



# UC3M R&D IN THE

# area of artificial intelligence

IDENTIFICATION OF THE RESEARCH ACTIVITY, TECHNOLOGIES,  
PATENTS, INFRASTRUCTURES, AND OTHER UC3M CAPABILITIES  
IN THE AREA OF ARTIFICIAL INTELLIGENCE

**uc3m**

Universidad **Carlos III** de Madrid

Vicerrectorado de Política Científica

Servicio de Apoyo al Emprendimiento y la Innovación



The Entrepreneurship and Innovation Service Supportz SEI of the Universidad Carlos III de Madrid wants to present the potential of the university in this "knowledge map" through the research areas developed in the frame of R&D projects, both national and international, patents and other results of UC3M investigators, in the Area of Artificial Intelligence.

The global knowledge obtained, the experience of collaborating with the industry, the existence of infrastructures and proper laboratories and, above all, the multidisciplinary nature of UC3M are characteristics that provide an added value so that our support towards the innovation of institutions, big companies and SMEs has an integral quality.

We invite you to deepen the knowledge of the UC3M and to collaborate in new R&D and innovation projects.

Entrepreneurship and Innovation Service Support  
Universidad Carlos III de Madrid

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# Index

<b>BIOENGINEERING AND AEROSPACE ENGINEERING</b> .....	<b>6</b>
<b>Biomedical Imaging and Instrumentation Group</b> .....	<b>6</b>
<i>PI: Manuel Desco</i>	
<b>Plasmas and Space Propulsion Team (EP2)</b> .....	<b>7</b>
<i>PI: Eduardo Ahedo</i>	
<b>Aerospace Engineering Research Group</b> .....	<b>8</b>
<i>PI: Manuel García-Villalba</i>	
<b>COMPUTER SCIENCE</b> .....	<b>10</b>
<b>Computer, Communications, and Systems Architecture (ARCOS)</b> .....	<b>10</b>
<i>PI: Jesús Carretero</i>	
<b>COSEC (COMputer SECurity Lab)</b> .....	<b>12</b>
<i>PI: Arturo Ribagorda, Juan E. Tapiador</i>	
<b>Evolutionary Computation and Neural Networks Group (EVANNAI)</b> .....	<b>13</b>
<i>PI: Pedro Isasi</i>	
<b>GigaBD</b> .....	<b>14</b>
<i>PI: Jorge Luis Morato</i>	
<b>Applied Artificial Intelligence Group (GIAA)</b> .....	<b>15</b>
<i>PI: José Manuel Molina, Jesús García Herrero</i>	
<b>Human Language and Accessibility Technologies (HULAT)</b> .....	<b>17</b>
<i>PI: Paloma Martínez, Belén Ruiz</i>	
<b>Knowledge Reusing</b> .....	<b>19</b>
<i>PI: Juan Llorens</i>	
<b>Systems Control, Learning and Optimisation Laboratory (CAOS)</b> .....	<b>21</b>
<i>PI: Araceli Sanchis</i>	

<b>Planning and Learning Group (PLG)</b> .....	22
<i>PI: Fernando Fernández Rebollo</i>	
<b>Interactive Systems (DEI)</b> .....	24
<i>PI: Paloma Díaz</i>	
<b>SoftLab</b> .....	25
<i>PI: Ángel García Crespo</i>	
<b>TELEMATIC ENGINEERING</b> .....	27
<b>Telematic Applications and Services Group (GAST)</b> .....	27
<i>PI: Carlos Delgado Kloos, Carlos García Rubio, Andrés Marín López, Luis Sánchez Fernández</i>	
<b>NETCOM (Network and Communication Technologies). (NETWORK TECHNOLOGIES Group)</b> .....	29
<i>PI: Arturo Azcorra</i>	
<b>ADSCOM (Advanced Switching and Communication Systems). (NETWORK TECHNOLOGIES)</b> .....	31
<i>PI: David Larrabeiti</i>	
<b>SYSTEMS AND AUTOMATIC ENGINEERING</b> .....	32
<b>ROBOTICS LAB</b> .....	32
<i>PI: Carlos Balaguer, Miguel A. Salichs, Luis Moreno</i>	
<b>Intelligent Systems Laboratory (LSI)</b> .....	34
<i>PI: Arturo de la Escalera, José María Armingol</i>	
<b>ELECTRONIC TECHNOLOGY</b> .....	36
<b>Microelectronic Design and Applications (DMA)</b> .....	36
<i>PI: Luis Entrena, Luis Hernández</i>	
<b>University Technological Identification Group (GUTI)</b> .....	37
<i>PI: Raúl Sánchez Reillo</i>	

<b>SIGNAL AND COMMUNICATIONS THEORY</b> .....	<b>38</b>
<b>Multimedia Processing (GPM)</b> .....	<b>38</b>
<i>PI: Fernando Díaz de María</i>	
<b>Signal Processing and Learning (GTSA)</b> .....	<b>39</b>
<i>PI: Antonio Artés</i>	
<b>Machine Learning for Data Science (ML4DS)</b> .....	<b>41</b>
<i>PI: Jerónimo Arenas</i>	
<b>UC3M – BANCO SANTANDER BIG DATA INSTITUTE</b> .....	<b>42</b>
<b>UC3M – Banco Santander Big Data Institute</b> .....	<b>42</b>
<i>PI: Rosa Lillo</i>	
<b>PRIVATE SOCIAL AND INTERNATIONAL LAW</b> .....	<b>43</b>
<b>Labour Law, Economic Changes, and a New Society (DTCENS)</b> .....	<b>43</b>
<i>PI: Jesús Rafael Mercader</i>	
<b>PRIVATE LAW</b> .....	<b>44</b>
<b>Society, Technology, and Business Law (SOCITEC)</b> .....	<b>44</b>
<i>PI: Marta García Mandaloniz</i>	
<b>PUBLIC LAW</b> .....	<b>47</b>
<b>Services of General Interest, Economic Activity, and Public Intervention</b> .....	<b>47</b>
<i>PI: Tomás de la Cuadra Salcedo</i>	
<b>HUMANITIES – PHILOSOPHY, LANGUAGE, AND LITERATURE</b> .....	<b>48</b>
<b>HERMES: Scientific Research in its Historical, Philosophical, Linguistic, and Literary Aspects</b> .....	<b>48</b>
<i>PI: Carlos Thiebaut, Fernando Broncano</i>	

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>BIOENGINEERING AND AEROSPACE ENGINEERING</b>			
<p><b><u>Biomedical Imaging and Instrumentation Group</u></b></p> <hr/> <p><b>PI: Manuel Desco</b></p>	<ul style="list-style-type: none"> <li>• <b>Support for clinical research</b> <ul style="list-style-type: none"> <li>· Intraoperative Radiation Therapy</li> <li>· Image Guided Surgery</li> <li>· Optical Imaging</li> <li>· Neuroimaging</li> </ul> </li> <li>• <b>Technological development</b> <ul style="list-style-type: none"> <li>· MR Image Reconstruction</li> <li>· X-ray Imaging</li> <li>· PET technologies</li> <li>· Simulation devices</li> </ul> </li> <li>• <b>Preclinical research</b> <ul style="list-style-type: none"> <li>· Molecular Imaging Probes</li> <li>· Neural Cell Biology and Optical Tissue Clearing</li> <li>· Neuroimaging</li> <li>· Oncology</li> <li>· Infection and Inflammation</li> <li>· Quantitative Microscopy</li> <li>· Cardiology</li> </ul> </li> </ul>	<p>In the last five years there have been almost 50 competitive public research projects on the European, national, and regional levels, and funding has come in through the transfer of products to industry. Among the largest multi-centre projects led by the group, the ones that stand out the most are a Programme Contract for strategic groups of the Region of Madrid (with the National Research Council (CSIC), Universidad Complutense, Spanish Open University (UNED) and Universidad Politécnica), the <i>Red Temática de Investigación Cooperativa</i> (Thematic Network for Cooperative Research) (RETIC) of the Ministry of Health (IM3: Molecular and multimodality medical imaging, with 50 groups), and two National Strategic Technical Research (CENIT) projects (CDTEAM 2006 and AMIT 2010). The group participates in a Networking Biomedical Research Center (NBRC) (CIBERSAM), in the cardiovascular RETICS (RECAVA), and has led the Platform for Technological Innovation in Hospitals (ITEMAS).</p>	<p><b>Experience and Capabilities</b></p> <p>The work of the Biomedical Imaging and Instrumentation Group (BiiG) of the UC3M Bioengineering and Aerospace Engineering Department fundamentally focuses on researching medical imaging techniques, with regard to both the development of new technologies and advanced reconstruction and processing methods and to the practical application of this research in the areas of X-ray tomography, nuclear imaging, magnetic resonance, and optical tomography. The group is highly multidisciplinary, and this helps to foster a strong connection between real clinical and preclinical needs. Collaboration with hospitals and other biomedical research centres helps to quickly validate and readily transfer the results to industry. Several of the developments of the group are commercialised worldwide.</p> <p><b>AI technologies applied or developed in the group</b></p> <p>Big data and data analysis; machine learning; intelligent prediction systems; structural processing and learning in images; computer vision.</p> <p><b>AI-related activities developed or implemented in the group</b></p> <p>Innovative Public Procurement or another type of Procurement with the public administration.</p> <p><b>AI-related services developed or implemented in the group</b></p> <p>Medical image processing; predictive models based on medical imaging; analysis of surgery video sequences; automatic image segmentation.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>BIOENGINEERING AND AEROSPACE ENGINEERING</b>			
<p><b><u>Plasmas and Space Propulsion Team (EP2)</u></b></p> <hr/> <p><b>PI: Eduardo Ahedo</b></p>	<ul style="list-style-type: none"> <li>• Hall-Effect-class Thrusters</li> <li>• RF and Microwave Plasma Thrusters</li> <li>• Magnetic Nozzles and thrust vector control</li> <li>• Hollow Cathodes</li> <li>• Plasma Plume Characterisation</li> <li>• Plasma-satellite Interaction</li> <li>• Active Space Debris Removal</li> <li>• Electrodynamical Tethers</li> <li>• Plasma Waves and Instabilities</li> <li>• Plasma Modelling and Simulation</li> <li>• Plasma Thruster Design and Development</li> <li>• Plasma Diagnostics</li> <li>• Micropropulsion and Space Systems Engineering</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• CHEOPS: Consortium for Hall Effect Orbital Propulsion System</li> <li>• E.T.PACK: Electrodynamical Tether Technology for Passive Consumable-less Deorbit Kit</li> <li>• Collaborative platform for the creation of European student nano-satellites</li> <li>• MINOTOR: Magnetic NOzzle thruster with elecTron cyclOtron Resonance</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Electromagnetic thrusters for space exploration</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• MadridFlightOnChip</li> <li>• MARTINLARA-CM. Millimeter wave Array at Room Temperature for INstruments in Leo Altitude Radio Astronomy</li> <li>• Nuclear fusion and plasma propulsion: innovating space transportation</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• UC3M-SENER Aerospace Chair</li> <li>• UC3M-ISDEFE SPACE Chair</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>Research group dedicated to the modelling, simulation, design, development, and testing of plasma thrusters for use in space and related topics.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>BIOENGINEERING AND AEROSPACE ENGINEERING</b>			
<p><b><u>Aerospace Engineering Research Group</u></b></p> <p><b>PI: Manuel García-Villalba</b></p>	<ul style="list-style-type: none"> <li>• Aerodynamics               <ul style="list-style-type: none"> <li>· Bioinspired Aerodynamics</li> <li>· Fluid-Structure Interaction</li> <li>· Turbulence</li> <li>· Turbulent Heat Transfer</li> <li>· Computational Fluid Mechanics</li> <li>· High-Performance Computing</li> <li>· Experimental Aerodynamics</li> <li>· Advanced Thermo-Fluid Dynamic Measurement Techniques</li> <li>· Machine Learning for the Modelling and Control of Thermo-Fluid Dynamic Phenomena</li> </ul> </li> <li>• Air Navigation               <ul style="list-style-type: none"> <li>· Commercial Aircraft Trajectory Optimisation</li> <li>· Meteorological Uncertainty Management</li> <li>· Aviation Induced Environmental Impact</li> <li>· Artificial Intelligence Applied to Air Traffic Management</li> </ul> </li> <li>• Aeronautical Technology               <ul style="list-style-type: none"> <li>· Aerostructures</li> <li>· Multidisciplinary Optimisation and Design</li> <li>· Unconventional Aircraft</li> <li>· Unmanned Air Vehicles (UAVs)</li> <li>· Structural Health Monitoring</li> <li>· Structural Dynamics and Vibro-acoustics</li> <li>· Composite Materials and Advanced Materials</li> <li>· Airborne Wind Energy Systems</li> </ul> </li> </ul>	<p><b>European R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• STORMY. A pilot/dispatcher support tool based on the enhanced provision of thunderstorm forecasts considering its inherent uncertainty</li> <li>• E.T.PACK. Electrodynamical Tether Technology for Passive Consumable-less Deorbit Kit</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Forward-flight aerodynamics of a micro air vehicle with two pairs of flapping wings: three-dimensional, aeroelastic, and dynamic effects of the vehicle</li> <li>• Convective heat transfer and coherent structures in turbulent boundary layers</li> <li>• MetATS. Management of the meteorological uncertainty for more efficient air traffic</li> <li>• GreenKite. Simulation and Flight Testing of Power Kites Applied to Wind Energy Generation</li> <li>• LOWFAT. Manufacture and Testing of Low Work Function Space Tethers</li> <li>• Consolidation of European Consortium in Space Tethers</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• PREFI-CM. Customisation of the Risk of Stroke by means of the Intracardiac Flow Analysis</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The research activity of the Aerospace Engineering group is structured around four areas:</p> <ul style="list-style-type: none"> <li>• Computational Fluid Mechanics</li> <li>• Dynamics and Control in Aerospace Systems</li> <li>• Experimental Aerodynamic and Propulsion Laboratory</li> <li>• Space Technology</li> </ul>

