



UC3M R&D FOR INNOVATION in the areas of **security and defence**

IDENTIFICATION OF THE RESEARCH ACTIVITY,
TECHNOLOGIES, PATENTS, INFRASTRUCTURES
AND OTHER CAPABILITIES OF UC3M IN THE
AREAS OF SECURITY AND DEFENCE

uc3m

Universidad **Carlos III** de Madrid

Vicerrectorado de Investigación y Transferencia

Servicio de Apoyo al Emprendimiento y la Innovación



The Entrepreneurship and Innovation Service Support (SEI) of the Universidad Carlos III de Madrid (UC3M) presents this "Security and Defense Knowledge Map," a tool designed to highlight the current capabilities and the university's research potential in a strategic area of great importance to society

This map includes the main lines of research developed in national and international R&D&I projects, as well as patents and other relevant results generated by our researchers.

We invite you to deepen into UC3M's capabilities to generate knowledge in this field, to contact and collaborate with us to find solutions through the development of new R&D&I projects that promote innovation.

Entrepreneurship and Innovation Support Service
Universidad Carlos III de Madrid

Index

ENGINEERING

IT	7
Computer Architecture, Communications and Systems (ARCOS)	7
<i>PI: Jesús Carretero</i>	
COSEC (Computer Security Lab)	8
<i>PI: Juan M. Estévez Tapiador</i>	
Applied Artificial Intelligence (GIAA)	10
<i>PI: José Manuel Molina, Jesús García</i>	
Systems Control, Learning and Optimisation Laboratory (CAOS)	12
<i>PI: Araceli Sanchis</i>	
Interactive Systems (DEI)	13
<i>PI: Paloma Díaz</i>	

MECHANICAL ENGINEERING

Advanced Vehicle Dynamics and Mechatronic Systems (VEDYMEC)	14
<i>PI: María Jesús López Boada, Daniel García-Pozuelo Ramos, Abdulla Hussein Abdulrahman Al Kaff</i>	
Experimental, mechanics, calculations and transport (MECATRAN)	16
<i>PI: Vicente Díaz</i>	

SYSTEMS ENGINEERING AND AUTOMATION	17
Robotics Laboratory (ROBOTICS LAB)	17
<i>PI: Miguel A. Salichs, Carlos Balaguer, Luis Moreno</i>	
Intelligent Systems Laboratory (LSI)	18
<i>PI: Arturo de la Escalera, José María Armingol</i>	
TELEMATIC ENGINEERING	20
ADSCOM (Advanced Switching and Communication Systems) (Subgroup of the NETWORK TECHNOLOGIES Group PI: Francisco Valera)	20
<i>PI: David Larrabeiti</i>	
NETCOM (Network and Communication Technologies) (Subgroup of the NETWORK TECHNOLOGIES Group PI: Francisco Valera)	22
<i>PI: Arturo Azcorra</i>	
Pervasive Computing Laboratory Laboratory of the Telematic Services and Applications Group (GAST)	24
<i>PI: Carlos Delgado Kloos, Carlos García Rubio, Andrés Marín López, Luis Sánchez Fernández</i> <i>Laboratory coordinators: Florina Almenarez . Celeste Campo, Daniel Díaz, Carlos García Rubio</i>	
CONTINUOUS MEDIA MECHANICS AND STRUCTURE THEORY	25
Light Structures Dynamics	25
<i>PI: David Varas, Jorge López Puente</i>	
Dynamics and Fracture of Structural Elements	26
<i>PI: Ramón Zaera</i>	
Advanced Materials Mechanics	27
<i>PI: Enrique Barbero, Sonia Sánchez</i>	
Nonlinear Solid Mechanics	28
<i>PI: José Antonio Rodríguez</i>	

ELECTRONIC TECHNOLOGY	29
Microelectronic Design and Applications (DMA)	29
<i>PI: Luis Entrena, Luis Hernández</i>	
Photonic Displays and Applications (GDAF)	30
<i>PI: José Manuel Sánchez Pena, Carmen Vázquez</i>	
University Identification Technologies Group (GUTI)	32
<i>PI: Raúl Sánchez Reillo</i>	
Optoelectronics and Laser Technology (GOTL)	34
<i>PI: Guillermo Carpintero, Horacio Lamela</i>	
SIGNAL THEORY AND COMMUNICATIONS	36
Communications	36
<i>PI: Ana García Armada</i>	
Radiofrequency, electromagnetism, microwaves and antennas (GREMA)	37
<i>PI: Daniel Segovia</i>	
Audiovisual Intelligence	38
<i>PI: Fernando Díaz de María</i>	
MATHEMATICS AND PHYSICS	
PHYSICS	39
Sensors, Remote Detection and IR Imaging Laboratory (LIR) – InfraRed LAB	39
<i>PI: Juan Meléndez</i>	
QUEST: Quantum engineering, science and technology	41
<i>Manager: Jesús Iñarrea, Erik Torrontegui</i>	

SOCIAL SCIENCES

POLITICAL SCIENCE AND SOCIOLOGY DEPARTMENT 42

Political Analysis and Public Policy Management (Public Policy and Politics) 42

Manager: Antonio Natera

LABORATORIES

Aeronautical Structures Impact Laboratory - ImpactLab 43

PI: José Antonio Loya, Jorge López Puente

RESEARCH INSTITUTES

Duque de Santomauro Institute for Motor Vehicle Safety 44

Director: Vicente Díaz

Institute of Policy and Governance 45

Director: Álvaro Ribagorda

R&D GROUP

LINES OF RESEARCH

RESEARCH PROJECTS

EXPERIENCE AND CAPABILITIES

ENGINEERING

IT

Computer Architecture, Communications and Systems (ARCOS)

PI: Jesús Carretero

Real-time systems:

- Wireless sensor networks
- Remote system monitoring

High-performance computing:

- Scalable big data management
- Cloud and grid computing
- Parallel file systems

Distributed and parallel systems:

- High-performance data recovery and transmission system
- Data analysis in social media
- Peer-to-peer systems

Research Projects

- European Projects
- [ADMIRE: Adaptive multi-tier intelligent data manager for Exascale](#)
- [ASPIDE: exAScale Programming models for extreme Data procEssing](#)

National Projects

- [New scalable I/O techniques for hybrid HPC and data-intensive workloads. - SCIOT](#)
- [New Methods in High-End and Edge Computing for Data-intensive Computing](#)
- [Expand- High-performance storage systems for HPC and Big Data Environments](#)
- [ADMIRE - Adaptive multi-tier intelligent data manager for Exascale](#)

UC3M Funding

- [Real-time Monitoring and Evaluation of Cloud and HPC Infrastructures by means of AI - METRIC-AI](#)

A dynamic research group currently investigating various areas of HPC. Its activities are focused on developing new software for large-scale distributed and parallel systems. These activities encompass the development and optimisation of distributed and parallel applications, real-time applications, reliable designs, and high-performance computing, including cross-layer optimisations of HPC storage I/O stacks, parallel file systems, I/O acceleration of scientific workflows, automatic parallel I/O tuning based on machine learning, dynamic monitoring of HPC infrastructures, convergence of HPC and Big Data software stacks, and resource allocation elasticity in HPC and clouds.

