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SUBPROGRAMA RAMON Y CAJAL

CONVOCATORIA 2011

Nombre: **KONSTANTATOS , GERASIMOS** **Referencia:** RYC-2011-08865

Area: Tecnología Electrónica y de las Comunicaciones

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Titulo:

Colloidal Quantum Dot Optoelectronics

Resumen de la Memoria:

Colloidal Quantum Dot (CQD) optoelectronics are expected to revolutionalize the optoelectronics industry as they combine the large-scale low-cost deposition of solution processed materials with the unique optical and electronic properties of quantum dots whose bandgap is determined by the size of the nanocrystal. Trmendous progress has been achieved in the last decade in developing a variety of optoelectronc devices based on colloidal quantum dots: light emitting diodes, solar cells and photodetectors. My expertise lies in the field of colloidal quantum dot optoelectronics employing electronically active quantum dot films. During my phd studies I have conducted pioneering research in the field of colloidal quantum dot photodetectors, demonstrating the first-ever ultra sensitive photodetector based that outperforms the single crystalline costly counterparts. In addition my research expanded also in the field of CQD solar cells and my achievements in the field include the first demonstration of infrared sensitization of polymer solar cells employing PbS quantum dots as well as the record power conversion efficiency of ~5% from solution processed CQD solar cells. I have now moved to Spain, bringing this (probably unique in the country) expertise in CQD optoelectronic devices and have established a group at ICFO with various activities in the field: advanced heterostructures for CQD phototransitors, plasmonically enhanced CQD photodetectors and solar cells as well as non-toxic, solution processed nanocrystalline solar cells. Our group¿s efforts will be focused into the following main thrusts:1. plasmonically enhanced performance CQD photodetectors and solar cells: we will employ plasmonic nanostructures in order to enhance the optical absorption of the CQD films. We will develop strategies to achieve nearly full absorption of light within a CQD layer of 200-400 nm. Such achievement is expected to have huge impact in the performance of the devices currently limited by the poor electrical conduction 2. Solution processed solar cells based on non toxic high abundance nanomaterials: Despite the great progress in the field of CQD solar cells, their commercial deployment is under doubt due to the use of highly toxic materials of Pb and Cd in the synthesis of the materials. In this thrust we will explore novel nanomaterials that are free of toxic elements and are highly abundant in Earth¿s crust to allow for TW deployment. The results of this project is expected to bridge the gap between lab-demonstrated devices and commercial products and is capable of creating a disruptive technology on the market of thin film solar cells.

Resumen del Curriculum Vitae:

I completed my undergrad studies in Electrical Engineering with expertise in communications and antenna design where I published my first journal on ultra-small highly efficient fractal antennas. Then I moved to University of Toronto to receive training on nanotechnology; For my M.A.Sc. degree I worked on colloidal quantum dot light emitting diodes for optical communications and IR sensing. As a Ph.D student and then postodoctoral fellow at University of Toronto I led the colloidal quantum dot (CQD) photodetector project at Sargent¿s group (www.light.utoronto.ca). The goal of the project was to introduce a disruptive technology in order to replace the costly InGaAs epitaxial technology with a low-cost, CMOS-compatible, top-surface photodetector based on colloidal quantum dots for night vision and biomedical imaging applications in the short-wavelength Infrared (SWIR) spectrum. Then the scope was extended towards the broad consumer market of visible-wavelength, high-sensitivity cameras currently facilitated by CCD platforms. We developed CMOS-compatible CQD photodetectors for visible wavelength applications in planar and conformal architectures for single and multispectral imaging. The main scientific outcomes of my research during my stay in Toronto can be partially summarized in a series of Nature-family and Nanoletters (for further details on publications, patents, projects etc. please see at Curriculum Vitae. Summarizing my publication activities, these consist of 22 accepted Journal publications having more than 750 citations and leading to an h-index of 10, despite the very recent graduation from my phd in 2008.The technology developed in my Ph.D. research has resulted in a number of patents and was the cornerstone for the foundation of a start-up company, Invisage Technologies (www.invisageinc.com), whose mission is to commercialize the technology of colloidal quantum dot photodetectors for imaging sensors. During the period of the foundation of the company, being the main inventor of the technology, I played the role of technology liaison responsible for the technology transfer from the University of Toronto to Invisage Technologies. These efforts resulted in a number of patents (see CV) not only exclusively on the developed technology at the University but also on integrating electronic read-out circuits with colloidal quantum dot photodetectors.The research also attracted broad media coverage by several ¿popular science and engineering¿ websites (Nanotsunami.com, Physorg.com, nanotechwire.com, sciencedaily.com, eetimes.com etc.), in several magazines (Optics and Photonics News, Materials today), a record in Encyclopedia Britannica as well as local and international newspapers (Toronto Star, Financial Times). During the last year in Toronto I was involved in a project supported by a KAUST award to develop a high efficiency solution processed solar cell combining the colloidal quantum dot technology with the nanoporous titania Graetzel technology. We performed this project in collaboration with Prof. Graetzel¿s group at EPFL resulting in a record efficiency colloidal quantum dot solar cell with PCE of ~5.6% (submitted for publication to Nature Photonics). This achievement makes a significant step towards reaching the projected figure of merit of 10% PCE for commercialization of this new technology platform.