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BIOENGINEERING AND AEROSPACE ENGINEERING			
<p><u>Aerospace Engineering Research Group</u></p> <hr/> <p>PI: Manuel García-Villalba</p>	<ul style="list-style-type: none"> <li>• Space Technology               <ul style="list-style-type: none"> <li>· Space Propulsion</li> <li>· Space Tethers</li> <li>· Mission Analysis and Trajectory Optimisation</li> <li>· Orbit Determination and Space Surveillance and Tracking</li> <li>· Satellite Design and Systems Engineering</li> <li>· Space Debris Removal</li> </ul> </li> </ul>	<p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Research and development of a distributed computing platform applied to the liquidity risk analysis by means of architectures such as "PIPELINES" (PALM PIPELINES)</li> <li>• DONUT Project</li> <li>• Control and monitoring of tests on plasma devices for cooling in drones</li> <li>• Cooperation agreement in the form of subcontracting for project "PARSIFAL"</li> </ul>	

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>COMPUTER SCIENCE</b>			
<p><b><u>Computer, Communications, and Systems Architecture (ARCOS)</u></b></p> <p><b>PI: Jesús Carretero</b></p>	<ul style="list-style-type: none"> <li>• Real time systems:               <ul style="list-style-type: none"> <li>· Real Time Simulation Systems in Planes and Trains</li> <li>· Wireless Sensor Networks</li> <li>· Remote System Monitoring</li> </ul> </li> <li>• High-Performance Computing:               <ul style="list-style-type: none"> <li>· Scalable Massive Data Management</li> <li>· Cloud and Grid Computing</li> <li>· Parallel File Systems</li> </ul> </li> <li>• Distributed and Parallel Systems:               <ul style="list-style-type: none"> <li>· High-Performance Data Retrieval and Transmission System</li> <li>· Social Media Data Analysis</li> <li>· Peer-to-Peer Systems</li> </ul> </li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• eID4Spain: Connecting Regional and Local Administrations to Spanish eIDAS Node</li> <li>• MADE: Multiple Access to eDelivery</li> <li>• eID@Cloud: Integrating of eIdentification in European cloud Platform according to the EIDAS Regulation</li> <li>• GOVeIN European and Invoicing Project: Implementation of the European electronic invoice within the Public health</li> <li>• ASPIDE: exAScale Programming models for extreme Data processing</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Towards the unification of HPC and big data paradigms</li> <li>• Scalable data management techniques for high-end computing systems</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Big dAta-Hpc Convergence: from sensors to Applications</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Nalej Storage Fabric</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The main objective of the ARCOS group is to perform research in and develop hardware and software systems in the fields of real time and built-in systems, high-performance computing, high-throughput computing (Cloud and Grid), storage systems, and systems and reliable systems.</p> <p>ARCOS research focuses on tools and methods for software development, high-performance computing, and data utilisation and management.</p> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• RCM tool for preventive maintenance in complex organisations handling large volumes of data with scattered terminals and a range of failures</li> <li>• Tool for efficient massive data storage management</li> <li>• ParFiSys, parallel file system compatible with UNIX which can be executed outside the operating system</li> <li>• Lightweight adaptive fault-tolerant data storage system (AFTSYS)</li> <li>• Platform for the automatic creation of secure applications for wireless sensor networks using MDA (Model Driven Architecture)</li> </ul>

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COMPUTER SCIENCE			
<p><u>Computer, Communications, and Systems Architecture (ARCOS)</u></p> <hr/> <p>PI: Jesús Carretero</p>			<p><b>Scientific-Technical Services</b></p> <ul style="list-style-type: none"> <li>• Design, development and improvement of real-time telematic applications</li> <li>• Design and development of distributed applications</li> <li>• Improvement of operating system capability both in Windows and in UNIX and LINUX environments</li> <li>• Development of parallel applications for the management and storage of large volumes of data</li> <li>• Optimisation of the computer infrastructure and data analysis centres</li> <li>• Tools and methods for software development</li> <li>• High-performance computing</li> <li>• ICT for smart cities</li> </ul>

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<b>COMPUTER SCIENCE</b>			
<p><b>COSEC</b> <b>(Computer Security Lab)</b></p> <hr/> <p><b>PI: Arturo Ribagorda, Juan E. Tapiador</b></p>	<ul style="list-style-type: none"> <li>• Cyberdefense systems</li> <li>• Security in the Internet of things (RFID, implantable medical devices, controllers, etc.)</li> <li>• Security in smartphones</li> <li>• Malware analysis</li> <li>• Applied cryptography</li> <li>• Data leak prevention (DLP)</li> <li>• Security in vehicular ad-hoc networks (VANETs)</li> <li>• Security in location-based systems (LBSs)</li> <li>• Hardware security</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• Challenges and opportunities of establishing a sovereign and trustworthy ICT industry in the EU. EU STOA Project PI/G/STOA/FWC-2013-1 - LOT 4 - ICT and Information Society (2017).</li> <li>• ARVI: Runtime Verification beyond Monitoring. ICT COST Action IC1402</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Security and privacy in the IOT</li> <li>• Security Mechanisms for Fog Computing - Advanced Security for Devices</li> <li>• Advanced simulator for Organised Cyberdefense (SACO)</li> <li>• ASCET: Advanced Simulator for Cyberdefense Experimentation and Training</li> </ul> <p><b>Proyectos Planes Regionales I+D</b></p> <ul style="list-style-type: none"> <li>• CYBERDINE-CM. Cybersecurity:Data, information, risks</li> <li>• Cybersecurity, Network Analysis and Monitoring for the Next Generation Internet</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• INDRA Chair for Cybersecurity</li> <li>• Predictive intelligence components for Security Operation Centres</li> <li>• CARDIOSEC: Cybersecurity for Implantable Heart Devices</li> </ul>	<p><b>Experience and Capabilities</b></p> <ul style="list-style-type: none"> <li>• Solution for security problems (networks, authentication, data leak, encryption solutions, and digital signature, etc.) in public and private entities</li> <li>• Development of solutions, provision of comprehensive R&amp;D services, consultation, audits, training, and high-level guidance in the field of System Security and Information Technologies.</li> </ul>

