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AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2014

Turno de acceso general

Nombre: **VIDAURRE ARBIZU, CARMEN**
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Título:

Efficiency of Motor Imagery based Brain-Computer Interfaces

Resumen de la Memoria:

A relevant type of Human-Machine Interface is the Brain Computer Interface (BCI). It translates the intent of a subject measured from brain signals into control actions to command machines or computer applications. To measure brain activity, many BCI systems rely on electroencephalography (EEG), because it is relatively cheap, easy to acquire, minimally intrusive and does not involve risks for the user. However, EEG has a very poor signal to noise ratio and is highly non-stationary. These are major challenges for BCI systems that limit their application in real-life settings. It has been shown that a non-negligible portion of the healthy population, estimated 30%, cannot achieve BCI control to an acceptable level. This percentage may become as high as 100% for patients depending on their pathology. BCI systems are inefficient.

My research has addressed the inefficiency of BCI systems in the following three directions:

First, the use of adaptive techniques during online experiments. Adaptation helps overcoming non-stationarities during the online operation and offers the possibility to study co-adaptation of human and machine. My work demonstrated that co-adaptation significantly improves system performance and is a key factor to reduce BCI inefficiency. My PhD showed adaptive BCI systems working in online operation and compared them to non-adaptive BCIs, finding that co-adaptive systems are significantly better. During my postdoc I integrated machine learning methods and adaptive signal processing techniques into the Berlin BCI system. This novel approach allowed users who before were not able to operate a BCI to attain control after 30 minutes of BCI training and reduced BCI inefficiency to the half or even less.

Second, the use of invariance learning. Noisy signals are challenging for adaptive systems because of the risk of learning uninformative signal variations. One way to reduce the effect of noise is to learn it and make the BCI invariant to it. Another option is to extract informative invariant information and compute features taking only this subspace into account. Using invariant methods supports developing robust (adaptive) BCIs. Part of my work used invariance learning to discriminate between effective tasks and irrelevant background mental states that can seriously affect BCI performance.

Third, the use of alternative signals during the calibration procedure (signal acquisition without neuro-feedback) on the motor imagery tasks where bad or very bad performance is expected. We have shown that it is possible to significantly increase the efficiency of BCI systems using induced movements of the limbs for calibration and simultaneously reduce the time needed to optimze the system, thus relieving the users from performing tiring motor imagery sessions. Quick calibration is a key factor for the design of BCI systems for patients.

The results of this new technology can be applied in two contexts: first, robust systems are necessary in rehabilitation during patient training, co-adaptive BCI systems allow very fast user training and thus target the recovery of certain brain areas with the help of neuro-feedback. Second, neuro-prostheses for restoration of lost functions that are based on BCI technology must be robust and efficient.

Resumen del Currículum Vitae:

Dr. in Telecommunication Engineering, M Sc. in Telecommunication Engineering. Currently: maternity leave. Before, from April 2013 to August 2014 part-time (10h/week) for the DFG project VitalBCI. From 2010 to 2013 managing the EU-project MUNDUS in the Machine Learning department (maternity break approx. Jan 2012 to Jan 2013). The project was about neuro-prostheses controlled with BCIs. Recently, we showed that it is possible to use NMES signals to decode motor imagery and improve classification performance. This has implications in the field of neuro-rehabilitation, because it is possible to infer a better model using NMES signals for poor performing users. Before, I was co-manager of the EU-IP-project TOBI (2010-2008) in the same department. The project was a large consortium to bring forward BCI. My work focused in the training of users who could not reach BCI control with the state-of-the-art system. We reduced the percentage of people suffering from BCI inefficiency to the half and showed that it is possible to learn to modulate sensorimotor rhythms in less than one hour of training with the use of machine learning and adaptive techniques. In parallel, I have been working in the analysis of non-stationarities in EEG data and the robustification of BCI systems within the projects co-BCI and ABCI where I was PI. From 2006 to 2008 I was Marie-Curie granted postdoc at the Intelligent Data Analysis group in the Fraunhofer Institute. My research was about the use of autoregressive models to describe sensorimotor rhythms. I developed a the Time Domain Parameters. From 2005 to 2006 I was predoc and postdoc researcher at the CIMA in Pamplona (Spain), in the field of fMRI processing. My work there was about the influence of 40-Hz auditory stimulation on the cerebellum. From 2002 to 2005 I was guest researcher at the Graz University of Technology. PhD students: Claudia Sannelli (Summa Cum Laude, Dec. 2012), Wojtech Samek (Summa Cum Laude, June 2014), Javier Pascual (June 2015). External Funding: More than 1 Million Euros (EU-project MUNDUS, DFG project in SPP 1527, BMBF project ABCI). International collaborations: BCI

