpass filter has been fabricated to validate its usefulness.

Un circuito equivalente para superficies periódicas basado en vectores y valores propios

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

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

The use of an eigenstate-based equivalent circuit topology is proposed for the analysis and modeling of lossless and lossy periodic scatterers, which significantly reduces the number of elements with respect to other general equivalent circuits. Two scatterers have been analyzed: a symmetrical one without losses and a more complex asymmetrical one with losses. In all these cases, the modeling of the circuit admittances has been successfully achieved with a few positive and frequency-independent RLC elements. In the case of the structure with symmetries, the turns ratio directly reflects the physical orientation of the scatterer eigenexcitations. In the case of the lossy

scatterer without symmetries, the resulting equivalent circuit reveals that its eigenexcitations are elliptic polarizations.

Remote BLAS monitoring using EPICS

Andoni Pérez Segura[1], **Andrés Roldán Aranda**[1], **Moisés Weber Suárez**[2], **Juan Lluch Ladrón de Guevara**[3]

[1]Universidad de Granada, España; [2]National Fusion Laboratory, Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (CIEMAT); [3]Broad Telecom S.A. (BTESA)

This document describes a procedure to test the RF power subsystem of a RF linear accelerator and the LLRF (Low Level RF system). In order to test the system without building the definitive accelerator, a novel technique to reduce costs has been developed. A BLAS (Beam Loading Advanced Simulator) consisting in a SSPA (Solid State Power Amplifier) RF power system designed by the company BTESA and a Pillbox resonant cavity, by the CIEMAT (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas). A LLRF is needed to generate an input signal for the amplifiers in order to make the linear accelerator (LINAC) work when the beam is loading the pillbox. The LLRF selected for this research is an Adalm-Pluto from Analog Devices, capable of generating the input signal and monitoring a sample from the pillbox cavity to ensure maximum RF energy inside the cavity and hence the acceleration power. This capability to adapt is important because when the particles beam is loaded into the pillbox cavity it's resonance characteristics could change.

Lugar: sala Calisto (1.0.1.C) Lunes, 05/09/2022: 09:30-10:30

L.1.3. Comunicaciones por satélite

Presidente de la sesión: Miguel Alejandro Salas-Natera

Diseño e implementación de un sistema de detección automática de descargas de RF de alta potencia

Raúl Cervera Marín[1], Miguel Rodríguez Jodar[1], Óscar Monerris Belda[1], Carlos Alcaide Guillén[2], Vicente Boria Esbert[2], Pablo Soto Pacheco[2], David Raboso[3]

[1]Val Space Consortium; [2]Universitat Politécnica de València; [3]Agencia Espacial Europea

Radio frequency (RF) breakdown testing is of paramount importance in the space industry. The main aim of this paper is to evaluate the performance of a novel RF breakdown detection system, which extends the capabilities of the nulling system widely used in multipactor testbeds. This novel technique allows to detect multipactor discharges with broadband signals using the in-phase and quadrature (IQ) information of the reflected signal from the device under test (DUT). This new detection system does not require a continuous tuning to keep its sensitivity, and reduces the testbed complexity. With the proposed method, even small and short discharges can be easily detected without human interaction.

Estudio y mejora de métodos rápidos para la estimación del umbral de descarga multipactor

Miguel Rodríguez Jodar[1], Raúl Cervera Marín[1], Carlos Alcaide Guillén[2], Óscar Monerris I Belda[1], Pablo Soto Pacheco[2], Vicente E. Boria Esbert[2], David Raboso[3], César Miquel España[3]

[1]Val Space Consortium (VSC); [2]Universitat Politécnica de València (UPV); [3]Agencia Espacial Europea (ESA)

High-power effects are becoming key factors for the final performance of telecommunication systems, due to the challenging power requirements for pushing up the transmission throughput. Multipactor is usually the most relevant one for satellite links, which operate under vacuum condition. The aim of this work is to improve the performance of the so-called coarse method. The coarse method improves the execution time of the multipactor power threshold predictions when analyzing long arbitrarily time-varying signals. However, the performance of this method can be hindered by the noise in the growth factor curves computation. Different fitting and smoothing techniques are studied in this paper to mitigate the effect of this noise and, therefore, to improve the prediction accuracy.

Geometrical Phase Adjustment Method for Beam-Steered Radial Line Patch Antennas with Enhanced Axial Ratio Performance

Alfonso Tomás Muriel Barrado, Óscar Alberto Pla Terrada, Pablo Sánchez Olivares, José Manuel Fernández González, Manuel Sierra Pérez

Centro de Investigación en Procesado de la Información y Telecomunicaciones, ETSI Telecomunicación, Universidad Politécnica de Madrid, España

This paper presents a design procedure for circularly polarized radial line patch array antennas that allows the steering of the main beam whereas the axial ratio is not drastically affected. This method is an extension of a previous publication, in which the radiated phase of each element was adjusted by rotation depending on its position in the lattice. This way, a partial sequential rotation is included. The used radial line patch array antenna is composed by double stacked patches as radiating elements. The design procedure allows to perform any of the two circular polarizations at K-Band (19.7 – 20.2 GHz) for SATCOM. An axial ratio below 2.2 dB for a ±30º steering

angle in the azimuth and the elevation plane is achieved, with a gain decay of 2.5 dB with respect to broadside. All the configurations exhibit a good behaviour in terms of efficiency, with values near to 90%.

New Dual-Band Dual-Circular Polarization Antenna Feed with High-Isolation and Low Axial Ratio

Fernando Teberio[1], **Ibai Calero**[1], **Jorge Teniente**[2,3], **Itziar Maestrojuán**[1]

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In this paper, Anteral presents a novel dual-band dual-circular polarization antenna feeding network for satellite communications. Circumplexer is the idea of Anteral for compactness of an antenna feeding network by integrating a septum in the common port of a diplexer. Therefore, the new device provides dual circular polarization with excellent axial ratio levels and very high isolation between channels simultaneously. Two different waveguide filters are utilized to provide very high isolation between two different channels while a septum in the common port is used to provide with the dual circular polarization. This kind of components is presented for the first time in the literature. The proposed design example accomplishes measured results with more than 23 dB return loss, 70 dB isolation between channels with an axial ratio better than 0.45 dB. Due to its compact design, it is especially attractive for satellite communications where size and weight are key parameters. We have called this component circumplexer since it is really the junction of circular polarization inside a diplexer.

Lugar: sala Ganímedes (2.0.1.A) Lunes, 05/09/2022: 09:30-10:30

L.1.4. Aplicaciones biomédicas (I)

Presidente de la sesión: Javier Reina Tosina

Supervivencia del trasplante renal en Andalucía y Estados Unidos: estudio combinado del sexo y grupo sanguíneo

Alejandro Talaminos Barroso[1,2], Javier Reina-tosina[1,2], Laura M. Roa[1,2], Jorge Calvillo-Arbizu[1,3], Miguel A. Pérez-Valdivia[4], Rafael Medina-López[4], Pablo Castro-de-la-Nuez[5]

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Renal transplantation is the election treatment for chronic renal disease. The success or failure of a renal transplantation at short and long term depends on diverse factors, which include the characteristics of donor and receiver, as well as their degree of compatibility. This work applies Kaplan-Meier estimator to study the effect of parameters sex and blood group on the graft survival probability in the populations of Andalusia and United States, including a comparison of both. Results show that while the consideration of these variables individually does not reveal a significant effect on short- and long-term outcomes, they take some relevance when addressed jointly. The differences between sexes considering both populations are also significant at mean and long term.

Análisis de una antena monopolo impresa de banda ancha para aplicaciones de imagen médica

Andrea Martínez-Lozano[1], Carolina Blanco-Angulo[1], Héctor García-Martínez[1], José María Sabater-Navarro[2], Ernesto Ávila-Navarro[1]

[1]Dpto. de Ciencia de Materiales, Óptica y Tecnología Electrónica. Universidad Miguel Hernández de Elche.; [2]Dpto. de Ingeniería de Sistemas y Automática. Universidad Miguel Hernández de Elche.

This paper presents the design of a printed monopole antenna with two rectangular slots in the ground plane for medical imaging applications. The antenna has been manufactured on a low-cost FR4 substrate, has a size of 20 x 30 mm^2 and a working frequency range between 3.05 GHz and 9.05 GHz. To analyse the effect of biological material on the characteristics of the antenna, two models of the abdomen with and without intestinal liquid have been simulated, imitating an anastomosis suture. With this, it has been observed that the response of the antenna is influenced by the biological material, besides there is a small difference between the models under study, demonstrating the usefulness of the antenna in the proposed application.

Automatic classification and permittivity estimation of organic solvents using a dielectric resonator sensor and Machine Learning techniques

Miguel Monteagudo Honrubia, Francisco Javier Herraiz-Martínez, Javier Matanza Domingo

Universidad Pontificia de Comillas, España

This paper presents the application of a dielectric resonator sensor to characterize organic solvents. Two different acquisition systems were implemented to test the sensor and compare the results between an expensive Vector Network Analyzer (VNA) and our cheap portable electronic reader designed. Six dissolutions and air were measured within a permittivity range from 1 to 80. Principal Component Analysis (PCA) and Support Vector Machine (SVM) were used to perform automatic classification achieving an accuracy close to the 100% for both systems

Diseño de sonda coaxial de circuito abierto con control de profundidad para la adquisición de propiedades dieléctricas de tejidos mamarios

Elizabeth Gladys Fernandez Aranzamendi[1], Patricia Castillo Aranibar[2], Ebert San Román Castillo[2], Eber Huanca Cayo[2], Manuel Condori Huayna[2], Vicente Gonzalez[3], Daniel Segovia Vargas[1]

[1]Universidad Carlos III de Madrid; [2]Universidad Catolica San Pablo; [3]Universidad Politécnica de Madrid

Este artículo, desarrolla el diseño de una sonda coaxial de circuito abierto, la cual permite regular la distancia de penetración en tejidos biológicos mamarios. Esta sonda fue validada en simulación y comparada con resultados clínicos dados por las propiedades dieléctricas (permitividad y conductividad), utilizando el equipo DAK (sonda coaxial de circuito abierto) junto a un VNA. Estas pruebas se realizaron bajo un sistema de ambiente controlado para mediciones In-vivo y Ex-vivo de tumoraciones mamarias. Se realizaron una serie de experimentos que demuestran el efecto gradual del diámetro coaxial abierto con respecto a la profundidad de penetración. Se utilizaron las propiedades dieléctricas obtenidas con el equipo DAK de los tejidos mamarios y se llevó a simulación, para realizar las pruebas de la sonda diseñada. Como resultado, se obtuvo el mismo comportamiento de los tejidos mamarios y tumoraciones con un margen de error de +/-0.05% de conductividad y permitividad, así como un control de profundidad desde 1.5mm hasta 10mm, en un rango de frecuencia de 2 a 8 GHz.

Lugar: sala Europa (1.0.2.B) Lunes, 05/09/2022: 12:30-14:00

L.2.1. Antenas (I)

Presidente de la sesión: Carlos Camacho Peñalosa, José Luis Gómez Tornero

Sobre el uso de antenas Leaky-Wave para la comparación monopulso de amplitud

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

The performance of a single bidirectionally-fed scanning leaky-wave antennas for low-cost amplitude monopulse synthesis, is compared to the more conventional use of two tilted antennas. The main advantages and drawbacks are demonstrated in detail with a practical design for direction finding in the 2.4 GHz ISM band. It is demonstrated that leaky-wave antennas offer a much more compact design, which reduces the near-field zone for proximity sensing. However, the frequency beam-squinting must be considered for accurate performance in the entire operational bandwidth.

Fully Modular Stacked SIW Antenna Array at mmWaves

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Department of Signal Theory, Telematics and Communications, Universidad de Granada, 18071 Granada, Spain

This paper presents an efficient design to stack 4 different arrays with only 2 types of layers plus the feeding layer, all of them in substrate integrated waveguide (SIW) technology. The first layer is the radiation layer (RL) composed of a corporate network to feed 8 H-plane horn antennas which include a transition to radiate to free space. The second layer only has components to produce the corporate network in the E-plane and in consequence, modular arrays of 1, 2, 4 and 8 RL are obtained. The feeding layer is carried out through a grounded coplanar line to SIW transition. The SIW layers are manufactured and there is a high agreement between measurements and simulations with a stable gain and impedance bandwidth at [35-41] GHz. The directivity in the H-plane is fixed while in the E-plane it increases by the number of RL.

Fully Metallic Luneburg Lens Antenna in Gap Waveguide Technology at 60 GHz

Dayan Pérez-Quintana[1,2], Christos Bilitos[3], Jorge Ruiz-García[3], Iñigo Ederra[1,2], Jorge Teniente-Vallinas[1,2], David González-Ovejero[3], Miguel Beruete[1,2]
[1]Universidad Publica de Navarra, España; [2]Institute of Smart Cities (ISC), Public University of Navarra, Navarra, Spain; [3]Univ. Rennes, CNRS, IETR (Institut d'Electronique et des Technologies du numeRique) - UMR 6164, F-35000, Rennes, France.

This paper presents a Luneburg lens (LL) antenna using Gap Waveguide (GW) technology at 60 GHz. A Groove Gap Waveguide (GGW) horn antenna is used to feed the metamaterial lens, which is placed in a parallel plate waveguide (PPW) and allows one to achieve a plane wavefront in the direction of propagation. Owing to its fully metallic composition, the proposed structure is more robust and presents lower losses than PCB-based lenses, and it is equally amenable for integration on flat surfaces. The experimental results are in excellent agreement with the simulations, yielding an impedance bandwidth (BW) (S11 < -10 dB) from 50 to 65 GHz, a -3 dB directivity bandwidth of 34.6% and a peak directivity of 22.4 dB. These features make this flat lens an apt solution for Internet of Things (IoT) and 5G applications

Low Band Massive MIMO For Future Base Stations

Ahmed El Yousfi, Kerlos Atia Abdalmalak, Abdenasser Lamkaddem, Daniel Segovia Vargas
Carlos III Universisty of Madrid, España

This work presents a dual-polarized massive MIMO antenna based on a compact dielectric resonator antenna element (DRA) designed for future base stations technology.The main DRA radiator consists of three dielectric layers that guarantee a compact and wideband performance. The entire system consists of three subarrays where each subarray has four DRA unit elements. Three metallic patches placed above each subarray are used to adjust the vertical half-power beamwidth (HPBW), while four vertical metallic walls are used to control the antenna gain. The measured results show a wideband of 13.1% ranging from 700MHz to 800MHz, port isolation in each subarray of more than 15 dB, isolation between subarrays of more than 17 dB, a gain of 8 dBi, average vertical HPBW of 33º, and good radiation patterns.

Wideband Archimedean Rectangular Spiral Antenna Integrated over a High Gain Ka-band Antenna

Óscar Gil Lucía, Adrián Tamayo Domínguez, Pablo Sánchez Olivares
Universidad Politécnica de Madrid, España

This paper presents a compact, low-profile, low-weight, high-efficiency rectangular spiral antenna with a large relative S-band bandwidth for navigation data in satellite link applications. The antenna system is composed of a rectangular spiral formed by two copper wire arms, fed by a balun structure and backed by a perfect electrical conductor (PEC) reflector placed at a distance of approximately one-quarter wavelength. The antenna can achieve almost 8 dBi of directivity while maintaining an axial ratio lower than 1 dB and an efficiency greater than 94%. Also, it will be placed over a 40 dBi-Gain Ka-band gap-waveguide antenna in order to provide an integrated solution for navigation and communication data.

Nueva versión impresa de la antena Volcano para aplicaciones UWB, WLAN y 5G

Jesús Antonio Ortiz Fuentes, Daniel Segovia Vargas
Departamento de Teoría de la Señal y Comunicaciones, Universidad Carlos III de Madrid, España

En este trabajo se presenta una nueva versión de la antena clásica volcano (VSA por sus siglas en inglés) de forma impresa. También, se ha investigado la influencia de los parámetros físicos que rigen la eficiencia de la antena reportada. El modelo presentado cuenta con un ancho de banda en simulaciones numéricas, S11≤-10, de 1.86-40 GHz y un ancho de banda medido, S11≤-10 dB, de 1.9-13.5 GHz el cual cubre la banda UWB (3.1-10.6 GHz), la banda WLAN (2.4, 3.6 y 4.8-5 GHz) y la banda intermedia de 5G (2.5, 3.5, 3.7-4.2 GHz). Además, la antena muestra una variación de ganancias máximas que van de 2.04 a 9.55 dBi.

Lugar: sala Ío (1.0.2.A) Lunes, 05/09/2022: 12:30-14:00

L.2.2. Componentes y circuitos pasivos de microondas (II)

Presidente de la sesión: Miguel Ángel Gómez Laso, Ángela Coves Soler

Análisis de Circuitos Inductivos Multipuerto con las Funciones de Green del Resonador Rectangular 2D Aceleradas con el Método de Ewald

Fernando Daniel Quesada Pereira[1], Antonio Manuel Huescar de la Cruz[1], Celia Gómez Molina[2], Alejandro Álvarez Melcón[1], Vicente Enrique Boria Esbert[3]

[1]Dept. TICs, Universidad Politécnica de Cartagena, 30202 Cartagena, España; [2]Erzia Technologies, Josefina de la Maza 4, 39012, Santander; [3]Instituto iTEAM, Universitat Polit`ecnica de Val encia, Camino de Vera s/n, Valencia

A novel integral equation technique for the study of multiport inductive microwave devices is presented in this contribution.The analyzed microwave circuits are defined by a 2D rectangular cavity that connects different rectangular waveguide input/output ports. The structure can contain inside a non-limited number of arbitrarily shaped conducting and/or dielectric objects. The boundary conditions corresponding to the walls of the 2D rectangular cavity and input/output rectangular waveguides are taken into account by means of especially suited Green's functions. Namely, parallel plate Green's functions are used for the rectangular waveguides, whereas the center cavity is modeled by means of 2D rectangular resonator Green's functions. The evaluation of these last Green's functions has been accelerated, for the first time, with the Ewald Method. Convergence studies have been carried out, showing the speed up obtained after the application of the Ewald Method. Finally, the proposed integral equation formulation is employed to analyze a microwave diplexer, showing a good agreement with commercial software results obtanied with a lower computational cost.

Red de Adaptación Reconfigurable controlada por tensión en 2.6 GHz

Candela Muzás, Jesús de Mingo, Pedro Luis Carro, Paloma García-Ducar, Antonio Valdovinos, María Mazo

Universidad de Zaragoza, España

Muchas aplicaciones, como el diseño de amplificadores de potencia reconfigurables, o la adaptación de impedancias en antenas, requieren de sintetizadores de impedancias variables. En este artículo, se diseña una red de adaptación reconfigurable (RMN) para la banda 7 de LTE (Long Term Evolution), basada en una red en pi, construida a partir de elementos variables controlados por tensión. Además del diseño de la red, se realiza la caracterización experimental de las bobinas y condensadores variables, desarrollados a partir de varactores, que actúan como elementos variables en la red.