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<b>COMPUTER SCIENCE</b>			
<p><b><u>Evolutionary Computation and Neural Networks Group (EVANNAI)</u></b></p> <hr/> <p><b>PI: Pedro Isasi</b></p>	<ul style="list-style-type: none"> <li>• Genetic Algorithms</li> <li>• Genetic Programming</li> <li>• Evolutionary Strategies</li> <li>• Particles Swarms</li> <li>• Ant Colonies</li> <li>• Artificial Neural Networks</li> <li>• Multi-objective Optimisation Applications (classification, clustering, etc.)</li> <li>• Finance and economy</li> <li>• Brain Computer Interfaces</li> </ul>	<p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Metaheuristic for decision making under structural change. Applied to finance</li> <li>• Learning and evolutionary optimisation for the prediction and integration of solar radiation</li> <li>• Multi-objective Metaheuristic and Applications</li> <li>• Multidisciplinary (MSTAR)</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Bioinspired computation for data mining</li> <li>• Evolutionary computation for classification tasks in data mining</li> <li>• Machine learning techniques Applied to the Brain Computer Interface (ML-BCI)</li> <li>• Bioinspired Computation for Data Mining (CibMin)</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Artificial intelligence for childhood education</li> <li>• MEMENTO Project: Technological platform for the analysis and storage of Big data, which is adaptable and self-configuring in the Cloud</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>EVANNAI conducts research in the area of Subsymbolic Artificial Intelligence, specifically in the fields of artificial neural networks, evolutionary computation, and biological computation systems (Ant Colony Optimisation, Swarm Intelligence, Artificial Immune Systems, etc.).</p> <p>EVANNAI has experience in the following applied areas:</p> <ul style="list-style-type: none"> <li>• Data structure</li> <li>• Robotics</li> <li>• Brain computer interface</li> </ul> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• System for the efficient control of power and chemical plants</li> <li>• Consumption market segmentation tool.</li> <li>• Artificial intelligence software for data optimisation, prediction and analysis</li> </ul>

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<b>COMPUTER SCIENCE</b>			
<p><b>GigaBD</b></p> <hr/> <p><b>PI: Jorge Luis Morato</b></p>	<ul style="list-style-type: none"> <li>• Deep learning applications and data enrichment</li> <li>• Accessibility and comprehensibility of data</li> <li>• Veracity and reliability of data</li> <li>• Infrastructure to facilitate Big Data</li> </ul>	<p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Advanced and multidisciplinary estimation of the complexity of the comprehension of documents with a high degree of consultation</li> <li>• Repository of Spanish Historiography (1700-1939)</li> <li>• CLARC: European Clearing House for Open Robotics Development Plus Plus (ECHORD++). Subproject "Smart Clinic Assistant Robot for CGA (CLARC)</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Services for housing contents on the www and technical assistance for the on-line training platform in standardisation of the clinical content of Medical Records in the National Health System</li> <li>• Secure maintenance of the CES application for managing users, technical support and troubleshooting</li> <li>• Optimisation of work methods, documentary tools and recovery algorithms on information resources of the SM Group for the implementation of a future Digital Asset Management (DAM) system</li> </ul>	<p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• <b>Software Registrations:</b> <ul style="list-style-type: none"> <li>· Automatic detection of scientific publication authors</li> <li>· Monek desktop search</li> </ul> </li> </ul> <p><b>Patents</b></p> <ul style="list-style-type: none"> <li>• Method of estimating positioning in information retrieval systems (<i>Método de estimación del posicionamiento en sistemas de recuperación de información</i>)</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>COMPUTER SCIENCE</b>			
<p><b>Applied Artificial Intelligence Group (GIAA)</b></p> <p><b>PI: José Manuel Molina, Jesús García Herrero</b></p>	<ul style="list-style-type: none"> <li>• Machine learning and data mining techniques</li> <li>• Evolutionary computation and multi-objective optimisation</li> <li>• Agents and multi-agent systems: web, information retrieval, recommendation, e-commerce, sensor management</li> <li>• Computer vision</li> <li>• Contextual information and data fusion systems</li> <li>• Surveillance systems</li> <li>• Air Traffic Control (ATC)</li> <li>• Coastal and maritime traffic surveillance</li> <li>• Indoor localisation systems</li> <li>• Inference in dynamic, non-linear, and adaptive systems</li> <li>• Unmanned vehicles</li> </ul>	<p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Unmanned Air Vehicles Air Traffic Management and Supporting Technologies for the Operation</li> <li>• Advanced monitoring in ports and airports: concepts, tools and evaluation</li> <li>• Autonomous System for Surveillance and Security based on multirotors (ADVISE)</li> <li>• Autonomous System for Intervention in Emergencies (SALINE)</li> <li>• Autonomous Submarine for the Inspection of Off-shoRe Installations (SAILOR)</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• GenObIA-CM: Design, by means of artificial intelligence, of predictive algorithms for the identification of individuals at risk of becoming overweight/obese and developing associated pathologies: providing genetic analysis</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Masmóvil Group Chair</li> <li>• BQ Chair</li> <li>• SOLERA Chair – Intelligence applied to the automotive field</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The Applied Artificial Intelligence Group (GIAA) is made up of a team of physicists and telecommunication and computer engineers who are nationally renowned for their capacity to solve engineering problems by incorporating state-of-the-art artificial intelligence techniques: machine learning, evolutionary computation, data analysis, multi-objective optimisation, fuzzy systems, and intelligent agents.</p> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Camera-based surveillance system to monitor and identify airport surface traffic (planes, trucks, buses)</li> <li>• Airport data fusion simulation system, for the processing of surface radar and integration with other sensors, following the A-SMGCS paradigm</li> <li>• Data optimisation, prediction, and analysis software</li> <li>• System of software agents for surveillance. The technology improves the surveillance process, reducing human attention and introducing automatic alarms.</li> <li>• Context-based reasoning system for high-level fusion</li> <li>• Multi-sensor fusion platform for monitoring systems.</li> </ul> <p><b>AI technologies applied or developed in the group</b></p> <p>Big data and data analysis; machine learning; modelling based on intelligent agents; data flow processing; computer vision.</p>