Technological Offer

- RCM tool for preventive maintenance in complex organisations that handle large volumes of data and have widely scattered terminals and variety of faults
- Platform for the automatic creation of secure applications for wireless sensor networks using MDA (Model Driven Architecture).

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
IT			
<p>COSEC (Computer Security Lab)</p> <hr/> <p>PI: Juan M. Estévez Tapiador</p>	<ul style="list-style-type: none"> • Applied cryptography • Privacy • Cyberdefence systems • Security in smart devices (sensors, RFID, smartphones, wearables) • Advanced malware detection and analysis techniques • Security and e-health (biosignals and implantable medical devices) • Hardware security (PUFS, hardware trojans) • Security in VANET environments • Computer forensics 	<p>European Projects</p> <ul style="list-style-type: none"> • European cybersituational awareness platform • TRUSTaWARE - Enhancing Digital Security, Privacy and TRUST in softWARE <p>National Projects</p> <ul style="list-style-type: none"> • Advanced Evidence-based Research Methods in Cybersecurity • Remote Cybersecurity -CYCAD • Security Mechanisms for Fog Computing - Advanced Security for Devices • Cybersecurity in Connected Medical Infrastructures • MORE4AIO - Monitoring and correcting threats in artificial intelligence systems in operating environments • Attribution and prevention of threats affecting multiple groups relevant to cybersecurity. - APAMCiber <p>Regional Projects</p> <ul style="list-style-type: none"> • Cybersecurity, Network Analysis and Monitoring for the Next Generation Internet • Proactive Defence against Disinformative Cyberthreats: Background, Consequences, and Mechanisms of Detection and Prediction of Fake Content (DEPROFAKE-CM-UC3M) • Advanced Cyberthreats: Mechanisms Analysis and Sociopolitical Ties <p style="text-align: right;">+</p>	<p>A group with extensive and recognised experience in solving security problems in public and private entities, for which they develop solutions and provide comprehensive R&D, consulting, auditing, training and high-level advisory services in the field of Information Systems and Technology Security.</p> <p>Technological Offer</p> <p><i>Software registrations</i></p> <ul style="list-style-type: none"> • AKARI-1: Pseudorandom number generate for lightweight devices • Alterdroid: Tool for analysing obfuscated malicious software for Android • Targetdroid: Tool for analysing targeted malicious software for Android • SETiChat (a secure Android chat) • eStorePass: Password manager based on electronic ID (DNI) • Tool for predicting volumes of fake news based on Artificial Intelligence • Tool for analysing the impact of contamination attacks for general artificial intelligence • Crypto Go

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
IT			
<p><u>COSEC (Computer Security Lab)</u></p> <hr/> <p>PI: Juan M. Estévez Tapiador</p>		<p>Private Funding</p> <ul style="list-style-type: none"> • Vulnerabilities of quantum random number generation systems for post-quantum security and cryptography 	

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
IT			
<p><u>Applied Artificial Intelligence (GIAA)</u></p> <p>PI: José Manuel Molina, Jesús García</p>	<ul style="list-style-type: none"> • Machine Learning and Data Mining Techniques • Evolutionary Computation and Multi-objective Optimisation • Machine Vision • Data Fusion Systems and Contextual Information • Vigilance Systems • Air Traffic Control (ATC) • Coastal Surveillance and Maritime Traffic • Indoor localisation system • Inference in adaptive, non-linear dynamic systems • Unmanned vehicles • Augmented reality 	<p>National Projects</p> <ul style="list-style-type: none"> • ASPID – Advances in Protection and Intelligence Systems with Drone Swarms • Concepts of Aerial Vehicles in the City: Transport, Urban Planning and Security • SIMBAT: Solutions for Intelligent Monitoring based on drone data and AI Tools • Advanced monitoring in ports and airports: concepts, tools and evaluation • Autonomous Surveillance and Security System based on multirotors (ADVISE) <p>Private Funding</p> <ul style="list-style-type: none"> • MARVISION 	<p>A group with nationally recognised prestige for its ability to solve engineering problems by incorporating the latest artificial intelligence techniques: machine learning, evolutionary computing, data analysis, multi-objective optimisation, fuzzy systems and intelligent agents.</p> <p>Artificial Intelligence – Machine Learning</p> <ul style="list-style-type: none"> • Classification • Rules • Prediction <p>Data fusion / Information / Sensors</p> <ul style="list-style-type: none"> • Tracking • Control <ul style="list-style-type: none"> · Data Analysis, Big Data · Decision-making Support Systems · Smart Video · Internet of Things · Autonomous Navigation · Surveillance Systems <p>Technological Offer</p> <ul style="list-style-type: none"> • Camera-based surveillance system for tracking and identifying airport surface traffic (aircraft, trucks, buses)

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IT			
<p><u>Applied Artificial Intelligence (GIAA)</u></p> <hr/> <p>PI: José Manuel Molina, Jesús García</p>			<ul style="list-style-type: none"> • Simulation system for data fusion at airports, for surface radar processing and integration with other sensors following the ASMGCS paradigm • Data Optimisation, Prediction and Analysis Software • Software agent system for surveillance + • Context-based reasoning system for high-level fusion • Multi-sensor fusion platform for monitoring systems <p>Equipment</p> <ul style="list-style-type: none"> • Time-of-flight cameras and Kinect • High-performance computing systems, cameras, localisation and communications network • Unmanned ground vehicle (UGV) and light UAVs with navigation sensors <p>Related News</p> <ul style="list-style-type: none"> • A system that alerts to dangerous situations via video surveillance cameras <p>Group's Video</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
IT			
<p><u>Systems Control, Learning and Optimisation Laboratory (CAOS)</u></p> <p>PI: Araceli Sanchis</p>	<ul style="list-style-type: none"> • Artificial intelligence • Machine learning • Data analysis • Predictive control • Optimisation • Artificial neural networks • Pattern recognition • Evolutionary computation • Agent modelling • Driving assistance • Intelligent transport systems 	<p>National Projects</p> <ul style="list-style-type: none"> • Artificial intelligence for human-machine collaboration in driving tasks • Artificial intelligence for Smart, Autonomous, Sustainable and Safe Mobility (IA4MOV*) • System to ensure minimum risk conditions in the event of autonomous vehicle failures: Perception for situational awareness and environment simulation. - SAFE4CAR • EITEL, Smart Energy for All: An Approach from Local Governments 	<p>A group skilled in the prediction, optimisation, control and automatic planning of business processes and services based on data analysis using advanced artificial intelligence technologies and other systems with proven effectiveness in solving complex problems in business and industrial environments.</p> <p>Technological Offer</p> <ul style="list-style-type: none"> • Time Series Prediction by means of Artificial Neural Networks and Evolutionary Computation • Activity recognition: algorithms for recognising the activities of people/agents

