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## AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2014

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**Nombre:** MORENO , JUAN  
**Referencia:** RYC-2014-16613  
**Área Científica:** Ingeniería Eléctrica, Electrónica y Automática  
**Correo Electrónico:** jc.moreno@csic.es

### Título:

Neurorehabilitación de la locomoción humana

### Resumen de la Memoria:

A lo largo de estos más de diez años de trabajo, el Dr. Moreno ha abordado sin interrupción retos científicos y tecnológicos asociados a la mejora de la calidad de vida de las personas afectadas por trastornos neurológicos con especial atención a aquellos que cursan con problemas de la marcha y el equilibrio, como por ejemplo la enfermedad de Parkinson, el accidente cerebrovascular o la lesión medular. Su carrera está, por tanto, íntimamente ligada al desarrollo de soluciones tecnológicas con un impacto social incuestionable, especialmente en sociedades occidentales que se encuentran abocadas a un envejecimiento paulatino de su población. El impacto de su trabajo en la mejora de la calidad de vida de estas personas, su independencia, su desarrollo físico y cognitivo, está demostrado por los méritos de su carrera.

En este contexto el Dr. Moreno ha liderado el desarrollo de técnicas robóticas y neuroprotésicas para el desarrollo de ayudas tecnológicas a la rehabilitación de estas enfermedades o para la mejora de la calidad de la vida cuando la mejora funcional mediante rehabilitación no es posible. Su trabajo doctoral, titulado "Monitorización, diagnóstico y compensación de inestabilidad articular a nivel de rodilla y tobillo: aproximación mediante ortesis activas" y leído con la máxima calificación el 1 de Septiembre de 2002, ha sido ampliamente reconocido tanto en el ámbito nacional como europeo e internacional al ser receptor de diversos premios, tal como figura en su Currículo. Cabe destacar la obtención del Premio IMSERSO Infanta Cristina 2011 (Premios a la Investigación, al Desarrollo y a la Innovación, Modalidad Premio a la investigación).

El Dr. Moreno ha hecho suya la filosofía de trabajo y ha liderado, en el entorno internacional, la investigación en este campo mediante su participación activa en la consecución de proyectos Europeos y su posterior coordinación científica. En este sentido conviene destacar su liderazgo en los proyectos GAIT (Intelligent knee and ankle orthosis for biomechanical evaluation and functional compensation of joint disorders, IST-2001-37751, 09/2002 a 09/2005), ESBIRO (Bio mimetic actuation, sensing and control technology for limit cycle bipedal walkers, IST-2005-045301, 11/2006 a 10/2009), BETTER (Brain-Neural Computer Interaction for Evaluation and Testing of Physical Therapies in Stroke Rehabilitation of Gait Disorders, EU INFSO-ICT-247935, 01/20010 a 01/2013) y BIOMOT (Smart Wearable Robots with Bioinspired Sensory-Motor Skills, EU CONNECT-ICT-611695, 09/2013 hasta la actualidad) que han permitido la aplicación de tecnologías robóticas y neuroprotésicas no invasivas a los problemas de la marcha y equilibrio anteriormente referidos. En los tres últimos proyectos, ya como investigador posdoctoral contratado con cargo a proyectos de convocatorias competitivas, en el periodo 11/2006 hasta la actualidad, ha llevado a cabo la coordinación científico técnica del equipo internacional involucrado, lo cual supone más de 8 años de experiencia de investigación posdoctoral del más alto nivel. Esta complejidad creciente en los métodos propuestos por el Dr. Moreno y el rigor con que los aborda lo hacen uno de los más destacados expertos en su campo a nivel mundial.

### Resumen del Currículum Vitae:

Juan C. Moreno recibió el título de Doctor Ingeniero Industrial por la Universidad Politécnica de Madrid en 2006. En 2001 se integró en el Consejo Superior de Investigaciones Científicas (CSIC) como investigador en el Instituto de Automática Industrial. Tras obtener su título de Doctor, ha liderado la líneas de neurorehabilitación de la marcha en el Instituto de Automática Industrial y en la actualidad en el Instituto Cajal, desarrollando y estudiando exoesqueletos y dispositivos neuroprotésicos para rehabilitar la marcha en pacientes con alteraciones neuromotoras, interactuando con el cuerpo humano. La finalidad de su línea de investigación es derivar intervenciones que restauren la función perdida mediante la inducción de neuroplasticidad o sustituyan la función cuando la rehabilitación ya no es posible. En esta visión convergen la Neuroingeniería, la Biomecánica y la Neurofisiología. Como tema principal de su tesis doctoral, el Dr. Moreno desarrolló la Ortesis Inteligente GAIT, en el seno de proyectos internacionales del Programa Marco de la UE, por la cual el Instituto de Mayores y Servicios Sociales (IMSERSO) le otorgó el primer Premio a la Investigación, al Desarrollo y a la Innovación "Infanta Cristina" en su edición 2011. Dicho dispositivo se encuentra en vías de explotación por la empresa multinacional OSSUR. Los objetivos globales de Dr. Moreno consisten en la transformación de ideas de I+D en productos y aplicaciones innovadoras, de la mano de la generación de innovación en cooperación con instituciones académicas, clínicas e industriales para acelerar la investigación biomédica transnacional. Es socio y cofundador de Technaid, empresa spin-off del CSIC, donde ha participado en las actividades de I+D que han resultado en productos, en concreto, sistemas hardware y software para captura y análisis no-obstrusivo del movimiento humano (Sistema Tech MCS) y exoesqueletos robóticos.