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
COMPUTER SCIENCE			
<p><u>Applied Artificial Intelligence Group (GIAA)</u></p> <hr/> <p>PI: José Manuel Molina, Jesús García Herrero</p>			<p><b>AI-related activities developed or implemented in the group</b> Development of customised AI projects for public or private entities.</p> <p><b>AI-related services developed or implemented in the group</b> Data and information fusion; decision-making supporting systems; surveillance systems.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>COMPUTER SCIENCE</b>			
<p><b>Human Language and Accessibility Technologies (HULAT)</b></p> <p><b>PI: Paloma Martínez, Belén Ruiz</b></p>	<ul style="list-style-type: none"> <li>• Natural Language Processing</li> <li>• Deep Learning methods applied to Natural Language Processing</li> <li>• Information Extraction in biomedical domain (clinical narrative, scientific publications, and social media)</li> <li>• Methodological frameworks for developing accessible web applications</li> <li>• Speech processing and speaker recognition</li> <li>• Text Simplification</li> <li>• Corporate information systems, business process integration</li> <li>• Information and communications technology and accessibility</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• TRENDMINER_ENLARGED: Large-scale, Cross-lingual Trend Mining and Summarisation of Real-time media Streams Enlarged</li> <li>• MobilePass: A secure, modular and distributed mobile border control solution for European land border crossing points</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• DeepEMR: Extraction of clinical information using deep learning and Big Data techniques</li> <li>• Framework based on models for the development of accessible services in e-administration</li> <li>• Extraction of multilingual information in health and its application to scientific documentation and information disclosure-extraction</li> <li>• Intelligent Distribution of Semantic Contents through Multimodal Interfaces (SEMANTS)</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Development of a state-of-the-art intelligent energy efficiency management system</li> </ul> <p><b>Otros</b></p> <ul style="list-style-type: none"> <li>• Technical task assistance and support service to control and monitor accessibility to television contents</li> <li>• Spanish Centre for Subtitling and Audio Description (<i>Centro Español de Subtitulado y Audiodescripción</i>)</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The Human Language and Accessibility Technologies Group (HULAT) is made up of a multidisciplinary team of professionals working on R&amp;D&amp;I projects related to natural language processing technologies and accessibility to the information society.</p> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Automatic semantic analysis of health information (clinical notes, scientific publications, etc.)</li> <li>• System for searching for Spanish responses applied to medical texts</li> <li>• Information extraction techniques for more precise detection of pharmacological interactions described in biomedical texts</li> <li>• New system for detecting adverse effects of medicines using social media</li> <li>• Extraction of information in the biomedical domain using Deep Learning techniques</li> </ul> <p><b>Servicios Científico Técnicos</b></p> <ul style="list-style-type: none"> <li>• Guidance and design of solutions for non-structured information analysis</li> <li>• Guidance for the development of accessible web applications</li> <li>• Help systems for human operators: coding processes (e.g. diagnoses in ER discharge reports)</li> <li>• Monitoring of medical events (adverse reactions, treatments) in different media (blogs, social media, etc.)</li> </ul> <p style="text-align: right;">+</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
COMPUTER SCIENCE			
<p><u>Human Language and Accessibility Technologies (HULAT)</u></p> <hr/> <p>PI: Paloma Martínez, Belén Ruiz</p>			<p><b>AI technologies applied or developed in the group</b> Natural language technologies, processing, and generation.</p> <p><b>AI-related services developed or implemented in the group</b> Methods for extracting information in texts in the biomedical domain (scientific papers, clinical narrative, social media); recognition of entities; relation extraction; medical terminology acquisition; text simplification.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>COMPUTER SCIENCE</b>			
<p><b>Knowledge Reusing</b></p> <hr/> <p>PI: Juan Llorens</p>	<ul style="list-style-type: none"> <li>• Knowledge graphs               <ul style="list-style-type: none"> <li>· Universal representation of Information (digitalisation and integration)</li> <li>· Retrieval</li> <li>· Reusing</li> </ul> </li> <li>• Engineering methods:               <ul style="list-style-type: none"> <li>· Requirements engineering</li> <li>· Model-based Systems Engineering</li> <li>· Product Lifecycle Management</li> <li>· Variability Management</li> <li>· - Application to processes of:</li> <li>· Analysis and design of complex critical systems</li> <li>· Traceability</li> <li>· Quality assurance and management</li> <li>· Evidence and certification</li> <li>· Supply (provision) chains</li> </ul> </li> <li>• Interoperable data and knowledge (“smart data”) management platforms for:               <ul style="list-style-type: none"> <li>· Engineering artefacts reusing</li> <li>· Continuous quality</li> <li>· Continuous and collaborative engineering</li> <li>· Business intelligence, processing large amounts of data and knowledge interference</li> <li>· “Internet of Tools”</li> <li>· “Industrial Internet”</li> </ul> </li> <li>• Industry: Aerospace, automotive, railway, and health</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• Arrowhead Tools: Arrowhead Tools for Engineering of Digitalisation Solutions</li> <li>• NewControl: Integrated, Fail-Operational, Cognitive Perception, Planning and Control Systems for Highly Automated Vehicles</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Continuous Reverse Engineering for Software Product Lines</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• MadridFlightOnChip</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Design and development of a semantic engine</li> <li>• Magnus: Big data as a support for making legal decisions</li> <li>• TRC-Research Chair</li> <li>• Design and development of the artificial intelligence engine (MIACP)</li> <li>• Interoperability Model for Land Registers</li> </ul> <p><b>Others</b></p> <ul style="list-style-type: none"> <li>• Outsourcing of the design and implementation of a social media monitoring service and real-time notification of news to information professionals</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The area of interest of the Knowledge Reuse group lies in knowledge representation, identification, retrieval, and reusing.</p> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Automatic knowledge discovery and extraction techniques</li> <li>• Traceability identification systems</li> <li>• Knowledge quality measuring algorithms</li> <li>• Knowledge visualisation</li> <li>• Standard-based interoperable platforms</li> <li>• Technology and standardisation consultation               <ul style="list-style-type: none"> <li>· Members of the BoD (Board of Directors) of <i>Asociación Española de Ingeniería de Sistemas</i> (Spanish Association of System Engineering) (Official chapter of INCOSE)</li> <li>· Members of OMG and OSLC</li> </ul> </li> </ul> <p><b>Software</b></p> <ul style="list-style-type: none"> <li>• Research group management system</li> <li>• Automatic document summary system for legal environments</li> </ul> <p><b>AI technologies applied or developed in the group</b></p> <p>Big data and data analysis; reasoning, logic and ontologies; recommendation systems; natural language technologies, processing, and generation; structural processing and learning in images.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
COMPUTER SCIENCE			
<p><u>Knowledge Reusing</u></p> <hr/> <p>PI: Juan Llorens</p>			<p><b>AI-related activities developed or implemented in the group</b></p> <p>Development of customised AI projects for public or private entities; AI-based product development; development of applications/services integrating AI technology.</p> <p><b>AI-related services developed or implemented in the group</b></p> <p>Knowledge engineering; industrial systems.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>COMPUTER SCIENCE</b>			
<p><b><u>Systems Control, Learning and Optimisation Laboratory (CAOS)</u></b></p> <hr/> <p><b>PI: Araceli Sanchis</b></p>	<ul style="list-style-type: none"> <li>• Artificial intelligence</li> <li>• Intelligent data analysis</li> <li>• Pattern recognition</li> <li>• Activity recognition</li> <li>• Control optimisation</li> <li>• Machine learning</li> <li>• Intelligent data analysis</li> <li>• Artificial neural networks</li> <li>• Evolutionary computation</li> <li>• Agent modelling</li> </ul>	<p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Integration of cooperative systems for autonomous vehicles in shared traffic: Analysis of the driving environment</li> <li>• Advanced driving assistance system for interurban environments: environment perception and simulation</li> <li>• Autonomous air-ground system for the collaborative inspection and digitalisation of the railway network</li> <li>• Ultralight unmanned vehicle that can travel on rails for automatic track and railway infrastructure inspection tasks, maintenance, and surveillance with intelligent positioning and behaviour by means of computers and sensors</li> <li>• Sensory fusion for the analysis of manoeuvres in urban environments for ADAS</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• SEGVAUTO-TRIES-CM. Automotive vehicle security through intelligent, efficient, and secure transport</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Technological services in the data analysis area</li> <li>• Recognition of images based on deep learning techniques</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The Control Learning and System Optimisation (CAOS) Laboratory is formed by a team of professionals whose expertise lies in the prediction, optimisation, control and automatic planning of business services and processes based on data analysis, using to that end advanced artificial intelligence technologies and other systems with a proven efficacy in complex problem solving in business and industrial environments.</p> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Trend prediction and process optimisation based on intelligent data analysis</li> <li>• Design of intelligent data retrieval systems - data mining based on state-of-the-art technology</li> <li>• Time series prediction by means of machine learning techniques</li> <li>• Representation of an explicit mode of key processes and knowledge of complex organisations</li> <li>• Application of artificial intelligence techniques for solving business problems</li> <li>• Application of activity recognition methods in Ambient Assisted Living, video games and Man-Machine Interaction</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>COMPUTER SCIENCE</b>			
<p><b>Planning and Learning Group (PLG)</b></p> <hr/> <p><b>PI: Fernando Fernández Rebollo</b></p>	<ul style="list-style-type: none"> <li>• Artificial intelligence</li> <li>• Task planning</li> <li>• Machine learning</li> <li>• Reinforcement learning</li> <li>• Problem solving</li> <li>• Heuristic optimisation</li> <li>• Decision support systems</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• GOTCHA (European Space Agency). Mars Rover task planning</li> <li>• CCI (European Space Agency). Estimation of costs, risk, and quality in large projects</li> <li>• SSA-DCII (European Space Agency). Planning for the observation of objects in space</li> <li>• CLARK- Smart Clinic Assistant Robot for CGA: European Clearing House for Open Robotics Development Plus (Echord++)</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Architectures for planning-based automatic social training</li> <li>• Managing goals for long-term autonomy in smart cities (GLASS)</li> <li>• Lifelong learning technologies in social robots and smart homes (LifeBots)</li> <li>• Multi-agent interaction for planning (PLANINTERACTION)</li> <li>• System for the intelligent planning of collective transport with optimised route generation (PLICOGOR)</li> <li>• Intelligent intermodal transport of goods (TIMI)</li> <li>• Design, automatic planning, and evaluation of neurorehabilitation therapies directed by an interactive social robot</li> <li>• Lifelong technologies for social robots in intelligent homes</li> <li>• THERAPIST: An autonomous and socially interactive robot for motor and neurorehabilitation therapies</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The Planning and Learning Group (PLG) is formed by a consolidated team of experts skilled in the development of effective and innovative software solutions for automating planning tasks and data analysis by means of advanced artificial intelligence technologies. PLG is one of the first Spanish groups to delve into task planning and machine learning technologies, winning various international accolades with its ground-breaking technology.</p> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Automating dynamic planning and decision making processes</li> <li>• Process optimisation based on intelligent data analysis and trend or risk prediction</li> <li>• Automatic data analysis (data mining) process optimisation</li> <li>• Task planning in social or scientific robots</li> <li>• Application of artificial intelligence techniques for solving business problems (business intelligence)</li> <li>• Development of motor rehabilitation therapies and geriatric evaluation with humanoid robots</li> </ul> <p><b>AI technologies applied or developed in the group</b></p> <p>Machine learning; design of systems and cognitive assistants; heuristic optimisation; planning and automatic deduction; robotics.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
COMPUTER SCIENCE			
<p><u>Planning and Learning Group (PLG)</u></p> <hr/> <p>PI: Fernando Fernández Rebollo</p>		<p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Knowledge modelling and analysis of planning techniques for the automation of data mining processes</li> <li>• Solving cases of use of reinforcement learning in REPSOL</li> </ul>	<p><b>AI-related activities developed or implemented in the group</b></p> <p>AI-based product development.</p> <p><b>AI-related services developed or implemented in the group</b></p> <p>Heuristic optimisation-based application development, task planning, reinforcement learning, machine learning, or cognitive robotics; training in heuristic optimisation, task planning, reinforcement learning, machine learning, or cognitive robotics; guidance in heuristic optimisation, task planning, reinforcement learning, machine learning, or cognitive robotics.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>COMPUTER SCIENCE</b>			
<p><b><u>Interactive Systems (DEI)</u></b></p> <p><b>PI: Paloma Díaz</b></p>	<ul style="list-style-type: none"> <li>• Design of interactive systems</li> <li>• Virtual, augmented, and mixed reality</li> <li>• Semantic data visualisation</li> <li>• Ubiquitous and social computing</li> <li>• Multisensory interaction</li> <li>• Collaboration technologies</li> <li>• Educational and learning environments</li> <li>• Educational games and simulations</li> <li>• ICT in emergency and crisis management</li> <li>• Digital culture</li> <li>• E-Health</li> <li>• Accessibility</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• Interactive media to improve knowledge on NPBTs in H2020 CHIC</li> <li>• Network for sOcial compuTing Research</li> <li>• Mesch: Material Encounters with Digital Cultural Heritage</li> <li>• Evaluation of the SlideWiki Platform, SlideWiki EU project</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Pervasive and Affordable technologies for Civic Engagement</li> <li>• Global emergency management system (emergensys)</li> <li>• CrossColab: Identifying cross-reality environment capabilities to improve collaboration</li> <li>• CreAx: End-user development for creating augmented experiences in archaeological sites</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The Interactive Systems (DEI) Laboratory has spent over 20 years conducting research relating to the opportunities presented by successive technological advancements in the area of human-computer interaction. This research has been applied to the development of innovative solutions which effectively and efficient support work, learning, or communication in different environments.</p> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Tools for co-designing and prototyping games, virtual and augmented environments, and development by end users</li> <li>• Design and development of interactive mobile, social, and multiplatform applications</li> <li>• Design and development of virtual, augmented, and mixed experiences</li> <li>• Design and development of complex data visualisation platforms in multi-device environments</li> <li>• Performing usability and accessibility studies</li> <li>• Ontologies for personalisation and accessibility</li> <li>• Natural and multisensory interaction environments</li> <li>• Collaboration processes in complex and citizen participation environments</li> <li>• Design and development of educational video games and 3D training and simulation environments</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>COMPUTER SCIENCE</b>			
<p><b>SoftLab</b></p> <hr/> <p><b>PI: Ángel García Crespo</b></p>	<ul style="list-style-type: none"> <li>• Semantic Web Technologies</li> <li>• Social Web 2.0</li> <li>• Linked Data</li> <li>• Software-as-a Service &amp; Cloud Computing Environments</li> <li>• Soft Computing in Corporate Information Systems</li> <li>• Business processes integration</li> <li>• Software Engineering</li> <li>• Distributed and Global Software Development</li> <li>• ITC Project Management</li> <li>• Business information systems</li> <li>• IT Government</li> <li>• People Issues in Software Development</li> <li>• Audiovisual Accessibility</li> <li>• Biometry</li> <li>• Natural Language Processing</li> <li>• Natural Interaction Systems</li> <li>• HCI and Accessibility</li> </ul>	<p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Collaboration agreement between the Region of Madrid and UC3M for carrying out a research project for technological innovation and exploitation of educational management information</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• System for server synchronisation by means of open audio for accessibility elements</li> <li>• Service Agreement GoCC4All: Using Pervasive Technology to Provide Access to TV to the Deaf-blind Community</li> <li>• Analysis of usability by means of Big Data techniques: Non-functional prototype</li> <li>• Detection of behavioural modifications in the elderly by means of non-invasive IoT systems with AI.</li> <li>• System for accessing subtitles in augmented reality</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The work of the group Softlab relates to:</p> <ul style="list-style-type: none"> <li>• Effective system integration by means of concurrent engineering, artificial intelligence, and information management systems</li> <li>• System analysis, modelling, and design using principles of incremental development</li> <li>• Design and creation of tools by means of rapid prototyping systems</li> <li>• Design and development of mobile applications in high productivity environments</li> <li>• Integration of client-server architecture-based systems by using Internet as the development platform</li> <li>• Development of accessible multimodal interfaces</li> </ul> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Social network corpus generating system</li> <li>• Social network analysis and tracking tool</li> <li>• Analysis system for obtaining product recommendations from non-structured data</li> <li>• Analysis system for obtaining predictions from non-structured data</li> </ul>