Comparativa de prestaciones entre cavidades resonantes y multicavidad para detección de axiones de materia oscura

Jose Ramón Navarro Madrid, Alejandro Díaz Morcillo, Jose María García Barceló

UPCT, España

En este artículo introducimos los conceptos generales en un experimento de detección del axión de materia oscura. Analizamos dos formas de aumentar el volumen y, por tanto, mejorar la sensibilidad del experimento. Concretamente, se lleva a cabo una comparación del rendimiento entre cavidades largas y diseños multicavidad, centrándose en la separación frecuencial del modo de operación con su vecino más cercano.

Design and experimental validation of a 94-GHz waveguide feed for a 3D tracking radar

Marta Ferreras, Mariano Barba, Jesús Grajal

Information Processing and Telecommunications Center, Universidad Politécnica de Madrid, España

We report on the first demonstration of a full-waveguide feed at W-band, enabling transmit-receive duplexing and 2D tracking of targets. The prototype is a compact unit designed to be used as feed of a 94-GHz radar. The duplexing concept relies on a septum orthomode transducer polarizer for transmitting and receiving sum signals with opposite circular polarizations. Additionally, the first higher-order mode of circular waveguide (TM01) is allowed to propagate inside the device to extract a difference signal for tracking. Both angular dimensions defining the target position can be derived upon comparison of the received sum and difference signals. The fabricated prototype features return loss and port-to-port isolation above 23 dB at 94 GHz for all ports. It is also shown that the obtained radiation patterns fulfill the radar specifications and are suitable for tracking inside the 10-dB beamwidth of the antenna.

Fuentes de error aleatorio en la estimación de la constante de propagación de líneas de transmisión usando medidas de dos puertos

Mario Pérez-Escribano, Enrique Márquez-Segura

Telecommunication Research Institute (TELMA), Universidad de Málaga, E.T.S. Ingeniería de Telecomunicación

In this contribution, we study different error sources that affect the estimation of the propagation constant in broadband methods. For this purpose, a study on the state-of-the-art has been made. The behavior of different error sources was examined separately: errors in the vector network analyzer, in the line lengths, in the inhomogeneity of the substrate, and the repeatability of the launchers. It has been shown that, depending on the method used, the behavior of the random errors can be different. In this sense, an excellent strategy to reduce the errors is to increase the number of lines, choosing their length reasonably. On the other hand, it has been seen that both the errors in the length of the lines and in the inhomogeneities of the substrates will work as a bias in the solution of the estimated propagation constant. The bias will depend on the difference between lengths or substrates. Finally, it has been studied how the repeatability of transitions and connectors affects the methods. To improve this problem, it has been demonstrated that always using the same pair of connectors is an efficient way to reduce the uncertainty of the results.

Diseño de Acoplador Direccional de 30 dB de Banda Ancha en Tecnología Microstrip

Sergio García Martínez[1], Pablo Sánchez Olivares[1], Adrián Tamayo Domínguez[1], Pablo García Carreño[2], José A. López Pérez[2], José Manuel Fernández González[1]

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An ultra-wideband directional coupler has been designed for the receiver chain of a radio telescope. The coupler is designed in microstrip technology to allow the usage of a superconductor substrate. In order to compensate the phase velocity of the even and odd modes of the microstrip lines, and therefore obtain a high directivity, saw teeth have been added to the inner edge of the coupler. Moreover, to achieve a directivity of 15 dB with a coupling of 30 dB, two couplers of 15 dB coupling and 15 dB directivity have been connected. Finally, a coupler of 30 dB with a ripple of ±2 dB and a directivity higher than 16.5 dB has been obtained.

Lugar: sala Calisto (1.0.1.C) Lunes, 05/09/2022: 12:30-14:00

L.2.3. Sesión Especial: Artificial Intelligence in Beyond 5G/6G Networks (I)

Presidente de la sesión: Oriol Sallent, Raquel Barco Moreno

Dimensionality Reduction techniques and its application on Propagation Channels

Alejandro Ramírez-Arroyo[1], Luz García[1], Antonio Alex-Amor[2], Juan F. Valenzuela-Valdés[1]

[1]Universidad de Granada (UGR), España; [2]Universidad CEU San Pablo (USP CEU), España

This work presents the application of t-SNE dimensionality reduction technique on a dataset formed by 3267 propagation channels and three different scenarios: anechoic, reverberation and indoor. Since the number and type of propagation channels are increasing, their identification is essential. Therefore, t-SNE provides a low-dimensional space where a visual classification over a large number of propagation channels can be performed. However, some of t-SNE's configuration parameters must be carefully chosen, e.g., distance metric, perplexity or learning rate. Throughout the paper, different strategies for their choice are discussed. Maximizing the distance between different scenarios and minimizing the distance between the same scenarios simultaneously, in the low-dimensional space, have proven to be the best strategy for obtaining good embeddings.

Identificación de la relevancia de métricas celulares en clústeres no supervisados

Javier Villegas[1], Sergio Fortes[1], Juan Cantizani[1], Javier Rasines Suarez[2], Raúl Martín Cuerdo[3], Raquel Barco[1]

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The increase in the size and complexity of the cellular network is progressively complicating the operation andmaintenance activities, as well as rising its operation cost. The growing complexity of the networks makes them more prone to failures, which can degrade the quality of experience (QoE) of the network users. In this way, to prevent the degradation of QoE, network operators are focusing on creating networks with self-healing functions, which are capable of automatically troubleshooting problems, making them more reliable and reducing their operation costs. For this matter, unsupervised Machine Learning (ML) algorithms are deployed to detect anomalous network status, however, these frequently lack explanation and network experts are required for this step. For this matter, the proposed paper presents a method to determine the relevant Key-Performance Indicators for any unsupervised clustering to facilitate the explanation of the clusters.

Modelado de rendimiento de segmento en redes de acceso radio mediante aprendizaje supervisado

Carolina Gijón Martín, Matías Toril Genovés, Salvador Luna Ramírez, Juan Luis Bejarano Luque

Telecommunication Research Institute (TELMA), Universidad de Málaga, Málaga, España.

In 5G systems, the Network Slicing (NS) feature allows to deploy several logical networks customized for specific verticals over a common physical infrastructure. In the Radio Access Network (RAN), cellular operators need slice performance models for re-dimensioning purposes. In this work, we present a comprehensive analysis assessing the performance of Supervised Learning (SL) to estimate slice throughput in the down link of RAN-sliced networks, relying on information collected in the operations support system. Different SL algorithms are tested in two NS scenarios with single-service and multi-service slices, respectively. To this end, two synthetic datasets with performance indicators and connection traces are generated with a system-level simulator emulating the activity of

a sliced RAN in a live scenario. Results show that the best model (i.e., combination of SL algorithm and input features) may vary depending on the NS scenario. The best models have shown an error below 10%.

Gestión de redes 5G basada en clasificadores de imágenes de aprendizaje profundo

Eduardo Baena Martínez, Sergio Fortes Rodriguez, Francisco Muro Correro, Carlos Baena González, Raquel Barco Moreno
Universidad de Málaga, España

Los enfoques tradicionales de resolución de problemas de la red celular se han basado en el análisis de alarmas o métricas de rendimiento para identificar la causa de los fallos de la red. A diferencia de este esquema, la creciente disponibilidad de trazas de equipos de usuario posicionados implica una fuente de datos mucho más rica para la gestión de la red celular. La información generada en forma de mapa es mucho más compleja de analizar que las clásicas métricas celulares de estilo serie temporal. Por ello, su aplicación para la resolución de problemas sigue dependiendo en gran medida de la inspección humana directa. Para superar este reto, el presente trabajo propone e implementa un marco de trabajo con conciencia de localización que define los procesos necesarios para transformar las trazas posicionadas de los móviles en un formato denominado imagen de red sintética. Estas imágenes se utilizan como entrada para los mecanismos de clasificación de aprendizaje profundo con el fin de proporcionar una mejor gestión de la red celular. El sistema propuesto se evalúa bajo diferentes condiciones y configuraciones, mostrando las capacidades del enfoque para apoyar el diagnóstico de fallos.

DRL-Assisted Radio Resource Provisioning in multi-WAT Private 5G Networks

Lorena Chinchilla Romero, Jonathan Prados Garzón, Pablo Muñoz Luengo, Pablo Ameigeiras Gutiérrez, Juan José Ramos Muñoz
Universidad de Granada, España

Multi-Wireless Access Technology (WAT) Radio Access Networks (RANs) are becoming a key enabler in 5G and beyond networks due to the public spectrum scarcity, the level of signal confinement and security offered by some wireless technologies (e.g., Light Fidelity (Li-Fi)), and the reduction of the deployment and operational costs. For instance, Wireless Fidelity (Wi-Fi) technology is cheaper and easier to manage than 5G New Radio (NR). Besides, as Wi-Fi is one of the dominant technologies to provide wireless connectivity in private networks, leveraging Wi-Fi infrastructure allows for a smoother infrastructure upgrade and further contributes to the capital expenditures saving. Developing autonomous radio resource provisioning (RRP) solutions is fundamental to fulfilling the service requirements in private 5G networks while facilitating the zero-touch management of the network and reducing operational costs. However, modeling the Key Performance Indicators (KPIs) of the radio interface in emergent 5G and beyond is a complex task that requires high-domain knowledge. Furthermore, the resulting models, as well as solving the respective RRP optimization problem using exact methods usually offer a high computational complexity. These issues are accentuated by considering multi-WAT scenarios. In order to cope with these issues, in this work, we propose an initial design of a Deep Reinforcement Learning (DRL)-assisted solution for the RRP in a multi-WAT private 5G network. The results of a simulation-based proof-of-concept are reported to support the proposal's proper design and operation. We consider a realistic private 5G network setup for the validation of the solution.

Método de posicionamiento de drones LTE-5G para compensación de fallos en situaciones de emergencia

Ana Rosa Romero, Jesús Burgueño, Isabel De-la-Bandera, Raquel Barco
Universidad de Málaga, España

The failures resulting from cells outages or the partial loss of communications infrastructures make it impossible to serve users in the affected area. Such services would allow them to establish communication in order to get help or provide additional information about the situation to the emergency services. To solve this problem, a compensation method based on a drone deployment is proposed to be used in emergency situations. The proposed algorithm determines the position and power configuration of the drones to cover the affected area. To test and evaluate the effectiveness of the system, the throughput offered in the network after the deployment of the drones is analyzed and compared with a uniform distribution of drones.

Lugar: sala Ganímedes (2.0.1.A) Lunes, 05/09/2022: 12:30-14:00

L.2.4. Aplicaciones biomédicas (II)

Presidente de la sesión: Rafael Verdú Monedero

Technology for exergames: Arduino-based reactive floor

Isaac Ariza, Lorenzo J. Tardón, Ana M. Barbancho, Isabel Barbancho

Universidad de Málaga, España

Studies conducted by the World Health Organization (WHO) indicate that most adolescents do not perform enough physical activity, endangering their current and future health; also, elder persons gain great benefit from moderate physical activity adapted to their shape. A novel way to promote and motivate people to engage in physical activity is exergames. Exergames are games relying on technology or video games of in which the player has to perform different types of movements or exercise to interact with the game. To do this, devices capable of capturing and monitoring this movement to develop their gaming experience or send that information to a computer or console to running the part of the game to interact with are needed. In this context, an interactive floor that allows to detect the player's position in real time has been designed. This can be linked to the development of exergames of serious exergames to obtain new skills while doing physical exercise on this intelligent floor.

Análisis de la asimetría en el grosor de la capa RNFL mediante medidas de OCT Spectralis en pacientes sanos y con glaucoma

Francisco Rodriguez-Robles[1], Rafael Berenguer-Vidal[2], Oleksandr Kovalyk[1], Rafael Verdú-Monedero[1], Juan Morales-Sánchez[1], Inmaculada Sellés-Navarro[3]

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One of the main diseases that affect to the optic nerve is glaucoma, which causes progressive and irreversible damage that reduces the vision field of the patient. The thickness of the retinal nerve fiber layer is an indicator of the status and progression of this illness. A line of research in the early diagnosis of glaucoma is based on the analysis of the asymmetry between the morphological characteristics of both eyes. This article presents preliminary results that start from this hypothesis and use the relative absolute difference between the thickness of the RNFL in both eyes of the same patient as a characteristic of asymmetry. Results indicate that there is a significant difference in the mean value of the asymmetry between healthy patients and those with glaucoma. As future work, the inclusion of automatic methods for the measurement of the RNFL thickness and the use of classification techniques based on these characteristics of asymmetry for the early diagnosis of glaucoma will be developed.

Diseño, fabricación y caracterización de tejidos realistas de mama y su aplicación en sistemas de microondas

Carolina Blanco-Angulo[1], Andrea Martínez-Lozano[1], Álvaro Bernabeu-Pujante[1], Concepción Parejo-Prados[2], Héctor García-Martínez[1], Ernesto Ávila-Navarro[1], José María Sabater-Navarro[3]

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This work presents the methodology used to fabricate breast models with electrical characteristics similar to real cases and their behaviour in the presence of microwaves. The final objective of these models is their use in a non-invasive system based on microwaves for the detection of tumours in breast cancer. Three different types of models have been made for this study, on the one hand a tumour model has been made and on the other hand two breast models have been made that simulate two types of real breasts classified as dense breast and less dense breast. To determine their dielectric constant, a 2.3 GHz resonator was used and a study was made of this variable over time.

Finally, electromagnetic simulations have been carried out with the breast model and two antennas to study how the material affects the transmission parameter.

Diseño de un Sensor Activo para Monitorización no Invasiva

Sandra Santiago Mesas, Daniel Segovia Vargas, Adrián Amor Martín, Ignacio Aranda Conde
Universidad Carlos III de Madrid, España

The performance of traditional sensors can be greatly improved by introducing an active feedback loop which compensates its electrical losses through an active feedback loop. As a result, higher-resolution sensors may be developed to improve non-contact and real-time monitoring for biological, industrial and environmental applications. This paper deals with the design and implementation of an active sensor operating in L-band. A prototype of the sensor has been manufactured and transmission measurements have been carried out when placing different liquids in the sensor's hot-spot in order to test its sensing capability.

Cancer detection using dielectric properties of the breast tissue

Renato Ramos-Soto[1], Elizabeth Fernandez-Aranzamendi[1], Jimmy Ludeña-Choez[1], Juan J. Choquehuanca-Zevallos[1], Vicente Gonzalez-Posadas[2], Daniel Segovia-Vargas[2]
[1]Universidad Católica San Pablo, Perú; [2]University Carlos III of Madrid, Spain

Detection of breast cancer is an important and demanding task to solve since it represents one of the principal causes of women's death. This paper presents classification results using a microwave sensing device and a machine learning approach. For that, a dataset is formed with permittivity and conductivity as features measured at 4GHz acquired with an open-ended probe and a VNA based system. Classification results indicate that a good performance is achieved when discriminating tumorous samples from normal ones taking into account such dielectric characteristics as inputs to the classifier.

Lugar: sala Ío (1.0.2.A) Lunes, 05/09/2022: 16:00-17:30

L.3.1. Sesión Especial: Nuevas tecnologías de antenas para aplicaciones de ondas milimétricas

Presidente de la sesión: Eva Rajo Iglesias, José Ignacio Herranz Herruzo

Hyperbolic Lens Antenna in Groove Gap Waveguide Technology at Sub-millimeter waves

Dayan Pérez-Quintana[1,2], Carlos Biurrun-Quel[1,2], Iñigo Ederra[1,2], David González-Ovejero[3], Miguel Beruete[1,2]

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In this paper, a flat hyperbolic lens antenna using Groove Gap Waveguide (GGW) technology is designed at 300 GHz. A GGW horn antenna is used to feed the metamaterial lens placed in a parallel plate waveguide (PPW), in order to increase the directivity in the direction of propagation. The combination of both devices, the metalens and the GGW antenna, leads to an excellent radiation performance.

Agrupación de ranuras alimentadas por una novedosa guía semi-modo en Gap Waveguide

Miguel Ferrando Rocher[1,3], Alejandro Pérez-Guimerá[3], Jose Ignacio Herranz Herruzo[2,3], Alejandro Valero-Nogueira[2,3], Stephan Marini[1]

[1]Universidad de Alicante, España; [2]Universitat Politècnica de València; [3]Antennas and Propagation Lab, España

This paper presents a novel antenna feed network that significantly facilitates the design and fabrication in Gap Waveguide technology. In particular, a 1 x 4 linearly polarized Ka-band antenna array with a novel corporate distribution network using a half-mode slot waveguide (HM-GGW). The good simulated results obtained from 29 GHz to 31 GHz by this breadboard give the first validity to this new development for GW.

Antenas con Haz Escaneado en Frecuencia en Banda Milimétrica para RADAR MIMO

Miguel Poveda García[1], Alejandro Gil Martínez[1], Francisco Salmerón[2], José Luis Gómez Tornero[1]

[1]Universidad Politécnica de Cartagena, Cartagena, España; [2]A4Radar, Murcia, España

We propose a new type of compact planar Leaky-Wave Antennas (LWA) for mm-wave MIMO RADAR systems. The antennas are based on the Substrate Integrated Waveguide (SIW) leaky-wave technology which combines low profile and simple feeding with frequency scanning capability. Theoretical results show the flexibility of the design to adapt to different frequency ranges in the 60 GHz band. This is possible by just changing the dielectric material used for the SIW substrate. Designs with different angular Field-of-View (FoV) and frequency ranges are presented along with an example of signal-processing for Direction-of-Arrival (DoA) estimation.

Array plano en tecnologías Gap Waveguide para aplicaciones satelitales 5G en banda Ka

Alejandro Álvarez Pérez, Jose Luis Masa Campos, Jorge A. Ruiz Cruz
Universidad Autonoma de Madrid, España

The 28 GHz band is being considered for 5G communications by LEO satellites, due to their proximity to the earth's surface and the speed of this band. Gap Waveguide (GW) technologies have proven very effective when designing high-frequency multilayer devices, due to their robustness against imperfect layer contacts and their high gain. On the other hand, in satellite communications, circular polarization is required. For these reasons, in this work an 8x8 multilayer antenna is designed, consisting of two layers: feeding network and bow-tie radiating elements that generate circular polarization. Different GW guides, mainly narrow RGW and GGW in E-Plane, according to the needs, and a novel topology for these that is presented in the article. The complete antenna design achieved has a bandwidth from 26 to 29.9 GHz, being a 13.95% relative bandwidth, and achieving a gain of 27.26 dB at 28GHz with circular polarization from 26.5 GHz.