Recientemente ha sido coordinador científico en el proyecto europeo BETTER, en el que se combinaron interfaces cerebro-ordenador con exoesqueletos robóticos. Este proyecto ha dado lugar a desarrollos novedosos de sistemas de neuro-rehabilitación. El Proyecto REHABOT en su aplicación en lesionados medulares, coordinado científicamente por el Dr. Moreno, ha dado lugar avances sin precedentes en el



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ámbito de la neuroingeniería y la robótica de rehabilitación (ver sistema híbrido de marcha en publicaciones). Otra acción a destacar en la que el Dr. Moreno ha jugado un papel esencial ha sido el proyecto de cooperación en inteligencia artificial aplicada a la rehabilitación física lo que ha impulsado la cooperación Bilateral Japón-España estrechando vínculos entre el CSIC y su análogo en el país asiático, RIKEN (en cooperación con el fabricante Toyota). Los resultados del proyecto coordinado por el Dr. Moreno en cooperación con el Dr. Shimoda (RIKEN-BSI Toyota Collaboration Center) han dado lugar a la consecución de la financiación Europea en el contrato BIOMOT del 7º Programa Marco de la Unión Europea. Juan Moreno ha sido autor o coautor de más de 110 artículos técnicos en revistas, libros y conferencias en el emergente campo de la bioingeniería abordando de un modo multidisciplinar áreas de robótica, biomecánica, neurofisiología, mecatrónica, interacción hombre-máquina y sistemas asistenciales. Las innovaciones científicas propuestas por Juan Moreno han sido galardonadas en 2012 por el Massachusetts Institute of Technology con el premio TR35.



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**Nombre:** PASTOR PASTOR, DAVID  
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**Área Científica:** Ingeniería Eléctrica, Electrónica y Automática  
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### Título:

New materials and strategies for optoelectronic devices based on silicon supersaturated

### Resumen de la Memoria:

David Pastor has developed a career focused in the development and transference of technology aimed to the production of new and powerful microelectronic devices based on supersaturated silicon with impurities for increase the efficiency in photovoltaic devices and the infrared detectors. The core objective of his research line has been aimed to the development of intermediate band semiconductors for more efficient photonic devices for covering a wide range of applications fields, from the renewable energies to the environmental, and in the imaging formation and remote sensing fields, looking forward to the technological transfer into useful products for industrial and domestic commercialization. During his career he gathered an interdisciplinary scientific background, with solid experience at Clean Room techniques, in the design and fabrication of higher efficiency photovoltaic devices based on Si which are compatible with mature microelectronics and the infrared detection field, with the development of silicon based infrared photodevices compatible with the CMOS mature technology. Nowadays, he is in charge of the synthesis and properties of novel semiconductors line, at the Aziz group in the School of Engineering at Applied Physics at Harvard University, where he is mainly focus in the using melting and rapid solidification of semiconductors and metals induced by nanosecond pulses, studying the properties of these nonequilibrium materials formed by rapid solidification. As postdoctoral researcher he is also in charge of the black silicon line in the group of Professor Eric Mazur at Harvard University, where he is focused in the properties of hyperdoping silicon with sulfur mixed by a texturing of the surface induced by femtosecond laser pulses in a sulfur content gas atmosphere. It is a very technological project, which final aim is the development of silicon supersaturated infrared photodetectors and high efficiency intermediate band solar photovoltaic devices, allowing the collection of sub-bandgap photons.

He has developed three main projects, where he pretended solving the current limitations found to take advantage of sub-bandgap photons on semiconductors, which prevent many applications in the renewable energy, environmental, diagnostics or biotechnology fields.

(i) Intermediate band semiconductors: Photovoltaic devices based on supersaturated semiconductors formed by ion implantation of deep level centers followed by nanosecond pulsed melting. The formation of an intermediate band in the semiconductor would act as intermediate step to promote electrons from valence band to conduction band absorbing sub-bandgap photons and increasing the solar cell efficiency; (ii) Hyperdoped silicon based infrared detectors: Infrared detection on materials based Si that are compatible with the mature CMOS detection technology. In the hyperdoped silicon infrared detectors the principle of operation is based on the introduction of deep level centers in concentrations above the insulator to metal transition to form a band of states into the bandgap of the semiconductor. The metallic behavior of this band could decrease the electrical level noise allowing room temperature silicon based photodetectors. (iii) Black silicon and black germanium for photonics devices: High absorptance in these materials is based on the texturing and hyperdoped.