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
COMPUTER SCIENCE			
<p><u>SoftLab</u></p> <hr/> <p>PI: Ángel García Crespo</p>			<p><b>Software</b></p> <ul style="list-style-type: none"> <li>• Intelligent adaptive questionnaire</li> <li>• Node generator for visualisation and graphics filters</li> <li>• System for subtitle pickup and synchronisation via DCP</li> <li>• System for server synchronisation by means of open audio for accessibility elements</li> <li>• Intelligent system for UC3MTitling accessibility</li> <li>• Intelligent system for generating accessibility elements</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>TELEMATIC ENGINEERING</b>			
<p><b><u>Telematic Applications and Services Group (GAST)</u></b></p> <hr/> <p><b>PI: Carlos Delgado Kloos, Carlos García Rubio, Andrés Marín López, Luis Sánchez Fernández</b></p>	<ul style="list-style-type: none"> <li>• E-Learning</li> <li>• WEB technologies</li> <li>• Ubiquitous computing</li> <li>• Real time</li> </ul>	<p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Healthy and Efficient Routes in Massive Open-Data Based Smart Cities: Smart Driving and Semantic Data Handling "Hermes-Smartdriver"</li> <li>• Analytics Using sensor DATA for FLAT City</li> <li>• Incident Response in Smart Communities (INRISCO): security and mobility</li> <li>• SMARTLET: Learning analytics to enhance the design and orchestration in scalable, IoT-enriched, and ubiquitous Smart Learning Environments</li> <li>• RESET: Reformulating Scalable Educational Ecosystems</li> <li>• SNOLA: Spanish Network of Learning Analytics</li> <li>• Surgery Simulation Platform - SimLap Project</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• e-Madrid-CM. Research and development of educational technologies in the Region of Madrid</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Development and validation of techniques for the energy signal conditioning and prediction in smart buildings</li> <li>• Applications of analytics and recommendation systems</li> <li>• HIBRIDS – Hybrid simulation systems for clinical training</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The GAST group activity is focused on research in the field of telematic services and applications. The group's main lines of research are within the fields of e-learning, ubiquitous computing, and web technologies.</p> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Agile, modular and flexible design of learning experiences in real, virtual, and mixed environments based on existing courses by means of using simulation engines and templates</li> <li>• Design of games, storyboards and interaction for training and evaluation based on expertise: targets, missions, rewards, and learning analysis</li> <li>• Design of in-situ training experiences based on mobile learning</li> <li>• Use of gaming techniques in technology-guided learning environments</li> <li>• Development of personal recommenders</li> </ul> <p><b>AI technologies applied or developed in the group</b></p> <p>Big data and data analysis; machine learning; recommendation systems; intelligent prediction systems; intelligent tutoring systems.</p> <p><b>AI-related activities developed or implemented in the group</b></p> <p>Development of customised AI projects for public or private entities; development of applications/services integrating some AI technology.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
TELEMATIC ENGINEERING			
<p><u>Telematic Applications and Services Group (GAST)</u></p> <hr/> <p>PI: Carlos Delgado Kloos, Carlos García Rubio, Andrés Marín López, Luis Sánchez Fernández</p>			<p><b>AI-related services developed or implemented in the group</b></p> <p>Publication of semantically enriched data; disambiguation of entities with a proper name; preference aggregation; detection of elements hindering mobility in urban thoroughfares; extraction and prediction of mobility patterns in cellular networks; extraction and prediction of mobility patterns in social media; detection of anomalies in cellular networks, social media, and smart grids; artificial intelligence in education; educational data analysis; learning analytics.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>TELEMATIC ENGINEERING</b>			
<p><b>NETCOM</b> <b>(Network and Communication Technologies)</b> <b>(Grupo NETWORK TECHNOLOGIES)</b></p> <hr/> <p><b>PI: Arturo Azcorra</b></p>	<ul style="list-style-type: none"> <li>• Network architecture and distributed services</li> <li>• Communication protocols</li> <li>• Internet of the Future</li> <li>• Content Delivery Networks (CDN)</li> <li>• Mobile and vehicle networks</li> <li>• Wireless networks</li> <li>• Optical Access, Metropolitan, and Backbone Networks</li> <li>• Network Science</li> <li>• Security in Communications Networks</li> <li>• Energy Efficiency in Telecommunication Systems and Networks</li> <li>• High-performance Switching</li> <li>• Traffic Analysis</li> <li>• Internet of Things (IoT)</li> <li>• Cognitive Networks</li> <li>• 5G Networks</li> <li>• Connected Industry</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• 5G MoNArch: 5G Mobile Network Architecture</li> <li>• 5G-TOURS</li> <li>• 5G-DIVE: eDge Intelligence for Vertical Experimentation</li> <li>• 5G-GROWTH: 5G-enabled Growth in Vertical Industries</li> <li>• 5G_VINNI: 5G Verticals Innovation Infrastructure</li> <li>• 5GcITY: Adaptive Management of 5G Services to Support Critical Events in Cities</li> <li>• BRADE: BRAin inspired Data Engineering</li> <li>• ReCRED: From Real-world Identities to Privacy-preserving and Attribute-based CREDENTIALS for Device-centric Access Control</li> <li>• EMpowering transatlantic PlatfOrms for advanced WirEless Research</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Design and optimisation of cloudified 5G networks</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The NETCOM Group closely collaborates with IMDEA Networks International Research Institute in various research projects and scientific activities. Both groups conduct complementary research in the areas of network architecture, communication protocols, wireless and mobile networks, peer-to-peer systems, and distributed services.</p> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Network Architectures</li> <li>• Communication Protocols</li> <li>• Wireless and Mobile Networks</li> <li>• Peer-to-Peer Systems</li> <li>• Distributed Services</li> </ul> <p><b>Patents</b></p> <ul style="list-style-type: none"> <li>• Energy-saving method based on micro-shutdowns for a wireless device in a telecommunication network (<i>Método de ahorro de energía basado en microapagados para un dispositivo inalámbrico en una red de telecomunicación</i>)</li> <li>• Data frame routing method and network bridge (<i>Procedimiento de Encaminamiento de Tramas de Datos y Puente de Red</i>)</li> <li>• Method for link management at the data link level for communication networks, data frame routing method, network interconnection device, and network combining both methods (<i>Procedimiento de gestión de enlaces en el nivel de enlace de datos para redes de comunicaciones, procedimiento de encaminamiento de tramas de datos, dispositivo de interconexión de redes y red que combina ambos procedimientos</i>)</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
TELEMATIC ENGINEERING			
<p><u>NETCOM</u> (Network and Communication Technologies) (Grupo NETWORK TECHNOLOGIES)</p> <hr/> <p>PI: Arturo Azcorra</p>			<ul style="list-style-type: none"> <li>Method and device for managing IP mobility located in the network, access network and fixed and mobile access gateway devices to domains with localised IP mobility (<i>Procedimiento y Dispositivo de Gestión de Mobility IP Localizada en la Red, Red de Acceso y Dispositivos de Pasarela de Acceso fijos y Móviles a Dominios con Movilidad IP Localizada</i>)</li> </ul> <p><b>AI technologies applied or developed in the group</b> Big data and data analysis; machine learning; design of systems and cognitive assistants; intelligent agent-based modelling; dataflow processing.</p> <p><b>AI-related activities developed or implemented in the group</b> Development of customised AI projects for public or private entities.</p> <p><b>AI-related services developed or implemented in the group</b> Data driven networking; cognitive networks; networking data measurement and analysis; 5G networks and automation; telemetry.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>TELEMATIC ENGINEERING</b>			
<p><b><u>ADSCOM</u></b>  <b><u>(Advanced Switching and Communication Systems)</u></b>  <b><u>(NETWORK TECHNOLOGIES)</u></b></p> <p><b>PI: David Larrabeiti</b></p>	<ul style="list-style-type: none"> <li>• Ultra-wideband Networks</li> <li>• 5G Networks</li> <li>• Security in Communication Networks</li> <li>• Security in the Internet of Things (IoT)</li> <li>• Cyberterrorism</li> <li>• Security in Critical Infrastructure Systems and Networks</li> <li>• Deployment and Design of Emergency Networks</li> <li>• Multimedia Networks</li> <li>• Design of networks for real-time multimedia data transport (RTP/RTCP)</li> <li>• Traffic modelling for efficient communications in bandwidth and delay</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• Photonic technologies for programmable transmission and switching modular systems based on Scalable Spectrum/space aggregation for future agile high capacity meter Networks</li> <li>• TYPES: Towards Transparency and Privacy in the Online Advertising Business</li> <li>• SMOOTH: GDPR Compliance Cloud Platform for Micro Enterprises BlueSpace: Building on the Use of Spatial Multiplexing 5G Networks Infrastructures and Showcasing Advanced technologies and Networking Capabilities</li> <li>• METER-HAUL: METER High bandwidth, 5G Application-aware, optical network, with edge storage, compute and low Latency</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Flexible and Elastic Optical Network Technologies with Tb/s capacity for 5G support</li> <li>• Elastic Networks: New Elastic Network Paradigms for Radically Cloud- and Fog Computing-based World</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Advanced Techniques for Enhancing 5G Network Intelligence</li> <li>• EMPATÍA-CM. Integral protection of victims of gender-based violence by means of multimodal affective computing</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Key Value Table (KVT) Bandwidth performance and Telemetry Research</li> </ul>	<p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Telecommunication network optimisation</li> <li>• Big Data and privacy: Analysis of the value of private data for large online companies</li> <li>• Design of distributed web crawlers, collection and analysis of data from social media and web data platforms</li> <li>• Processing of large volumes of data with Apache Hadoop and Spark ecosystems</li> <li>• Traffic analysis in networks and massive data capture analysis in lawful interception</li> <li>• Cluster optimisation and parallelisation for analysing large volumes of data</li> <li>• Deployment and design of emergency networks</li> <li>• Use of Big Data techniques for detecting malware and criminal activity</li> </ul> <p><b>Patentes</b></p> <ul style="list-style-type: none"> <li>• Connection mechanism for energy-efficient peer-to-peer networks (<i>Mecanismo de conexión para redes entre pares energéticamente eficientes</i>) (ES2537722)</li> <li>• Method and device for controlling write access to a resource in a RELOAD network (<i>Método y dispositivo para control de acceso de escritura a un recurso en una red RELOAD</i>) (ES2552707)</li> <li>• Method and apparatus for communication with a restricted Internet device (<i>Procedimiento y aparato para la comunicación con un dispositivo de Internet restringido</i>) (P201590024)</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>SYSTEMS AND AUTOMATIC ENGINEERING</b>			
<p><b>ROBOTICS LAB</b></p> <hr/> <p><b>PI: Carlos Balaguer, Miguel A. Salichs, Luis Moreno</b></p>	<ul style="list-style-type: none"> <li>• Actuators/Control</li> <li>• Software architectures</li> <li>• Industrial automation</li> <li>• Control of mobile manipulators</li> <li>• Computer-aided mechatronics design</li> <li>• 2D/3D modelling</li> <li>• Multimodal human-robot interaction</li> <li>• Remote human-robot interaction</li> <li>• Visual human-robot interaction</li> <li>• Remote manipulation</li> <li>• Dynamic modelling of mobile manipulators</li> <li>• Autonomous platforms</li> <li>• Object recognition</li> <li>• Humanoid robots</li> <li>• Topological navigation</li> <li>• Rehabilitation robotics</li> <li>• Robotic exoskeletons</li> <li>• Trajectory planning for UAVs</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• BADGER: Robot for autonomous underground trenchless operations, mapping and navigation</li> <li>• RoboCom++: Rethinking Robotics for the Robot Companion of the Future</li> <li>• INDIRES: Information Driven Incident Response</li> <li>• STAMS: Long-term stability assessment and monitoring of flooded shafts</li> <li>• ROBO-SPECT: ROBOTic System with Intelligent Vision and Control for Tunnel Structural INSPECTIon and Evaluation</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• ROBOESPAS: Active rehabilitation of patients with upper limb spasticity using collaborative robots</li> <li>• Modelling, evaluation and rehabilitation of patients with upper limb spasticity using collaborative robots</li> <li>• HORUS: Robotic inspection of protective suits worn by healthcare personnel for patients in high-level isolation, including Ebola</li> <li>• HumaSoft: Design and Control of Soft Links for Humanoid Robots</li> <li>• EDAM: Exoskeleton for diagnosis and assistance in manipulation tasks. Development of the light-weight exoskeleton for manipulation tasks based on the SME technology</li> <li>• NAVEGASE-AUTOCOGNAV: Extending cognitive and semantic capabilities to outdoor robot navigation</li> </ul> <p style="text-align: right;">+</p>	<p><b>Experience and Capabilities</b></p> <p>The group's main areas of work encompass robotics (humanoid robots, social robots, and assistive robots), industrial automation, robotics and automation in construction, mobile manipulators, and aerospace applications.</p> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Automation and robotisation of industrial processes</li> <li>• Design and development of robots</li> <li>• Development of sensory perception systems</li> <li>• Development of process simulators</li> </ul> <p><b>AI technologies applied or developed in the group</b></p> <p>Machine learning; man-machine cooperation; robotics; computer vision.</p> <p><b>AI-related activities developed or implemented in the group</b></p> <p>Development of customised AI projects for public or private entities.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
SYSTEMS AND AUTOMATIC ENGINEERING			
<u>ROBOTICS LAB</u> <hr/> PI: Carlos Balaguer, Miguel A. Salichs, Luis Moreno		<b>Regional R&amp;D Plan Projects</b> <ul style="list-style-type: none"> <li>• RoboCity2030-DIH-CM. Madrid Robotics Digital Innovation Hub</li> </ul>	