Channel-Aware Millimeter-Wave Vehicular Beam-Formed Array Antenna

Miguel Albert Galí[1], Christian Ballesteros Sanchez[1], Luca Montero Bayo[1], Cristina Insalaco[1], Jordi Romeu Robert[1], Luis Jofre Roca[1], José María Molina Garcia Pardo[2], Miguel Ferrando Bataller[3]
[1]Universitat Politècnica de Catañunya, España; [2]Universidad Politécnica de Cartagena; [3]Universidad Politécnica de Valencia

Millimetre-Wave communications for advanced connected and automated vehicle driving scenarios have drawn significant attention for their adaptability in a wide variety of applications. However, when Line-of-Sight and link stability cannot be assured in urban scenarios, the exchange of information between two vehicles becomes more complex and sometimes even dangerous if the information sent through the channel is not guaranteed to be correct. In this paper, an improved millimeter-Wave beamforming method based on array antenna beam steering is presented. By using a channel-aware imaging algorithm, it aims to solve in large part the above-mentioned problematic by finding the most reliable path in non Line-of-Sight scenarios. Thus, link stability over road infrastructures might be potentially improved besides enhancing safe-channel communications and traffic efficiency

38 GHz Low-Profile Transverse Horn Array Antenna with a 3D Printed Anisotropic Dielectric Polarizer

Nelson Castro Salas[1], Francisco Pizarro Torres[2], Eva Rajo Iglesias[1]
[1]Universidad Carlos 3 de Madrid, España; [2]Pontificia Universidad Católica de Valparaíso, Chile

This paper presents the design of a dielectric anisotropic composite material to be used as a polarizer to achieve circular polarization. The proposed design is imple- mented into an antenna array composed of five low-profile horns fed by transverse slots placed in a rectangular waveguide. The antenna is designed at 38 GHz and it exhibits 22 dBi gain with grating lobes attenuated in 12 dB with respect to the main lobe, with a small fractional bandwidth as expected for this type of topology. The polarizer provides circular polarization in the whole matched band, with an axial ratio lower than 3 dB. The addition of the polarizer does not change significantly either the matching or the radiation pattern, when compared to the design without it. Experimental results are in very good agreement with simulations

Lugar: sala Europa (1.0.2.B) Lunes, 05/09/2022: 16:00-17:30

L.3.2. Electromagnetismo

Presidente de la sesión: Jaime Esteban Marzo, Francisco Mesa

Cálculo Eficiente de las Derivadas de las Funciones de Green de una Fuente Puntual en una Guía Rectangular Mediante el Método de Ewald

Antonio Manuel Huéscar de la Cruz[1], Celia Gómez Molina[2], Fernando Daniel Quesada Pereira[1], Alejandro Álvarez Melcón[1], Vicente Enrique Boria Esbert[3]

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In this contribution, the Ewald Method has been efficiently applied to accelerate the computation of the rectangular waveguide Green's functions derivatives. Based on previous works, we have developed new approximation formulae that avoid the evaluation of computationally expensive complementary error functions of complex argument, needed by the Ewald Method. On the other hand, different convergence numerical studies have been carried out, showing a similar convergence rate between the original Green's functions and their derivatives. Moreover, we have checked that the computational time is only slightly increased for obtaining the derivatives as compared to the original Green's functions, after the application of the Ewald Method. These results are useful for the evaluation of electromagnetic fields, or the characterization of dielectric materials, inside rectangular waveguides using integral equation formulations.

Impacto de la polarización magnética en el análisis modal de guías de onda con capas de grafeno

Gines Garcia-Contreras, Juan Córcoles, Jorge A. Ruiz-Cruz

Universidad Autonoma de Madrid, España

El grafeno es uno de los nanomateriales con mayor relevancia en el mundo de la investigación, debido a sus propiedades físicas y electromagnéticas. Entre sus principales aplicaciones, sobre todo enfocadas a la banda de terahercios, están la nanotecnología y optoelectrónica. Además, su capacidad de modificar sus propiedades conductivas según campos electrostáticos y magnetostáticos usados a modo de polarización intuye su aplicación en dispositivos en guía de onda versátiles y programables. Mediante el Método de los Elementos Finitos 2D, es posible analizar el efecto de la conductividad variable de este material, que depende de sendos potenciales eléctrico y magnético. Este segundo, menos estudiado en la literatura, tiene como resultado unos efectos interesantes, que en este trabajo se analizan en detalle.

Comportamiento de la función de green estocástica en entornos cerrados de nula o muy baja disipación

Luis Landesa, Javier Losada, Lucia Bautista, Inmaculada T. Castro, José Manuel Taboada

Universidad of Extremadura, España

La propagación electromagnética dentro de cavidades muestra, por lo general, un comportamiento caótico en caso de entornos no disipativos o de muy bajas pérdidas. Esto es, pequeños cambios en el problema (frecuencia, geometría, permitividad y permeabilidad del interior, cambios de temperatura, cambios de presión, etc.) producen grandes cambios en el campo electromagnético interior. Es por ello que una caracterización estocástica es más conveniente que una caracterización determinista. Bajo este enfoque, y continuación de trabajos anteriores se presentan desarrollos teóricos de la función de Green estocástica para estos casos tanto en cavidades Wignerianas

como Poissonianas. En todos los casos se demuestra que la función de green estocástica puede modelarse como variable aleatoria de tipo α-estable con diferentes parámetros de escala, posición, asimetría y estabilidad

Using NDDO semi-empirical quantum chemistry methods for the study of the terahertz spectra of materials

Pedro Chamorro Posada
UNIVERSIDAD DE VALLADOLID, España

The use of semi-emprical quantum chemistry methods for the study of the terahertz spectra of materials is discussed in this work. In the far infrared, the signature of a given substance is built from contributions from crystal and/or very long-range vibrational modes. Therefore, theoretical studies require to perform quantum chemistry computations over largely extended molecular systems most likekly including periodic crystal arrangements. Modern semi-emprical methods offer a very appealing alternative to ab-intio Hartree-Fock and density functional theory methods in order to perform these calculations in a effective manner due to the excellent compromise between the accuracy of the predictions obtained and their computational cost. A review of recent results in the modelling of the terahertz spectra of different materials is presented.

Análisis del "scattering" por estructuras multicapa periódicas con plano de simetría mediante modos par e impar. Aplicación al diseño de convertidores de polarización lineal a circular.

Miguel Camacho Aguilar[1], Rafael Rodríguez Boix[1], Juan Córcoles Ortega[2], Francisco Medina Mena[1]
[1]Universidad de Sevilla, España; [2]Universidad Autónoma de Madrid

This work focuses on the analysis of plane wave scattering by multilayered periodic structures with a mirror symmetry plane. The work shows that the calculation of the fields reflected and transmitted by the whole multilayered structure can be carried out in terms of the fields reflected by half the structure when the symmetry plane behaves both as a magnetic wall -even mode- and as an electric wall -odd mode-. It is demonstrated that the splitting of the original problem into two simpler problems makes it possible a CPU time reduction larger than 50% in the analysis of the whole structure. This even/odd mode decomposition strategy is used to desing a linear to circular polarization converter made of stacked apertures and patches. The resulting design shows a 3-dB axial ratio bandwidth of 23% at a center frequency of 13 GHz for incidence angle variations of 45 degrees in the two principal planes of incidence

Una librería GNU para resolución de ecuaciones integrales de orden superior y adaptativa para problemas de electromagnetismo

Felipe Vico Bondía, Miguel Ferrando-Bataller, Eva Antonino-Daviu, Marta Cabedo-Fabres
UPV, España

En esta ponencia se presentará una librería GNU disponible en GITLAB para el análisis electromagnético y la resolución de ecuaciones integrales. La librería cubre la posibilidad de resolver problemas de scattering de objetos conductores perfectos y dieléctricos homogéneos. La librería utiliza tas técnicas más avanzadas de computación científica, como el Fast Multipole, integración adaptativa, funciones base de orden polinómico arbitrario, paralelización mediante openmp y otras técnicas de optimización informática como SIMD. La librería se ha realizado en colaboración con la universidad de Nueva York y el instituto Flatiron de la fundación Simons (NYC).

Lugar: sala Calisto (1.0.1.C) Lunes, 05/09/2022: 16:00-17:30

L.3.3. Sesión Especial: Artificial Intelligence in Beyond 5G/6G Networks (II)

Presidente de la sesión: Raquel Barco Moreno, Oriol Sallent

Análisis y clasificación automática de anomalías de red mediante análisis multiresolución y métodos no supervisados

Juan Cantizani Estepa[1], Sergio Fortes Rodríguez[1], Javier Villegas Carrasco[1], Javier Rasines Suarez[2], Raúl Martín Cuerdo[3], Raquel Barco Moreno[1]

Telecommunication Research Institute (TELMA), Universidad de Málaga, E.T.S. Ingeniería de Telecomunicación, Bulevar Louis Pasteur 35, 29010, Málaga (Spain); [2]Ericsson - GAIA Sweden; [3]Ericsson - NDO SW R&D

Las redes celulares han ido aumentando en tamaño y complejidad constantemente desde las primeras generaciones. Esta creciente complejidad hace más difícil para los operadores de redes gestionar y mejorar la eficiencia de la red la vez que se maximiza la calidad de la experiencia (QoE) de sus usuarios. Como forma de facilitar la gestión de estas complejas redes, se han desarrollado métodos de autocuración y métodos de optimización automática de la red a lo largo de los años. La implementación de estos métodos hizo a las redes capaces de resolver problemas que antes eran identificados por expertos en redes, reduciendo el trabajo necesario para mantener una alta QoE. Para identificar automáticamente estos problemas de red se han utilizado técnicas de clasificación no supervisadas, ya que la cantidad de datos etiquetados necesarios para las técnicas supervisadas no siempre está disponible o es completa. Este trabajo propone un método basado en el análisis multirresolución y el clustering para la detección e identificación de anomalías en redes celulares a través de diferentes indicadores clave de rendimiento (KPI).

Modelado de rendimiento de segmento en redes de acceso radio mediante aprendizaje supervisado

Carolina Gijón Martín, Matías Toril Genovés, Salvador Luna Ramírez, Juan Luis Bejarano Luque

Telecommunication Research Institute (TELMA), Universidad de Málaga, Málaga, España.

In 5G systems, the Network Slicing (NS) feature allows to deploy several logical networks customized for specific verticals over a common physical infrastructure. In the Radio Access Network (RAN), cellular operators need slice performance models for re-dimensioning purposes. In this work, we present a comprehensive analysis assessing the performance of Supervised Learning (SL) to estimate slice throughput in the down link of RAN-sliced networks, relying on information collected in the operations support system. Different SL algorithms are tested in two NS scenarios with single-service and multi-service slices, respectively. To this end, two synthetic datasets with performance indicators and connection traces are generated with a system-level simulator emulating the activity of a sliced RAN in a live scenario. Results show that the best model (i.e., combination of SL algorithm and input features) may vary depending on the NS scenario. The best models have shown an error below 10%.

Leveraging DRL for Traffic Prioritization in 5G and Beyond TSN-based Transport Networks

Jonathan Prados Garzón, Lorena Chinchilla Romero, Pablo Muñoz Luengo, Pablo José Ameigeiras Gutiérrez, Juan José Ramos Muñoz

Universidad de Granada, España

Time-Sensitive Networking (TSN) is expected to become a key layer 2 technology for 5G and Beyond (5GB) transport networks (TN) as it allows for services with stringent and deterministic quality-of-service constraints and their coexistence with non-performance-sensitive traffic. Autonomous solutions for configuring TSN-based TNs are essential to ensure the deterministic QoS requisites of the 5GB streams while facilitating the zero-touch management of the network and reducing the operational costs. However, due to the configuration flexibility offered by TSN networks, using exact optimization methods to develop such solutions usually results in algorithms with high computational complexity. In this work, we propose and evaluate an initial design of a Reinforcement Learning

(RL)-based solution for the long-term configuration of asynchronous TSN-based 5GB TNs. We successfully validated the proper operation of the proposal for an industrial private 5G scenario.

A PPO Reinforcement Learning MAC Scheduler

Anxo Tato, J. Joaquín Escudero-Garzás, Pablo González, Luis Pérez Roca
GRADIANT (Galician Research and Development Center for Advanced Telecommunications), Vigo, Galicia, Spain

Artificial Intelligence (AI) is a key element in current mobile networks and will have an important role in future 6G, even as an AI-based air interface. Within AI, Reinforcement Learning (RL) appears as a solution to develop intelligent agents that learn to take actions in a given environment. Several works propose the use of RL algorithms at the MAC layer to perform radio resource scheduling at the base station. In this work, we validate the state-of-the-art Proximal Policy Optimization (PPO) algorithm as a promising approach to MAC scheduling. We develop the proposed approach within the OpenAI Gym environment to simulate the scheduling problem in a cellular network. For this, we employ the Stable-Baselines3 library and the Nokia Wireless Suite. We compare the results obtained by the PPO algorithm with a classical scheduling algorithm, showing the advantages and disadvantages of this RL approach.

Filtrado de trazas MDT de alta movilidad mediante aprendizaje supervisado

Joaquín Manuel Sánchez Martín, Matías Toril Genovés, Carolina Gijón Martín, Juan Luis Bejarano Luque, Salvador Luna Ramírez
Telecommunication Research Institute (TELMA), Universidad de Málaga, E.T.S. Ingeniería de Telecomunicación, Bulevar Louis Pasteur 35, 29010, Málaga (España)

En las redes más allá de la 5G, la información radioeléctrica geolocalizada desempeñará un papel fundamental para impulsar los algoritmos de autogestión en un paradigma sin intervención. La funcionalidad de minimización de pruebas en ruta (Minimization of Drive Test, MDT) proporciona a los operadores estadísticas de rendimiento de la red y eventos radio geolocalizados. Sin embargo, las trazas de MDT contienen importantes errores de localización debido a los modos de ahorro de energía de los terminales, lo que requiere filtrar las muestras erróneas para garantizar un rendimiento adecuado de los algoritmos impulsados por MDT. En este contexto, el aprendizaje supervisado (Supervised Learning, SL) surge como una solución prometedora para automatizar el diseño de los procedimientos de filtrado de MDT en comparación con las soluciones basadas en reglas. Este trabajo presenta un método basado en SL para filtrar mediciones de MDT en escenarios de carretera, combinando trazos de movilidad de usuarios y mapas de uso de suelo en ausencia de trazas de movilidad etiquetadas de usuarios reales. La evaluación se realiza sobre datos MDT recogidos en una red LTE real. Los resultados muestran que el modelo se comporta mejor en las mediciones con información de precisión de posicionamiento.

Marco de Desarrollo Software e Implementación de Algoritmos de Inteligencia Artificial para la Gestión de Redes Radio 5G

Irene Vilà Muñoz, Oriol Sallent, Jordi Pérez-Romero
Universitat Politècnica de Cataluny

The increase in complexity of 5G and beyond mobile communications networks to accommodate multiple services with stringent requirements has led to the introduction of Artificial Intelligence (AI) capabilities for automating their management and operation, particularly in the Radio Access Network (RAN). Although there exist a large number of proposals of AI algorithms for different problems in the RAN, little attention has been paid to their practical implementation. This paper intends to fill this gap by discussing the practical aspects on the software development and implementation of AI algorithms for the RAN. This is done based on a specific example that uses deep reinforcement learning for the capacity sharing problem in RAN slicing. The paper presents an implementation of this solution in the context of the O-RAN architecture, detailing the operation of the involved interfaces and the containerization of the solution.

Lugar: sala Ganímedes (2.0.1.A) Lunes, 05/09/2022: 16:00-17:30

L.3.4. Telemática: IoT, interfaces de comunicación (I)

Presidente de la sesión: Isabel de la Bandera Cascales, Emil Jatib Khatib

Evaluación de la latencia de NB-IoT con medidas reales

David Segura[1,2], Emil J. Khatib[1,2], Jorge Munilla[2], Raquel Barco[1,2]

[1]Instituto de Telecomunicación (TELMA), Universidad de Málaga; [2]Departamento de Ingeniería de Comunicaciones, Universidad de Málaga

In the 3GPP LTE Release 13, NB-IoT was standardized to provide wide-area connectivity for IoT. To optimize network signalling and power consumption, control plane (CP) optimization was introduced. In Release 15, to support infrequent small data transmissions, Early Data Transmission was also included, in which the data are sent during the random access procedure. Thus, this paper analyses the latency performance of the different NB-IoT optimizations for the CP. The study, carried out in a real equipment, has been performed for different packet sizes and coverage levels. Evaluation results show lower latencies for EDT, particularly with small packets, where a reduced transport block is used, being more efficient from a network point of view. Additionally, we verify that EDT, unlike Release 13 optimization, fulfills 3GPP latency requirement for extreme coverage.

Diseño de un sistema de gestión de los carritos portaequipajes en un aeropuerto

Pablo Vera Soto, Juan Cantizani Estepa, Sergio Fortes Rodríguez, Raquel Barco

Instituto de Telecomunicación (TELMA), Universidad de Málaga, CEI Andalucía TECH

Collecting luggage trolleys at an airport poses a problematic that is usually done in a very inefficient way due to the lack of information about the position and state of the trolleys. In this sense, a management system for the luggage trolleys using NB-IoT and BLE is proposed. Based on a capillary architecture, this system can track the trolleys and distinguish through some sensors whether they are being used or not, as well as if they are in their correspondent storage and displays the information in a dashboard created with Grafana.

Sistema IoT Distribuido de Bajo Coste para la Detección de Fallos en la Inclinación de los Espejos en Plantas LFR

Rowida Meligy[1], Hicham Klaina[2], Imanol Picallo[2], Peio Lopez-iturri[2,3], Leyre Azpilicueta[4], José Javier Astrain[3,5], Mohamed Rady[6], Jesús Villadangos[3,5], Ana Alejos[7], Francisco Falcone[2,3]

[1]Dpt. of Mechatronics Engineering, Helwan University, Egypt; [2]Electric, Electronic and Communications Department, Public University of Navarre, Spain; [3]Institute of Smart Cities, Universidad Pública de Navarra, España; [4]School of Engineering and Sciences, Tecnologico de Monterrey, Mexico; [5]Dpt. of Statistics, Computer Science and Mathematics, Public University of Navarre, Spain; [6]Mechanical Engineering Department, King Abdulaziz University, KSA; [7]Dpt. of Signal Theory and Communications, University of Vigo, Spain

The advances in renewable solar energy generation have led to the development of Linear Fresnel Reflector (LFR) technology, in which solar energy is focused by means of a set of longitudinal mirrors onto a tubular receiver. The efficiency in the energy generation process is mainly given by the relation between the angle of incidence of incoming sunlight rays and the fixed location of the elevated tubular receiver. The angular variation process of the mirrors is generally based on the use of encoders implementing a wired closed-loop feedback system to provide information to the controller in relation with actual mirror angular position. This work presents an alternative wireless low cost mirror tilt angle monitoring system for LRF plants based on inclinometers. The proposed system uses accelerometers coupled to low cost wireless transceivers, enabling distributed real time data collection. The system allows fault or damage detection at all monitored mirror sections, avoiding long periods of efficiency loss of the LFR plant. The proposed system has been implemented enabling remote LFR facility monitoring by means of cloud-based infrastructure.