research group in Graz, Austria. Group of Dr. Motoaki Kawanabe at ATR in the Brain Information Communication Research Laboratory Group (BICR). Group of Prof. Birbaumer in Tübingen (Dr. Ander Ramos) and the group of Prof. Villringer in Leipzig. Career breaks: Maternity leave from 01-12-11 to 14-01-13, and from 15-08-14 until 31-08-15. Grants: Post-doctoral Marie Curie Grant of the EU (2006-2008). Post-doctoral Grant "Juan de la Cierva" (declined 2006). Pre-doctoral Grant "Formación de profesorado Universitario, FPU" from the former Spanish Ministerium for Research (2001-2005). Grant for outstanding academic results (Master Project, 2000). Grant for outstanding academic results (high school diploma,1994). Other: Project reviewer for the Spanish Government and the Czech Research Foundation. Reviewer of two PhD dissertations and examiner of one PhD exam. I was invited speaker at several Universities in Europe. Scientific production: H-index 18, number of citations 1728 according to Google scholar. Number of papers: 30, book chapters: 5, number of conferences and seminars: 50. Participation in 18 research projects (4 as Principal Investigator). My citation count shows that I published relevant papers in all fields where I worked.

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AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2014

Turno de acceso general

Nombre: **GASULLA MESTRE, IVANA**
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Título:

Innovative Microwave Photonics

Resumen de la Memoria:

As a researcher in photonics, my field of expertise embraces two innovative areas: Microwave Photonics (MWP) and Space-Division Multiplexing (SDM).

My research career started with my PhD in 2005 exploring novel ideas in high-speed multimode fiber (MMF) transmission, which led to a new research line at the ITEAM Institute (Polytechnic Univ. of Valencia). I developed a novel and comprehensive model for the evaluation of MMF transmission that allowed me to identify the two requirements that must be fulfilled to achieve broadband transmission: low-linewidth lasers and central-mode excitation. Thanks to this model, I identified that MMF links actually display passbands above baseband that can be employed for the transmission of radio-over-fiber signals in addition to traditional baseband digital signals. This finding meant a paradigm shift in the current MMF telecommunications infrastructure that resulted in a series of record experiments. The most important one was the transmission of 1 Tb/(s.km), at the time the world record in capacity sent through a MMF. This work had a high potential impact since it opened the path to ultra-high capacity in-house communications.

Upon completing my PhD in 2008, I continued my career on the application of Slow and Fast Light (SFL) techniques to MWP under the framework of the European Project GOSPEL. My principal role was linked to the proof-of-concept application of 3 SFL technologies (photonic crystal waveguides, active semiconductor waveguides based on quantum dots and optical fibers nonlinearities) to MWP, specifically to broadband phase shifters and tunable complex-valued filters. Among my most relevant outcomes, it is worth mentioning the first-ever demonstration of tunable & reconfigurable integrated MWP filters based on a Photonic Crystal waveguide delay line and a world record in the bandwidth of a tunable microwave phase shifter.

In 2011 I was awarded a Fulbright Fellowship in support of research to be carried out at Stanford Univ. (US) on SDM, 2012-2014. With the exploitation of the last degree of freedom for multiplexing available -space- my work pursued a solution to the capacity bottleneck of Digital Communications. The future optical network can benefit from SDM by establishing independent multiple light paths via multicore fibers or MMFs. The line of work carried out at Stanford focused on a special type of MMF, the few-mode fiber (FMF), which propagates only a limited number of modes, allowing a much more stable performance and, thus, the practical realization of SDM systems. This approach demonstrated that SDM in FMFs can potentially increase per-fiber capacity by a factor of 10 or more in access networks and dense data center interconnects.

Back in Valencia in 2014, my current interests are focused towards the innovative application of SDM to MWP. This concept was firstly introduced by me in the research community in 2012, proposing the pioneering extension of SDM to the areas of analog photonics and radio-over-fiber systems. The research background and experience developed through the years around the areas of MWP and SDM puts me in a privileged position to unify them in what is my ongoing line of research: the design and demonstration of SDM technologies specifically tailored for novel MWP applications, exploiting unique features brought by the inherent parallelism of multicore or FMFs.