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
IT			
<p><u>Interactive Systems (DEI)</u></p> <hr/> <p>PI: Paloma Díaz</p>	<ul style="list-style-type: none"> • Web Emergency Management Information Systems (WEMIS) • Interaction and visualisation tools to improve situation awareness in crisis and operation centres • Communities of practice and communities of interest • Social networks • Situation awareness • Citizen participation • Knowledge management and visualisation 	<p>National Projects</p> <ul style="list-style-type: none"> • Detailed study on methods for capturing and exploiting expert knowledge in Army maintenance tasks • Pervasive and Affordable technologies for Civic Engagement • Civic engagement in emergency management • Building citizens emergency preparation and response capacity through web 2.0 tools • Global Emergency Management System (Emergensys) • Information Technologies for the Planning and Training for Emergency Situations • Start-up, administration and corrective maintenance service for the SIGAME system • (ENERGOS) Operator- Operating Environment Interaction Study 	<p>A group with extensive experience researching the opportunities offered by successive technological advances in the field of human-computer interaction, applying them to the development of innovative solutions that provide efficient and effective support for work, learning or communication in different environments.</p> <p>Technological Offer</p> <ul style="list-style-type: none"> • ARCE, secure web portal that allows government defence and civil protection agencies to share information on normal and alert situations, as well as facilitating international cooperation in emergency situations • SIGAME: Web platform to promote cooperation and coordination between national civil protection agencies • Sema4ra: Ontology for representing knowledge about alerts and accessible emergency routes • INeres: App for viewing alerts and accessible emergency routes • RemerWeb: Web platform for communication between volunteer networks in tracking early warnings • emerCien: Multi-device platform for integrating citizens into crisis management, including social media monitoring • iWARN: App for citizen participation in tracking early warnings

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MECHANICAL ENGINEERING			
<p><u>Advanced Vehicle Dynamics and Mechatronic Systems (VEDYMEC)</u></p> <hr/> <p>PI: María Jesús López Boada, Daniel García-Pozuelo Ramos, Abdulla Hussein Abdulrahman Al Kaff</p>	<ul style="list-style-type: none"> • Advanced vehicle dynamics • Vehicle control (robust, optimal and fault-tolerant control) • Automotive mechatronics • Motion control for advanced mechatronics • Smart and eco-friendly tire • Multisensor fusion for advanced mechatronics • Fault detection and identification in mechatronic systems • Quantification and analysis of uncertainties in mechanical systems • Numerical simulation and tests • Convoy of vehicles • Multimodal and multisensory perception • Autonomous connected vehicles 	<p>European Projects</p> <ul style="list-style-type: none"> • EcoMobility - Intelligent, Safe and secure connected Electrical Mobility solutions: Towards European Green Deal and Seamless Mobility • PLIADES. AI-Enabled Data Lifecycles Optimisation and Data Spaces Integration for Increased Efficiency and Interoperability <p>National Projects</p> <ul style="list-style-type: none"> • Networked, fault-tolerant driving automation system for trajectory tracking affected by disturbances to improve safety and comfort. - PATHAS • Multimodal and Multisensory Perception for Autonomous Connected Vehicles • EcoMobility - "Intelligent, Safe and secure connected Electrical Mobility solutions: Towards European Green Deal and Seamless Mobility" • MARTA -Digital mapping for road topology acquisition • DIVEC -Intelligent design of connected electric vehicles • IoT4SafeDriving. Intelligent Driving Safety System under an IoT platform with low-cost devices • New concept of eco-friendly tire based on long life casing and a removable tread with low environmental impact - ECOTIRE 	<p>A multidisciplinary group with extensive consolidated experience in the design and engineering of manned, autonomous connected vehicles.</p> <p>Equipment</p> <ul style="list-style-type: none"> • CO.Sync: Driving robot • Racelogic's VBOX 3i RTK with IMU integration • Dual antenna for Vbox 3i RTK • Racelogic RTK Base Station to improve the positional precision of GPS VBOX systems, by calculating and then transmitting differential correction data by radio to allow the mobile GPS system to correct its position • Kistler's MSW sensors for contactlessly measuring the steering moment, steering angle and steering speed • Kistler's WPT sensors for detecting wheel rotation, wheel speed, distance travelled and vehicle speed • Microsoft Augmented Reality (AR)/Mixed Reality (MR) HoloLens 2 Headset • Slice Micro Data Acquisition System DTS • CarSim software for simulating passenger vehicle and light truck performance • National Instruments' CompactRIO • Tumaker BIGFoot PRO 200 DUAL Direct Drive HR - PELLET 3D Printer

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MECHANICAL ENGINEERING			
<p><u>Advanced Vehicle Dynamics and Mechatronic Systems (VEDYMEC)</u></p> <p>PI: María Jesús López Boada, Daniel García-Pozuelo Ramos, Abdulla Hussein Abdulrahman Al Kaff</p>		<p>Regional Projects</p> <ul style="list-style-type: none"> • Design of an efficient perception algorithm for uncertainty management-based autonomous driving (APBI-CM-UC3M) • New paradigm for emergency transport service management: ambulances <p>UC3M Funding</p> <ul style="list-style-type: none"> • Planning and control of trajectory tracking for an automated driving system at intersections without traffic lights, considering heterogeneous vehicle dynamics <p>Private Funding</p> <ul style="list-style-type: none"> • Road safety based on digital twins and perceptions • Improved vehicle dynamics of a driving simulator 	<ul style="list-style-type: none"> • High-performance servers for machine vision and neural network training • 2 automated vehicles for use in remote operation and autonomous driving • 1 sensor-equipped vehicle for recording sequences and generating datasets • 2 Meta Quest Virtual Reality headsets • Several cameras and lidars for 2D and 3D perception • 1 Nvidia Drive embedded computer for autonomous driving <p>Technological Offer</p> <p><i>Software</i></p> <ul style="list-style-type: none"> • 2D Object detection algorithm for a Jetson Nano using Yolov5 • 2D Semantic Segmentation for Intelligent Vehicles using Segmentron-CNN and ROS-1

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MECHANICAL ENGINEERING			
<p><u>Experimental, mechanics, calculations and transport (MECATRAN)</u></p> <hr/> <p>PI: Vicente Díaz</p>	<ul style="list-style-type: none"> • Industrial security and maintenance • Accident reconstruction • Intelligent vehicles • Transportation • Intelligent transport systems • Traffic engineering 	<p>National Projects</p> <ul style="list-style-type: none"> • GENESIS - Gender and Road Safety Systems - Analysis of the Impact of Gender Variables on the Response of Restraint Systems to Emergency Braking <p>Regional Projects</p> <ul style="list-style-type: none"> • ORIGEN: Opportunities for Reflection and Research on Gender in Road Safety (ORIGEN-CM-UC3M) <p>Private Funding</p> <ul style="list-style-type: none"> • Study of the behaviour of a kerb protection system to improve post-accident dynamics in the event of a vehicle leaving the road • FBRAKE desktop software for determining the braking efficiency of industrial vehicles at ITV la Sagra SL • Development of ITV equipment calibrations, metrological verifications of opacimeters and gas analysers, equipment verification between calibrations and development of internal technical audits 	<p>A group with extensive experience in a broad spectrum of disciplines related to Mechanical Engineering.</p> <p>Technological Offer</p> <ul style="list-style-type: none"> • The MECATRAN Group dominates the main commercial software and hardware tools related to dynamic simulation and virtual reality applied to the technological fields of Mechanical Engineering. <p>Patents</p> <ul style="list-style-type: none"> • System and method for evaluating a driving style <p>Equipment</p> <ul style="list-style-type: none"> • Group members are part of the Duque de Santomauro Institute for Motor Vehicle Safety, which has an ENAC (LABITV) accredited laboratory for calibrating measuring equipment at the ITV (technical vehicle inspection facility).