Access Control in Wireless Corporate Networks based on the Security Profile of Devices and Users

Víctor José López Marín, Pedro García Teodoro
Universidad de Granada, España

Providing security in network environments is becoming an increasing difficult task. The weakest link regarding security of a complete system is the final user, so that te use of protocols and security schemes can be completely useless if the user and her/his device is not in some sense "controlled". As a consequence, the potential inappropriate behavior of a given user/device puts the entire network ecosystem into risk. This is of especial relevance in new communication paradigms like IoT and 5G/6G. In this context, the objective of the present work is to dynamically monitor the status and behavior of each user/device in a corporate wireless network environment over time, so that the access to network services will be authorized or not depending on the specific security profile exhibited by the user/device.

All Cryptolibraries Are Beautiful, But Some Are More Beautiful Than Others: A Survey of CP-ABE Libraries

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Ciphertext-Policy Attribute-Based Encryption (CP-ABE) is a one-to-many asymmetric encryption scheme that generates users' secret keys based on attributes and protects information according to access policies. This qualifies it as an asymmetric encryption scheme, which are computationally inefficient. There are numerous CP-ABE schemes, but libraries do not always implement the same ones. Therefore, developers can find it challenging to choose the proper library for their projects since it requires a balance between efficiency and security. This paper studies 11 CP-ABE libraries, analyzing their design goals, the mathematical libraries used, the CP-ABE schemes provided, as well as whether they are being maintained. We also identify the libraries that deploy insecure CP-ABE schemes and conclude by providing an experimental analysis of three of them, in which we measure their execution times on an ARMV architecture. The goal is to provide developers with the information required to choose the most appropriate library for their projects.

Comparativa entre técnicas de localización en interiores basadas en RSSI y AoA con tecnología Bluetooth

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En este artículo, se presenta una comparativa entre dos técnicas de localización basadas en el protocolo de comunicación Bluetooth Low Energy: RSSI (Indicador de la fuerza de la señal recibida) y AoA (Ángulo de llegada). El indicador RSSI ha sido utilizado a lo largo del tiempo en el entorno de la localización en interiores (recurriendo a su vez a otra técnica llamada trilateración) para ofrecer una posición estimada del elemento que se desea localizar. La técnica AoA ha sido aplicada con anterioridad en otras tecnologías, y recientemente, se ha incorporado a Bluetooth bajo el perfil de Direction Finding para el mismo fin: localización o posicionamiento de dispositivos cercanos. La comparativa se basa en una serie de desplazamientos y posiciones fijas en un entorno indoor con áreas definidas en donde se mide: - Latencia – Fiabilidad. Para cualquier sistema de posicionamiento en interiores es importante ofrecer una precisión óptima, y por lo tanto, tener limitaciones en la etapa de recepción de la señal condiciona el procesado de la misma y por lo tanto aumenta el error en el resultado final de la posición.

Lugar: sala Europa (1.0.2.B) Martes, 06/09/2022: 11:30-13:00

M.2.1. Sesión Especial: Premio Jóvenes Científicos

Presidente de la sesión: Francisco Medina Mena, Monica Fernandez Barciela

Improvement of Liquid Crystal Transition Times in Thick mm-Wave Devices

Robert Guirado, Gerardo Perez-Palomino, Eduardo Carrasco
Universidad Politécnica de Madrid, España

This paper describes and validates the dynamic modelling of Liquid Crystal (LC)-based planar multi-resonant cells, as well as its use as bias signals synthesis tool to improve their reconfigurability time. The dynamic LC director equation is solved in the longitudinal direction through the finite elements method, which provides the z- and time-dependent inhomogeneous permittivity tensor used in an electromagnetic simulator to evaluate the cells behaviour. The proposed model has been experimentally validated using reflective cells and measuring the transient phase, both in excitation and relaxation regimes. Then, a bias signal design tool is proposed to significantly reduce the transition times of LC cells, and hence, of electrically large antennas composed of them.

Design of a Wideband Metal-only Reflectarray with Phase Control of Orthogonal Polarizations

Ángel Palomares Caballero[1], Carlos Molero[1], Pablo Padilla[1], María García Vigueras[2], Raphaël Gillard[2]
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This paper presents a metal-only reflectarray that enables the control of incident orthogonal polarizations in a large bandwidth. The proposed reflectarray is based on a metal-only unit cell whose tuning elements allow the control of the reflection phase value for the vertical and horizontal impinging polarizations. Due to the symmetry exhibited by the geometry of the reflectarray unit cell, the same performance is obtained for both polarizations. The designed unit cell for the complete reflectarray provides a fairly linear phase response along the frequency with a phase modification in the orthogonal polarization of +-1º in the phase range of the tuned polarization. The performance under oblique incidence of the proposed unit cell is also investigated. From this unit cell, a metal-only reflectarray that produces circular polarization from a linear polarization is designed. Thanks to the performance provided by the unit cell, the reflectarray presents a simulated directivity greater than 27 dBi with an axial ratio below 1.5 dB from 32 GHz to 50 GHz (43.9% of bandwidth). The 3-dB gain bandwidth also covers the considered frequency range.

Aperture Illumination Control of Leaky-Wave Antennas Based on Bianisotropic Huygens' Metasurfaces

Pablo Mateos Ruiz, Elena Abdo Sánchez, Carlos Camacho Peñalosa
Instituto TELMA, Universidad de Málaga, España

In this contribution, a methodology for controlling the aperture field distribution of recently-proposed leaky-wave antennas based on omega-type bianisotropic Huygens' metasurfaces is presented. The antenna is based on a parallel-plate waveguide with a metasurface on top, which enables independent control in the LWA phase constant and leakage factor. However, the arbitrary control of the aperture requires a variable leakage factor, which was constrained to being constant in the previous works. In this sense, the required modifications in the theoretical model to account for a variable leaky wavenumber are presented. A slowly varying amplitude approximation approach is used to satisfy Maxwell's equations and obtain the relation between the horizontal and vertical

wavenumbers. Some designs are carried out using the proposed methodology with ideal unit cells, obtaining metasurfaces for different aperture configurations. Electromagnetic simulations results validate the theoretical predictions, showing an excellent agreement even for very high radiation efficiencies.

Sector Unit-Cell Methodology for the Design of Sub-6 GHz 5G MIMO Base Station Antennas

Jaime Molins-Benlliure, Miguel Ferrando-Bataller
Universitat Politècnica de València, España

A novel methodology based on the sectorization of multiple-port cavities with azimuthal symmetry into sector unit cells is presented to design 5G multiple-input multiple-output (MIMO) sub-6 GHz indoor base station antennas. The methodology divides an N-port cavity antenna into N unit cells and predicts the performance of the N-port design with the analysis of two adjacent cells. This approximation reduces the time and complexity of the simulation of cavity antennas with a high number of ports. For the theoretical justification, cavity mode analysis of a closed cavity and characteristic modes analysis of open and sector cavities is addressed. With the use of the proposed methodology, five different cavity designs with circular, square, hexagonal, octagonal, and saw-tooth geometries are presented in this article. In addition, the fabrication of the 4-port circular shape design and its MIMO performance is also studied. Results show an impedance bandwidth of 130% (1.27-6 GHz), isolation between ports higher than 15 dB, and an ECC lower than 0.1 confirming the viability of the methodology.

Satellite SAR Antenna based on Multi-faceted Reflectarray with tilted panels

Borja Imaz Lueje, Marcos Rodríguez Pino, Manuel Arrebola Baena
Universidad de Oviedo, España

In this contribution, a multi-faceted reflectarray for SAR applications onboard a satellite is evaluated and designed. The reflectarray antenna consists of 9-panels distributed in a parabola along the axis with the largest size. Working in Kaband, the antenna generates a beam on each polarization to illuminate different areas of the Earth's surface. The multifaceted structure achieves a good in-band stability in terms of gain, sidelobes and beamwidth of the pattern, which suppose an improvement in the antenna performance with regard to a conventional printed reflectarray.

Full-Metal 3D Metasurface for Wideband Polarizers using phase-resonance

Miguel Ángel Balmaseda Márquez[1], Salvador Moreno Rodríguez[1], Carlos Molero Jiménez[1], Pablo Helio Zapata Cano[2], Juan Francisco Valenzuela Valdés[1]
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This paper presents an innovative way to control the phase response of each polarization using the excitation of phase resonance. A novel full-metal 3D periodic structured based on square waveguides with non-closed resonators perforated on their walls is showed. It has been modelled via accurate equivalent circuits who were previously characterized and intented to be used as an efficient optimization tool. A dual band electric-field polarizer has been designed with the aid of the circuit model and also an ultra-wideband electric-field rotator with a bandwith of 143%. The last one has been manufactured via 3D-printing laser powder bed fusion (LPBF). The experimental results have been validated with success.

Lugar: sala Ío (1.0.2.A) Martes, 06/09/2022: 11:30-13:00

M.2.2. Sesión Especial: Antenas y dispositivos de RF basados en nuevas técnicas y tecnologías de fabricación (I)

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

Desarrollo de antena espiral con alimentación lateral realizada mediante fabricación aditiva

Francisco José Martín-Bayona, Mario Pérez-Escribano, Enrique Marquez-Segura
Telecommunication Research Institute (TELMA), Universidad de Málaga, E.T.S. Ingeniería de Telecomunicación

Esta contribución presenta el diseño paso a paso y la fabricación de una antena espiral con alimentación lateral enfocada en aplicaciones de automoción. La antena en espiral está pensada para trabajar en banda ultra-ancha (UWB), una nueva tecnología que mejora el posicionamiento, la seguridad y la protección de los vehículos conectados utilizando frecuencias de 3,1 GHz a 10,6 GHz. Este elemento radiante tiene polarización circular y su diagrama de radiación permanece razonablemente constante en toda la banda de uso, ya que pertenece a la categoría de antenas independientes de la frecuencia. El prototipo ha sido implementado usando fabricación aditiva, específicamente un conjunto de tecnologías que incluyen modelado por deposición fundida (FDM) e impresión de tinta conductiva. Se presentan los resultados de la medida, los cuales evalúan la validez de la antena propuesta.

Diseño y fabricación 3D de lente plana dieléctrica con polarizador integrado para generación de polarización circular dual en banda W

Javier Melendro Jiménez, Pablo Sánchez Olivares, Adrián Tamayo Domínguez, Xiaoliang Sun, José Manuel Fernández González
Universidad Politécnica de Madrid, España

En este trabajo se ha llevado a cabo el diseño y optimización de una lente plana dieléctrica con un polarizador integrado que permite convertir polarización lineal dual en polarización circular dual en banda W. La lente presenta un índice de permitividad relativa decreciente en dirección radial para conformar los rayos en una dirección determinada, aumentando así la directividad mediante la generación de una onda plana o quasi-plana. La permitividad relativa de un material dieléctrico puede modificarse si se ve alterado su volumen efectivo, por lo que se plantea un diseño de lente perforada por capas para conseguir la disminución radial de permitividad relativa buscada. Una vez terminado el diseño de la lente, se diseña e integrará un polarizador consistente en una estructura cilíndrica formada por barras dieléctricas paralelas equiespaciadas. El polarizador permite la conversión de polarización lineal dual en polarización circular dual. El sistema completo (lente y polarizador) es alimentado por una guía de onda cuadrada con sus dos modos fundamentales (TE01 y TE10). El polarizador permite la conversión de polarización lineal vertical (excitación del modo TE10 en la guía cuadrada) en polarización circular a derechas y la conversión de polarización lineal horizontal (excitación del modo TE01 en la guía cuadrada) en polarización circular a izquierdas. Por otro lado, desplazamientos de la guía de onda cuadrada a lo largo del plano focal de la lente permiten desapuntar el haz principal, consiguiendo un amplio rango de desapuntamiento de +-30º en los planos de elevación y acimut. Lente y polarizador son fabricados en una sola pieza mediante impresión 3D utilizando tecnología de estereolitografía y medidos en cámara anecoica para verificar y validar sus características radiantes.

Full Metal 3-D Self Supported Frequency Selective Surface for X-band Space Applications

Mohamad Hosein Rasekhmanesh[1], Asrin Piroutiniya[1], Jose Luis Masa Campos[1], Juan Córcoles[1], Jorge A. Ruiz Cruz[1], Carlos Alberto Leal Sevillano[2], Esteban Celemín[2], Carlos Galleguillos Rioboo[3], Maarten Van Der Vorst[4]

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In this paper, a novel three-dimensional (3-D) full metal Frequency Selective Surfaces (FSS) that is located in front of a circularly polarized conical horn antenna has been presented to indicate frequency filtering properties for X-band space applications. Primarily, a 3-D wide band periodic structure is designed to reach the desired bandwidth centered at 7.5 GHz and wide rejection band from 14 to 30 GHz in order to reach this goal an FSS includes 2 layer of four arrow shape patches inside a wave guide has been introduced. The fractional frequency band width around 7.3 % with return loss below 20 Db has been achieved. The angular stability of the presented work has been studied in different angles of incident wave. Finally, the FSS is placed in different distance of Spline horn antenna to reach the best position and analyzing the filtering behavior of the FSS panel. By comparing the measurement results and simulating results, it can be concluded that the whole system works properly.

Guidelines for successful manufacturing of W-band full-metal waveguide devices

Pablo Sanchez-Olivares[1], Marta Ferreras[1], Eduardo Garcia-Marin[2], Lucas Polo-López[2], Adrián Tamayo-Domínguez[1], Juan Córcoles[2], José Manuel Fernández-González[1], José Luis Masa-Campos[2], José R. Montejo-Garai[1], Jesús M. Rebollar-Machain[1], Jorge A. Ruiz-Cruz[2], Manuel Sierra-Castañer[1], Manuel Sierra-Pérez[1], Mariano Barba[1], José Luis Besada[1], Jesús Grajal[1]

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Even experienced microwave designers might face technological challenges when upscaling their designs to upper frequency bands. Subtractive manufacturing techniques (e.g., computer numerical control milling or electrical discharge machining), electroforming, and additive manufacturing (e.g., stereolithography, direct metal laser sintering, or diffusion bonding) are explored in this work via the design, fabrication, and characterization of different passive components in the W-band. The advantages and disadvantages of these technologies have been evaluated in terms of manufacturing tolerances, accuracy, surface roughness, and cost. The final purpose is to offer some guidelines for the selection of the most appropriate waveguide manufacturing technology in the W-band depending on the topology of the component under development.

Stadium-Shaped versus Circular Glide-Symmetric Holes in Parallel Multi-Layer Gap Waveguides

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This work proposes a solution to minimize the separation between radiating elements in cavities or in waveguides using gap waveguide technology for grating lobe reduction. To ensure a low amount of leakage in this technology, two or three rows of metal pins are commonly used. These rows determine the minimum separation between waveguides and cavities. To reduce this separation, here, we propose a solution based on multi-layer waveguides with stadium-shaped holes in a glide-symmetric configuration. This shape significantly reduces the size of the waveguide sidewalls. The proposed stacked-layer configuration can be easily fabricated and provide low losses, as the sheets are all-metal. We provide a comparison in terms losses, coupling between waveguides and their separation between them, which is validated with measurements of different prototypes. Our proposed solution reduces the width of the central wall between waveguides up to 20% of the wavelength at 92.5 GHz.

DRA with symmetrical radiation pattern as Half Maxwell Fish-Eye dielectric lens antenna feed

José-Manuel Poyanco Acevedo[1], **Francisco Pizarro Torres**[2], **Eva Rajo Iglesias**[1]

[1]Universidad Carlos III de Madrid, España; [2]Pontificia Universidad Católica de Valparaís, Chile

This paper deals with the design of a dielectric resonator antenna (DRA) with symmetrical radiation pattern to be used as an integrated feed for a Half-Maxwell Fish- Eye dielectric lens antenna. The dielectric lens and its feed are designed to be both manufactured with 3D-printing. The entire lens and feed are implemented with four commercial filaments, reaching the needed refractive indexes varying the infill percentages. This feed allows multibeam operation or mechanical scanning, operating at a central frequency of 28 GHz.

Lugar: sala Calisto (1.0.1.C) Martes, 06/09/2022: 11:30-13:00

M.2.3. Comunicaciones móviles e inalámbricas (I)

Presidente de la sesión: Matilde Sánchez Fernández, Lorenzo Rubio Arjona

Caracterización de UWB y WiFi FTM en obras

Carlos Simón Álvarez Merino, Hao Qiang Luo-Chen, Joel Michel Llanes, Emil J. Khatib, Raquel Barco

Instituto de Telecomunicación (TELMA), Universidad de Málaga

The construction industry is one of the largest sectors not having a major movement towards digitalisation. For this reason, in recent years, there is an effort for stimulating innovation in the construction site mainly to improve the safety of workers. Thanks to precise, real-time location, workers can be monitored to minimise risks and avoid disasters. For this reason, in this paper ultra-wideband (UWB) and WiFi Fine Time Measurement (FTM) localisation technologies are characterised for this type of environment

Comparativa entre canales MIMO masivo concentrado y distribuido a 26 GHz

Javier Merino Polidura[1], Jesus Ramon Perez Lopez[1], Rafael Pedro Torres Jiménez[1], Luis Valle López[1], Óscar Fernández Fernández[1], Lorenzo Rubio Arjona[2], Vicent Miquel Rodrigo Peñarrocha[2], Juan Reig Pascual[2]

[1]Universidad de Cantabria, España; [2]Universitat Politècnica de Valencia, España

Este trabajo presenta un estudio comparativo entre canales concentrados y distribuidos de entrada múltiple y salida múltiple (C-mMIMO y D-mMIMO), realizado en la banda de frecuencias 5G de 26 GHz a partir de los resultados de simulación obtenidos mediante el uso de técnicas de trazado de rayos (RT) en un entorno interior de grandes dimensiones. Las simulaciones tratan de emular el enlace ascendente de una célula de interior en la que tanto la estaciones base concentrada como la distribuida han sido equipadas con 100 antenas receptoras, y se han considerado diferentes conjuntos de usuarios activos para analizar el rendimiento de ambos sistemas en términos de capacidad de canal. Se presentan los resultados que comparan los canales C-mMIMO y D-mMIMO teniendo en cuenta la influencia del emplazamiento y la distribución de los usuarios, mostrando que los sistemas D-mMIMO superan al C-mMIMO cuando dichos usuarios están dispersos o alejados del conjunto C-mMIMO.