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CONVOCATORIA 2011

Nombre: **WIDMER , JOERG** **Referencia:** RYC-2011-07793

Area: Tecnología Electrónica y de las Comunicaciones

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Titulo:

Cooperation and coding for next generation wireless networks

Resumen de la Memoria:

Given the scarcity of wireless spectrum resources and the rising demand for mobile applications, optimizing wireless communication is currently one of the most important and challenging research topics in networking. Many of my research activities in recent years were focused on this area. The proliferation of inexpensive, high-rate mobile communication devices and ubiquitous connectivity open up a vast spectrum of possible new services but also pose unique challenges concerning wireless interference and the unpredictability of the wireless medium. These problems are exacerbated as the number of devices as well as the data rates in a network increase.I am particularly interested in bridging the gap between theoretic results and practical implementation. Recent advances in information theory on topics such as network coding and cooperative communication show high promise to substantially improve the performance of wireless networks. I have been very active in these areas, closely collaborating with experts on information theory such as Ralf Koetter, Christina Fragouli, Joao Barros, and others. At the same time, in my previous work for a mobile operator I was deeply involved with the practical aspects of implementing and integrating such advanced technologies in actual wireless networks.With this project, I intend to mainly drive research in the areas of intelligent interference management, throughput improvements through cooperative coding and network coding, as well as improved medium access control mechanisms that make use of advanced physical layer technologies such as MIMO, successive interference cancellation, etc. This work will go beyond mere simulation and will make use of recent advances in software defined radios, which turn them into an excellent platform for experimentation and performance analysis. Many of the issues concern the lower protocol layers, but a thorough understanding of all the layers of the protocol stack is essential to tackle these challenges. As an example for such work, we were among the first to implement a full cooperative coding solution that exploits spatial diversity on a software defined radio but many challenges remain to translate these first steps into practical gains for real-world systems. In a similar vein, initial joint work with the Technical University of Munich has shown high theoretical potential performance improvements through joint network and channel coding for relay base stations, and further extending this work is likely to be highly beneficial in practice.

Resumen del Curriculum Vitae:

Since September 2010, Joerg Widmer is Senior Researcher at Institute IMDEA Networks. From June 2005 to July 2010, he was manager of the Ubiquitous Networking Research Group at DOCOMO Euro-Labs in Munich, Germany, working on several projects in the area of wired and wireless networking. Before joining DOCOMO Euro-Labs, he was senior researcher in the group of Prof. Jean-Yves Le Boudec at EPFL. There, his main research focus was on UWB networks and MAC layer design as well as network coding in wireless networks. Joerg Widmer received his M.S. and PhD degrees in computer science from the University of Mannheim, Germany in 2000 and 2003, respectively. In 1999 and 2000 he was a visiting researcher at the ICSI Center for Internet Research in Berkeley, CA, USA.Joerg Widmer¿s current research interests include: Computer Networks and Distributed Systems (Wireless Communication, Network Coding, Peer-to-peer Communication; Ad-hoc Networking; Internet Architectures; Transport Protocols).Joerg Widmer has around 90 papers, 5000citacions and h-index 25, being the 220th most cited researcher in the area of Networks and Communications.

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CONVOCATORIA 2011

Nombre: **BERUETE DIAZ, MIGUEL** **Referencia:** RYC-2011-08221

Area: Tecnología Electrónica y de las Comunicaciones

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Titulo:

Terahertz Extraordinary Transmission Metamaterials

Resumen de la Memoria:

The main research line is to advance in the theoretical analysis, design, experimental measurement and practical application of devices based on metamaterials and plasmonics concepts working in the millimeter and terahertz waves range. Metamaterials and plasmonics are hot topics of electromagnetic research, which are sufficiently evolved to be considered mature. In addition, terahertz frequencies are gaining relevance due to the promising applications foreseen in this range, in several fields such as communications, sensing, biomedicine, imaging, etc.Metamaterials are artificial structures whose electromagnetic behavior is dictated both by the arrangement and properties of their constituents, providing properties not available in natural materials, such as negative or extreme parameters. Plasmonics encompasses different phenomena of surface wave propagation along metallic structure. Extraordinary Transmission (ET) is an unexpected outcome of plasmonics, and was crucial to develop the topic and to open the path to the use of small apertures in a variety of applications. Metamaterials were initially studied in microwaves and millimeter-waves and now the tendency is to increase the frequency, where plasmonic concepts must be considered. By definition, plasmonics were originally studied at optics but their concepts are now applied lower frequencies, making use of ideas reminiscent of metamaterials. Then, plasmonics and metamaterials converge at terahertz frequencies, so ideas from both realms can be fruitfully applied in this rangeTherefore, metamaterials and plasmonics are intimately related. Moreover, the discovery of Extraordinary Transmission Metamaterials (ETM) joined both concepts in a very interesting realization of metamaterials obtained by simply stacking ET hole arrays.Along the last years, the candidate has been actively involved in ET and metamaterials, and was pioneer in proposing ETMs as a way to overcome intrinsic limitations (losses) of classical metamaterials configurations. Thanks to his work, negative refraction prisms, demultiplexers, metallic lenses, intrinsic negative refraction bulk materials, polarizers, low profile horn antennas etc. have been demonstrated. His trajectory started at ET experiments at millimeter-waves, progressively increasing the frequency towards terahertz. The objective here is to follow this work and widen the scope and in the envisioned applications: planar transmission lines, extreme parameters lenses, plasmonic based planar antennas, etc.

Resumen del Curriculum Vitae:

RESEARCH: extraordinary transmission, metamaterials, terahertz, millimeter waves, quasioptics, antennas, microstrip circuits, frequency selective surfaces, periodic structures, photonic bandgap.ACADEMIC BACKGROUND: (September 2002) Telecommunication Engineer, Public University of Navarre; (November 2006) PhD Telecommunication Engineer, Public University of Navarre. THESIS: ¿Millimeter-Wave Extraordinary Transmission. Connection to Metamaterials and Technological Applications¿; MARK: Summa cum laude; SUPERVISOR: Prof. Mario Sorolla. EVALUATION COMMITTEE: Prof. J. Pendry, Prof. N. Engheta, Prof. J. M. Pitarke, Prof. V. Lomakin, Prof. F. Falcone.SCIENTIFIC EXPERIENCE: 1 Feb 2007-1 Sep 2009: CEMITEC (Fundación Cetena)1 May 2003-31 Jan 2007: FPI Grant Public University of NavarreRESEARCH PROJECTS 12CONTRACTS: 6PUBLICATIONS: 57 Int. Journal (29 First Author).SELECTED PUBLICATIONS: M. Beruete, M. Sorolla, I. Campillo, J. S. Dolado, L. Martín-Moreno, J. Bravo-Abad, F. J. García-Vidal, "Enhanced millimeter wave transmission through subwavelength hole arrays" Opt. Lett., 29(21), 2500-2502 (2004).F. Falcone, T. Lopetegui, M.A.G. Laso, J. D. Baena, J. Bonache, M. Beruete, R. Marqués, F. Martin, M. Sorolla, "Babinet Principle Applied to the Design of Metasurfaces and Metamaterials" Phys. Rev. Lett., 93(197491) (2004)M. Beruete, M. Sorolla, I. Campillo, "Left-handed extraordinary optical transmission through a photonic crystal of subwavelength hole arrays" Opt. Express, 14(12), 5445-5455 (2006) M. Navarro-Cía, M. Beruete, M. Sorolla, I. Campillo, "Negative refraction in a prism made of stacked subwavelength hole arrays" Opt. Express, 16(2), 560-566, (2008)M. Beruete, M. Navarro-Cía, M. Sorolla, I. Campillo, "Negative refraction through an extraordinary transmission left-handed metamaterial slab" Phys. Rev. B, 79(19), 195107-1-6 (2009)PATENTS: 3CONFERENCES: 124 (103 International, 21 National); 12 invitedSTAYS IN OTHER CENTRES: 1) Department of Electronics and Electromagnetism, Faculty of Physics, University of Seville, Seville (Spain), YEAR: 2005, LENGHT: 3 months (119 days), TOPIC: Study of phenomena associated to negative refraction in Metamaterials and possible application in antennas and frequency selective surfaces, KEY: D2) Department of Electronics, CEMITEC (Fundación Cetena), Noain, Navarre (Spain), YEAR: 2007-2009, LENGHT: 31 months (943 days), TOPIC: Design, optimization and measurement of RF transceivers, wireless customer projects, radio channel characterization, sensing techniques in microwaves and millimeter waves, wireless sensor networks, KEY: STHESIS SUPERVISED: Miguel Navarro-Cía, ¿Extraordinary Transmission and Geometrically-Induced Modes for Metamaterials: from Underlying Physics to Technological Applications¿ 16 Apr 2010. MARK: summa cum laude.H-INDEX: 11CITATIONS: 516 (293 without self-citations)REVIEWER: Opt. Express, IEEE Trans. Microwave Theory Tech., Journal of Electromagnetic Waves and Applications, Opt. Commun., Electron. Lett, Chin. Phys. Lett., Appl. Phys., Metamaterials 2010, KarlsruheSESSION CHAIRPERSON: Young Scientist Meeting on Metamaterials, YSMM, Barcelona, February 2008, 2nd International Conference on Metamaterials, Photonic Crystals and Plasmonics META'10, Cairo, March 2010.AWARDS: CST University Award 2005; IDEACTIVA 2009 Best Business Idea: Tafco Metawireless