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
SYSTEMS ENGINEERING AND AUTOMATION			
<p><u>Robotics Laboratory (ROBOTICS LAB)</u></p> <hr/> <p>PI: Miguel A. Salichs, Carlos Balaguer, Luis Moreno</p>	<ul style="list-style-type: none"> • Environment-robot control interaction • Object recognition • Remote human-robot interaction • Topological and Semantic Navigation • Visual tracking & servoing 	<p>European Projects</p> <ul style="list-style-type: none"> • LABYRINTH: Unmanned traffic management 4d path planning technologies for drone. Swarm to enhance safety and security in transport • INformation Driven Incident RESponse • BADGER: RoBot for Autonomous unDerGround trenchless opERations, mapping and navigation • ROBO-SPECT: ROBotic System with Intelligent Vision and Control for Tunnel Structural INSPECTION and Evaluation <p>Private Funding</p> <ul style="list-style-type: none"> • SWARM: System for the aerial traffic control of unmanned devices for highly reliable and safe applications • Risk analysis for UAVS (SAFEDYP025) 	<p>A consolidated group with skills in system and process automation using advanced robotics technologies with a high degree of technological innovation. The team has a multidisciplinary structure, bringing together researchers with complementary knowledge and cultures ranging from process control to industrial automation, robotics, mechatronics, sensory processing, artificial intelligence and industrial computing.</p> <p>Group's Video</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
SYSTEMS ENGINEERING AND AUTOMATION			
<p><u>Intelligent Systems Laboratory (LSI)</u></p> <p>PI: Arturo de la Escalera, José María Armingol</p>	<ul style="list-style-type: none"> • Autonomous vehicles • Unmanned aerial vehicles • Driving assistance systems • Vehicle perception systems • 2D and 3D camera surveillance systems • Computer vision 	<p>National Projects</p> <ul style="list-style-type: none"> • HUManAID4AMI - Human-centred intelligent dynamic assistance systems for autonomous vehicles • System to ensure minimum risk conditions in the event of autonomous vehicle failures: Perception for situational awareness and environment simulation. - SAFE4CAR • Assistance system for safer urban driving <p>Regional Projects</p> <ul style="list-style-type: none"> • Vehicle safety for smart, sustainable, safe and inclusive mobility • SEGVAUTO-TRIES-CM. Safety of motor vehicles for smart, efficient and safe transport • Cooperation of high-capacity drones for fighting forest and urban fires <p>Private Funding</p> <ul style="list-style-type: none"> • Design and manufacture of an autonomous exploration and reconnaissance vehicle - UGV RECO • Development of predictive road maintenance systems 	<p>A group with more than 30 years of experience researching topics related to intelligent vehicles. During this time, various systems have been developed in the field of perception technologies and intelligent systems. The lines of research include machine vision systems, intelligent transport systems, autonomous driving systems, data fusion, and more.</p> <p>Currently, the laboratory has various research platforms, including autonomous electric vehicles, a smart car with ADAS, and several drones.</p> <p>Technological Offer</p> <ul style="list-style-type: none"> • Object detection using thermal imaging • Design of perception systems for security and surveillance activities • Autonomous guidance of unmanned aerial vehicles • Control systems for motorised variable focal length optics • Lane Departure Warning System • Traffic Sign Recognition System • Pedestrian Detection System • Variable Speed Control System • Driver Monitoring System • 3D environment monitoring

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SYSTEMS ENGINEERING AND AUTOMATION			
<p><u>Intelligent Systems Laboratory (LSI)</u></p> <hr/> <p>PI: Arturo de la Escalera, José María Armingol</p>			<p>Technical-Scientific Services</p> <ul style="list-style-type: none"> • Design and development of surveillance systems based on autonomous aerial and land vehicles • Design and development of perimeter security systems based on computer vision <p>Patents</p> <ul style="list-style-type: none"> • Unmanned railway vehicle, system and method for inspecting railway infrastructure and superstructure • System and method for estimating train approach and detecting rail breaks <p>Equipment</p> <ul style="list-style-type: none"> • Autonomous electric vehicles • Unmanned aerial vehicles • Intelligent road vehicle • Field bus communications systems (Profibus, Can Bus) • 3D cameras • Image analysis equipment <p>Related News</p> <ul style="list-style-type: none"> • A smart car by UC3M detects pedestrians at night

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
TELEMATIC ENGINEERING			
<p><u>ADSCOM</u> <u>(Advanced Switching and Communication Systems)</u></p> <p><u>(Subgroup of the NETWORK TECHNOLOGIES Group</u> <u>PI: Francisco Valera)</u></p> <hr/> <p><u>PI: David Larrabeiti</u></p>	<ul style="list-style-type: none"> • Legal digital interception • Use of big data techniques in malware detection and criminal activity detection • Internet of Things (IoT) security • Telematic tools for public safety and cyberterrorism • Security in critical infrastructure networks and systems • Deployment and design of emergency networks 	<p>European Projects</p> <ul style="list-style-type: none"> • PROTEUS-6G - Programmable reconfigurable optical Transport for Efficiently offering Unconstrained Services in 6G • TSAR: Testability-driven Security And pRivacy testing for Web Applications <p>National Projects</p> <ul style="list-style-type: none"> • New technologies for the sustainable development of 6G in extreme environments - Subproject 3 - 6G-Xtreme III: WITH-SAT - New technologies for the sustainable development of 6G in extreme environments with picosatellite and intelligent control technologies • ITACA - IoT for all through LEO satellite-based systems <p>Regional Projects</p> <ul style="list-style-type: none"> • TUCAN6-CM - Detection and communication technologies in 6G networks • Advanced Techniques for Enhancing the Intelligence of 5G Networks <p>Private Funding</p> <ul style="list-style-type: none"> • Cybersecurity configuration and auditing of a VPN system for IoT 	<p>Technological Offer</p> <ul style="list-style-type: none"> • Legal interception of communications supported by specialised hardware: deep packet inspection, traffic analysis and digital tapwire warrant. Digital forensics • Digital forensics of Internet traffic • Consulting, design and implementation of public key infrastructure (PKI). Electronic signature products and secure protocols based on digital certificates • User and identity management. Design of single sign-on mechanisms. Interoperability and identity federation • Mobility and device management. Privacy, interoperability, remote management, data synchronisation, remote deletion and reset, geolocation • Design and implementation of custom cryptographic and steganographic algorithms • Design and implementation of systems based on strong multi-factor authentication: token, biotoken, OTP, biometrics • Design, implementation and installation of ad-hoc mobile networks (MANET) for emergency scenarios • Design of landline-mobile wireless emergency network infrastructure. Secure multi-path ad-hoc routing in vehicular and pedestrian systems • Networks and applications for citizen collaboration in emergencies