Caracterización experimental del factor K de Rice en laboratorio en la banda de frecuencias de 25 a 40 GHz

Bernardo Bernardo[1], Herman Fernández[3], Vicent Miquel Rodrigo[1], Lorenzo Rubio[1], Juan Reig Pascual[1], Jesús Ramón Pérez[2], Rafael P. Torres[2], Luis Valle[2]

[1]Universitat Politècnica de València, España; [2]Universidad de Cantabria, España; [3]Universidad Pedagógica y Tecnológica, Colombia

En este trabajo, el factor K de Rice se ha estimado a partir de una campaña de medidas realizada en un entorno de laboratorio en la banda de frecuencias de 25 a 40 GHz. La sonda de canal se ha configurado utilizando una matriz rectangular uniforme que se encuentra en un plano horizontal y considerando 6 posiciones en condiciones de visión directa (LOS) y sin LOS (NLOS). Los valores del factor K medios obtenidos varían de 0,48 a 3,43 dB para condiciones LOS, y de -5,54 a -0,56 dB para condiciones NLOS y pueden utilizarse para evaluar el rendimiento de las redes 5G en este tipo de entornos de interiores.

LPWAN-Based Tractor Communication Assessment for Large-Scale Smart Farming

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In this contribution, two scenarios for tractor communication and interaction for large-scale farm monitoring have been assessed. For this purpose, different Low-Power Wide-Area Network technologies are evaluated. The proposed scenario under analysis considers two communication links. The first link is nodes to tractor communication and the second is tractor to infrastructure communication. These scenarios are not proposed only for agricultural equipment performance enhancement and tracking, but also for resources management within large-scale farm fields. The obtained results demonstrate that LPWAN-based WSNs are providing better coverage and radio link quality results than ZigBee for a non-flat large-scale farm field in the case of a moving tractor within both scenarios. The proposed systems are validated by cloud-based platforms for LoRaWAN, Sigfox and NB-IoT communications, providing flexible and scalable solutions to enable interactive farming applications.

A Hybrid Adaptive Beamforming Algorithm for Fast Target Tracking

Aral Ertug Zorkun, Miguel Alejandro Salas-Natera, Ramon Martinez Rodriquez-Osorio

Polytechnic University of Madrid, Madrid, Spain

The adaptive beamforming algorithms are used to mitigate the fading at desired signal caused by environmental factors and are used to suppress the interference signals from irrelevant sources. In smart antenna systems, the noise mitigation and interference suppression, as well as, simultaneously, directing multiple beams for each distinct user, is a challenging task. In terms of convergence rate, interference cancelling and target tracking, such algorithms are both superior and inferior to each other. The hybrid beamforming is a concept of blending two and/or more different type of beamforming algorithm to enhance the aforementioned capabilities of a smart antenna system. A novel hybrid beamforming algorithm based on sliding window recursive least squares constant modulus algorithm with adaptive forgetting factor and variable regularization factor, is proposed. It is observed that, the proposed algorithm outperforms conventional sliding window RLS and RLSCMA algorithms in terms of target tracking convergence rate, interference cancelling and target tracking.

Comparación de estrategias de entrenamiento de modelos de predicción de tráfico mensual en redes celulares

María Isabel Quesada Gil, Salvador Luna Ramírez, Matías Toril Genovés, Carolina Gijón Martín, Álvaro Durán Martínez

Universidad de Málaga, España

Network dimensioning is a critical task for cellular operators to avoid degraded user experience and unnecessary upgrades of network resources in current network with changing mobile traffic patterns. The most cutting-edge smart network planning tools use forecasting models based on Supervised Learning (SL) over data stored in the operators support system to predict cell performance and detect potential bottlenecks in advance. When using data with low time resolution (e.g., monthly data), a model cannot be trained per time series due to the short length of historic data (e.g., 2 years of monthly data is equivalent to 24 samples). As an alternative, global models (i.e., valid for several cells) can be considered. Time correlation between samples strongly varies in different cells or in different consecutive months of the same cell. As a consequence, the training strategy is key to make the most of SL models. In this work, the performance of a SL-based forecasting algorithm to predict monthly busy-hour traffic is assessed considering 3 different training approaches: a) capturing the global behavior of the network across time, b) relying on the most recent data to make predictions and c) considering month-specific models. Results show that

the training strategy has a strong impact of model performance, depending the best approach on the forecasting horizon. In this work, specific-month models shows the best performance in short horizons, whereas last-data models preform best in long horizons.

Lugar: sala Ganímedes (2.0.1.A) Martes, 06/09/2022: 11:30-13:00

M.2.4. Radiación, dispersión y radiopropagación

Presidente de la sesión: José María Molina García-Pardo

Experimental characterization of propagation in vehicular scenarios using the real-time Massive MIMO channel sounder MaMIMOSA

Davy Gaillot[3], Pierre Laly[3], Eric Simon[3], N Dahmouni[3], G Delbarre[3], Martine Lienard[3], Jaime Molins-Benlliure[2], Marta Cabedo-Fabres[2], Eva Antonino-Daviu[2], Miguel Ferrando[2], Antonio Mateo Aroca[1], Jose-Maria Molina-Garcia-Pardo[1], Lluis Jofre[4]

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This work presents the preliminary results of two V2I channel sounding campaigns with the real-time massive MIMO radio channel sounder named MaMIMOSA. This equipment was jointly developed by the University of Lille (FR) and the University of Ghent (BE) for 5G V2X applications. The system is equipped with a massive 64 antenna array for Tx, while up to 16 individual antennas can be deployed for Rx. MaMIMOSA's hardware and software capabilities allow the probing parameters to be freely adapted to the scenario under investigation, demonstrating its versatility and flexibility. Radio channels were measured at 5.89 GHz with a bandwidth of 80 MHz on the University of Lille campus, with an average speed of 20 km/h under two scenarios. First, a 64 x 1 NLOS/LOS scenario was investigated where the Tx was placed as a Road-Side Unit and from which the delay spread values, SNR, and spatial stationarity of the Doppler properties were studied. In a second scenario, a 64 x 4 LOS scenario where the Tx was placed at the third floor of a building. For the latter, The vehicle was equipped on its rooftop either with a dedicated 5G 4-port MIMO wide-band omnidirectional antenna developed by the University of Valencia (SP) or a 4-port MIMO directive patch array. The Doppler spectra results are compared with directional patch antennas and highlight the richness of the radio channel with respect to the investigated scenario.

Desarrollo de algoritmos para la caracterización electromagnética en espacio libre

Jose Cidrás Estévez, Borja Plaza Gallardo, David Ramos Somolinos, David Poyatos Martínez

INTA (Instituto Nacional de Técnica Aeroespacial), España

Obtaining electromagnetic (EM) characterization of 3D printed, composite materials or a combination of them is essential to ensure safety and EM compatibility. Free space methods are widely used for this purpose, despite their inherent practical difficulties. This article describes the development of a series of algorithms for the extraction of the permittivity and permeability of dielectric materials from free space measurements between 6 and 13 GHz. The extracted properties are obtained from the transmission and reflection coefficients using the Time-Domain Gating from a vector spectrum analyzer (VNA).

Wideband Directional Measurements in the 32 GHz Frequency Band in a LoS Corridor Situation

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Universidad Politécnica de Cartagena, España

This work presents a Power Angular Delay Profile (PADP) channel sounder with preliminary measurements at 32 GHz in a corridor. A low cost device has been designed to perform the rotation of the directional antenna with a fully automatic measurement procedure. Initial measurements have been performed at 32 GHz within a bandwidth of 10 GHz, using a vector network analyzer (VNA). Measurements allow the study of the multipath behavior in this

indoor environment; a large number of sources of scattering objects were detected. This knowledge is of interest because the signals of 5G and 6G systems will operate in millimeter long wave bands, such as the one used in this work. The different multipath contributions were observed in the angular measurements, especially those produced by the walls at 40 and -40 degrees and those produced by the metal tubes at 25 and -65 degrees. In addition, above 80 degrees and below -80 degrees, the RMS Delay Spread increases up to 60 ns.

Hybrid Beamforming in Indoor Transmissions at 38 and 65 GHz for 5G/6G

Concepción Sanchis Borras[1], Maria Teresa Martinez Ingles[2], Jose María Molina Garcia-Pardo[2]

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The 5G Infrastructure Public Private Partnership (5GPPP) has recently published a white paper about the 5G service indoors, because up to now the technical focus has been on the outdoors. In the indoor environment, the requirements are different. In addition, previous works have shown that space frequency block code (SFBC) techniques applied to multiple antennas have a better performance than a single-input–single-output (SISO). This letter presents an experimental study in an indoor environment regarding the performance of a massive multiple-input–multiple-output (mMIMO) millimeter-wave (mmWave) system based on the standard 5G New Radio (NR). In the first step, the 38 and 65 GHz bands are compared by applying a low-complexity hybrid beamforming (HBF) algorithm. In the second step, the throughput and the maximum achievable distance are studied using a new algorithm that combines the SFBC technique with HBF.

Wireless Channel Analysis to Enable Context Aware Intra-Train Communications

Imanol Picallo[1], Hicham Klaina[1], Peio Lopez-Iturri[1,4], Mikel Celaya-Echarri[2], Leyre Azpilicueta[2], Jesus Villadangos[3,4], José Javier Astrain[3,4], Francisco Falcone[1,4]

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The advent of Smart Cities and Smart Regions is leading to the implementation of multiple interoperable systems, among with Intelligent Transportation systems are fundamental in relation with new mobility paradigms. In this sense, providing interactive context aware environments in relation with differet transportation means is compulsory in order to achieve highly interactive scenarios, with users as well as transportation infrastructure. Among these, train passenger transportation systems are relevant in relation with efficiency and sustainability. In this work, intra-train wireless channel characteristics will be analyzed for the adoptation of future dense/ultra dense connectivity requirements. Frequency-power as well as time domain analysis will be presented, with the aid of in-house deterministic 3D Ray Launching code, in order to aid in radioplanning system design phases of future train context aware environments.

Análisis del Canal Inalámbrico y Evaluación de un Sistema Ultra-WideBand en la Industria

Imanol Picallo Guembe[1], Peio López-Iturri[1,2], Hicham Klaina[3], Guillermo Glaria[4], Félix Saez de Jauregui[4], José Luis Zabalza[4], Leyre Azpilicueta[5], Francisco Falcone[1,2]

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Industry digitalization will be based on Industry 4.0, which will allow companies to improve their manufacturing processes thanks to the dense deployment of smart devices. As a result of the high number of devices, potential interfering systems during the communication will strongly increase significantly, requiring an in-depth analysis of

their behavior in complex and non-static environments. In this sense, this research characterizes the wireless channel using a 3D-Ray Launching (3D-RL) tool in a logistics plant to evaluate the use of Ultra-Wideband (UWB) technology. The research results will enable to obtain optimal node location in relation to radio planning tasks as well as to characterize the environments considering obstacles in terms of the received power level in the complete simulation volume and at the time domain level. These results provide values of time of flight simulations comparable to the values from UWB technology.

Lugar: sala Ío (1.0.2.A) Martes, 06/09/2022: 16:00-17:30

M.3.1. Antenas (II)

Presidente de la sesión: Daniel Segovia Vargas, Miguel Ferrando Bataller

Antena Leaky-Wave hecha a mano para propósitos educativos

María Mercedes Campo Valera[1], Miguel Poveda Poveda García[1], Joaquín García Fernandez[2], David Cañete Rebenaque[1], José Luis Gómez Tornero[1]

[1]Universidad Politécnica de Cartagena, España; [2]Università Di Siena

The design, manufacture and testing of a micro strip leaky-wave antenna in the UHF band is reported. The antenna is fabricated using low-cost materials and handmade techniques. This activity is intended for educational purposes and hands-on training of antenna engineering and related applications. Particularly, the proposed antenna can be used for localization of passive RFID tags and DVB-T base stations.

Dynamic Terahertz 2D Beam Steering by Joint Operation of Leaky Wave Antennas and CORPS Beamforming Networks

Carlos Biurrun-Quel[1], Thomas Haddad[2], Andreas Stöhr[2], Jorge Teniente[1], Carlos Del-Río[1]

[1]Institute of Smart Cities and Dept. of Electrical, Electronic and Communications Engineering. Public University of Navarra; [2]Center for Semiconductor Technology and Optoelectronics (ZHO). University of Duisburg-Essen

Performing a controlled 2D beam deflection at Terahertz (THz) frequencies is a key aspect for the broad implementation of multi-user, ultra-high capacity THz communication systems, as well as for other applications such as radar and imaging. In this work, controlled 2D beam steering is demonstrated by the combination of an array of Leaky Wave Antennas (LWA) and a beamforming network (BFN) based on Coherently Radiating Periodic Structures (CORPS). A system prototype is designed and measured, showing a scanning range of more than ±º40 in elevation and ±20º in azimuth. The system is driven by table-top photonic-based source that controls both the frequency and relative phase of the signals feeding the network. Due to the planar integration on indium phosphide (InP), this work contributes in paving the way to the future integration of photonic-based THz sources with antenna arrays

Procedimiento de diseño de un polarizador multicapa en un único entorno de simulación

Mariano Baquero Escudero[1], Alejandro Valero Nogueira[1], José Ignacio Herranz Herruzo[1], Miguel Ferrando Rocher[2], Bernat Bernardo Clemente[1]

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

Este trabajo presenta el diseño de un polarizador de cinco capas, que ha sido diseñado para cubrir las bandas de 19 GHz a 21 GHz y de 29 GHz a 31 GHz. Se propone un nuevo procedimiento de diseño que permite encontrar rápidamente la solución óptima utilizando un único simulador electromagnético. Se construyó y midió el polarizador diseñado, presentando excelentes resultados, tanto en relación axial como en adaptación.

Agrupación lineal con barrido electrónico para antena conformada de estación base de interior 5G a 3.5 GHz

Jorge Sánchez Castillo[1], Jose Luis Masa Campos[1], Pablo Sánchez Olivares[2]

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

En este artículo se presenta un agrupación lineal de parches microstrip con red alimentadora impresa basada en desfasadores digitales para el control de apuntamiento del diagrama de radiación en el plano de elevación. Dicha agrupación lineal, forma parte de cada una de las ocho caras del prisma ortogonal que configura una antena conformada operando como estación base para comunicaciones 5G en entornos de interior de alto alcance.

Dual-Band Patch Antenna Design for On and Off-Body Wireless Communications

Sarosh Ahmad[1], **Ahmed El Yousfi**[1], **Shuvra Barua**[2], **Daniel Segovia Vargas**[1]

[1]Universidad Carlos III de Madrid (UC3M), Spain; [2]Ahsanullah University of Science and Technology, Dhaka, Bangladesh

For on- and off-body communications, this article presents a simple patch antenna of dual-band feature along with coupled L-shape slots. As in industrial, scientific, and medical which is known as ISM band, the proposed antenna resonates at two distinct frequencies: 2.45 GHz and 5.8 GHz. The antenna's radiation pattern feature of the antenna is broadsided directional in the lower frequency band and in upper frequency band it becomes omni-directional. By providing a full planar ground on the back of the substrate, the suggested antenna's efficiency and performance in the vicinity of the human corpse are increased, and the value of the specific absorption rate (SAR) is greatly lowered. The substrate is made of FR-4, which has 1.6 mm thickness and a tangent loss of tanδ = 0.02. The proposed design's overall dimensions are 40 mm x 30 mm x 1.6 mm. At 2.45 GHz and 5.8 GHz, physical tissue elements like as muscle, fat and skin are employed to be assessed the effect of human somatic tissues. Over 1 gram of bulk tissue, the SAR values were 1.18 W/kg and 0.19 W/kg at 5.8 GHz and 2.45 GHz, respectively. According to the findings, the proposed antenna could be employed for the forthcoming communication technique of on-body and off-body as well as wireless communications.

Antenas Leaky-Waves Acústicas Moduladas

María Campo Valera[1], **José Luis Gómez Tornero**[1], **Alejandro Fernández Garrido**[2]

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

This paper shows the ability of Leaky-Wave antennas (LWAs) to provide a tapering of the phase and the leakage rate of the constituent Leaky mode, what allows synthesis of broadbeam radiation patterns with decreased lateral lobes, high efficiency focusing near field patterns, or highly directive antennas. These features can be applied to Acoustic Leaky-Waves Antenna (ALWAs), allowing scanning of a directional acoustic beam in the angular space using only a single-transducer for SONAR applications.

Lugar: sala Europa (1.0.2.B) Martes, 06/09/2022: 16:00-17:30

M.3.2. Sesión Especial: Metamateriales, metasuperficies y otras estructuras periódicas

Presidente de la sesión: Miguel Camacho Aguilar, Dayan Pérez Quintana

Electric Field Enhancement in THz Tripod Metasurfaces for Sensing Applications

Irati Jáuregui-López[1], Bakhtiyar Orazbayev[2], Victor Pacheco-Peña[3], Miguel Beruete[1]

[1]Grupo de Antenas-TERALAB, Universidad Pública de Navarra, España; [2]Laboratory of Wave Engineering, École Polytechnique Fédérale de Lausanne (EPFL), 1015 Lausanne, Switzerland; [3]School of Mathematics, Statistics and Physics, Newcastle University, Newcastle

In this work, we propose, design, and evaluate three types of metasurfaces consisting of tripod-shaped cells working as thin-film sensors in the THz regime. We improved the electric field enhancement and thus the sensitivity by modifying its geometry from a straightforward, solid tripod design to a hollow structure. The best design showed a mean numerical sensitivity of 1.27 × 10−4 nm for extremely thin samples, meaning an improvement of 341% with respect to the initial designs. These results highlight the importance of having designs with geometries (usually more complex) that enable high-intensity electric field distributions over the whole metasurface.

Aplicación de la simetría glide al diseño de líneas diferenciales en estructuras DGS periódicas para la mejora del rechazo del modo común

Boules A. Mouris[1], Armando Fernández Prieto[2], José Luis Medrán del Río[2], Ragnar Thobaben[1], Jesús Martel Villagrán[2], Francisco Mesa Ledesma[2], Francisco Medina Mena[2], Óscar Quevedo-Teruel[1]

[1]KTH (Royal Institute of Technology), Estocolmo, Suecia; [2]Universidad de Sevilla, Sevilla, España

In this communication a planar common-mode filter based on a pair of coupled microstrips interacting with a periodic defected ground structure (DGS) is introduced. The novelty of the proposed structure lies on the incorporation of glide symmetry in the underlying periodic distribution of resonators. When comparing with the conventional non-glide implementation, the glide version shows a significant increasing of the rejection bandwidth of the common-mode whereas the differential-mode is barely affected, thus ensuring the integrity of the transmitted differential signal. Circuit models, simulations and experimental validation are provided to support the proposed concepts.

Average periodicity effects in aperiodic Fibonacci metasurfaces

Miguel Camacho Aguilar[1], Joshua K. Hamilton[2,3], Rafael Rodríguez Boix[1], Ian R. Hooper[3], Christopher R. Lawrence[2]

[1]Universidad de Sevilla, España; [2]Qinetiq LTD.; [3]University of Exeter, Reino Unido

In this paper we study the transmission and far-field energy distribution obtained when an aperiodic array, dictated by a long but finite Fibonacci sequence of slots which are cut onto an infinite zero-thickness metal and illuminated by a plane wave. To do so we exploit a tailored Method of Moments implementation and experimental measurements of a reduced-size array. We find that, when the aperiodic array is considered, the well-known arithmetic sequence of transmission anomalies due to the onset of grating lobes is replaced by those found in a an array with two periodicities, and we also find two families of corresponding grating lobes and their combinations. These two families are dictated by the smallest of the two separations of the Fibonacci sequence and the effective (average) periodicity of the array, given by the well-known Golden Ratio.