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CONVOCATORIA 2011

Nombre: **IONESCU , SEPTIMIU RADU** **Referencia:** RYC-2011-09724

Area: Tecnología Electrónica y de las Comunicaciones

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Titulo:

Biomedical chip based on organic molecule-terminated cross-reactive multi-sensors array for premature diagnosis of diseases

Resumen de la Memoria:

The main outcome of this research line is the development of a small, inexpensive, easy-to-use, portable, non-invasive biomedical chip based on an array of organic molecule-terminated carbon nanotubes and/or silicon nanowires cross-reactive sensors for premature diagnosis of diseases, when they are easier to treat. The most suitable organic receptors will be selected to have a high affinity towards the volatiles biomarkers of interest for any specific application, which will be determined from GC-MS studies.The sensing methodology proposed is based on exposing the multi-sensors array to the headspace of biomedical samples and analyzing their response. During the experiments, the sensors will be operated in the dynamic mode by thermally modulating their operating temperature. This method was never applied before in the biomedical field, and has the attractive capability of detecting and analyzing complex chemical mixtures by using very few sensors, because of the multivariate nature of the information that can be extracted from the response of every sensor. In this context, the lower is the number of sensors the lower is the complexity, power consumption and size of the biomedical chip device.Pattern recognition models able to accurately detect and classify the stage of the disease will be developed from the characteristic patterns extracted from sensors responses to the biomedical samples. This will allow furthermore the selection of the most suitable sensors for a specific application. Any new generated pattern after the exposure of the biomedical chip to an unknown biomedical sample will be then compared with patterns stored in a database in order to be identified. An additional outcome of the project will be the important know-how that will be gained in the technological fabrication of molecule-terminated carbon nanotubes and/or silicon nanowires sensors, which would allow us to fabricate very reproducible devices. Successful application of the ideas presented in this proposal could lead to the fabrication of a single-use biomedical chip for premature disease diagnosis. In this case, the biomedical chip could be attached by a simple plug-in procedure to an external unit comprising the electronics necessary to control, acquire, store and process sensors readout, and an EEPROM memory in which it will be stored the most accurate pattern recognition model built for disease detection. Ultimately, this approach would enable the production of disposable diagnosis chips for various disease tests.

Resumen del Curriculum Vitae:

In 1993 I won the 1st place at the admission exam organised by the Power Eng. Faculty, Polytechnic Univ. of Bucharest, Romania. I showed independence at an early stage, realizing my graduating project in a foreign university (Helsinki Univ. of Technology, Finland). In 1998 I started my PhD studies at Polytechnic Univ. of Catalonia, Barcelona. The objective of my thesis was to develop new techniques for improving the selectivity of metal oxides gas sensors. In 2003 I realized a 6 months doctoral training in Solid State Physics group, Uppsala Univ, Sweden, where I learnt to use the Nanoparticle Film Formation facility that allows fabricating metal oxides with extremely small grain size. I got my PhD diploma in 2003 with the qualification excellent cum laude by unanimity. After that I worked for 1.2 years as researcher at Rovira i Virgili Univ of Tarragona, performing tasks of multisensors signals processing for medical applications. In 2004 I won a Juan de la Cierva fellowship and I joined as postdoctoral researcher MINOS group from URV. The main objective of my research was to fabricate chemical sensors able to detect traces of volatiles at low operating temperatures. I investigated the possibility to employ carbon nanotubes, as well as hybrid materials made of CNT dispersed in a metal oxide matrix with the aim to combine the sensing characteristics of both of them. The very promising results obtained led to the approval of the European project NANO2HYBRIDS. During that period I put the basis of a fructuous collaboration between URV and Uppsala Univ. I was the responsible researcher of a joint project whose objective was to fabricate novel hybrid materials based on CNT coated with ultrafine tungsten oxide nanoparticles. During 2007 I won a José Castillejo grant and I realised a postdoctoral stage in Szeged Univ, Hungary. There I learnt a new technique for improving the chemical selectivity of the gas sensors, Fluctuation Enhanced Sensing, and I got experience in nanomaterials fabrication by Pulsed Laser Deposition and in CNT fabrication by Chemical Vapour Deposition. In 2008 I got an experienced researcher position at Mediterranean Univ. of Reggio Calabria, Italy. I worked for 20 months in the project Wireless Sensors for Environmental Networks (TOK program, EU), acquiring experience in gas sensor networks remotely controlled by wireless communication. At the end of 2009 I was employed as senior researcher at URV, and I worked on chemical gas sensors employing nanoporous anodic alumina as innovative matrix template for growing nanostructured metal oxides or metal oxide nanodots. Since 2010 I am Visiting Scientist at Technion, where my research activity focuses on biomedical applications. We got very good results in the detection of the Parkinson disease, discrimination between Parkinson, Alzheimer and healthy persons, as well as in classification of different lung cancer biomarkers by analysing the headspace of cell cultures. I published 29 articles (9 as 1st author), plus 3 submitted, and 60 presentations at conferences (4 invited). 5 of my articles were in Top 25 of best articles published in Sens. Actuators B; I was awarded 1 Best Poster Award. I have an h factor of 10. I was involved in the realization of 13 projects (7 Europeans, 5 nationals and 1 of a Spanish health institute). I leaded the execution of 1 project under Access to Major Research Infrastructures program of EU Commission. I directed 2 PhD thesis.