### Resumen del Currículum Vitae:

David Pastor obtained his degree in Applied Physics from Autonomía University of Madrid, Spain in 2001. Just after in July of 2001, he joined to the Research Group of Macromolecules (GIDEM) of the C.S.I.C. in Madrid, where he studied the physical properties of polymers in a project (I + D) coordinated with the national R & D of Repsol-YPF. In 2003 he moved to Barcelona to the Group of Optical properties of solids at CSIC where he obtain his PhD in the program and Electronics Engineering Department of Electronics at the University of Barcelona (UB). The main objective of this research was to obtain high p-type activation on GaN semiconductors for high efficient Light emitting diodes (LEDs). This period of research will culminate with the presentation of the thesis through the electronics department at UB and obtaining a PhD in Physics cum laude from the University of Barcelona. In 2007 began to work as a PhD in Physics in the Thin Films and Microelectronics group (LDM) of the Department of Applied Physics III (Electrical & Electronics) in the department of Physics at the UCM, where he began working on a project CONSOLIDER during the period from 2007 to 2011. During this period he played his research project for the new generation of materials, solar cells and photovoltaic strategies for better use of solar energy, focusing particularly on the development of new photovoltaic intermediate band materials by ion implantation could increase dramatically the current efficiency of photovoltaic cells. In 2012 is awarded with a contract Juan de la Cierva to work with the Prof Antonio Luque at the Instituto de Energía Solar (IES) at UPM to develop an intermediate band solar cell. He built and publish the results of the first intermediate band solar cell based on Si with external Quantum efficiency in the infrared region. At August of the same year is awarded with a postdoctoral contract of the program MEC-Fulbright at the School of Engineering and Applied Sciences at the Harvard University to develop intermediate band materials and infrared detectors with Pulsed-Laser melting processes, where he develops new strategies to supersaturate semiconductors and worked on fabrication of improve the crystallinity on black silicon semiconductors. In August 2014, he joined as assistant teacher to



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the group of Professor Eric Mazur at Harvard University to impart classes on a highly innovative Physics courses. Currently he is the responsible on this group as a postdoctoral researcher of the black silicon line to develop new infrared sensing devices.

David Pastor is coauthor of 55 publications (16 publications as first author): 21 conference proceedings, 33 published papers in journals with impact factors in the first quartile and one chapter in edited books (Springer Editorial). He has coauthored four patents: two related with intermediate solar cells, one related with silicon infrared detectors and one focused in improving quality of black silicon. He has made important contributions on the supersaturated semiconductors field, publishing in journals such as APL, Solar Energy Materials and Solar Cells, JAP, JPD, etc. some of the publications being highly cited (for example the five most cited papers have 79, 51, 47, 46 and 40 publications respectively) He has an h index of 12, with 514 cites in total according to the Web of Science database.



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**Nombre:** FERNANDEZ SAAVEDRA, ROEMI EMILIA  
**Referencia:** RYC-2014-16361  
**Área Científica:** Ingeniería Eléctrica, Electrónica y Automática  
**Correo Electrónico:** roemi.fernandez@car.upm-csic.es

### Título:

Robotics, Control Theory and Instrumentation

### Resumen de la Memoria:

In 2002 the candidate was granted with a FPU fellowship for the execution of her PhD at the Industrial Automation Institute-CSIC. In there, she completed her thesis work in the area of robotics and automation and participated in various European projects related to robotics, such as ROWER-II (Brite-EuRam BRPR-CT97-0554), and AURORA (Growth 99 GRD1-1999-11153). In 2006 she received the European Ph.D. degree in Robotics and Artificial Vision from the ETSII-UPM for her thesis entitled **Reference Tracking Control for Non-Classically Actuated Robotic Systems**. The thesis was focused on the design of new actuators for improving the energy efficiency in mobile robots and the design of the corresponding non-linear controllers for dealing with the new robotic systems resulting from incorporating non-linear actuators. She has been a visiting PhD student at the Centre for Control Engineering and Computation-University of California in 2003 and at the Department of Automatic Control-Lund University, Sweden in 2004. From 2005 to 2009 the candidate was first an assistant, then an associate, and finally an aggregate Professor at the San Pablo-CEU University. During this period she directed 3 end of career projects and received the award for best teaching of 2008. Based on her experience in sensors, instrumented systems and novel actuators, during this period, the candidate also initiated collaboration with some M.D. from the University Hospital of Getafe in order to design a new device for sensing and monitoring the urine of critical care patients. With this sensing device a series of clinical studies are being conducted in order to find the relationships between urine output patterns and therapeutic actions, such as the administration of drugs, or the patients' evolution throughout his/her pathology. This experience may lead to further research in new medical sensor devices, instrumentation, or robotic assisted surgery systems, where a proposal has been submitted at the end of 2014 to Explora **Ciencia** **MINECO**: New Robotic Concepts for Minimally Invasive Surgery.