Resumen del Currículum Vitae:

My research career in the field of Photonics started with my PhD in 2005 (funded by the Spanish FPI fellowship) exploring new ideas in high-speed transmission over multimode fibres at the ITEAM Research Institute (Polytechnic University of Valencia, UPVLC). The impact of my doctoral work was reflected in the 2008 Graduate Student Fellowship awarded by the IEEE Photonics Society. I am the last Spanish researcher that collected this extremely competitive international award. Upon completing my PhD in 2008, I continued my career at ITEAM working on the application of Slow and Fast light techniques to Microwave Photonics. From 2012 to 2014 I was a Fulbright Visiting Scholar at Stanford University (US) working on Space-division multiplexing. Back to the ITEAM in 2014, my current interests are focused towards the innovative application of Space-division multiplexing to Microwave Photonics. I was evaluated as category A in both steps 1 & 2 in the 2014 ERC Starting Grant call.

I have participated as a researcher and co-manager in several projects or Networks of Excellence funded by public or private bodies. During my career at UPVLC, I was involved in 5 European projects, (highlighting the FP7-ICT projects Alpha and GOSPEL), 4 national projects, 3 regional projects and 1 project funded by UPVLC. I also participated in a private project funded by Telefónica Investigación y Desarrollo. My 2-year stay at Stanford was conducted under a competitive project funded by the Spanish Ministerio de Educación and the US Fulbright Commission, in which I participated as the scientific coordinator. Simultaneously, I collaborated in a project funded by the US National Science Foundation (NSF) and in a project funded by Google Inc. Last, I acted as a contributor to a second NSF-supported project to be developed in 2014-2016. Among my international activities, I carried out productive collaborations with Universität Duisburg-Essen (Germany), Universidad Carlos III, Ecole Polytechnique Fédérale de Lausanne (Switzerland), Universidad Pública de Navarra, DTU Fotonik (Denmark), Thales Research & Technology (France). These collaborations resulted in 5 joint journal papers and 3 joint conference papers.

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The results of my work have led to 53 international peer-reviewed publications, classified as 24 SCI-JCR journal publications (13 as 1st author) and 29 conferences (15 as 1st author). Among them, 5 are invited papers to SCI-JCR journals (2 as 1st author) and 9 are invited conference talks (6 as 1st author). I would like to highlight an invited paper to the prestigious journal Nature Photonics (1st journal in the JCR ranking for the Optics category, IF=29.27 in 2011) and a paper in Nature Communications (3rd journal in the JCR ranking for the Multidisciplinary Science category, IF=10.02 in 2012). The current number of citations for my publications is 352 Scopus /466 Google Scholar, which leads to an h-index of 10 Scopus /11 Google Scholar. I have also published a Spanish patent of invention on 2012 and served as a reviewer for 7 IEEE/OSA international journals. Concerning training activities, I acted as the co-advisor of a PhD thesis and 2 Master Thesis, and I am the on-going advisor of 1 PhD thesis and co-advisor of 2 PhD theses. I am a member of the Technical Program and Local Organizing Committees of ECOC, the most relevant European conference in optical communications.

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AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2014

Turno de acceso general

Nombre: **MANCUSO , VINCENZO**
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Título:

Opportunistic Wireless Architectures

Resumen de la Memoria:

Wireless networks are evolving towards fully flexible protocols by leveraging software-defined operations, both in terms of network control (via SDN mechanisms) and radio reconfigurability (via SDR techniques) [1]. Moreover, desity and traffic in wireless networks are exponentially increasing [2], which requires novel architectures to efficiently use the scarce wireless resources with heterogeneous network protocols (LTE, 802.11, mmWave solutions, etc.) and devices (small/metro cells, WiFi, etc.).
In this framework, the proposed project focuses on "opportunistic" solutions for the forthcoming 5th generation (5G) of highly dense and efficient wireless networks. The project targets analysis, design, implementation and experimental evaluation of energy-efficient, robust, fair and high-throughput wireless protocols.
Based on the SDN/SDR paradigm and on the features of modern user's devices and mobile OSs, such solutions will be thought to smartly and promptly reconfigure network access mechanisms in the shared wireless spectrum. The proposed solutions will be "opportunistic", meaning that users and operators will engineer radio links to access radio channels when they offer high performance. Therefore, the proposed solutions will allow to either minimize transmission powers or maximize throughput. Moreover, the project will study and assess the role of users' collaboration in two directions: (i) promoting user-based cellular offloading mechanisms, and (ii) designing infrastructure-less services based on local context information. The former direction fosters high spectral efficiency at cell level, whereas the latter is meant to avoid that traffic passes unnecessarily through the operator's network.
In general, user-assisted offloading and infrastructure-less services can reduce delays and airtime consumed for transmissions in a cell. E.g., by using only good radio channels, the transfer time for a given amount of traffic is minimized, and more traffic can be exchanged in the network. Similarly, context-aware infrastructure-less services require very low power, thereby allowing for frequency reuse (i.e., multiple parallel transmissions will be possible over the same frequency).
Device-to-Device (D2D) [3] is the key technique needed to enable the foreseen solutions, while the characterization of radio channels in dense environments will be key to understand how to trigger opportunistic network mechanisms.
In the short term, the research will target the study and design of: (i) SDN-controlled D2D architectures for efficient and fair data relay, and (ii) SDR-based D2D infrastructure-less architectures for context-aware services.
In the long term, the research will target a few practical SDN/SDR demos and evaluate the possibility to produce new patents on opportunistic networking with SDN and SDR.
In general, research results will be used to pursue the publication of new ideas in international renowned peer-reviewed conferences and journals.