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CONVOCATORIA 2011

Nombre: **PUEYO PAULES, ESTHER** **Referencia:** RYC-2011-08398

Area: Tecnología Electrónica y de las Comunicaciones

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Titulo:

Development of multi-scale stochastic models and signal processing tools for investigation of cardiac arrhythmias

Resumen de la Memoria:

This proposal deals with the development of signal processing techniques as well as computational modeling and simulation methodologies to investigate the mechanisms underlying the generation and maintenance of cardiac arrhythmias and their manifestations at the body surface. The ultimate aim is that those computational tools can be used as complementary instruments to support medical decisions. Nowadays, the electrocardiogram (ECG) is the clinical test routinely used to detect cardiac disorders by reason of being non-invasive, simple and low-cost. Despite the fact that many medical decisions rely only upon interpretation of ECG patterns, the cellular and sub-cellular mechanisms underlying pathophysiological ECG changes remain mostly unclear. A major hypothesis supporting this proposal is that a better understanding of those involved mechanisms can improve the way we use the ECG signal and, based on that, contribute to an improvement in the prevention, diagnosis, and treatment of cardiac diseases that affect millions of people throughout the world.In this project a methodology will be used to model and simulate the heart¿s electrical activity at different scales, ranging from the cell membrane ion channels (using ordinary differential equations to describe the pass of ions through those channels) up to the ECG (using partial differential equations to represent tissue electrical behavior, and integral equations to compute the potential at the body surface). Also, signal processing algorithms will be developed to extract relevant information from the ECG. Four main research lines L1-L4 are defined to accomplish the overall aim of gaining insight into the intricate causes and manifestations of the following arrhythmias: Atrial Fibrillation (AF) and Ventricular Tachycardia/Fibrillation (VT/VF), as well as into therapeutical approaches to prevent or terminate them. The specific objectives and methodologies for lines L1-L4 are as follows: L1) Multi-scale mathematical models of human atrial electrical activity will be built up that serve to connect intra-cavitary and body surface processed waveforms with activation patterns in the entire atria, both in healthy hearts and in hearts subject to conditions promoting AF; L2) Ischemic and non-ischemic human ventricular models will be developed and validated, and ECG signals will be derived. Arrhythmic risk markers at preclinical and clinical stages will be investigated and their specificity/sensitivity to identify VT/VF occurrence will be assessed. L3) A new generation of atrial and ventricular models able to reproduce not only the mean population behavior (at ion channel, cell, tissue or ECG level) but also the temporal and spatial variability present in experimental and clinical recordings will be investigated. Those stochastic models, going beyond the commonly used deterministic models, will involve investigation of stochastic differential equations to describe the random channel gating (intrinsic noise), statistical distributions to model cell-to-cell differences in ion channel numbers (extrinsic noise), and algorithms tailored at reproducing cardiac response under subtle heart rhythm variations. L4) Whole-cavity drug action models will be developed, and their efficacy/cardio-toxicity will be assessed based on proposed arrhythmic risk markers.