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>SYSTEMS AND AUTOMATIC ENGINEERING</b>			
<p><b><u>Intelligent Systems Laboratory (LSI)</u></b></p> <p><b>PI: Arturo de la Escalera, José María Armingol</b></p>	<ul style="list-style-type: none"> <li>• Autonomous vehicles</li> <li>• Unmanned aerial vehicles</li> <li>• Intelligent transport systems</li> <li>• Driving assistance systems</li> <li>• Perception systems for vehicles</li> <li>• Driving assistance and surveillance systems</li> <li>• 2D and 3D camera surveillance systems</li> <li>• Computer vision systems</li> <li>• Production planning, programming, and control systems</li> <li>• System modelling and simulation</li> <li>• Microrobotics</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• Enhanced Neutralisation of explosive Threats Reaching Across the Plot</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Autonomous air-ground system for the collaborative inspection and digitalisation of the railway network</li> <li>• Integration of electric autonomous vehicles in urban environments</li> <li>• Help system for safer urban driving</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Vehicle safety for intelligent, sustainable, safe, and integrative mobility</li> <li>• Cooperation of high extinguishing capacity drones for forest and urban fires</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Intelligent aerial platform with full coverage for the protection and surveillance of installations by means of computer vision</li> <li>• Aerial machine learning system for the detection of construction anomalies</li> <li>• Analysis of aerial images of railway environments</li> <li>• Machine vision Chair</li> <li>• Personal electric and autonomous vehicle (PEAV)</li> <li>• Fixed and moving obstacle detection system</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The Intelligent Systems Laboratory has extensive experience in providing innovative solutions to companies from wide-ranging sectors, such as the automotive sector, construction sector, automation and control sector, among others, for the automation, control, and optimisation of their manufacturing systems.</p> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Design of perception systems for security and surveillance activities</li> <li>• Design and development of surveillance systems based on autonomous aerial and land vehicles</li> <li>• Autonomous guiding of unmanned aerial vehicles</li> <li>• Design and development of solutions to automate production processes</li> <li>• Computer vision systems             <ul style="list-style-type: none"> <li>· Deep Learning for perception applications</li> <li>· 3D Vision &amp; Point Cloud</li> <li>· Vision applied to robots</li> <li>· IR images</li> <li>· Machine Learning Algorithms</li> <li>· Analysis of characteristics: colour and texture</li> <li>· Surveillance systems</li> <li>· Quality control</li> </ul> </li> <li>• Analysis of the suitability of changing or redesigning production systems by means of computer process modelling, simulation and optimisation techniques</li> <li>• Detection of objects in thermal images</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
SYSTEMS AND AUTOMATIC ENGINEERING			
<p><u>Intelligent Systems Laboratory (LSI)</u></p> <hr/> <p>PI: Arturo de la Escalera, José María Armingol</p>		<p><b>Others</b></p> <ul style="list-style-type: none"> <li>• CITIES Timanfaya</li> </ul>	<ul style="list-style-type: none"> <li>• Advanced driving assistance systems               <ul style="list-style-type: none"> <li>· IVI Platform 2.0 (Intelligent Vehicle based on Visual Information)</li> </ul> </li> </ul> <p><b>Timanfaya Autonomous Bus</b></p> <p>LSI is one of the partners of the CITIES Timanfaya project. In this project, an autonomous bus prototype is being developed and will be deployed in the National Timanfaya Park in Lanzarote, Canary Islands. The project is the first prototype of this type designed in Spain.</p> <p><b>AI technologies applied or developed in the group</b></p> <p>Machine learning; intelligent prediction systems; structural processing and learning in images; computer vision.</p> <p><b>AI-related activities developed or implemented in the group</b></p> <p>Development of customised AI projects for public or private entities.</p> <p><b>AI-related services developed or implemented in the group</b></p> <p>Object recognition and tracking; detection of persons and movement analysis; semantic image segmentation.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>ELECTRONIC TECHNOLOGY</b>			
<p><b><u>Microelectronic Design and Applications (DMA)</u></b></p> <p><b>PI: Luis Entrena, Luis Hernández</b></p>	<ul style="list-style-type: none"> <li>• Design with FPGAs and applications. Acceleration Hardware</li> <li>• Design for low consumption</li> <li>• CAD tools for electronic design (EDA)</li> <li>• A/D and D/A Conversion. Sigma-Delta modulation</li> <li>• Fault Tolerant Circuits. Validation of fault tolerance through simulation and emulation</li> <li>• Reconfigurable computing</li> <li>• Smartcards and applications</li> <li>• Biometric and cryptographic identification systems</li> </ul>	<p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Design and verification of nano-scale electronic circuits for space and land applications in radiation environments</li> <li>• Analogue signal acquisition and processing with maximally digital circuits</li> <li>• Time-referenced data acquisition interfaces for sensors, medical imaging, and communications</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Design of fault-tolerant SoCs (SystemonChip) for space applications</li> <li>• MadridFlightOnChip</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Control firmware for the experiment associated with the React Project in the International Space Station</li> <li>• UC3M-SENER Aerospace Chair</li> <li>• Verification of Seu-Mitigation Techniques in 3rd 4th Generation Flash FPGAs</li> <li>• System level architecture of a VCO-based TI Continuous-Time Sigma Delta modulator</li> <li>• Design and characterisation of main building blocks for Medical instrumentation ADCs</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The group's scientific-technical activity is related to the design of digital electronic circuits, both application-specific integrated circuits (ASICs) and circuits implemented by means of programmable hardware (FPGA, CPLD).</p> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Electronic data acquisition systems in communications and sensing, with IP generation at the system and microelectronics level</li> <li>• Acceleration hardware for biometry and cryptography</li> <li>• TRNGs and "lightweight" cryptographic modules for RFID</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>ELECTRONIC TECHNOLOGY</b>			
<p><b>University Technological Identification Group (GUTI)</b></p> <p><b>PI: Raúl Sánchez Reillo</b></p>	<ul style="list-style-type: none"> <li>• Identification solutions in mobility (smartphones, tablets, netbooks...)</li> <li>• Identification devices (especially smartcards and RFID)</li> <li>• Security and cryptographic instruments (both secret and public key)</li> <li>• Biometric identification systems</li> <li>• Biometric modalities: Iris, hand geometry, vascular systems, handwritten signature and fingerprint</li> <li>• Multibiometrics: Multimodal, multisensor, multi-algorithm, both for fusion and complementarity</li> <li>• Integration of biometrics in smartcards and tokens</li> <li>• Biometrics protection: in process, storage, communications, etc.</li> <li>• Testing methodology: Both in performance and in security</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• AMBER: enhAnced Mobile BiomEtRics</li> <li>• PYCSEL: PYroelectric Conformable SEnsor matrix for Large area applications in security and safety</li> <li>• EKSISTENZ: Harmonized framework allowing a sustainable and robust identity for European Citizens</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Secure and convenient authentication in mobile environments based on voice biometrics</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Authentication platform using multi-modal bio-signals and ITU-T international standards (2018)</li> <li>• MADRID II: Fingerprint Performance Evaluation</li> </ul>	<p><b>Experience and Capabilities</b></p> <ul style="list-style-type: none"> <li>• Functional identification systems evaluation <ul style="list-style-type: none"> <li>· Biometrics</li> <li>· Smartcards</li> </ul> </li> <li>• Security evaluation according to common criteria <ul style="list-style-type: none"> <li>· Preparing protection profiles</li> </ul> </li> <li>• Creating evaluation methodology</li> <li>• Consultancy, research, and development in identification systems</li> <li>• National and international standardisation</li> </ul> <p><b>Registros Software</b></p> <ul style="list-style-type: none"> <li>• Handwritten signature toolbox (M-005590/2014)</li> <li>• Tool for the forensic analysis of dynamic biometric signatures made with electronic devices (M-005589/2014)</li> <li>• Automatic Remote Evaluation System (ARES) (M-006232/2013)</li> <li>• System for human recognition by means of the vascular structure of the wrist with homogenous lighting (M-006231/2013)</li> <li>• Biometric application development interface with BioAPI-based object orientation (ISO/IEC 19784-1) and implemented in C# (M-006230/2013)</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>SIGNAL AND COMMUNICATIONS THEORY</b>			
<p><b>Multimedia Processing (GPM)</b></p> <hr/> <p>PI: <b>Fernando Díaz de María</b></p>	<ul style="list-style-type: none"> <li>• Machine vision</li> <li>• Voice, audio, image, and video processing</li> <li>• Speech technologies</li> <li>• Image/video classification, analysis, and indexing</li> <li>• Object recognition and tracking in images/video</li> <li>• Multimedia applications of machine learning</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• SMOOTH: GDPR Compliance Cloud Platform for Micro Enterprises</li> <li>• METER-HAUL: METER High bandwidth, 5G Application-aware. optical network, with edge storage, compUte and low Latency</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Interactive Touristic Display. Accessible from any mobile (without an application) and with contents extracted from analysing and interpreting public pictures uploaded onto social media by tourists visiting that same area (ESITUR)</li> <li>• Saliency and Attention: rePresentation, Interpretation and Emergency</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Detection of cylindrical or angular bollards for an automated roadway conservation and maintenance system</li> <li>• Automatic inspection by machine vision of airport pavement from images captured by a drone</li> <li>• Technical collaboration, optical component tests and validations for SQS System</li> <li>• Developments of machine vision algorithms for road safety and other applications</li> <li>• Collaboration agreement for the creation of the UC3M-SENER Aerospace Chair</li> </ul>	<p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Applications of machine vision in safety: Video analytics, event detection, anomaly detection, road incident detection, etc.</li> <li>• Applications of machine vision in the health sector: Systems for aiding in diagnosis, brain tumour classification, disease follow-up, etc.</li> <li>• Voice, audio, image, and video processing</li> <li>• Object/person recognition and tracking in images/video</li> </ul> <p><b>Hardware Equipment</b></p> <ul style="list-style-type: none"> <li>• Video acquisition and reproduction hardware</li> <li>• Audio capture, processing, effects, storage and reproduction hardware</li> <li>• Computing cluster for HPC (high-performance computing) with a sustained computing power of 4.5 Tflops</li> </ul> <p><b>Software Means</b></p> <ul style="list-style-type: none"> <li>• Software for the automatic indexing of multimedia information</li> <li>• Audio and video editors</li> <li>• Simulation software for enclosure electroacoustics and acoustics</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>SIGNAL AND COMMUNICATIONS THEORY</b>			
<p><b>Signal Processing and Learning (GTSA)</b></p> <p><b>PI: Antonio Artés</b></p>	<ul style="list-style-type: none"> <li>• Signal and image detection and classification, including parametric and non-parametric, centralised and distributed formulations</li> <li>• Machine learning for signal and image processing, including both design of classifiers and estimators as feature extraction and information for classification and estimation</li> <li>• Advanced adaptive signal and image processing techniques, including, among others, nonlinear filtering, Monte Carlo methods, Bayesian methods or signal decomposition</li> <li>• Applications of information theory               <ul style="list-style-type: none"> <li>· Wireless system performance limits</li> <li>· Data compression</li> </ul> </li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• Machine Learning Frontiers in Precision Medicine</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Machine learning and massive computing for customised medicine and quantitative climate analysis</li> <li>• Microfoundations of behaviour: An ICT-based approach to understanding human behaviour and interaction</li> <li>• Advanced Bayesian computing methods for the estimation, prediction, and control in complex multisensory systems</li> <li>• Anomalous human behaviour Detection</li> <li>• Use and training in scientific-technical equipment and laboratory support tasks</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• PRACTICO-CM Computational psychiatry and integrated behavioural models</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Domain Alignment and Data Wrangling with Deep Generative Models</li> <li>• Stress Level assessment with non-intrusive sensors</li> <li>• Supervision of the development of algorithms for multispectral satellite image analysis</li> <li>• Deep learning for predicting client terminal change</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The Signal Processing and Learning Group's research and educational activity focuses on the following areas:</p> <ul style="list-style-type: none"> <li>• Signal and image detection, estimation and classification</li> <li>• Machine learning and signal and image processing</li> <li>• Computational statistics in signal processing</li> <li>• Information theory and related applications in communications, medicine, geophysics, or social sciences.</li> </ul> <p><b>Technological Offer</b></p> <ul style="list-style-type: none"> <li>• Sensor network-based intelligent monitoring systems with military, environmental, home automation, security, and tracking applications</li> <li>• Communication systems analysis</li> <li>• Psychiatry:               <ul style="list-style-type: none"> <li>· Determination of latent causes and discriminatory factors in mental diseases (based on care-related and genetic data)</li> <li>· Behaviour characterisation by means of wearable devices</li> </ul> </li> <li>• Neurology:               <ul style="list-style-type: none"> <li>· EEG processing in man-machine interfaces</li> <li>· Portable functional image from an EEG</li> <li>· Monitoring epileptic seizures</li> </ul> </li> <li>• Cardiology:               <ul style="list-style-type: none"> <li>· Outpatient monitoring by means of inertial, EKG, EEG, GSR, and image sensors</li> </ul> </li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
SIGNAL AND COMMUNICATIONS THEORY			
<p><u>Signal Processing and Learning (GTSA)</u></p> <hr/> <p>PI: Antonio Artés</p>			<p><b>Equipment</b></p> <ul style="list-style-type: none"> <li>• Computer cluster: 1280 cores, 15 sustained Tflops, 80 TB storage (40 internal + 40 external)</li> <li>• Computing servers for online access</li> <li>• Two GPU NVIDIA Tesla K20c</li> <li>• Wearable monitoring sensors, systems, and devices</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
SIGNAL AND COMMUNICATIONS THEORY			
<p><b>Machine Learning for Data Science (ML4DS)</b></p> <hr/> <p><b>PI: Jerónimo Arenas</b></p>	<ul style="list-style-type: none"> <li>• Machine learning for Big Data</li> <li>• Topic models for analysing large collections of documents</li> <li>• Semantic graph generation and processing</li> <li>• Distributed learning with privacy restrictions</li> <li>• Kernel methods</li> <li>• Feature selection and extraction</li> <li>• Graph embedding</li> <li>• Machine learning for web data analysis</li> <li>• Machine learning for neuroimaging</li> <li>• Energy-efficient adaptive algorithms for IoT</li> <li>• Signal processing</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• MUSKETEER: Machine learning to augment shared knowledge in federated privacy-preserving scenarios</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Machine learning for big data analysis of heterogeneous document sources</li> <li>• Machine learning of interpretable features and metrics for computational intelligence</li> <li>• Distributed learning in energy-efficient adaptive sensor networks</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Trend identification service in the R&amp;D&amp;I sector</li> <li>• Service for profiling R&amp;D&amp;I agents</li> <li>• Service for identifying impact and collaborative networks of R&amp;D&amp;I agents</li> </ul>	<p><b>Experience and Capabilities</b></p> <ul style="list-style-type: none"> <li>• Adaptation of machine learning algorithms to multiple applications</li> <li>• Mass data analysis on web domains and large databases</li> <li>• Machine learning for big data</li> <li>• Internally developed algorithm for adaptive estimation in distributed networks</li> <li>• Ad-hoc algorithm designs for machine learning: Classification, regression, clustering, topic modelling, and novelty detection</li> <li>• Intelligent website crawling</li> <li>• Experience in data visualisation</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
UC3M – BANCO SANTANDER BIG DATA INSTITUTE			
<p><b>UC3M – Banco Santander Big Data Institute</b></p> <p><b>PI: Rosa Lillo</b></p>	<p><b>Description</b></p> <p>The UC3M – Banco Santander Big Data Institute was established in may 2015 as a joint venture between Universidad Carlos III of Madrid and the Santander Group for the purpose of promoting interdisciplinary research in the analysis of large volumes of data, with a particular emphasis on financial applications. The Institute has a clear international outlook and its mission is to produce high-quality research with a high impact on the manner in which Big Data can contribute to better decision-making.</p>	<p><b>Lines/Research Projects</b></p> <ul style="list-style-type: none"> <li>• Social media analysis</li> <li>• Artificial intelligence</li> <li>• Bayesian inference in high-dimensional data</li> <li>• Behaviour change and Big Data</li> <li>• Clustering in high-dimensional data</li> <li>• Data visualisation</li> <li>• Deep learning</li> <li>• Dimension reducing methods</li> <li>• High-dimensional data factor models</li> <li>• Functional data analysis</li> <li>• Image analysis</li> <li>• Multidimensional time series</li> <li>• Multivariate risk measures</li> <li>• Machine learning</li> <li>• Atypical value detection and robust estimation in large data sets</li> <li>• High-dimensional optimisation</li> <li>• Parallel computing</li> <li>• Statistical learning</li> <li>• Stochastic processes for high-dimensional data</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The UC3M – Banco Santander Big Data Institute conducts basic interdisciplinary research in big data analysis that brings together solid experience in statistics, applied mathematics, IT, and machine learning and promotes collaboration between the different fields.</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
<b>PRIVATE SOCIAL AND INTERNATIONAL LAW</b>			
<p><b><u>Labour Law, Economic Changes, and a New Society (DTCENS)</u></b></p> <hr/> <p><b>PI: Jesús Rafael Mercader</b></p>	<ul style="list-style-type: none"> <li>• The impact of technological innovation on Labour and Social Security Law</li> <li>• Labour control and technology</li> <li>• Robotics and occupational risks</li> </ul>	<p><b>European Projects</b></p> <ul style="list-style-type: none"> <li>• New employment forms and Challenges to Industrial Relations, Improving expertise in the field of industrial relations</li> </ul> <p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Technological change and transformation in the sources of employment: Law and Collective Agreement with respect to Digital Disruption</li> <li>• Basic principles and foundations for regulating citizen rights in the digital environment</li> </ul> <p><b>Private Funding</b></p> <ul style="list-style-type: none"> <li>• Research chair in Labour Relations and Employment of the Sagardoy Institute</li> <li>• AIRBUS-UC3M Chair in Healthy Company, Well-being, and Performance</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The DTCENS group offers innovative and pragmatic answers to the new competitive social challenges produced by a working world and labour relations undergoing transformation.</p> <ul style="list-style-type: none"> <li>• "Derecho del trabajo, nuevas tecnologías y sociedad de la información" (ISBN: 10 8484069230, 13 9788484069232)</li> <li>• Ana Belén Muñoz, "La Inteligencia Artificial (IA), sus aplicaciones al mundo de los negocios y su relación con la ética y la equidad" ("Artificial Intelligence (AI), its applications in the world of business, and its connection with ethics and equality"). VI Technological Business Conference of Leganes at the Science Park of Universidad Carlos III of Madrid, 2019.</li> <li>• "Aspectos críticos de la inteligencia artificial en el ámbito jurídico privado". Jesús Mercader Conference on the "Aproximación a los retos jurídicos de la inteligencia artificial" ("Approach to the legal challenges arising from artificial intelligence"), UC3M, 2019</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
PRIVATE LAW			
<p><b>Society, Technology, and Business Law (SOCITEC)</b></p> <hr/> <p><b>PI: Marta García Mandaloniz</b></p>	<ul style="list-style-type: none"> <li>• Commercial contract law: buying/selling, transport and insurance</li> <li>• Law of small and medium-sized business financing</li> <li>• E-commerce law</li> <li>• International uniform commercial code (UCC) law</li> <li>• Electronification of commercial company law</li> <li>• Entrepreneurship</li> <li>• Technology-based companies (TBC's)</li> <li>• Social enterprises</li> <li>• Protection of innovation and knowledge transfer: industrial property</li> </ul>	<p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Basic principles and foundations for regulating citizen rights in the digital environment</li> </ul> <p><b>Regional R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Innovation in new companies: Promotion, Protection, Funding, and Marketing</li> <li>• Small and medium-sized businesses and new technologies</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>Teresa Rodríguez de las Heras Ballel, a group investigator, is a member of the European Commission Expert Group on Responsibility and AI/robotics/IoT.</p> <ul style="list-style-type: none"> <li>• PUBLICATIONS by Teresa Rodríguez de las Heras             <ol style="list-style-type: none"> <li>1.- Challenges of Fintech to Financial Regulatory Strategies, Madrid: Marcial Pons, 2019</li> <li>2.- "Digital Technology-Based Solutions For Enhanced Effectiveness Of Secured Transactions Law: The Road to Perfection?", Law and Contemporary Problems, Duke University School of Law, Vol. 81, num. 1, 2018, pp. 21-44.</li> <li>3.- "Legal challenges of artificial intelligence: modelling the disruptive features of emerging technologies and assessing their possible legal impact", Uniform Law Review, 1/2019, 1-13.</li> </ol> </li> <li>• GUEST LECTURES by Teresa Rodríguez de las Heras             <ol style="list-style-type: none"> <li>1.- "Digital tracing of assets and tracing and recovery of digital assets: scenarios, and taxonomy legal issues", UNCITRAL Colloquium on Civil Asset Tracing and Recovery, NU, Vienna, 6 December 2019</li> <li>2.- "Surveillance, Privacy, and Human Rights: Looking Ahead to 2020", International Law Weekend, The Resilience of International Law, Columbia Law School (10 October), Fordham Law School (11 October), 2019, New York</li> </ol> </li> </ul>