[1] A. Gudipati, D. Perry, L. E. Li, S. Katti, "SoftRAN:Software Defined Radio Access Network", in ACM HotSDN, 2013.
[2] J. Zander, P. Mahonen, "Riding the data tsunami in the cloud: myths and challenges in future wireless access," IEEE Comm. Magazine (2013).
[3] A. Asadi, Q. Wang, V. Mancuso. "A Survey on Device-to-Device Communication in Cellular Networks", IEEE Communications Surveys & Tutorials (2014).

Resumen del Currículum Vitae:

Dr. Vincenzo Mancuso obtained his master degree in Electronics from University of Palermo, Italy, in 2001, and a PhD in Electronics, Computer Science and Telecommunications from the same University in 2005. After the PhD, he has collaborated with University of Roma ''Tor Vergata''
and University of Palermo. He has been visiting scholar at the ECE Department of Rice University, Houston, Texas, and postdoc in the MAESTRO team at INRIA Sophia Antipolis, France. Since September 2010, Vincenzo is with IMDEA Networks Institute, working on analytical and experimental projects on cellular and opportunistic wireless networks (802.11, 802.16/LTE) and energy efficient network protocols. Vincenzo's publication record includes more than 60 peer reviewed journal articles and conference papers, among which 6 INFOCOM papers and several IEEE transactions, letters and magazines.

Ongoing research activities: (i) scheduling and inter-cell interference management in very dense cellular data networks (ICT CROWD project), (ii) design of SDN/SDR-based cellular networks (ICT CROWD project and TIGRE5-CM project), (iii) analysis and performance evaluation of inband and outband D2D communication schemes (ICT CROWD project), (iii) characterization and assessment of mobile broadband systems (H2020 MONROE project), (iv) analysis and implementation of context-aware mechanisms for mobile devices, (v)

modeling, measurements, and experiments with 802.3az (EEE links) in data centers.

Past projects: (i) experiments with modified 802.11 driver/firmware (ICT FLAVIA and ICT CROWD projects), (ii) design of flexible wireless architectures (ICT FLAVIA project), (iii) analysis and performance evaluation of opportunistic scheduling schemes for LTE/802.11 dual-mode users. (iv) analysis and optimization of power saving strategies for cellular packet networks, (v) design of green base stations, (vi) fairness in spatially biased mesh networks, (vii) performance analysis and experiments of 802.11-based mesh networks, (viii) support of streaming applications in wireless systems, (ix) wireless mesh networks operated by means of multiple technologies, namely IEEE 802.11, IEEE 802.16 and LEO/GEO Satellite solutions, (x) measurement-based admission control in IP networks.

Collaborative projects: Vincenzo has participated in several European, French, Italian and Spanish
research projects, and has recently contributed to the successful proposal of a new H2020 FIRE+ project. He is currently technical manager of two European projects: MONROE and CROWD.

Vincenzo has been and is involved in several technical program committees of international peer-reviewed conferences. Indeed he is constantly contributing with his peer-reviewing activity for works submitted to the most important IEEE, ACM, IFIP and Elsevier journals and conferences.

Vincenzo has also a good experience with teaching and tutoring students. He has taught Internet protocols and Fundamentals of communications at University of Palermo, and Switching, Wireless Communications and Performance Evaluation of Networks at University Carlos III of Madrid. He has also taught 19 short courses on 2G and 3G cellular networks, IP networking, voice over IP, QoS and network security. He has directed 12 Master Theses and 12 Bachelor Theses at University of Palermo, and 3 Master Theses and 1 PhD Thesis at University Carlos III of Madrid.