Resumen del Curriculum Vitae:

I received the MSc degree in Mathematics with honors from the University of Zaragoza, Spain, in 1999. In 2001 I was awarded with a Certificate of Advanced Studies (DEA) in ¿Mathematical methods and applications¿, and in 2002 with a second DEA in ¿Communication and Information Technologies¿. In 2001 I started my PhD studies in Biomedical Engineering supervised by Prof. Pablo Laguna, with research grants supported by Gobierno de Aragón (Predoctoral program) and MEC (FPU program). My PhD thesis focused on developing signal processing techniques applied to the electrocardiogram to investigate temporal dynamics of ventricular depolarization (activation) and repolarization (relaxation), and its relation to probability of major cardiac events. In 2006 I received my PhD degree with honors from the University of Zaragoza under a quality label doctoral program, being awarded with the European Doctorate mention and the Extraordinary Doctorate Award. Upon finishing my PhD, I moved to the University of Oxford (UK), where I started working on the field of cardiac modeling and simulation, opening new avenues of work so far not explored by my group at the University of Zaragoza. I have conducted a total of 38-month research visits, mostly in UK, but also in Portugal, Argentina as well as in other shorter visits to USA, Sweden and Hungary. I have participated in 21 national and international research projects supported through public programs, and 5 projects with private companies/centers (Medtronic Bakken Research Center, Royal Society, Center for Quantitative Electrocardiography and Cardiac Safety, Zaragoza University Hospital, and Pfizer). I have started my own research group, and I am Principal Investigator of 5 research projects: 1) a national project funded by MICINN (5 researchers, 9 international collaborators, 4 companies/medical centers); 2) a multidisciplinary project funded by Gobierno de Aragón; 3) an International Joint Project, supported by Royal Society-UK; 4) a project between the Universities of Zaragoza and Rochester; 5) a project with the pharmaceutical company Pfizer.I have regularly published a total of 44 SCI scientific publications (including peer-reviewed conference proceedings). Of those, I have co-authored 21 papers (3 under review) and 6 abstracts in peer-reviewed international journals. Additionally, I have published 2 book chapters. Of my 27 journal contributions, I am first or second author of 20 publications, and last author of 2 other publications. 61% of my JCR publications are in Q1 and 26% in Q2. I have contributed to 41 international conferences, 8 national conferences, and 8 invited talks. I have established my research group with three PhD students and two collaborating postdocs. In addition to supervising 3 PhD theses, I have supervised 3 postgraduate master theses, 4 MSc dissertations and 3 undergraduate internships. I am reviewer of 5 JCR journals. I have reviewed international research grants, and I have been jury member of PhD and MSc dissertation committees.In parallel to my research activity, I have been lecturing at undergraduate and postgraduate level at the University of Zaragoza as a Teaching Assistant (Profesor Ayudante, 2003-2007), Lecturer (Profesor Colaborador, 2007-2008), Senior Lecturer (Profesor Contratado Doctor, 2008-2011), and Associate Professor (Profesor Titular, 2011-date).

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SUBPROGRAMA RAMON Y CAJAL

CONVOCATORIA 2011

Nombre: **MARTINEZ , ALFONSO** **Referencia:** RYC-2011-08150

Area: Tecnología Electrónica y de las Comunicaciones

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Titulo:

Mismatched-Decoding Analysis of Finite-Length Information Transmission, with Applications to Communications and Data Compression

Resumen de la Memoria:

A través de los conceptos duales de entropía y capacidad de canal, la teoría de la información ha servido de guía en el desarrollo de numerosos sistemas de comunicaciones y compresión de datos a lo largo de las últimas décadas. A pesar de estos indudables éxitos, el punto de partida de la presente memoria de investigación es la constatación de que la necesidad práctica de usar cada vez más cortos intervalos de comunicación tiende a hacer inaplicable dos de las suposiciones básicas del análisis teórico. En primer lugar, se hace muy difícil la adquisición exacta de la ley estocástica que describe el comportamiento del canal, lo cual imposibilita el uso de técnicas óptimas de decodificación. En paralelo, ciertos métodos analíticos asíntoticos son de ardua justificación, y deberían ser reemplazados por otras herramientas válidas para duraciones de transmisión arbitrarias. La línea de investigación propuesta en esta memoria se concentra en crear nuevos métodos y herramientas aplicables a las nuevas condiciones de transmisión.1. Conocimiento inexacto del canal de transmisión. Esta nueva perspectiva para la teoría de la información, desde el punto de vista de decodificadores a máxima métrica (si bien subóptima, es decir, ni de máxima verosimilitud ni maximum a posteriori), permitirá extender y combinar resultados existentes en la teoría de compresión universal de datos, junto con trabajos parciales existentes sobre cotas de probabilidad de error para transmisiones de duración arbitraria por un lado, y con la teoría de cuantificación (rate-distortion theory) por otro lado. Simultáneamente, supondrá una herramienta para la consideración de efectos prácticos, tales como el ruido de fase de los osciladores, en la capacidad de canal, tanto en canales con un usuario, como en escenarios con múltiples usuarios. Finalmente, se desarrollarán nuevas técnicas de codificación universal. La relevancia de estos problemas sugiere que la investigación podría abrir nuevas líneas de conexión con otras disciplinas científicas, proporcionando en el proceso un nuevo punto de vista con el que estudiar problemas en teoría de la información cuántica (en el ámbito de la física), en criptografía, y en teoría de la apuesta y de la construcción óptima de carteras (economía).- Duración arbitraria, es decir finita, de la comunicación. Una línea de investigación prometedora, y que ha dado éxitos parciales hasta el momento presente, es el uso de la aproximación de Laplace en el estudio de la probabilidad de error. Aunque este método ha sido utilizado con éxito por físicos, ha recibido menos atención de la esperable en el campo de la teoría de la comunicación. El propósito de esta línea es demostrar cómo el método de Laplace proporciona notables mejoras en las estimaciones de la probabilidad de error, tanto para códigos específicos como para promedios sobre conjuntos de códigos, sin coste computacional adicional. Estas propiedades la hacen un buen candidato para su uso, no únicamente en análisis teóricos, sino también como herramienta didáctica y de trabajo para ingenieros de telecomunicaciones. Adicionalmente, el interés trasciende la propia teoría de la información y suministrará nuevas perspectivas en el campo de la probabilidad aplicada.