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
PRIVATE LAW			
<p><u>Society, Technology, and Business Law (SOCITEC)</u></p> <p>PI: Marta García Mandaloniz</p>			<ul style="list-style-type: none"> <li>3.- "Legal Standards and State-of-the-art practice in the formulation of rules for Artificial Intelligence", SOLAIR Conference, Prague, Academy of Sciences, 13 September 2019</li> <li>4.- "International Standards and State-of-the-art practice in the formulation of harmonized rules for emerging technologies", 11th Transnational Commercial Law Teachers' Meeting, Queen's Mary, London, 12 &amp; 13 September 2019, in Morgan and Lewis</li> <li>5.- "Inteligencia artificial y algoritmos", VI Congreso Internacional sobre Derecho Uniforme y Comercio Electrónico ("Artificial intelligence and algorithms", 7th International Conference on Uniform Law and E-commerce), Attorney Bar Association of Costa Rica, San José, Costa Rica, 24 and 25 June 2019</li> <li>6.- "Disruptive features of Emerging Technologies: challenges to liability regimes", EU-China Dialogue of Legal Affairs, Beijing, China, 20-21 March 2019.</li> <li>7.- "When something goes wrong...Liability and Emerging Technologies", UNIDROIT-UNCITRAL Joint Workshop on DLT, Smart Contracts and Artificial Intelligence, UNIDROIT, Roma, 6-8 May 2019</li> <li>8.- "Legal Challenges of Artificial Intelligence: A Case for Harmonisation", SOLAIR Conference, Prague, Academy of Sciences, 5 September 2018</li> </ul>