Metasuperficie 'Full-Space' a frecuencias milimétricas

María Ruiz Fernández de Arcaya[1], Miguel Beruete[1,2]

[1]Universidad Pública de Navarra (UPNA), España; [2]Institute of Smart Cities, Universidad Pública de Navarra

Las metasuperficies convencionales permiten controlar las ondas electromagnéticas en una sola frecuencia de trabajo operando en transmisión o en reflexión. Las metasuperficies Full-Space (FSM por sus siglas en ingés) permite operar en dos frecuencias con funcionalidades diferentes e independientes en transmisión y reflexión. Este trabajo presenta un dispositivo FSM basado en una celda unidad de 3 capas donde la fase se implementa siguiendo el principio de Pancharatman-Berry (PB). El dispositivo está diseñado para ondas milimétricas, operando la frecuencia más baja en reflexión y la más alta en transmisión. Para comprobar el rendimiento de la estructura se ha sintetizado un dirección de haz con dos ángulos de desviación, uno para cada modo de funcionamiento.

Wideband Polarization Converters Design Using Unit Cells with Diagonal Symmetry

Salvador Moreno Rodriguez[1], Jose Luis Medran del Rio[2], Ángel Palomares Caballero[1], Antonio Alex Amor[3], Armando Fernandez Prieto[2], Carlos Molero Jiménez[1]

[1]Universidad de Granada, España; [2]Universidad de Sevilla, España; [3]Universidad CEU San Pablo, Madrid, España

This paper presents a very simple unit cell with which two different wideband polarizers can be achieved. A theoretical study of diagonal symmetry has been carried out to reduce the complexity of the design by means of the decomposition of the incident electric field vector. Equivalent circuits are proposed based on transmission line theory, which have been very useful for designing both structures due to their ease of understanding resonant behavior. Both prototypes have been manufactured and measured, validating the designs and theoretical studies and leading us to the approach of a future mechanical or electronic reconfiguration.

Low profile dual-band linear-to-circular polarization FSS for satellite communications

Roberto Garrote Moreno, Miguel Alejandro Salas-Natera, Ramón Martínez

Universidad Politécnica de Madrid, España

A Dual-band linear to circular polarization single-layer transformer Frequency Selective Surface (FSS) in reflection mode for satellite communications is presented. The unit cell proposed provides a low-profile antenna implementation and low-cost solution, achieving an axial ratio below 1dB in a frequency range from 17.7-20.9GHz (16%) at K band and 28.6-30.1GHz (5%) at Ka band. The obtained bandwidth fulfils the ITU frequency band for most of the global region. Besides, a dual-circular polarization can be obtained by using a two linear polarization feed with two ports. This reduces feed chain complexity, weight, and cost.

Lugar: sala Calisto (1.0.1.C) Martes, 06/09/2022: 16:00-17:30

M.3.3. Comunicaciones móviles e inalámbricas (II)

Presidente de la sesión: Leandro Juan Llácer, José Ignacio Alonso Montes

Herramienta de detección de intervalos de degradaciones en redes móviles

Hao Qiang Luo-Chen, Emil J. Khatib, Carlos S. Álvarez-merino, Carlos Baena, Raquel Barco

Instituto de Telecomunicación (TELMA), Universidad de Málaga, España

Las redes móviles actuales han desarrollado una alta complejidad, haciéndose imposible una gestión manual. Esto se debe a la cantidad de usuarios existentes, los factores del entorno, el alto número de las posibles configuraciones (CMs) de los distintos aspectos de la red, entre otras razones. El paradigma de las redes autoorganizadas (SON) aborda dicho problema proponiendo soluciones noveles para la automatización de la gestión. Típicamente, las soluciones se basan en el uso de técnicas de Machine Learning (ML), requiriendo de muchos datos de las redes para poder explotar su potencial. No obstante, la resolución de las degradaciones (o troubleshooting) en el servicio provisto por las redes sigue siendo un proceso principalmente manual, debido a la falta de atención investigadora en este tema. Para ello, el objetivo de este trabajo es crear una herramienta que detecta la existencia de degradaciones en las redes, a partir del análisis de métricas conocidas como indicadores de rendimiento principales (KPI). La detección se logra usando una máquina de estados para determinar la condición de la red. Una vez encontradas las degradaciones y, a partir de ella, extraer las muestras de datos que estén degradadas y las que sean normales. Esta tiene la ventaja de solo requerir la especificación de pocos parámetros y ninguna referencia con la que comparar para determinar la existencia de degradación.

Infraestructura 5G Standalone para Investigación y Desarrollo

Antonio Tarrías, Eduardo Baena, Sergio Fortes, Raquel Barco

Telecommunication Research Institute (TELMA), Universidad de Málaga

The deployment of 5G infrastructures has been notably addressed during the last years. In contrast, most of the cellular operators are opting for deploying 5G Non- Standalone (NSA), which relies on LTE as anchor technology (signaling, guaranteed coverage...). Nevertheless, 5G NSA is not able to provide all the enhancements that 5G envisions to introduce, including a wide variety of services and use cases. From the University of Ma´ laga, a complete 5G Standanlone (SA) private network has been deployed for research and development purposes. This infrastructure is composed by both indoor and outdoor cells with different equipment, respectively. It enables the use novel technologies such as beamforming to achieve better capacity and coverage, which means higher bandwidths and lower latencies. The aim of this work is to analyze the benefits in terms of transmission bandwidth and latency with reference to a LTE private Network. To accomplish this, some tests have been performed over the 5G SA network, providing also some insights about the use of MEC (Multi-access Edge Computing) in 5G.

Half-Duplex Co-operative Transmission in Downlink 5G Network Based on SDR Platform with D&F Relaying Technique

Randy Verdecia-Peña[1,2], José I. Alonso[1,2]

[1]Universidad Politécnica de Madrid, España; [2]E.T.S.I de Telecomunicación, UPM

We propose developing and improving the capacity of a Decode-&-Forward (D&F) relaying 5G SDR platform implemented by our investigation team. First, we generate a new 10 MHz downlink signal with the 5G features standardized by the 3GPP to emulate the Base Station (gNodeB). We then validate the emulated 5G signal in the gNodeB through the Keysight FieldFox Microwave Analyzer and MS2090A-Anritsu Spectrum Analyzer. Therefore, we also have evaluated the developed synchronization, detection, correction, decoding, demodulation, encoding, and modulation algorithms of our D\&F protocol. A realistic indoor-to-indoor environment and Non-Line-of-Sight (NLOS) channel have been considered to evaluate the enhanced D&F Co-operative 5G Network. The experimental

results illustrate that emulated 5G signal fulfills the 3GPP requirements. Lastly, the implemented D&F protocol eliminates the impact of channel effect and path loss in indoor wireless communications improving the 5G system performance.

Estimación paramétrica de canal en mmWave

Matilde Sánchez Fernández[1], **Antonia Tulino**[2], **Adrián Vega**[1], **Álvaro Callejas Ramos**[1]
[1]Universidad Carlos III de Madrid, España; [2]Universidad de Nápoles Federico II

Los nuevos paradigmas de comunicación inalámbrica 6G requerirán una multiplicación de la capacidad global del sistema y funcionalidades adicionales de la red, como el posicionamiento extremadamente preciso, que van mucho más allá de las capacidades de los sistemas actuales. Los nuevos sistemas tendrán como requisito el conocimiento del espacio multidimensional y la conectividad ubicua, que sólo pueden lograrse con arrays de antenas de dimensiones adecuadas y despliegues de antenas en superficies/espacios volumétricos que coexisten con usos adicionales de ese espacio. La estimación paramétrica del canal en mmWave, debido a la naturaleza sparse de la propagación en estas frecuencias, es de hecho un problema de recuperación de una combinación lineal sparse de steering vectors caracterizados cada uno de ellos por un parámetro multidimensional de frecuencia que contiene información relevante sobre las características de propagación del canal, como el AoA y AoD. Presentamos en esta comunicación mecanismos para recuperar estos parámetros y realizar la estimación de canal.

Gestión de valores anómalos en series temporales de redes celulares

Candelaria Cerezo Chaves, **Salvador Luna Ramirez, Álvaro Durán Martínez, Matías Toril Genovés, Carolina Gijón Martín**
Universidad de Málaga, España

In current cellular networks, historical information about cell configuration and performance is often stored in the operations support system to be used in proactive network management tools (e.g., packet scheduling network dimensioning, anomaly detection). These time series often have outliers due to loss of data or temporary anomalous cell performance caused by events in the scenario (e.g., concerts, sport events…) or in the network (e.g., deployment of small cell). No matter the considered forecasting approach (e.g., machine learning, time series analysis), removing outliers is key to achieve accurate forecasts. In this work, the performance of several anomaly detection algorithms to manage outliers in daily data traffic time series from a live cellular network is compared. The considered methods are based on statistical analysis, machine learning and regression. Assessment is carried out by comparing the impact of outlier management in subsequent predictions obtained with a forecasting method based on supervised learning. Results show that outliers management significantly improves predictions. Among the compared methods, polynomial RANSAC has shown the best performance, improving the mean absolute error on 25% compared to the start point.

Obtención de intervalos de confianza en redes neuronales para predicción en redes celulares

Juan Luis Bejarano Luque, **Matías Toril, Carolina Gijón, Salvador Luna Ramírez, Álvaro Durán**
Telecommunication Research Institute (TELMA), Universidad de Málaga, Málaga (Spain)

Nowadays, cellular networks present an extreme complexity and high degree of dynamism, making predict fluctuations in the network performance an extremely challenging task. Because of previous research, deep-learning models have emerged as an attractive tool for predicting systems behavior. Unfortunately, the random nature of users conduct in cellular networks precludes an exact prediction, so knowing the possibly error is, in some cases, as important as the prediction. In this context, confidence interval grant a valuable information, defining a range around the prediction where the real future value must be found, with a certain percentage of confidence. In this work, a study of the performance of different models to predict confidence intervals in artificial neural networks is presented. Results highlight Bayesian Networks as a better option than traditional models, obtaining the same performance with less complexity and time execution to model aleatoric uncertainty, enabling also modelling the epistemic component.

Lugar: sala Ganímedes (2.0.1.A) Martes, 06/09/2022: 16:00-17:30

M.3.4. Radioastronomía

Presidente de la sesión: Eduardo Artal Latorre, Luisa de la Fuente

Desarrollo de filtros HTS en el Observatorio de Yebes

Pablo García Carreño, José Antonio López Perez, Isaac López Fernández, Juan Daniel Gallego Puyol
Observatorio de Yebes, España

En este artículo se pretenden mostrar los diferentes avances realizados en el Observatorio de Yebes en relación con el diseño de filtros Superconductores de Alta Temperatura (HTS). Esta tecnología nos permite eliminar las interferencias de radiofrecuencia a la entrada de los amplificadores criogénicos de bajo ruido (LNA) con pérdidas muy bajas, por lo que la contribución al ruido general del receptor es despreciable. Además, estos filtros comienzan a trabajar a temperaturas por debajo de 70 Kelvin, por lo que esta temperatura coincide con la temperatura de trabajo del criostato. Se mostrarán dos filtros diferentes, así como diferentes aspectos a considerar en su diseño.

Radio Frequency Interference Measurement System

Marta Bautista Durán, Pablo García, Francisco Beltrán, Sergio Henche, José Antonio López Pérez
Observatorio de Yebes, España

This document shows the Yebes Observatory radio frequency interference (RFI) monitoring system, including, hardware and software. The system is composed by a set of antennas installed at the rooftop of the laboratory building, covering the frequency range from 1 to 40 GHz. A downconverter is used to transport the signal down to the laboratory through a low loss coaxial cable, and an spectrum analyzer is used to monitor the spectrum and acquire data. The whole system is controlled remotely by a control software developed in Python. It integrates all of the different parts of the system. The purpose of this system is to monitor the Yebes Observatory RFI radio environment, and to check wether the radio astronomy bands are free from RFI. Some preliminary results show that the most polluted band is below 3 GHz, where almost all of the fixed and mobile services are present. The 5 GHz band presents WiFi signals, and the 9 GHz one is polluted by radars from aircrafts.

Adaptación de técnicas de holografía coherente de microondas en radiotelescopios conformados

Celia Fontá Romero[1], Fernando Rodríguez Varela[1], Belén Galocha Iragüen[1], Jose Antonio López Pérez[2]
[1]Universidad Politécnica de Madrid, España; [2]Observatorio de Yebes

The surface of radio telescope suffers degration over time due to athmospheric effects, gravity, etc. Radio holography is typically used in radio telescopes in order to characterize the errors in the surface by computing the complex radiation pattern and obtaining an aperture field directly related to the surface anomalies. Once obtained this aperture field, some corrections are made so as to substract the effects of the antenna geometry, aberrations and feed imperfections. Contrary to parabolic reflectors, for which these corrections have been broadly studied and can be modelled through equations, conformal surfaces require a more ellaborate analysis on how to implement the corrections. This paper shows the changes that must be applied and the obtained results.

Correlador para un receptor de radioastronomía en la banda Ku con guías integradas en substrato

Eduardo Artal Latorre, Javier Bustillo López, Beatriz Aja Abelán, Luisa de la Fuente Rodríguez
Universidad de Cantabria, España

A typical receiver for Cosmic Microwave Background (CMB) polarization measurements is a broadband polarimeter radiometer. In a direct detection receiver scheme, a suitable way to obtain polarization data is to use a microwave correlator prior to diode detection section. Such correlator is designed to provide output signals having an average power proportional to Stokes parameters combinations. These Stokes parameters define univocally the polarization degree of the incoming CMB waves from the sky. To achieve a good enough sensitivity for a complete receiver instrument installed in a radio telescope, there is a need of a high number of pixels (individual receivers). A low-cost solution for the broadband microwave correlator is to use Substrate Integrated Waveguide (SIW) technology. The correlator described in this document covers from 10 to 14 GHz inside the Ku band. It is manufactured following a modular concept, to check individually each SIW component before the integration of the prototype demonstrator. The selected dielectric substrate is a commercial one with 1.52 mm thickness, a relative dielectric constant of 3.55 and low loss tangent. Experimental results have shown the correlator right performances within the operational bandwidth.

Compact and Integrated MM-wave Radio Astronomy Receivers Working at Room Temperature

Kerlos Atia Abdalmalak[1], Gabriel Santamaría-Botello[2], Enderson Falcón-Gómez[1], Luis Enrique García-Muñoz[1]
[1]Department of Signal Theory and Communications, Carlos III University of Madrid, 28903 Madrid, Spain; [2]Electrical, Computer and Energy Engineering Department, University of Colorado, Boulder, CO 80309, USA

Recently, there is an increasing demand for mm-wave radio astronomy receivers that simultaneously are compact, easy to integrate, and operating at room temperature. This paper presents two typologies of such receivers (down-conversion and up-conversion) that are capable of working efficiently at room temperature. Firstly, an Antenna-based Emitter (AE) to be used as a local oscillator for the down-conversion receivers. It covers UWB from 100GHz to 1THz and can be readjusted easily to cover different UWB ranges. The AE is based on an array version of 3 × 3 self-complementary bow-tie antennas and photomixers that lies on a dielectric lens. It is compact, operates at room temperature and can be integrated easily to other receiver components. This is along with the possibility for extending it to a larger number of elements without a corresponding increase in the fabrication/alignment complexity in case higher directivity and radiated power are needed. Secondly, photonic nonlinear up-conversion receiver for Cube-Sat satellite climate change forecasting at 183GHz. Compared to the previous receiver which down-converts the mm-wave radiation to lower frequencies, here the radiation is nonlinear up-converted into the optical domain using Whispering Gallery Mode (WGM) resonators. This allows the detection with commercially available optic devices which can work at room temperature efficiently providing a compact and low-cost integrated receiver. For such advantages, this concept is a good candidate for CubeSat missions at the mm-wave band for water vapor profile measurements and weather forecasting as it would reduce the cost, weight, and volume of the satellite receiver. Additionally, removing such cryogenic components will significantly increase the satellite mission lifetime.

Lugar: sala Ío (1.0.2.A) Miércoles, 07/09/2022: 09:00-10:45

X.1.1. Sesión Especial: Reflectarrays, Transmitarrays and Spatially-fed Antennas

Presidente de la sesión: Alvaro Fernández Vaquero, José Daniel Martínez de Rioja del Nido

Multivariate Look-Up Table Based on N-Linear Interpolation for General Reflectarray Design

Daniel Rodríguez Prado, Jesús A. López Fernández, Manuel Arrebola
Universidad de Oviedo, España

We present a multivariate look-up table (LUT) based on N-linear interpolation for a fast general reflectarray design. In order to achieve an efficient implementation of the LUT, details are provided on its structure and a technique for a fast memory access of the reflection coefficients is described. A general formulation for the N-linear interpolation is given and then it is applied to a general reflectarray design procedure, including the improvement of the cross-polarization figures of merit. In order to benchmark the computational efficiency of the LUT, it is compared with other two tools, a method of moments based on local periodicity and surrogate models based on support vector regression. Results show that the LUT achieves a high computational efficiency while preserving a high degree of accuracy.

Optimization-Based Design of Reflectarrays and Automatic Construction and Simulation with CST

Ignacio Parellada Serrano, Ángel Palomares Caballero, Carlos Molero Jiménez, Pablo Padilla de la Torre
Universidad de Granada, España

This paper presents a full process of phase distribution calculation using an optimization algorithm and a total automation of designing reflectarrays (RAs) in CST. With our method, we can choose the number of beams in which the structure will split the incident wave and their main beam directions. Given that, the algorithm quickly calculates the distribution of phases needed in the RAs. Besides, we take advantage of CST API for Matlab in order to automatically build and simulate our 3D structure configuration in that software. We use all this to design some RAs that redirect, split the incident wave in the desired directions and produce holography.

Antena Reflectarray Multi-haz para Comunicaciones en Banda Ka desde Satélites LEO

Daniel Conde-Parraga, Daniel Martinez-De-Rioja, Jose A. Encinar
Universidad Politécnica de Madrid

In this contribution, a multibeam reflectarray antenna in Ka-band is proposed to generate a cellular coverage at 18.2 GHz from LEO satellites for the user's downlinks. The phase distribution provided by the reflectarray cells has been optimized to broaden the beams and reduce the distortion of the extreme beams of the coverage. The antenna performance of a standard reflectarray, with a conventional phase distribution to focus pencil beams, and the proposed reflectarray have been compared by simulated results. Preliminary simulations show that the proposed reflectarray can generate a continuous coverage of 36 beams with an End-Of-Coverage level of 26 dBi.