Resumen del Curriculum Vitae:

Tras mi graduación en 1997, obtuve una beca de postgrado para el centro de investigación de la Agencia Espacial Europea (ESA, Países Bajos). Desde finales de 1999, fui empleado como Ingeniero de Sistemas en la ESA, donde desarrollé tareas de investigación y desarrollo relativas a sistemas de comunicaciones por satélite. Mis tareas se centraban en la capa física, cubriendo codificación y modulación, sincronización digital y técnicas de acceso múltiple. Supervisé el proyecto fin de carrera de 6 estudiantes de varias universidades europeas y seguí el trabajo de un estudiante de doctorado. Fui responsable de la dirección técnica de varias actividades industriales por un importe de cerca de 1 millón de euros y estuve involucrado en la preparación de una nueva actividad de I+D sobre la implementación de un modem a alta velocidad por valor de 1.7 millones de euros. Mi trabajo de investigación se plasmó en dos artículos en revistas científicas y en dos patentes, una de las cuales fue adoptada para el estándar DVB de transmisión de datos y televisión por satélite. Su uso ha sido licenciado a varias compañías que fabrican receptores para el DVB.Mi tesis de doctorado, escrita bajo la supervisión del Profesor Frans Willems en el período 2003-2007, trata del análisis desde el punto de vista de la teoría de la información de una nueva familia de modelos para comunicaciones incoherentes, los canales de energía aditiva. Los resultados esenciales de mi investigación han sido publicados en una series de artículos en los IEEE Transactions on Information Theory, el Journal of the Optical Society of America-B y Physical Review A, entre las más prestigiosas en sus respectivos campos. En paralelo, estuve involucrado en el diseño del sistema de tratamiento de señal para un prototipo de un innovador sistema de comunicaciones ópticas que explota el principio de multiplexado del índice de grupo. Supervisé a 3 estudiantes en sus proyectos fin de carrera. Los resultados han sido publicados en IEEE Photonics Technology Letters.He sido Investigador Asociado en CWI (Amsterdam, Países Bajos) desde 2008 hasta el 2011, trabajando en un proyecto de investigación sobre la conexión entre teoría de la información, estadística y ¿machine learning¿ de acuerdo al principio de mínima longitud de descripción (MDL). En paralelo, y tanto durante mi estancia en Eindhoven como en Amsterdam, he colaborado con investigadores en la Universidad de Cambridge y de California del Sur en el análisis de sistemas de modulación y codificación de acuerdo al principio de ¿bit-interleaved coded modulation¿. Nuestro análisis dio la primera demostración rigurosa, usando la técnica de ¿mismatched decoding¿ de la posibilidad de alcanzar la capacidad del canal derivado por esta técnica. Nuestro libro monografía y nuestro artículo sobre la probabilidad de error, respectivamente publicados en 2008 y 2006, están entre las publicaciones más citadas en el área. Desde febrero del 2011 soy Investigador Asociado en la Universidad de Cambridge.He publicado más de 50 publicaciones, incluyendo 1 libro, 1 capítulo de libro, 2 patentes y 15 artículos en revistas internaciones con elevado índice de impacto. El número total de citas a mis publicaciones es superior a 100 y mi índice h es 7 (de acuerdo a los datos de Scopus).Soy Senior Member del IEEE. He actuado como revisor para numerosas revistas y conferencias internaciones, así como para proyectos de la Unión Europea y la Agencia Espacial Europea.