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
PRIVATE LAW			
<p><u>Society, Technology, and Business Law (SOCITEC)</u></p> <hr/> <p>PI: Marta García Mandaloniz</p>			<p>9.- "Mirarnos en el espejo...: viviendo con robots" ("Looking at ourselves in the mirror...: living with robots"), Pint of Science, Madrid, Bar Moe, 15 May 2018.</p> <p>10.- "El uso de algoritmos en los contratos de seguro y sus implicaciones" / Digitalización en la lógica contractual regulatoria del seguro ("The use of algorithms in insurance contracts and their implications"/Digitalisation in the regulatory contractual logic of insurance"), Insurtech Conference, Blockchain and digitalisation in the Insurance Sector, SEADA-Hogan Lovells, Universidad Carlos III of Madrid, 19 April 2018.</p> <p>11.- "Technological Shifts and Political Shifts", 2018 Ambassador Milton A. Wolf Media and Diplomacy Seminar: Public Diplomacy in Moments of Geopolitical Transformation, Diplomatic Academy, Vienna, 16-18 April, 2018</p> <p>12.- "Aspectos críticos de la inteligencia artificial en el ámbito jurídico privado" ("Critical aspects of artificial intelligence in private legal perspective"), Conference on the "Aproximación a los retos jurídicos de la inteligencia artificial" ("Approach to the legal challenges arising from artificial intelligence"), UC3M, 2019</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
PUBLIC LAW			
<p><b><u>Services of General Interest, Economic Activity, and Public Intervention</u></b></p> <hr/> <p>PI: Tomás de la Cuadra Salcedo</p>	<ul style="list-style-type: none"> <li>• Free Market Public Assistance</li> <li>• Non-economic Public Services</li> <li>• Public Intervention in the Economy</li> <li>• Health Care, Education and Social Services</li> </ul>	<p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• The impact of artificial intelligence on public services: A legal analysis of its scope and consequences in healthcare assistance.</li> <li>• The social state at the crossroads: Limitations, conditions, and improvements in providing public services</li> <li>• Basic principles and foundations for regulating citizen rights in the digital environment</li> </ul>	<p><b>Experience and Capabilities</b></p> <ul style="list-style-type: none"> <li>• "Los retos jurídicos de la inteligencia artificial en el ámbito jurídico público" ("Legal challenges of artificial intelligence in public legal perspective"). Tomás de la Cuadra Salcedo, Agustín de Asís, José Vida Conference on the "Aproximación a los retos jurídicos de la inteligencia artificial" ("Approach to the legal challenges arising from artificial intelligence"), UC3M, 2019</li> </ul>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	TECHNOLOGICAL OFFER / OTHERS
HUMANITIES – PHILOSOPHY, LANGUAGE, AND LITERATURE			
<p><b><u>HERMES: Scientific Research in its Historical, Philosophical, Linguistic, and Literary Aspects</u></b></p> <hr/> <p><b>PI: Carlos Thiebaut, Fernando Broncano</b></p>	<ul style="list-style-type: none"> <li>• Gender studies, post-feminism and queer theory</li> <li>• Moral Philosophy and Ethics</li> <li>• Philosophy of History and recovery of the historical memory</li> <li>• Identity and representation. Models for understanding the mind, technology and society based on representative models and identifying values.</li> <li>• Philosophy and Literature, interdisciplinary approaches.</li> </ul>	<p><b>National R&amp;D Plan Projects</b></p> <ul style="list-style-type: none"> <li>• Subjects, emotions, and structures: for a critical social theory project</li> <li>• Identity, memory, and experience</li> <li>• Political epistemology: knowledge pathologies</li> <li>• Constitution of the subject in social interaction: identity, norms, and meaning of the action from the perspective of the philosophy of action, epistemology, and philosophy</li> <li>• Agency, normativity, and identity, the presence of the subject in the action</li> </ul>	<p><b>Experience and Capabilities</b></p> <p>The purpose of the group's lines of work is to promote and develop knowledge and scientific research in its historical, philosophical, linguistic, and literary aspects, and to perform work aimed at learning, diffusion, and communication of this knowledge, using new information technologies.</p> <ul style="list-style-type: none"> <li>• "Situación actual y perspectiva de futuro de la inteligencia artificial" ("The current situation and future perspective of artificial intelligence"). Fernando Broncano. Conference on the "Aproximación a los retos jurídicos de la inteligencia artificial" ("Approach to the legal challenges arising from artificial intelligence"), UC3M, 2019</li> </ul>

*Co-funding:*

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