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TELEMATIC ENGINEERING			
<p><u>ADSCOM</u> (Advanced Switching and Communication Systems)</p> <p>(Subgroup of the NETWORK TECHNOLOGIES Group PI: Francisco Valera)</p> <hr/> <p>PI: David Larrabeiti</p>		<ul style="list-style-type: none"> • Key distribution systems and federation of identity management systems in vehicular networks • Alternative reputation-based systems. • Adaptive security, securing and optimisation of complex networks • Machine learning in malware identification, IDS, IPS, etc. <p>Patents</p> <ul style="list-style-type: none"> • System and method for determining a user's emotional state 	

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
TELEMATIC ENGINEERING			
<p><u>NETCOM</u> <u>(Network and Communication Technologies)</u></p> <p><u>(Subgroup of the NETWORK TECHNOLOGIES Group</u> <u>PI: Francisco Valera)</u></p> <hr/> <p>PI: Arturo Azcorra</p>	<ul style="list-style-type: none"> • Network Architectures • Communication Protocols • Wireless and Mobile Networks • Peer-to-Peer Systems • Distributed Services 	<p>European Projects</p> <ul style="list-style-type: none"> • DESIRE6G: Deep Programmability and Secure Distributed Intelligence for Real-Time End-to-End 6G Networks • PREDICT 6G: PRogrammable AI-Enabled Deterministic neTworking for 6G • QUBIP: Transition to Post-Quantum Cryptography • PQREACT: Post Quantum Cryptography Framework for Energy Aware Contexts • QSNP - Quantum Secure Networks Partnership <p>National Projects</p> <ul style="list-style-type: none"> • Preservación de la privacidad de las redes multi-tenANT - Subproject 3 - 6G-RIEMANN-SI: pRIvacy prEserving Multi tenANt Networks - System Implementation • Preservación de la privacidad de las redes multi-tenANT - Subproject 3 - 6G-RIEMANN-SI: pRIvacy prEserving Multi tenANt Networks - System Implementation • Preservación de la privacidad de las redes multi-tenANT - Subproject 4 - 6G-RIEMANN-FR: pRIvacy prEserving Multi tenANt Networks - Framework <p style="text-align: right;">+</p>	<p>NETCOM works closely with the international research institute IMDEA Networks on various research projects and scientific activities. The two groups conduct complementary research in the areas of network architectures, communication protocols, wireless and mobile networks, peer-to-peer systems, and distributed services.</p> <p>Technological Offer</p> <p><i>Patents</i></p> <ul style="list-style-type: none"> • Method for supporting admission control and/or path selection in a communication network and communication network

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
TELEMATIC ENGINEERING			
<p><u>NETCOM</u> (<u>Network and Communication Technologies</u>)</p> <p>(<u>Subgroup of the NETWORK TECHNOLOGIES Group</u> <u>PI: Francisco Valera</u>)</p> <hr/> <p>PI: Arturo Azcorra</p>		<ul style="list-style-type: none"> • Data-driven next-generation networks (B5G and 6G) for sustainable manufacturing and emergency response - Subproject 1: 6G-DATADRIVEN-01: Dynamic and agile interconnection between NPN and PNs (for industrial environments) • Data-driven next-generation networks (B5G and 6G) for sustainable manufacturing and emergency response - Subproject 4 -6G-DATADRIVEN-04: Enhanced time sensitive, reliable and available (wireless) networks • New generation intelligent services in the cloud-edge continuum. PRITIA-CLOUD: Privacy, Transparency and AI-based Optimisation of efficient services for the new generation of the Cloud-Edge Continuum • Habilitando redes 6G determinísticas seguras con inteligencia artificial nativa para entornos hiperconectados. 6G-INSPIRE: Enabling native-AI secure deterministic 6G networks for hyper-connected environments 	

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
TELEMATIC ENGINEERING			
<p><u>Pervasive Computing Laboratory</u></p> <p><u>Laboratory of the Telematic Services and Applications Group (GAST)</u></p> <p><u>PI: Carlos Delgado Kloos, Carlos García Rubio, Andrés Marín López, Luis Sánchez Fernández</u></p> <hr/> <p>Laboratory Coordinators: Florina Almenarez, Celeste Campo, Daniel Díaz, Carlos García Rubio</p>	<ul style="list-style-type: none"> • CyberSecurity • Analysis • IoT/M2M • Prediction 	<p>National Projects</p> <ul style="list-style-type: none"> • DISCOVERY - DISCOVERY: Energy-Aware IoT Protocols and Security • QURSA – Quantum computing-resistant architectures and techniques: Post-quantum security • Improving confidentiality and privacy in communications protocols • I-SHAPER - Strengthening authentication, confidentiality, privacy and reliable access in Internet services <p>Regional Projects</p> <ul style="list-style-type: none"> • RAMONES-CM - Research in Advanced Monitoring and Optimisation for Next-gene post-quantum Encryption and cyberSecurity • Cybersecurity, Network Analysis and Monitoring for the Next Generation Internet <p>Private Funding</p> <ul style="list-style-type: none"> • QuantumCrip – Research into the ambivalence of quantum computing for solving optimisation and post-quantum encryption problems 	<p>The goal of researchers at the Pervasive Computing Laboratory (Perlab) is to contribute to the development of ubiquitous computing, helping in the adoption and integration of the growing variety of small, portable devices that are becoming part of our daily lives. Aligned with Mark Weiser's vision of the future of computing, they provide solutions in security, prediction, protocol, data analysis, IoT/M2M, and cybersecurity.</p> <p>Technological Offer</p> <ul style="list-style-type: none"> • Systems for managing identity, trust and reputation for distributed services. • Improvement and adaptation of specific cases of identity management in next-generation networks. Aggregation of profiles or accounts of third-party services to the network profile for use in accessing services. • Management and assessment of risks as part of the decision-making process affecting the level of security in open environments. • Development of middleware and drivers for interaction with devices and applications in smart cards for Windows Mobile Android (ADK) for authentication and signature purposes. • Secure management of user policies and profiles with trust-based access control schemes. • Flexible authorisation mechanisms with trust negotiation based on different authentication mechanisms, testing and capabilities. Anonymity and interaction with previously unknown devices in opportunistic interactions.