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CONVOCATORIA 2011

Nombre: **CHEN , TONG LAI** **Referencia:** RYC-2011-08862

Area: Tecnología Electrónica y de las Comunicaciones

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Titulo:

Novel Transparent Electrodes for Flexible Optoelectronics

Resumen de la Memoria:

A crucial challenge in the optoelectronics industry is the realization of inexpensive and reliable transparent electrodes (TEs), i.e. thin films that permit to bring electrical current or potentials in proximity of optically active regions without significant loss of optical energy. Transparent oxide thin-film electrodes, which are wide band gap semiconductors, represent the current state-of-the-art solution. Among them, Sn doped In2O3 (ITO) is the most widely used for many optoelectronic devices, such as organic light emitting diodes (OLEDs), photovoltaic cells, flat panel displays, electrochromic devices and photodetectors. Despite its maturity, the prevailing TE technology suffers from several drawbacks: (i) it is made up of indium, a scant material resulting in high cost, (ii) complex fabrication process as its electrical properties depend much on its fabrication which leads to difficulty for integration in industry (iii) incompatibility with certain active compounds (organic materials) in device due to indium migration, (iv) poor mechanical ductility that could lead to film cracking under bending in flexible devices. These disadvantages have led to the search for alternatives, including electrodes based on graphene films, carbon nanotubes or silver nanowires. Another approach is based on ultrathin (80% in the visible) and low sheet resistance (a few Ω/sq);·extended transparency into the UV and/or IR regions;·stability against temperature, humidity, chemical reagents and mechanical stress;·processability with standard fabrication processes suitable also for mass production;·compatibility with active lighting and photovoltaic materials, be it an organic (polymer) or inorganic (semiconductors) compound;·Competitive device performance of OLEDs, photovoltaic cells using the developed TEs technology with regarding to ITO-based ones.

Resumen del Curriculum Vitae:

Tong Lai Chen received his PhD from Shanghai Institute of Ceramics (SIC), Chinese Academy of Science (CAS), in March 2006. He is currently a research fellow at the Institute of Photonic Sciences (ICFO) in Spain. His research is focused on developing transparent electrodes based on ultrathin metals and wide-band-gap oxides for efficient organic lighting, solar cells, displays and modulation devices. Prior to ICFO, he had research experience in several internationally recognized centres. In 2005, he was offered a short-term guest research position at the Research Institute of Nanoscience (RIN), Kyoto Institute of Technology (KIT), Japan. After receiving his PhD in 2006, he was awarded the distinguished Japanese Society for Promoting Science (JSPS) postdoctoral scholarship and then moved to Kanagawa Academy of Science & Technology, and The University of Tokyo, Japan, for developing novel indium-free transparent conductors for replacing indium-tin-oxides in optoelectronics device applications. In 2008, he moved to Suzhou Institute of Nano-tech and Nano-bionics, CAS and became one of key faculty members for establishing a laboratory for nano-electronics and (N)-MEMS and also responsible for drafting a five-year long-term development plan for the institute. In June of 2009, Dr Tong Lai Chen joined the optoelectronics research group, led by Prof. Valerio Pruneri, at the Institute of Photonic Sciences (ICFO), Spain, to carry out research on thin-film growth and engineering for energy efficiency devices, in an aim to develop low-cost transparent electrodes based on ultrathin metals and wide-band-gap oxides for device applications in organic lighting, solar cells, and displays. Dr Tong Lai Chen has almost seven years experience in the field of thin film growth and engineering, and related integrated micro-devices, during his doctoral and postdoctoral research. He has participated in several key research projects In Japan, China and Spain, including the prestigious program ¿Hundreds Talents Project¿ of the Chinese Academy of Sciences and Chinese State ¿973 Project¿ and ¿MEXT Elements Science and Technology Project¿ of Japanese government. His work has been widely recognised with about 30 publications in international peer-review journals (most of them ranked first or second in the field), several patents, and some oral presentations at international conferences. His hard-work and efficiency in research has lead to a very good publication record and also made him winning several awards, including the famous fellowship of American Applied Materials foundation in Shanghai, the fellowship of ¿Promoting International Exchange¿ from Kyoto Institute of Technology (KIT), and the distinguished Japanese Society for Promoting Science (JSPS) postdoctoral scholarship. He has been actively involved in reviewing journal papers of international repute like Applied Physics Letters, Applied Surface Science, Solid State Communication, and Thin Solid Films etc.In the context of technological transfer activities, his ongoing research on ultrathin metal transparent electrodes and related device applications has attracted great attention from several companies, including: Sefar AG (Switzerland), ADTelecom (Spain), Corning (USA), and IBM (USA), projects and agreements with those companies are ongoing.