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AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2014

Turno de acceso general

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Título:

Desarrollo de estructuras semiconductoras III-V para células solares multunión de alta eficiencia

Resumen de la Memoria:

Mi carrera investigadora se ha enmarcado en el desarrollo de células solares fotovoltaicas de alta eficiencia, con enfoque en células solares multiunión de semiconductores III-V. Durante mi Tesis Doctoral en el Instituto de Energía Solar de la Universidad Politécnica de Madrid (IES-UPM), desarrollé células solares de doble unión de GaInP/GaAs ajustadas en red sobre substratos de GaAs, abarcando el crecimiento epitaxial de las estructuras semiconductoras mediante epitaxia en fase de vapor con precursores metalorgánicos (MOVPE), la fabricación de los dispositivos de célula solar y su modelado y caracterización. Este trabajo estuvo enmarcado por la participación en el proyecto europeo FULLSPECTRUM, y por otros proyectos nacionales y contratos con empresas nacionales e internacionales. Un resultado global importante fue un record mundial de eficiencia a alta concentración en este tipo de células publicado en Applied Physics Letters e incluido en las listas oficiales de eficiencias record. Esta tecnología fue transferida a empresas españolas y extranjeras, y fue objeto de una patente. Mi Tesis Doctoral fue galardonada con el Premio Extraordinario de Doctorado de la UPM.

Con el objetivo de superar las limitaciones termodinámicas intrínsecas a las estructuras ajustadas en red, en 2012 emprendí mi estancia postdoctoral en el National Renewable Energy Laboratory (NREL, Golden, CO, Estados Unidos), con un contrato Fulbright (2012-2013) y posteriormente con un contrato Marie Curie - IOF (2013-presente, proyecto METACELLS) de la Unión Europea. El trabajo en estos 3 años en NREL se ha centrado en el desarrollo de estructuras metamórficas de célula solar, con el objetivo de conseguir ajustar las anchuras de banda prohibida de las subcélulas al óptimo para el espectro solar de trabajo. El logro principal se puede resumir en la obtención de eficiencias de conversión fotovoltaica record (>46%) mediante el desarrollo de células de 4 uniones de GaInP/GaAs/GaInAs(1eV)/GaInAs(0.7eV). Esto fue posible gracias al diseño e implementación de una unión túnel metamórfica de GaAsSb/GaInAs y de células metamórficas de GaInAs de 1eV con densidades de dislocaciones < 5e5 cm-2 y eficiencias de luminescencia interna > 90%, en mi proyecto METACELLS.

Otro trabajo importante durante este postdoc es el análisis y aprovechamiento de la luminescencia en células solares III-V, y en concreto del reciclaje de fotones y del acoplamiento de fotones, en el marco de un proyecto F-PACE del US Department of Energy. Con este trabajo hemos conseguido acercarnos al límite teórico de eficiencia en células monounión de GaAs y GaInP mediante reciclaje de fotones, y en células de dos uniones, aprovechando el acoplamiento de fotones. Además hemos demostrado experimentalmente que el efecto de las variaciones espectrales en estas células es menor, gracias al acoplamiento de fotones, y, por lo tanto, su producción de energía es mayor.

Con todo esto he adquirido una amplia experiencia multidisciplinar en el desarrollo de estructuras semiconductoras III-V y células solares de alta eficiencia de varias tecnologías. Mi plan es transferir este conocimiento en la fase de retorno de mi proyecto Marie Curie y seguidamente aplicarlo al desarrollo de células solares de alta eficiencia y/o campos adyacentes como la optoelectrónica de comunicaciones o la iluminación de estado sólido.

Resumen del Currículum Vitae:

Web: http://scholar.google.com/citations?hl=en&user=WiH_XPIAAAAJ
Publicaciones: 29 en revistas internacionales, 47 en conferencias (24 ponencias, 5 ponencias invitadas).
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Selección de publicaciones en revista.

I. García, C. F. Kearns-McCoy, J. S. Ward, M. A. Steiner, J. F. Geisz, and S. R. Kurtz, "Back reflectors based on buried Al2O3 for enhancement of photon recycling in monolithic, on-substrate III-V solar cells," Applied Physics Letters, vol. 105, no. 13, p. 133507, Sep. 2014.

R. M. France, I. García, W. E. McMahon, A. G. Norman, J. Simon, J. F. Geisz, D. J. Friedman, M. J. Romero (2014) "Lattice-Mismatched 0.7-eV GaInAs Solar Cells Grown on GaAs Using GaInP Compositionally Graded Buffers", IEEE Journal of Photovoltaics, 4 pp. 190-195.

I. García, J. F. Geisz, R. M. France, J. Kang, S.-H. Wei, M. Ochoa, D. J. Friedman, (2014), "Metamorphic Ga0.76In0.24As/GaAs0.75Sb0.25 tunnel junctions grown on GaAs substrates", Journal of Applied Physics, 116, p: 074508.

I. García, R. M. France, J. F. Geisz, J. Simon (2014) "Thin, high quality GaInP compositionally graded buffer layers grown at high growth

rates for metamorphic III-V solar cell applications", Journal of Crystal Growth, 393, pp: 64-69.