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
CONTINUOUS MEDIA MECHANICS AND STRUCTURE THEORY			
<p><u>Light Structures Dynamics</u></p> <hr/> <p>PI: David Varas, Jorge López Puente</p>	<ul style="list-style-type: none"> • Behaviour of metal structures under impact • Behaviour of structures made of composite materials under impact • Development of models of material behaviour at high deformation speeds • Analysis of the behaviour of ice under impact conditions • Behaviour of fuel tanks subjected to impact (HRAM) • Analysis of impacts of composite material fragments • Homogenisation in elastic conditions, for materials with anisotropic microstructure and elasticity 	<p>European Projects</p> <ul style="list-style-type: none"> • ELEMENT: CROR Engine debris Middle level Impact and Mechanical test • BEDYN: Development of a methodology (test, measurement, analysis) to characterise the BEhaviour of composite structures under DYNamic loading <p>National Projects</p> <ul style="list-style-type: none"> • Auxetic protections for high-speed impacts of deformable objects • Analysis and development of auxetic protections for carbon/epoxy structures • Mechanical behaviour of thermoplastic composite materials at high deformation speeds for storage. - H-FROST <p>Private Funding</p> <ul style="list-style-type: none"> • H2 High and Low Energy Impact Test Panels • NEOTAIL-Cien-Impact test campaign 22 • FUSSION / FFoT REAR FUSELAGE nonlinear stress activities 2024 • FUSELAGE 	<p>A group composed of researchers from different specialities, all focused on the field of structural behaviour under dynamic conditions. The group has developed various experimental methodologies for conducting complex high- and medium-speed impact tests. The group also has extensive experience in developing behavioural models for materials under high deformation speeds and in developing simple analytical models for modelling impact phenomena.</p> <p>Equipment</p> <ul style="list-style-type: none"> • Aeronautical Structures Impact Laboratory (ImpactLab)

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
CONTINUOUS MEDIA MECHANICS AND STRUCTURE THEORY			
<p><u>Dynamics and Fracture of Structural Elements</u></p> <p>PI: Ramón Zaera</p>	<ul style="list-style-type: none"> • Dynamic behaviour of structural elements: simulation and experimental analysis. • Structures for energy absorption • Impact problems on structural elements for aeronautical use • Constitutive models of materials at high deformation speeds • Fracture mechanics • Damage mechanics • Fracture testing under dynamic conditions • Metal matrix composite materials • Residual stresses in structural elements 	<p>European Projects</p> <ul style="list-style-type: none"> • BEDYN: Development of a methodology (test, measurement, analysis) to characterise the BEhaviour of composite structures under DYNamic loading <p>National Projects</p> <ul style="list-style-type: none"> • Study of the behaviour of structural elements made from biodegradable composite materials under low-speed impact • Development of lightweight, self-supporting, multi-laminate armour with a metal base reinforced with advanced fibres • ECOHELMET - Advanced helmet design using biodegradable materials, taking gender and age into account <p>Regional Projects</p> <ul style="list-style-type: none"> • Implementation of metamaterials in human hand protection systems <p>Private Funding</p> <ul style="list-style-type: none"> • Analysis of the ballistic behaviour of materials for UGV • Design and manufacture of advanced head and torso protection, taking into account biomechanical effects and gender perspective (PROTEC BIO GENE) 	<p>A group with extensive experience in providing innovative solutions in experimental, analytical and numerical analysis of mechanical behaviour, as well as in the adaptation of mechanical and structural components to service.</p> <p>They serve industry in fields that require knowledge of the mechanical properties of any type of material at different deformation speeds and temperatures, especially in dynamic conditions and under impact.</p> <p>Technological Offer</p> <p>Analysis of the behaviour of structural components. The group offers a highly qualified team and advanced technical support for:</p> <ul style="list-style-type: none"> • Analysing the mechanical behaviour of materials, under both static and dynamic conditions • Designing and calculating structural elements <p>Related News</p> <ul style="list-style-type: none"> • New launchers to analyse impact resistance and improve armour <p>Equipment</p> <ul style="list-style-type: none"> • Aeronautical Structures Impact Laboratory (ImpactLab) <p>Group's Video</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
CONTINUOUS MEDIA MECHANICS AND STRUCTURE THEORY			
<p><u>Advanced Materials Mechanics</u></p> <hr/> <p>PI: Enrique Barbero, Sonia Sánchez</p>	<ul style="list-style-type: none"> • Analysis and modelling of laminate and sandwich structures subjected to high- and low-speed impulse loads • Analysis and modelling of energy-absorbing structures made of composite materials • Study of the damage tolerance of structural elements made of composite materials subjected to different load conditions • Innovation and development of unconventional testing methodologies for structural elements subjected to impact loads, with special emphasis on damage tolerance assessment • Modelling and experimental analysis of the mechanical behaviour of composite materials under dynamic conditions 	<p>National Projects</p> <ul style="list-style-type: none"> • Response to impulse loads on sustainable sandwich structures under low-temperature conditions • Study of the behaviour of structural elements made from biodegradable composite materials under low-speed impact • Development of lightweight, self-supporting, multi-laminate armour with a metal base reinforced with advanced fibres <p>Regional Projects</p> <ul style="list-style-type: none"> • Optimisation of personal protection design through the use of numerical models <p>Private Funding</p> <ul style="list-style-type: none"> • Structural response of aeronautical RX antenna panel subjected to impact loads 	<p>A group focused on the analysis and modelling of structural elements made from composite and sandwich materials subjected to impulse loads, as well as on the study of their damage tolerance. The group has extensive experience in the development of unique testing methodologies.</p> <p>Equipment</p> <ul style="list-style-type: none"> • Mechanical Characterisation of Materials Laboratory (LabMec) • Aeronautical Structures Impact Laboratory (ImpactLab) <p><u>Group's Video</u></p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
CONTINUOUS MEDIA MECHANICS AND STRUCTURE THEORY			
<p><u>Nonlinear Solid Mechanics</u></p> <hr/> <p>PI: José Antonio Rodríguez</p>	<ul style="list-style-type: none"> • Buckling behaviour of beams with cracks and other defects • Experimental characterisation of the mechanical behaviour of metallic materials under wide deformation speed and temperature ranges, and for different stress states • Development, calibration and implementation in numerical codes of non-linear constitutive models to describe the mechanical behaviour of metallic materials • Experimental, analytical and numerical study of localisation, damage and ductile fracture processes in metallic materials subjected to complex loading states • Experimental and numerical study of dynamic perforation processes in metallic structures • Numerical analysis of vibrations in elastic structures 	<p>European Projects</p> <ul style="list-style-type: none"> • DIAGONAL - Ductility and Fracture Toughness analysis of functionally graded materials • PURPOSE: Opening a new route in solid mechanics: Printed Protective Structures • The mechanics and physics of dynamic localisation and fracture in heterogeneous ductile materials • QUANTIFY: Unravelling the role of anisotropy in material failure • OUTCOME: The outstanding challenge in solid mechanics: engineering structures subjected to extreme loading conditions (NETWORK-ITN) <p>National Projects</p> <ul style="list-style-type: none"> • An unresolved challenge in solid mechanics: engineering structures subjected to extreme load conditions • An unresolved challenge in solid mechanics: the effect of anisotropy and porosity on the mechanical strength and ductility of printed metals 	<p>Analytical and numerical models and software:</p> <ul style="list-style-type: none"> • Development of analytical and numerical models to predict the behaviour of materials • Development of routines to implement constitutive models that describe the behaviour of material structures in commercial finite element codes • Mechanical characterisation of materials to identify their behaviour under a wide variety of loading conditions <p>Flyer</p> <ul style="list-style-type: none"> • Technological innovation in solid mechanics in the transport and civil security industries <p><u>Group's Video</u></p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p><u>Microelectronic Design and Applications (DMA)</u></p> <p>PI: Luis Entrena, Luis Hernández</p>	<ul style="list-style-type: none"> • Hardware Security and Cryptography • Design with FPGAs and applications. Hardware Acceleration • Fault-Tolerant Circuits. Validation of fault tolerance through simulation and emulation • Design of mixed-signal CMOS integrated circuits for A/D and D/A conversion in sensors and communications • CMOS circuit design for impulsive neural networks • CAD tools for electronic design (EDA) • A/D and D/A conversion. Sigma-Delta modulation • Reconfigurable computing 	<p>European Projects</p> <ul style="list-style-type: none"> • TEVI: Time Encoded Voice Interfaces <p>National Projects</p> <ul style="list-style-type: none"> • High-reliability hardware modules for RISC-V • Edge computing based on temporal coding <p>Private Funding</p> <ul style="list-style-type: none"> • Vulnerabilities of quantum random number generation systems for post-quantum security and cryptography • Quantum random number generation systems for security and cryptography • Random number generator for cryptographic applications in ASIC • Research on online testing and statistical analysis of random number generators for CIFRA • Online detection and diagnosis for radiation-induced errors in COTS microprocessors • Development of PUF Architecture for FPGA • Sensor-based PUF identification system 	<p>Design of digital, analogue and mixed-signal electronic circuits, including both application-specific integrated circuits (ASICs) and circuits implemented using programmable hardware (FPGAs, SoCs).</p> <p>Technological Offer</p> <ul style="list-style-type: none"> • Conception, design and development of data converters • Complete design flow of the test integrated circuit or ASIC • Design and development of specific circuits for low power consumption and/or high scalability in different CMOS technologies • Electronic data acquisition systems for communications and sensing, with IP generation at the system and microelectronic levels • Hardware acceleration for biometrics and cryptography • TRNGs and lightweight cryptographic modules for RFID