Preliminary Geometry Analysis for Compact Scanning and Multi-Beam Reflectarray Antennas

Andrés Gómez Álvarez, Álvaro Fernández Vaquero, Manuel Arrebola Baena, Marcos Rodríguez Pino
Universidad de Oviedo, España

This work presents a comparative study between two common compact configurations for reflectarray (RA) beam scanning in Ka-band: focal-arc and linear feed displacements. A reference phase-only design is defined for a collimated pattern, and the natural degradation caused by feed de-focusing is studied for each case. Practical considerations regarding the implementation of each solution are also discussed. Finally, the discrepancies between the presented phase-only study and a physical cell response are evaluated. A layout is defined, and its response is calculated for a set of feed positions considering the real incidence angles at each cell. These results are compared to the previous phase-only analysis.

Antena reflectarray polarizadora de doble banda con operación en polarización dual circular para nanosatélites CubeSat

Eduardo Martínez de Rioja[1], Ignacio Linares[2], Daniel Martínez de Rioja[2], José A. Encinar[2]
[1]Universidad Rey Juan Carlos, España; [2]Universidad Politécnica de Madrid, España

This contribution proposes a dual-band polarizer reflectarray antenna in K/Ka-bands for CubeSat applications. The reflectarray has been designed to generate a collimated high-gain beam at both 19.7 and 29.5 GHz, while converting the incident polarization from dual-linear into dual-circular polarization. The independent operation at two separate frequency bands is accomplished by a dual-layer reflectarray cell. The flat surface of the reflectarray simplifies the mounting of the antenna on the small spacecraft and the linear-to-circular polarization conversion allows to reduce the number of components in the feed chain, also reducing the cost and complexity of the antenna subsystem.

Dual-Polarized Plane Wave Generator based on Reflectarray for its Application to Portable CATR Systems

Alvaro F. Vaquero[1], Rafael Florencio[2], Marcos R. Pino[1], Manuel Arrebola[1]
[1]Universidad de Oviedo, España; [2]Universidad de Alcalá, España

In this work, a reflectarray antenna is introduced to act as a plane wave generator (PWG) to evaluate devices in mm- Wave frequencies. The reflectarray is designed to radiate a uniform plane wave close to the aperture to reduce the size of the system. The Intersection Approach is used to design the reflectarray carrying out two phase-only synthesis for the two linear polarizations. The synthesis significantly improves the results obtained by an analytical approach obtaining a dualpolarized PWG. The result of the synthesis is used to carry out a design. The unit cell is a double set of orthogonal coplanar dipoles printed on a single-dielectric layer. The designed reflectarray shows significantly good performance in terms of the uniform plane wave obtained. Finally, the reflectarray-based PWG is used for the first time to evaluate the radiation pattern of an antenna. This compact measuring system presents quite good results evaluating the radiation pattern.

3D printing as an effective tool for Transmit-array design at Ka band

Sergio Matos, Jorge Costa, Joao Felicio, Carlos Fernandes
Instituto de Telecomunicações, Portugal

Transmit-arrays (TAs) can be a cost-effective solution for Satellite on-the-Move (SoTM) applications. Combining the flexibility of TAs with 3D printing can further enhance the low-cost potential of these antennas. This work shows that Fuse Deposition Modelling (FMD) 3D printing technique can be effective even for demanding designs, as the one considered in this study. A dielectric TA antenna with wide mechanical beam scanning (up 50 degrees) with an extremely low profile (F/D=0.34) and 26 dBi maximum gain at 30 GHz is optimized. Although the resulting aperture is thicker and have higher losses comparing with solutions based on printed circuit board (PCB) technology, we show that the performance of this low-cost antenna is still competitive. We study how different ways of crafting the TA phase correction in the dielectric block can improve the performance of the antenna.

Lugar: sala Europa (1.0.2.B) Miércoles, 07/09/2022: 09:00-10:45

X.1.2. Sesión Especial: Antenas y dispositivos de RF basados en nuevas técnicas y tecnologías de fabricación (II)

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

Diseño novedoso de un array transversal de 16 ranuras en SIW

Alfonso Gómez García[1], Jesús Rubio[1], Jose Luis Masa Campos[2], Juan Córcoles[2], Yolanda Campos Roca[1], Rafael Gómez Alcalá[1]

[1]Universidad de Extremadura, Escuela Politécnica de Cáceres, España; [2]Universidad Autónoma de Madrid, Madrid

Slot arrays, placed on the top plate of waveguides, have historically presented many problems in terms of adaptation and broadside radiation. Transversal slots usually worsen this problem, due to the increased difficulty to adapt this radiating element. This work introduces the design process of a novel unidimensional transversal 16-slot array, fed by a substrate integrated waveguide, that does not follow the tendencies shown in the state of the art. An optimization process with 47 optimization variables, using U-NSGA-III, is carried out. The obtained design is validated with CST Studio Suite 2020, manufactured and experimentally characterized. A 440MHz bandwidth under −10 dB, in terms of |S11|, a maximum gain of 15,36 dBi at θ = −6◦ in the array plane at 17GHz, with a total efficiency of 56,5% and a 96,5% impedance mismatch factor, is measured.

A Fully 3D-Printed Patch Antenna using a New ABS Conductive Material

Javier Jiménez Peña[1,2], Joseba Irigoyen Otamendi[1], Maite Aresti Bartolomé[1], Iñigo Ederra Urzainqui[2,3], Javier Bravo Larrea[1], Juan Carlos Iriarte Galarregui[2,3]

[1]NAITEC - Centro Tecnológico de Automoción y Mecatrónica; [2]Departamento de Ingeniería Eléctrica, Electrónica y de Comunicación. Universidad Pública de Navarra; [3]Instituto de Smart Cities, Universidad Pública de Navarra

Additive manufacturing technology is rapidly overcoming some of its initial limitations and, thus, creating a very useful engineering option for prototyping complex geometries for a wide range of electronic devices. Based on important advantages such as turn-around, realiability, material waste reduction, and low implementation costs, the technology is being continuously developed and improved. This paper presents a completely 3D-printed microstrip patch antenna to demostrate the feasibility of a new conductive Acrylonitrile Butadiene Styrene (ABS) material in the fabrication of flexible three-dimensional (3D) antennas using additive manufacturing method. The prototype of the antenna has been fabricated using Raise3D E2 printer, comercial ABS and a new ABS filament developed by Naitec for dielectric and conductive parts of the antenna, respectively. The fabricated antenna possesses compact size and light-weight structure

Additive Single-Piece Manufactured Dual-Band Multi-Polarization Cavity Antenna Design for SATCOM Frequency Bands

Jorge Calatayud Maeso, Alfonso Tomas Muriel Barrado, Adrian Tamayo Dominguez, Pablo Sánchez Olivares, Jose Manuel Fernandez Gonzalez

Information Processing and Telecommunications Centre, ETSI Telecomunicación, Universidad Politécnica

A highly reconfigurable dual band cavity structure for satellite communications at K/Ka band is proposed. The key of the presented structure lies on a compact dual stacked cavity system. By modifying the radius of each cavity and the dimensions of the feeding slot, both cavities have been matched at the center frequency of their respective band. Correctly enabling and phasing each input port allows to generate any desired polarization scheme. Cavity radiuses were carefully chosen to prevent any coupling of the K band cavity with the Ka band one. This structure has been integrated with a Turrin horn antenna that operates as a multimode horn for the Ka band. Monomode operation at the lower band was ensured by limiting the horn aperture radius. In this configuration a directivity of 10.3/12.4dB in K/Ka band was achieved. Additive manufacturing techniques enable the fabrication of this structure as a single piece.

Advanced Manufacturing Techniques Applied to Geodesic Lens Antennas

Jose Rico Fernandez[1], Omar Orgeira[2], Manuel Arrebola[3], Oscar Quevedo-Teruel[2]

[1]TheNextPangea SL; [2]KTH Royal Institute of Technology, Sweden; [3]University of Oviedo

To compensate for path loss and propagation attenuation, new high-frequency telecommunication and radar systems require high-directivity antennas with low scan losses. Geodesic lens antennas are an attractive alternative for these new applications due to their high directivity, efficiency, and low scan losses. Here, it is described how to generate rotationally symmetric geodesic lenses using non-Euclidean transformation optics. With this technique, the corresponding geodesic shape of a Luneburg lens is determined. This lens transforms cylindrical waves to planar waves. Afterwards, we introduced the concepts of half-Luneburg and modulated geodesic lenses. Furthermore, an advanced additive manufacturing technique known as laser bed-powder fusion is described and thoroughly analysed. To demonstrate the potential of these technologies together, two different 10-port half-Luneburg lens antennas in K_a-band were designed and manufactured. The antennas present a scan angle of 60º with a 23.3dBi gain and 1.5dB and 2.3dB scan losses, respectively.

Diseño y análisis de Antena Semitransparente mediante grid

Luis Inclán Sánchez

Universidad Carlos III de Madrid, España

This paper analyzes the design of a semi-transparent Planar Inverted-F Antenna (PIFA) to operate in the 5G band. The proposed antenna consists of a set of metallic wires that form a grid which configures the conductive parts of the antenna. This new radiant element offers an adequate response in terms of gain and impedance matching. On the other hand, it can be easily manufactured using 3D printing techniques. The semitransparent element has been integrated into a 2x2 subarray to analyze its application in MIMO systems. The subarray has been tuned to provide port isolation, good impedance matching, envelope correlation coefficient and radiation characteristics which are desired for MIMO applications. The proposed element offers utility to implement large antennas in array configuration and, at the same time, allows visible light to pass through it.

Lugar: sala Calisto (1.0.1.C) Miércoles, 07/09/2022: 09:00-10:45

X.1.3. Procesado de señal: voz, imagen y datos

Presidente de la sesión: Ana M. Barbancho Pérez, Pedro Núñez Trujillo

Censo Automático de Bateas Mejilloneras Utilizando Imágenes de Sentinel 2

Fernando Martín-Rodríguez, Fernando Isasi-De-Vicente, Mónica Fernández-Barciela

Universidade de Vigo, España

Las bateas mejilloneras son grandes estructuras flotantes hechas de madera (el tamaño es, normalmente, de unos 20x20 metros o, incluso, más) que se utilizan para la acuicultura. Estas estructuras son propias de las rías gallegas, siendo interesante elaborar un censo periódico de estas estructuras que permita conocer su número y posiciones, así como detectar cambios, bateas nuevas y dadas de baja… Los satélites que obtienen imágenes periódicas para la observación de la Tierra son una elección natural para este tema. Existen trabajos anteriores con este objetivo utilizando datos SAR. En esta comunicación se describe una aplicación que usa la información óptica de Sentinel 2. Aun tratándose de una versión preliminar, somos capaces de construir automáticamente un censo útil. Sentinel 2 es un satélite del proyecto Copernicus, administrado por la Agencia Espacial Europea (ESA). Las imágenes producidas se obtienen libremente en Internet, se trata de imágenes multiespectrales de trece bandas que se actualizan cada cinco días. En nuestra aplicación utilizamos índices diferenciales normalizados (muy comunes en teledetección) y también Redes Neuronales artificiales aplicadas a datos multibanda. Se describen y prueban diferentes métodos y se presentan los resultados.

EEG Signal Analysis for the Detection of Spoken Language Comprehension

Sergio Guillén[1], Lorenzo J. Tardón[1], Ana M. Barbancho[1], Irene de-Torres[2], Isabel Barbancho[1]

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The human brain performs a series of complex processing steps to translate spoken language from mere sound into meaning. In this article, through the analysis of electroencephalogram (EEG) signals, we try to identify those areas with their signals in which there is a substantial difference in brain activity when different languages are sought aiming at the detection of language comprehension. For this purpose, a set of sentences, both in their native and foreign languages, have been presented to various individuals. Following previous works, we defined an analysis window to determinate whether the language presented is understood or not. Within the analysis window, in the first phase, a couple of evoked potentials (ERPs) are expected, showing a positive discrimination of language, followed by fluctuations of ERPs in a second-phase window depending on subject intelligibility of the language presented. The results point in the direction different ERP waveforms regarding the comprehension or not of the language.

Sonification of EEG signals by histogram-based mapping

Mario Molina-Molina[1], Lorenzo J. Tardón[1], Ana María Barbancho[1], Irene de-Torres[2], Isabel Barbancho[1]

[1]ATIC Research Group, E.T.S.I. Telecomunicación, Universidad de Málaga, E-29071, Málaga, Spain.; [2]Hospital Regional Universitario de Málaga, Av. de Carlos Haya, 84, E-29010 Málaga, Spain.

Sonification is the transformation of signal features into sounds or signals of audible ranges. Specifically, in the context of EEG sonification, its applications range from realtime monitoring to inform the brain status of a patient to rehabilitation. Currently, EEG sonification is also being used for music composition by using BCIs from music applications. Although the current state of technology makes it difficult to develop real-time applications via sonification (such as BCMI), they are often used offline. In our case, the mapping of prominent values in the EEG signals within each sonification sampling period, is used. These data are converted into MIDI values, making it

possible to listen to them. After this, the MIDI notes of EEG signals from subjects who have listened to the word ”yes” and ”no” in Spanish have been classified, using LOO crossvalidation and employing different classifiers (SVM, KNN and DT). It is shown that it is possible to perform classification on the basis of the sonification scheme used.

Aprendizaje y divulgación científica de los sistemas de grabación y reproducción sonora a través de los cuentos

Ana M. Barbancho, Isabel Barbancho, Alberto Peinado, Lorenzo J. Tardón
Universidad de Málaga, ETSI Telecomunicación, España

In this paper, we have presented the pilot experience of scientific dissemination based on the writing of stories by students of the ETSI Telecommunications, carried out in the academic year 2021-22. The aim of this experience is twofold: on the one hand, to learn how to popularize science to a children's audience and, at the same time, to work directly on the competence of transmitting information to a non-specialized audience (competence G-07). To evaluate the experience, questionnaires and interviews were carried out with both teachers and pupils involved in the activity. It was found that this experience has been very positive and has made it possible to work both on competence G-07 and on the writing of texts and scientific dissemination.

Comparing the Use of Soft and Hard Labels for Sound Event Detection

Carlos Mauricio Castorena Lara, Francesc Josep Ferri Rabasa, Maximo Cobos Serrano
Universidad de Valencia, España

Sound event detection with deep learning models such as convolutional recurrent networks have shown highly competitive results in performing this task. However, as they are supervised algorithms, the results are directly affected by the quality of the labeling, especially for events with an intermittent time activation. In this work, we evaluate the detection performance of a baseline architecture trained on artificial mixtures of events using the energy envelopes of isolated events as soft labels. Unlike with hard binary labeling, this allows not only to know the presence of the event, but also provides a prediction of its energy level, leading to a more informative description of the event temporal activation. The experiments show that the use of non-binary labels generate highly competitive results with respect to the state of the art and are a viable option to perform this task in the context of intermittent sounds.

Diseño de un laser 2D omnidireccional usando un array de cámaras RGBD para vehículos autónomos

Félix Vidarte Vidarte, Sergio Barroso Ramírez, Pablo Bustos García de Castro, Pedro Miguel Núñez Trujillo
Universidad de Extremadura, España

Research in the field of autonomous vehicles and advanced driver assistance systems is already unstoppable. Autonomous vehicles are based on different sensor technologies that perceive the environment to make logical decisions similar to humans. In the coming decades, the technology that will develop these onboard sensors will experience remarkable growth, improving their performance and lowering design and manufacturing costs. The most common sensors for obstacle detection while driving are those commonly known as range sensors, namely lidar, radar, or ultrasound. This paper describes the design of an omnidirectional 2D virtual laser built from the images captured by an array of RGBD cameras arranged along the vehicle's perimeter. This new omnidirectional virtual sensor's performance/cost ratio improves on most solutions on the market, facilitating its integration and deployment in future fleets of connected autonomous vehicles. Experimental results validate the proposed design on a vehicle equipped with six Intel RGBD cameras.

Lugar: sala Ganímedes (2.0.1.A) Miércoles, 07/09/2022: 09:00-10:45

X.1.4. Telemática: IoT, interfaces de comunicación (II)

Presidente de la sesión: Sergio Fortes Rodríguez

Sistema IoT para la monitorización de datos de temperatura y humedad en el compostaje

José Pulido Alegre, Sergio Fortes Rodríguez, Francisco Javier Hormigo Aguilar, Andrés Rodríguez Moreno, Victor Alonso Robles-carnero, Rafael Sesmero Carrasco

Universidad de Málaga

Approximately one-third of all annual food production in the world is lost or wasted. This supposes a serious problem for the society in which we live since it aspires to a circular economy model. Compost appears as a possible solution to palliate this problem, which helps take advantage of the nutrients from organic waste to convert them into fertilizer for plants. Sometimes, unbalance of the parameters in the composting process produces poor quality compost. In this work, an IoT system has been developed to monitor in real time the temperature and humidity of a compost pile at different heights to help obtain the best quality of the compost.

Modelo digital gemelo para vehículos conectados basado en una memoria compartida de baja latencia

Sergio Barroso Ramírez, Félix Vidarte Vidarte, Pablo Bustos García de Castro, Pedro Miguel Núñez Trujillo

Universidad de Extremadura, España

Digital twin models are an evolution of cyber-physical systems that reach an enormous interest in the scientificcommunity. These digital twins allow multiple possibilities by linking real-world activities with their twin counterparts, among others, to anticipate scenarios to prevent or improve the handling of different situations. This paper describes a digital twin model paradigm for connected vehicles used for different purposes, such as remote-controlled or autonomous driving. The core element of this twin digital model is a distributed architecture of software agents (CORTEX-DSR) that share a representation of the virtual environment. Onboard devices continuously update this virtual world in runtime. Our twin digital model is validated in simulated and real environments through different experiments where the system provides remote-controlled driving aids. The results show that the proposed digital twin framework can be applied to remote-controlled driving systems as long as communication delays and packet losses are acceptable.

Seguridad en B5G/6G

Joel Llanes Michel, Emil Jatib Kathib, David Segura Ramos, Raquel Barco Moreno

Universidad de Malaga, España

While the development and deployment of the 5G NR network is still ongoing, academia and industry has already started research on 6G. The development of 6G specifications is expected to start in 2026. Currently, one of the main concerns of the industry and public is security in cellular communications, therefore, security by design will be one of the driving factors in the future development of B5G/6G networks. This article aims to give a first insight into the current state of the art in the field of 6G security.