J. F. Geisz, M. A. Steiner, I. García, S. R. Kurtz, D. J. Friedman (2013), "Enhanced external radiative efficiency for 20.8% efficient single-junction GaInP solar cells", Applied Physics Letters, 103, p. 041118.

I. Garcia, I. Rey-Stolle, B. Galiana, C. Algora (2009), "A 32.6% efficient lattice-matched dual-junction solar cell working at 1000 suns", Applied Physics Letters, 94, p. 053509.

Patentes

Iván García, Pilar Espinet, Carlos Algora, Mathieu Baudrit, Ignacio Rey-Stolle (P5817EPPC), "Method Implemented In A Computer For The Numerical Simulation Of Semiconductor Devices Containing Tunnel Junctions", 5-4-2010, UPM

Premios

Premio Extraordinario de Doctorado, por la Universidad Politécnica de Madrid (2011).
Premio Extraordinario Fin de Carrera, por la Universidad de Valladolid (2004).

Trabajo en centros extranjeros.

Contrato Fulbright para realización de investigación post-doctoral en el National Renewable Energy Laboratory (Golden, CO, Estados Unidos) – 2012-2013.

Programa Marie Curie – IOF (Unión Europea): Proyecto "METACELLS" para realización de investigación post-doctoral en el National Renewable Energy Laboratory (Golden, CO, Estados Unidos) – 2013-2015.

Programa Nacional FPU: estancia en Phillips Universitat (Marburg, Alemania), Julio-Octubre 2007. Objetivo: estudio del ordenamiento en GaInP crecido por MOVPE.

Selección de participación en proyectos y contratos con empresas:

"Full Spectrum: A new PV wave making more efficient use of the solar spectrum", Unión Europea - Programa de Energías No Nucleares de la Unión Europea, VI P. Marco, Noviembre 2003 a Noviembre 2008

"Producción en Isofotón de células solares III-V multiunión con eficiencias del 35 % a 1000 soles", ISOFOTON, S.A., Febrero 2006 – Julio 2007

"Simulación de células solares de concentración", Abengoa Solar New Technologies, S. A., Febrero 2009 - Febrero 2010

"F-PACE: Foundational Program to Advance Cell Efficiency", US Department of State, Enero 2011 – Octubre 2014.

Dirección de trabajos de formación

1 Proyecto Fin de Carrera (IES-UPM), 1 Trabajo Fin de Master (IES-UPM) y 2 proyectos de investigación (NREL – Estados Unidos)

Acreditación de Contratado Doctor por la ANECA (2012)

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AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2014

Turno de acceso general

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Título:

Information-theoretic limits of communication systems under realistic assumptions

Resumen de la Memoria:

Dr. Koch conducted his undergraduate and graduate studies in Electrical Engineering from 1998-2004 and his doctoral studies from 2004-2009, both at ETH Zurich (Switzerland). From 2010-2012, he was a Marie Curie Research Fellow at the University of Cambridge (UK). Furthermore, he was a research intern at Bell Labs (Murray Hill, NJ) in 2004 and at Universitat Pompeu Fabra (Spain) in 2007. Dr. Koch joined the Universidad Carlos III de Madrid (Spain) in 2012 as a Visiting Professor. He is currently a Marie Curie Investigator at the same university.

Dr. Koch is an expert in information theory and his work has covered various topics in this area, including wireless communications, on-chip communications, quantization and sampling, communication with discrete signal constellations, and information theory at finite blocklength. He aims at realistic limits, taking the practical limitations in communication systems into account. For example, wireless communication channels are typically analyzed by assuming that the receiving terminals are aware of the channel propagation characteristics. However, in practical communication systems, such knowledge is a priori not available but must be obtained, for example, by transmitting pilot symbols. In his work, Dr. Koch takes the overhead due to channel estimation into account, thereby providing more realistic fundamental limits. He further incorporates hardware limitations into his work, taking the loss due to low-precision quantization or limitations on the signal constellation into account.

Inter alia, Dr. Koch's research currently concerns the information-theoretic limits of short-packet wireless communications. Indeed, most of the current information-theoretic analyses provide asymptotic results in the limit as the length of the employed error-correcting codes tends to infinity. As we move towards next-generation wireless communication systems (referred to as "5G"), such analyses may have limited significance, since emerging applications in 5G may require the exchange of short packets. Thus, more refined analyses of the achievable data rates as a function of the codeword length and a given target probability of error are required. In his work, Dr. Koch aims at information-theoretic limits that help better understand the fundamental tradeoff between spatial diversity, spatial multiplexing, and cost of channel estimation.