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p><u>Photonic Displays and Applications (GDAF)</u></p> <p>PI: José Manuel Sánchez Pena, Carmen Vázquez</p> <p>-</p>	<ul style="list-style-type: none"> Advanced Instrumentation and Sensors: Development of advanced instrumentation, fibre optic sensors and their integration into WDM networks Photonic Devices for Optical Networks: Design and characterisation of integrated optical devices, radio over fibre, monitoring, passive optical networks Electronic drivers for tunable liquid crystal lenses Devices for characterising materials against customised UV-VIS_NIR radiation 	<p>National Projects</p> <ul style="list-style-type: none"> Hybrid metal-dielectric nanostructures for enhancing quantum light-matter interactions: towards single-photon sources -HyQuana New technologies for the sustainable development of 6G in extreme environments - Subproject 1 - 6G-Xtreme I: PoF - New technologies for the sustainable development of 6G in extreme environments with optical fibres and "Power over Fiber" technology Advanced intelligent technologies based on optical fibres Optical fibres for developing intelligent light power supply, green communications and sensing Advanced 5G and 6G ecosystems supported by remote power supply via optical fibre LC-LENS- Tunable liquid crystal lenses. <p>Regional Projects</p> <ul style="list-style-type: none"> TALENTO-CM Photovoltaic remote power supply via fibre optics with record conversion efficiency and data transmission speed Geolocation of users and medium-high speed resources using visible light and infrared SINFOTON2-CM. Sensors and Instrumentation in Photonic Technologies 2 <p style="text-align: right;">+</p>	<p>A group formed by a multidisciplinary team of experts in telecommunications, photonics and advanced electronic instrumentation with a long track record and recognition for providing solutions to the needs and problems posed by the industrial sector.</p> <p>They design and develop pre-industrial prototypes for applications in optical communications systems, home automation and assistive technologies.</p> <p>Technological Offer (Patents)</p> <ul style="list-style-type: none"> System and method for monitoring power and temperature in fibre optic networks Method and system for monitoring fibre optic networks Two-colour fibre optic pyrometer Self-referenced fibre optic sensor for liquid detection and/or liquid level measurement Fuel level measurement system for ultralight aircraft <p>Singular Infrastructure</p> <ul style="list-style-type: none"> Optical component analyser at 1300 and 1550 nm with RF carrier up to 110 GHz. Analysis of 5G-NR communications in radio-over-fibre systems, microwave photonics. Light power systems up to 30 W. <p>Group's Video</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p><u>Photonic Displays and Applications (GDAF)</u></p> <hr/> <p>PI: José Manuel Sánchez Pena, Carmen Vázquez</p>		<p>Private Funding</p> <ul style="list-style-type: none"> • Augmented reality in circuit verification tasks • Photonic solutions for Heel effectors • UMATERIAL, optical fibres in additive manufacturing • Using fibre optics to measure temperature during rock mechanics experiments • Characterisation of fire detection sensors using the SUNBOX solar simulator 	

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p>University Identification Technologies Group (GUTI)</p> <p>PI: Raúl Sánchez Reíllo</p>	<ul style="list-style-type: none"> • Mobility identification solutions (smartphones, tablets, netbooks, etc.) • Identification devices (particularly smart cards and RFID) • Security and cryptographic instruments (both secret and public key) • Biometric identification systems <ul style="list-style-type: none"> · Biometric modalities: iris, hand geometry, vascular systems, handwriting and fingerprints · Multibiometric: multimodal, multisensor, multi-algorithm. Both fusion and complementary. · Integration of biometrics into smart cards and tokens · Biometric protection: in processes, storage, communications, etc. • Evaluation methodology: both in performance and security 	<p>European Projects</p> <ul style="list-style-type: none"> • AMBER: enhAnced Mobile BiomEtRics • PYCSEL: PYroelectric Conformable SEnsor matrix for Large area applications in security and safety <p>Private Funding</p> <ul style="list-style-type: none"> • Representation on Standardisation Committees relating to Identification Technologies 2022/23 • Forensic analysis tools for biometric handwritten signatures • Authentication platform using multi-modal bio-signals and ITU-T international standards <p>Others</p> <ul style="list-style-type: none"> • Consultancy and technical assistance service through participation in standardisation committees related to identification technologies • Consultancy on the development of biometric evaluation methodologies and support for files • Consultancy and advice on digital identity wallets focused on the future EUDIW 	<p>A group formed by a team of experts in the identification of individuals in different environments (identification devices, information security, and biometrics).</p> <p>Technological Offer (Software)</p> <ul style="list-style-type: none"> • Handwritten signature authentication service using graphology • Handwritten signature toolbox • Forensic analysis tool for dynamic biometric signatures made with electronic devices • Automatic Remote Evaluation System (ARES) • Object-oriented biometric application development interface based on BioAPI (ISO/IEC 19784-1) and implemented in C# • Low-cost computational iris recognition library with fraud control • System for person recognition using the vascular structure of the wrist with homogeneous lighting • Multi-platform user authentication system for secure document printing • Biometric recognition engine for handwritten signatures with web service development support and security mechanisms • Iris recognition algorithm for border control systems

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p><u>University Identification Technologies Group (GUTI)</u></p> <hr/> <p>PI: Raúl Sánchez Reillo</p>			<p>Scientific-Technical Services</p> <ul style="list-style-type: none"> • Functional Evaluation of Identification Systems • Biometric • Smart cards • Security Evaluation according to Common Criteria • Development of Protection Profiles • Creation of Evaluation Methodology • Consulting, Development and Research in Identification Systems • National and International Standardisation