Modelo de evaluación de calidad de experiencia para servicios de vídeo inmersivo por LTE basado en drones

Nuria González Serrato, Marta Solera Delgado, Fernando Ruiz Vega, Matías Toril Genovés, Carolina Gijón Martín
Telecommunication Research Institute (TELMA), Universidad de Málaga, Spain

Several upcoming 5G and 6G services rely on Unmanned Aerial Vehicles (UAV) sending live data to other remote User Equipments (UEs) in Beyond Visual Line of Sight (BVLOS) scenarios. Thus, understanding the traffic flows implied in these services and estimating Quality of Experience (QoE) perceived by end-users is key for network operators. One of this services is First Person View (FPV), consisting on the remote control of the UAV by the live video visualised in the Ground Control Station (GCS). In this work, an UAV quadrotor for FPV system connected by LTE is presented. The main contribution is the definition of a closed mathematical expression provided to define the Quality of Experience (QoE) for FPV use cases considering the video quality in terms of Video Multimethod Assessment Fusion (VMAF), network latency and video resolution as inputs. This expression will be applied to lab experiments taking into account link performance, in which network changes based in packet loss, throttling and latency alterations will be introduced to measure the QoE of the UAV system.

Estimación de KQIs para servicio de Vídeo-360

Sebastián Peñaherrera Pulla, Carlos Baena, Sergio Fortes, Antonio Tarrías, Raquel Barco
Telecommunication Research Institute (TELMA), Universidad de Málaga)

The evolution of mobile networks has led to great opportunities for the development of cutting-edge services. One of these is 360-Video, which is an application of VR (Virtual Reality) technology that intends for displaying immersive multimedia content. This work presents a framework that enables the estimation of Key Quality Indicators (KQI), through the use of ML (Machine Learning) mechanisms, based on Key Performance Indicators (KPI) and network configuration parameters. This methodology aims to quantify metrics that are useful for Quality of Experience evaluation using objective perspectives. The algorithms' performance is assessed through MAE in two estimation scenarios, per-sample and session average. The results describe the algorithms' performance of KQI estimation for 360-video over LTE service.

On QoS estimation over real 802.11 networks using machine learning models

Abraham Pérez-Hernández, Maydelis N. Barreras-Martín, Pablo Aguilera
Galgus, España

Nowadays, as wireless networks are becoming more complex, the troubleshooting of these networks is also more difficult. This paper addresses this problem divided in two steps: first a quality-of-service estimation in function of many metrics is implemented in real 802.11 networks, and secondly an analysis of the attained estimation and model is carried out in order to detect anomalies as well as provide the most probable root cause of these anomalous values. For this purpose, a complex system for remote data collection, post-processing, and analysis has been built, including its deployment and operation for weeks in two real-world corporate WiFi networks. In various experiments, some machine learning techniques, in particular different supervised classification models such as decision trees, random forest, and neural networks, have been applied. Impact of the hyperparameters, the influence of network features on the estimated values, as well as their accuracy depending on the size of the training set have been analysed.

Mitigating the fundamental problem of WiFi analytics: De-randomization of MAC addresses in real-world scenarios using radio signatures

Abraham Pérez-Hernández, Maydelis N. Barreras-Martín, Jesús Fernández-Manzano, Pablo Aguilera

Galgus

This paper addresses the problem of constructing stable and reliable identifiers of non-connected WiFi devices when they are continuously changing their MAC address precisely to confuse analytics systems. This problem is known as MAC randomization, and it is a real challenge for building services based on presence, location, and tracking data since the information is useless due to the distortion. We propose a new system that builds unique and stable device identifiers based on the radio signature of the Probe Request frames. In addition, we present what is (to the best of our knowledge) the most exhaustive field study on the accuracy of this type of system with real users and real devices in operation. In this study, we compare the hand count performed in a campus building with the count done automatically by the MAC de-randomization system, obtaining an accuracy between 87 and 95%.

Lugar: sala Ío (1.0.2.A) Miércoles, 07/09/2022: 11:30-12:30

X.2.2. Metamateriales

Presidente de la sesión: Rafael Rodríguez Boix

Diseño de metamateriales multicapa para enfriamiento radiativo mediante algoritmos genéticos

Carlos Lezaun Capdevila[1], Tania Jorajuría[2], Alicia E. Torres-garcía[1], Pilar Herrera[2], Miguel Beruete[1,3]

[1]Grupo de Antenas, Dpto. Ingeniería Eléctrica Electrónica y de Comunicación, Universidad Pública de Navarra, España; [2]Grupo de Sistemas Inteligentes, Asociación de la Industria Navarra; [3]Institute of Smart Cities, Universidad Pública de Navarra

In this work, we present a design flow for thin-film multi-layer metamaterials for radiative cooling devices based on genetic algorithms. It has the advantage of being automatable with further development, does not rely on commercial electromagnetic solvers and needs fewer design experience in metamaterials than conventional designs. Moreover, a metamaterial with 24 layers and a height of less than 4.8 µm that achieves a net cooling power of nearly 62 W/m2 is demonstrated. This design process can be used for other infrared applications of thin-films. Finally, this work can be used to develop easy automated design for thin-film multi-layered radiative coolers in the future.

Metamateriales para mejorar la emisión solar e infrarroja del compuesto CSH para enfriamiento radiativo

Carlos Lezaun Capdevila[1], Jorge S. Dolado[2,3], Alicia E. Torres-García[1], José M. Pérez-Escudero[1], Iñigo Liberal[1,4], Miguel Beruete[1,4]

[1]Universidad Pública de Navarra, España; [2]Centro de Física de Materiales (CFM); [3]Donostia International Physics Center; [4]Institute of Smart Cities

Calcium silicate hydrate (CSH) gel is the most important component of cement-based materials. In this work, we propose two different periodic structures based on metal bars to enhance CSH for daytime radiative cooling. This implies a high solar spectrum reflection and a high emission within the atmospheric window. The results suggest that lattice effects from the interaction between bars can be exploited in the design to enhance solar reflection. The sizes of the metal bars are selected according to current state of the art manufacturing techniques. This study is limited to a CSH gel permittivity model, with further research pending on a better description of the dielectric function of concrete that is currently in development.

Multipactor Threshold Comparative Study Between Groove Gap and Rectangular Waveguide Technologies

Irene Asensio[1], J. Joaquín Vague[1], Ángela Coves[2], Ángel A. San Blas[2], Mariano Baquero-Escudero[1], Vicente E. Boria[1]

[1]Universitat Politècnica de Valencia, España; [2]Universidad Miguel Hernández de Elche, España

This paper presents a comparative study of the different multipactor thresholds obtained in Rectangular Waveguide (RW) and Groove Gap Waveguide (GGW) technologies. Firstly, a technique developed by the authors has been used to analyse theoretically the multipactor level in RWs. Results have been compared with those from an available commercial software, obtaining negligible differences. Second, by using an accurate electron tracking code, the breakdown power levels in the equivalent GGW have been predicted, showing a reduction of the multipactor power threshold. Third, two aluminum WR90 symmetric E-plane RW transformers, one of them with the central section in GGW technology, have been designed and their multipactor breakdown power levels have been predicted at five different frequencies. Finally, both transformers have been manufactured and tested in an extensive multipactor campaign. The measured results agree well with simulations, thereby fully validating the obtained results.

Circuit Modelling of Time-varying Structures

Antonio Alex-Amor[1,2], **Pablo Padilla**[2], **Carlos Molero**[2]

[1]Universidad CEU San Pablo, España; [2]Universidad de Granada, España

This paper presents an analytical formulation for the analysis of time-modulated metamaterials. The formulation, which admits a circuit representation, is based on Floquet modal expansions and integral-equation techniques. Some results are presented to validate the present approach and a good agreement is observed with a self-implemented FDTD method.

Lugar: sala Europa (1.0.2.B) Miércoles, 07/09/2022: 11:30-12:30

X.2.3. Sesión Especial: Recent advances in Small Satellites for Communications and Earth Observation

Presidente de la sesión: Adriano Camps

FSSCat: demostración en órbita de las capacidades de los CubeSats para monitorizar variables climáticas esenciales del ciclo del agua

Adriano Camps
Universitat Politecnica de Catalunya, España

The "Federated Satellite Systems/3Cat-5" (FSSCat) mission was the winner of the 2017 ESA S^3 (Sentinel Small Satellite) Challenge and overall winner of the Copernicus Masters competition. FSSCat consists of two 6-unit CubeSats. The mission primary goals are the generation of: 1) coarse resolution soil moisture, sea ice extent and thickness maps using L-band microwave radiometry and GNSS-Reflectometry, 2) enhanced resolution soil moisture maps applying pixel downscaling techniques by combining passive microwave and multi-spectral optical data, and 3) the testing of techniques for future satellite federations. Secondary goals are the generation of sea surface salinity and wind speed maps. FSSCat has been the first ESA Third Party mission based on CubeSats. The FSSCat mission and its main scientific results are presented.

Diseño de una Espiral Radiométrica de SiGe a 183GHz con Polarización Circular Dual para Aplicaciones de Observación Terrestre

Juan María Herrera Martín[1], Daniel Segovia Vargas[1], Vicente González Posadas[2]
[1]Universidad Carlos III de Madrid, España; [2]Universidad Politécnica de Madrid

New radiometer technology is a key enabling factor for the upcoming new generation of space missions; earth observation applications, with the use of cubesats and nanosatellites, will benefit greatly from the insight into our own planet these sensors can offer. In this paper, a four-armed cavity-backed radiometer spiral antenna is designed and simulated to capture the 183GHz water absorption line, fundamental for measuring moisture levels in the atmosphere. Due to the manufacturing difficulties involved, a scaled design centered in 7GHz is also provided. This scaled design is manufactured and measured as a way to validate the EHF design.

Design of HAPs High Throughput and flexible 5G Communication Payloads

Miguel Alejandro Salas-Natera, Gonzalo Lazaro Macein, Antonio Abad, Ramón Martínez Rodríguez-Osorio
Universidad Politécnica de Madrid, España

This work presents a technical analysis and a proposal of the payload architecture including a 5G antenna design. The analysis covers the comparison with terrestrial networks and satellites, and the frequency bands and service area limitation versus available power and payload technology onboard actual High-Altitude Platforms (HAP). For this, a review of the HAP system capacity and payload requirements is done. Furthermore, the definition of the payload architecture is based on actual and mature state of the art of the technologies and the antenna aperture has dual-band and dual-circular polarization operation capacity.

Design of the CUBIQU Cubesat High-Polarization-Purity Antenna for calibration of Ka-band Astronomical Instrumentation

Daniel Kohler[1], Miguel Alejandro Salas-Natera[1], Marta Donate[1], Alfonso Tomas Muriel[1], Roberto Garrote[1], Ramón Martínez Rodríguez-Osorio[1], Julio Gallegos[2], Fernando Martín Porqueras[3], Marcos Lopez Caniego[4], Xavier Dupac[5]

[1]Universidad Politécnica de Madrid, España; [2]Serco for the European Space Agency (ESA); [3]Telespazio for the European Space Agency (ESA); [4]Aurora Technology for the European Space Agency (ESA); [5]European Space Agency (ESA)

This paper provides an overview of the main aspects of the design of ultra-low profile CubeSat antennas with high polarisation purity. The paper is framed within ESA's CUBIQU (CUBesat for I.Q.U) programme which aims to put into orbit a low-cost calibration source for the Cosmic Microwave Background observatories. The aim of this article is to present one of the antennas that make up the payload of this mission, based on microstrip technology to achieve an ultra-low profile. This antenna will act as the polarisation source onboard Cubesat for astronomical instrumentation operating at 30 GHz. The design proposal achieves a crosspolar discrimination of 42.9 dB and 55.2 dB for 0.2° and 0.1° accuracy, respectively, in accordance with the imposed scientific requirements

Lugar: sala Calisto (1.0.1.C) Miércoles, 07/09/2022: 11:30-12:30

X.2.4. Fotónica y comunicaciones ópticas

Presidente de la sesión: Luis Landesa Porras

Incremento de la capacidad del canal óptico submarino mediante técnicas MISO en presencia de dispersión y turbulencia oceánica

Pedro Salcedo Serrano, Rubén Boluda Ruiz, José María Garrido Balsells, Antonio García Zambrana

Wireless Optical Communications Lab., Telecommunication Research Institute (TELMA), Universidad de Málaga, España

En este trabajo se presenta un sistema con múltiples transmisores y un único receptor (MISO) con el objetivo de analizar las prestaciones en términos de capacidad ergódica de un canal óptico submarino bajo efecto de desvanecimiento de la potencia óptica recibida inducido por la dispersión del medio y turbulencias oceánicas bajo diferentes tipos de agua, distancias y severidad de turbulencias. Con este fin, se obtienen nuevas expresiones matemáticas en forma cerrada que permiten obtener la capacidad ergódica del sistema. Además, se aportan expresiones asintóticas que facilitan el análisis de las prestaciones en función de los diferentes parámetros físicos del sistema. Los resultados obtenidos confirman la mejora de prestaciones del sistema mediante el uso de un mayor número de transmisores en los diferentes escenarios estudiados. Todos los resultados presentados son validados a través de simulaciones Monte Carlo.

Electromagnetic modeling of infinite plasmonic crystals using periodic Green's function

Daniel Jericó Claro[1], Victor Francisco Martín Martínez[2], Luis Landesa Porras[2], José Manuel Taboada Varela[2]

[1]EM3 Works; [2]Universidad de Extremadura, España

In this work we present a formulation for light scattering on infinite periodic structures. It is based on the well-known Floquet theory for the periodic Green's function using Ewald transformations to speed-up convergence. The formulation is applied to the resolution of infinite two-dimensional (2-D) plasmonic crystals made up by periodic assemblies of plasmonic nanoparticles. Such crystals have gained interest in recent years as they can be tailored to support cutting-edge applications.

Diseño y desarrollo de un espectrofotómetro portátil para caracterización de vidrios

Rocío Chueca, Salvador Andrés, Raul Alcain, Carlos Heras, Íñigo Salinas

Universidad de Zaragoza, España

Nanometric coatings are increasingly being used on glazing to provide optical properties such as infrared rejection or to achieve a specific colour. We have designed a portable spectrophotometer in order to evaluate the performance and degradation of these coatings once the windows have been installed in buildings or trains. This device measures reflectance and transmittance using normal incidence of light on the sample. This way, windows of different thickness can be characterised without having to change the position of the receiver. A set of measurements of different glazing structures has been performed and compared with the results obtained from a conventional laboratory spectrophotometer.

Integrated radiometer with high sensitivity working at room temperature

Jessica César Cuello[1], **Gabriel Santamaria**[2], **Luis E. García**[1], **Guillermo Carpintero**[1]

[1]Universidad Carlos III de Madrid, España; [2]University of Colorado at Boulder, USA

This document presents the first results in the development of a monolithically integrated photonic-based submillimeter-wave radiometer for satellite payload weather monitoring sensor. Two key components: a whispering-gallery mode resonator (WGMR) and an asymmetric Mach-Zehnder interferometer (AMZI), have been designed and fabricated. The Photonic Integrated Circuit (PIC) was developed in a thin-film Lithium Niobate-on-insulator (LNOI) platform.

Lugar: sala Ganímedes (2.0.1.A) Miércoles, 07/09/2022: 11:30-12:30

X.3.3. Aplicaciones matemáticas: modelado y simulación

Presidente de la sesión: María José Madero Ayora

Variantes Spline y Diseño de Filtros

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

Se presenta una reformulación de funciones de transición spline, definidas en el dominio de la frecuencia, que forman un continuo de funciones que generan transiciones entre funciones spline básicas de órdenes naturales. A este conjunto de funciones le asignaremos un orden spline no entero, intermedio entre los órdenes naturales mencionados. Se utiliza este conjunto de funciones para modelar bandas de transición sobre filtros ideales atendiendo a diferentes criterios, dando lugar a filtros FIR de ciertos órdenes. Se comprueba empíricamente que con esta herramienta es posible diseñar filtros, con determinadas especificaciones, que presentan mejores prestaciones que los filtros diseñados utilizando funciones spline previas del mismo orden y que se citan en trabajos publicados con anterioridad. La complejidad (orden de los filtros) es la misma en ambos casos.

Genetic Volterra Subspace Exploring of Wideband Power Amplifiers Models

Miguel Nogales González-Regueral, Juan Antonio Becerra González, María José Madero Ayora, Elías Marqués Valderrama
Universidad de Sevilla, España

In this work, the branch of machine learning known as genetic algorithms (GAs) is applied in the context of digital predistortion (DPD), specifically as a way to find the best subspace from the regressors generated by the Volterra series. Predistortion of power amplifiers (PAs) requires a model, usually Volterra-based, which is key in terms of performance. The classical approach of selecting a subset from the Volterra space is disputed, proposing a genetic-based Volterra-subspace generator (GVG) which finds the most suitable set of regressors from the whole Volterra basis. To contrast this proposal, the models generated with the GVG are benchmarked against state-of-the-art pruned structures in PA modeling and DPD with different configurations in terms of their hyperparameters. Measurement experiments demonstrate the generality of the proposed method and reveal the lack of precision behind the choice of conventional structures. The proposal, shaped as an open source software, is made available as a tool to generate sparse structures for PAs and DPDs, laying the foundation for a new perspective in DPD design.

Modeling and Linearization of Wideband Power Amplifiers with Alternating Direction Method of Multipliers (ADMM)

Elías Marqués Valderrama, María José Madero Ayora, Juan Antonio Becerra González, Miguel Nogales González-Regueral
Universidad de Sevilla, España

This work provides a different solving method for modeling and linearization of power amplifiers (PA), applying the Alternating Direction Method of Multipliers (ADMM), and exploring its benefits. The ability of providing distributed computation is currently becoming a need, mainly on real-time scenarios where the resources are limited. Moreover, a large amount of regressors are typically needed to explain the behavior of the PA, presenting numerical issues at the resolution of the inverse when the regression is performed. The ADMM is also a compressing sensing (CS) technique, that ensures a solution since it involves a norm ℓ_1 regularization, translated into an underlying coefficient selection. Experimental results achieved with this approach are provided for a class AB power amplifier driven by 30 MHz 5G New Radio signals.

Algoritmo Sparse Bayesian Pursuit para la linealización de amplificadores de potencia

Carlos Crespo Cadenas, María José Madero Ayora, Juan Antonio Becerra González, Sergio Cruces
Universidad de Sevilla, España

En este trabajo se propone un tratamiento Bayesiano sparse para el modelado de comportamiento y la predistorsión digital de amplificadores de potencia. El marco Bayesiano incluye un grupo de procesos específicos que maximizan la verosimilitud de los datos medidos: selección e identificación de regresores, estimación de coeficientes, criterio de parada y deselección de regresores. Este enfoque, llamado algoritmo SBP (Sparse Bayesian Pursuit), se compara con otros dos algoritmos de selección previamente propuestos: orthogonal matching pursuit (OMP) y doubly OMP (DOMP). Se proporcionan resultados experimentales de linealización para amplificadores de potencia de clase AB y clase J con una señal 5G New Radio de 30 MHz. El algoritmo SBP presenta buenas prestaciones en términos de capacidad de linealización y coste computacional. Además, el enfoque Bayesiano permite el diseño de la estructura del modelo de un predistorsionador, la deselección de regresores y el reajuste de los coeficientes en una arquitectura de aprendizaje directo, demostrando su robustez frente a cambios en el nivel de potencia para un rango 10 dB.

Índice de autores

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