Resumen del Currículum Vitae:

Tobias Koch received his M.Sc. degree in electrical engineering (with distinction) in 2004 and his Ph.D. degree in electrical engineering in 2009, both from ETH Zurich, Switzerland. From June 2010 until May 2012, he was a Marie Curie Intra-European Research Fellow with the University of Cambridge, UK. He was also a research intern at Bell Labs, Murray Hill, NJ in 2004 and at Universitat Pompeu Fabra (UPF), Spain, in 2007. He joined the Universidad Carlos III de Madrid (UC3M), Spain, in June 2012 as Profesor Visitante. Since June 2013 he is an Investigador Marie Curie with UC3M.

Dr. Koch is an expert in information theory and his work has covered various topics in this area, including wireless communications, on-chip communications, quantization and sampling, communication with discrete signal constellations, the development of message-passing algorithms for continous-time synchronization, and information theory at finite blocklength. He has co-authored 10 journal articles in the IEEE Transactions on Information Theory and 24 conference articles in refereed conference publications. In addition, he was invited to present his work at 7 conferences.

Dr. Koch was awarded a Fellowship for Prospective Researchers from the Swiss National Science Foundation (which he turned down), a Marie Curie Intra-European Fellowship for Career Development, and a Marie Curie Career Integration Grant. He is co-author of a poster that won the Best Poster Award at the IEEE Communication Theory Workshop in 2013 and co-author of a paper that won the 2013 IEEE Sweden VT-COM-IT Joint Chapter Best Student Conference Paper Award.

Dr. Koch is participating or has participated in 10 research projects: 1 funded by the Comunidad de Madrid, 1 by the Spanish Ministry of Economy and Competitiveness, 2 by the Spanish Ministry of Science and Innovation, 4 by the European Commission, 1 by the Isaac Newton Trust, and 1 by the Swedish Research Council. He is or was principal investigator in 3 of these projects. He is currently directing or co-directing 3 Ph.D. theses and has directed or co-directed 1 Ph.D. thesis, 2 Master's theses, and 3 undergraduate projects or internships.

Dr. Koch was an invited speaker at the second and fourth International Symposium on Applied Sciences in Biomedical and Communications

Technologies (ISABEL) in 2009 and 2011, respectively, at the 9th Annual Information Theory and Applications Workshop (ITA), at the International Workshop on Frontiers of Telecommunications and Coding (held in honor of Ezio Biglieri's 70th birthday), and at the 11th International Symposium on Wireless Communication Systems.

Dr. Koch was a member of the Technical Program Committee of the 23rd Annual IEEE International Symposium on Personal Indoor and Mobile Radio Communication in 2012, the 2014 International Zurich Seminar on Communications, and the 11th International Symposium on Wireless Communication Systems. He organized the special session "Wireless communications at finite blocklength" at the 11th International Symposium on Wireless Communication Systems and he is the Publications Chair of the 2016 IEEE International Symposium on Information Theory. He has been a referee of various IEEE journals and conferences and has been Session Chair at various conferences.

Dr. Koch is currently serving as Vice Chair of the Spain Chapter of the IEEE Information Theory Society.

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Turno de acceso general

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Título:

High-Frequency Acoustic Lasers for Sensing and Time-Keeping Applications

Resumen de la Memoria:

During the first 8 of my 11 years of experience in research I was focused in exploring and optimizing alternatives for improving the light emission efficiency of Silicon (Si) based materials and photonic structures fabricated using CMOS compatible fabrication techniques. The main goals were to obtain optical stimulated emission and lasing integrated in a Si photonics platform. Following a timeline, three were my main research subjects:

1. Si nanostructures in different dielectric matrices and Si-nanostructures coupled to Erbium ions in various dielectric matrices.
2. Si based light emitting photonic waveguides for optical amplification purposes.
3. Optical microcavities (like light-emitting Si based rings and disks and rare-earth doped glass microsphere lasers) integratables in a Si chip for short-range telecomm and sensing applications.

Since 2011 my main research line has become cavity optomechanics, which concerns the understanding and exploitation of the interaction between light and mechanical objects on low-energy scales. In 2014, my coworkers and I demonstrated the first optomechanical crystal with localized acoustic modes appearing in a full acoustic gap, a work that has been published in Nature Communications. In the same year we demonstrated a self-stabilized acoustic laser driven by optical forces integrated in a Si chip, which operates at ambient conditions of temperature and pressure. The combined characteristics of this latter system are expected to impact intra-chip time-keeping and sensing applications, since high intensity sound waves can be converted to electric signals when impinging piezoelectric materials. The results of this work are under review in Nature Photonics since October 2014 and I have been invited to present them in an invited talk at the prestigious conference Phonons 2015, to be held in Nottingham (UK) from 12th – 17th July 2015.