At the end of 2008 the candidate was granted with a contract JAE-DOC for the incorporation of researchers to the Spanish Science and Technology System. With this contract she joined to the Centre for Automation and Robotics CSIC-UPM, where she is still researching with a temporary employment contract. During this last stage, the candidate has been actively involved in two European projects: Crops (FP7-NMP-2009-LARGE-3) and TIRAMISU (FP7-SEC-2011.4.2-2 284747).

The main research line the candidate has pursued so far is the robotics, and more specifically, the analysis and design of non-linear actuators for enhancing the efficiency of mobile robots, the integration and treatment of information acquired with diverse sensory and instrumentation systems for decision making processes, and the design and evaluation of non-linear controllers for robotic platforms with novel actuation systems. All these research subjects, who are closely related to each other within the field of robotics, pretend to significantly contribute to the main challenge of introducing new kind of service robots for improving the quality of life of human beings. These new kinds of service robots promise revolutionary advancements in such applications as biology, medicine, industry, space technology and environment protection.

### Resumen del Currículum Vitae:

The candidate has collaborated in a total of 21 research projects (9 European projects, 3 AECID, 3 CYCYT, 1 MICIN) and 5 research contracts of special relevance with the industry. She has published 4 books, 9 chapters of books, 20 articles in international journals and 10 patents (1 US patent and 6 international patents - PCT). She has also edited 1 book and presented results of her research at 41 international conferences (14 ISI proceedings, 6 upon invitation). In addition, the research activity of the candidate received the Angel Herrera Award in 2007.

#### Selected publications:

Roemi Fernández, Joao Hespanha, Teodor Akinfiyev, Manuel Armada. Nonlinear Control of the Dual Smart Drive Using Backstepping and a Time-Optimal Reference. *Autonomous Robots*, 19-3, pp. 233-255, Springer, 2005.

This article has been published in the journal *Autonomous Robots*, which in the year of the article publication had an impact factor of 1.246, ranking the second position in the list of publications of Robotics. Before the publication of this article, the work carried out resulted in the US Patent US7341122-B2, the European Patent EP1514776-B1 and the Spanish Patent ES2195792-B1.

Roemi Fernández; Carlota Salinas; Héctor Montes; Javier Sarria. Multisensory System for Fruit Harvesting Robots. *Experimental Testing in Natural Scenarios and with Different Kinds of Crops. Sensors*. 14 - 12, pp. 23885 - 23904. MDPI AG, 2014.



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This article has been published in the journal *Sensors*, which had an impact factor of 2.048 in year 2013. The journal is in the top 25% of the Instruments and Instrumentations journals.

Roemi Fernández; Héctor Montes; Carlota Salinas; Javier Sarria; Manuel Armada. Combination of RGB and Multispectral Imagery for Discrimination of Cabernet Sauvignon Grapevine Elements. *Sensors*. 13 - 6, pp. 7838 - 7859. MDPI AG, 2013.

This article has been published in the journal *Sensors*, which in the year of the article publication had an impact factor of 2.048. The journal is in the top 25% of the Instruments and Instrumentations journals.

Andrey Apalkov; Roemi Fernández; Jean-Guy Fontaine; Teodor Akinfiyev; Manuel Armada. Mechanical actuator for biomimetic propulsion and the effect of the caudal fin elasticity on the swimming performance. *Sensors and Actuators A-Physical*. 178, pp. 164 - 174. Elsevier Science SA, 2012.

This article has been published in the journal *Sensors and Actuators A-Physical*, which in the year of the article publication had an impact factor of 1.841. The journal is in the top 25% of the Instruments and Instrumentation journals. The candidate is the corresponding author in this publication.

Abraham Otero, Andrey Apalkov, Roemi Fernández, and Manuel Armada,  A New Device to Automate the Monitoring of Critical Patients  Urine Output,  BioMed Research International, vol. 2014, Article ID 587593, 8 pages, 2014.

This article has been published in the journal *BioMed Research*, which the last year had an impact factor of 2.880. Before the publication of this article, the design of the device for measuring the urine output has been presented in the Patent applications ES2395501, WO2012164123, in which the candidate is the first author. The Spanish patent ES2395501 has been conferred on 18/12/2013. This publication demonstrates the multidisciplinary nature of the research undertaken by the candidate during the last years.