Since I joined the CNR Nanoscience Insitute Pisa NEST in March 2014 I am also investigating optomechanical interactions in lasing devices, such as quantum-cascade-lasers operating in the THz region and rare earth doped glass microsphere lasers. The idea is to exploit the very high electromagnetic field intensities achieved above threshold and to obtain extremely high quality factors by exploiting laser linewidth narrowing.

I have acquired wide experience in several experimental techniques concerning the simulation, fabrication and characterization of photonic materials and structures:

- Continuous wave and time resolved standard and micro- luminiscence spectroscopy.
- Optical gain and losses measurements with Variable Stripe Length, Shifting Excitation Spot and Pump and Probe techniques in planar and bidimensional light-emitting waveguides.
- Optical characterization of active and passive photonic structures (waveguides, microdisk and ring resonators, 1D and 2D photonic crystal cavities, etc).
- Simulation of photonic structures with FDTD and BPM methods (MEEP, BEAMPROP and FULLWAVE) and optomechanical structures with FEM methods (COMSOL). Lithographic mask design (Tanner L-Edit tools).
- Fabrication of porous silicon samples in electrochemical laboratory and subsequent thermal and chemical treatments.
- Use of clean room facilities such as: e-beam lithography, UV photolitography, thermal evaporators, Scanning Electron Microscopy, etc

Resumen del Currículum Vitae:

I graduated in Physics in the University of La Laguna in 2002 (mark 2.08/4 of Spanish standard scale). My Ph.D thesis was done under the supervision of Dr. Néstor E. Capuj (University of La Laguna) and prof. Lorenzo Pavesi (University of Trento, Italy). An unofficial collaboration between the groups of both supervisors allowed me to perform several extended stages at the group of prof. Pavesi during my Ph.D. In december of 2006, I received the European Ph.D. degree from the University of La Laguna with Sobresaliente Cum Laude, obtaining the Ph.D Extraordinary Award from the Experimental and Technical Sciences Division.
From December 2006 to May 2008 I continued my research at the University of Trento with a post-doctoral contract.
In June 2008 I joined the MIND group in the Electronics Department of the University of Barcelona (UB) after being awarded with a Juan de la Cierva fellowship associated to the FP6-EU project LANCER.

AYUDAS RAMÓN Y CAJAL
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Turno de acceso general

In September of 2011 I joined the Catalan Institute of Nanoscience and Nanotechnology (ICN2). Soon afterwards, I was awarded with a Beatriu de Pinòs - Mod. B post-doctoral fellowship. This grant is co-financed by the Marie Curie-COFUND actions of the FP7-EU programme and by the Generalitat de Catalunya. I was appointed as the scientific coordinator of the ICN2 activities within the FP7-EU project TAILPHOX.
Since March of 2014 I am working as a Type III Researcher at the CNR Nanoscience Institute Pisa (NEST) (Italy) financed by the ERC-Advanced Grant SOULMAN.

- I have published 61 peer-reviewed regular scientific articles, indexed and with relative quality index. 37 of them are in the 1st Quartil of their respective area (n.a. the conference procedings are not included here). In addition, I have published 5 indexed articles without relative quality index, 1 book chapter and 1 book. My works have received 1234 citations according to GOOGLE SCHOLAR and 881 citations according to ISI WEB OF SCIENCE. My h-factor is 20 according to GOOGLE SCHOLAR and h=18 according to ISI WEB OF SCIENCE . The average number of citations/year during the last 5 years is 182 cit/year.
- I have 56 participations in congresses and 1 invited seminar. Within them there are 10 invited talks, 36 oral communications and 10 posters. These have led to the publication of 28 papers in conference proceedings.
- I have directed 1 Ph.D thesis in the UB and 1 Master Thesis in the BCN Photonics Master.
- I have participated in 14 R&D&I projects funded in competitive calls, 6 of them European under different framework programmes. I was the main investigator of two GICSERV projects (Proyectos de acceso a la instalación científico técnica singular (ICTS) denominada "Sala Blanca integrada de micro y nanofabricación") in collaboration with the Microelectronics Institute of Barcelona (IMB-CNM).
- I have also participated in two teaching innovation projects " SceTGo (funded bu EU-LLP) and "Maleta Pedagógica ECBI" (funded by La Fundación la Caixa), in which I collaborated with the Pedagogy Faculty of the UB as a physics expert.
- I am accredited as "Profesor Titular" by the ANECA and as "Profesor Agregado" and "Profesor Lector" by the AQU-Catalunya.
- I am reviewer in several journals such as: Applied Physics Letters, Optics Express, Journal of Lightwave and Technology, Journal of Applied Physics, Journal of Physics D, Optical Materials, etc.