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p><u>Optoelectronics and Laser Technology (GOTL)</u></p> <p>PI: Guillermo Carpintero, Horacio Lamela</p>	<ul style="list-style-type: none"> • Photonic integrated circuits (PIC): Design and characterisation of photonic chips for generating radio frequency (RF) carriers in microwave, millimetre wave and terahertz ranges. • Optical domain RF signal processing (modulation, filtering, multiplexing, demultiplexing) for broadband wireless communications links in radio frequency and free space optics. • Integrated antenna arrays in the millimetre and terahertz ranges with photonic phase control for beam pointing. • Integrated photonic circuits for payloads on satellite platforms, with application in radiometer development. • Design and development of diode laser systems for the generation of high-power nanosecond pulses using high-power diode lasers (HPDL) and high-current short-pulse controllers. 	<p>European Projects</p> <ul style="list-style-type: none"> • PIXSpain CC - Photonic Chips Spain Competence Centre • TERA6G: TERAhertz integrated systems enabling 6G terabit-per-second ultra-massive MIMO wireless networks • SPRINTER: Low-coSt and energy-efficient hybrid Photonic integrated circuits for fiber-optic, free-space optical and mmWave communication systems supporting Time critical networking in industrial EnviRonments • POLYNICES: POLYmer based electro-optic PCB motherboard integration with Si3N4 Chipllets, InP Components and Electronic ICs enabling affordable photonic modules for THz Sensing and quantum computing applications • TERAOPTICS: Terahertz Photonics for Communications, Space, Security, Radio-Astronomy, and Material Science <p>National Projects</p> <ul style="list-style-type: none"> • New technologies for the sustainable development of 6G in extreme environments - Subproject 2 - 6G-Xtreme II: THz - New technologies for the sustainable development of 6G in extreme environments with THz technologies • Integrated Photonics for Microwaves: From Integrated Photonic Circuits to Systems through New Coupling Schemes for Wireless Communications Applications <p style="text-align: right;">+</p>	<p>A group with extensive experience in semiconductor laser-based systems and photonic instrumentation for applications ranging from wireless communication links to new biomedical imaging applications.</p> <p>GOTL's research into broadband wireless links has pioneered the use of photonic integrated circuits (PICs) for the generation of carrier frequencies in the millimetre and terahertz ranges. Its field of application is the development of broadband wireless communications links for next-generation mobile networks. They also address the use of microwave photonics techniques to enable network analysers to reach frequencies in the terahertz range.</p> <p>Singular Equipment</p> <ul style="list-style-type: none"> • ANRITSU MS4647B Vector Network Analyser (VNA) – from 0 to 110 GHz. Frequency extenders up to 1100 GHz and optoelectronic extension up to 110 GHz. • KEYSIGHT UXR0704BP Infiniium UXR Real-Time Oscilloscope, 70 GHz, 256 GSa/s, 4Ch • KEYSIGHT MXR608A Infiniium MXR Mixed Signal Oscilloscope, 6 GHz, 16 GSa/s, 8Ch • KEYSIGHT E8527D PSD M8199B Arbitrary Waveform Generator (100 Gb/s) • R&S FSW50 Electrical Spectrum Analyser (70 kHz to 50 GHz) with harmonic mixers: FS-Z75 (50 – 75 GHz), FS-Z110 (75–110 GHz) and FS-Z170 (110 – 170 GHz) <p style="text-align: right;">+</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p><u>Optoelectronics and Laser Technology (GOTL)</u></p> <hr/> <p>PI: Guillermo Carpintero, Horacio Lamela</p>		<p>Private Funding</p> <ul style="list-style-type: none"> • EO-DDL: Design of a photonic RF/optical unit for radio frequency signal transmission • ENLACE: High-performance free-space laser links for terrestrial and space communications on an integrated photonic platform • THORMUX: Photonic RF tuneable demultiplexer for broadband satellites 	<p>Technological Offer (Patents)</p> <ul style="list-style-type: none"> • Compact optical multiplexer and demultiplexer with a high number of channels • Ultra-wideband interconnection probes • Dielectric radio frequency (RF) bidirectional coupler with power divider/combiner functionality

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
SIGNAL THEORY AND COMMUNICATIONS			
<p>Communications</p> <hr/> <p>PI: Ana García Armada</p>	<ul style="list-style-type: none"> • Multi-antenna systems (MIMO) for broadband communications • OFDM multi-carrier modulation • Channel estimation, synchronisation and power peak reduction • Cooperative transmission and relays • Signal processing in digital communications • Coordinated transmission and interference cancellation in cellular systems • Communications system simulation and modelling 	<p>European Projects</p> <ul style="list-style-type: none"> • 6G-LEADER: Learning-Driven and Evolved Radio for 6G Communication Systems • MiFuture - ultra-massive MIMO for future cell-free heterogeneous networks • ISAC-NEWTON: Intelligent Sensing and Communication as Training Network for Perceptive Mobile Networks in 6G <p>National Projects</p> <ul style="list-style-type: none"> • SOFIA-AIR - Wireless Communications and Sensing through Flexible Designs using Intelligence and Algorithms (SOFIA) • PASSIONATE - Physics-based wireless AI providing scalability and efficiency • Experimental evaluation of physical layer techniques for 6G Vehicular Communications • Geolocation of users and medium-high speed resources using visible light and infrared • Wireless Communications in Security and Emergency Environments (CIES) <p>Regional Projects</p> <ul style="list-style-type: none"> • TUCAN6-CM - Detection and communication technologies in 6G networks <p>Private Funding</p> <ul style="list-style-type: none"> • Remote driving based on ultra-fast video coding and 5G communications 	<p>A group with extensive experience in the analysis, design and evaluation of landline and mobile communications systems, as well as in the development of signal processing techniques to improve their performance, which allows alternatives to be offered to optimise the applications and services supported by them.</p> <ul style="list-style-type: none"> • Multi-antenna systems (MIMO and Massive MIMO) • OFDM multi-carrier modulation and variants (for NB-IoT, 5G, etc.) • Signal analysis, detection and inhibition • Coordinated transmission and interference cancellation (small cells, etc.) • Random access mechanisms and radio resource management (IoT, multicast, broadcast, etc.) <p>The group works on the design and application of the above techniques in: wireless local/metropolitan area networks (WLAN, WMAN), next-generation mobile systems, satellite communications systems and visible light communications (VLC, LiFi).</p> <p>Technological Offer (Patents)</p> <ul style="list-style-type: none"> • Method, system and device for receiving multi-user optical transmissions • Method and device for inhibiting mobile telephony signals • Joint transmission method

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
SIGNAL THEORY AND COMMUNICATIONS			
<p><u>Radiofrequency, electromagnetism, microwaves and antennas (GREMA)</u></p> <hr/> <p>PI: Daniel Segovia</p>	<ul style="list-style-type: none"> Technologies for advanced communications applications: Antenna arrays and active antennas for BTS in 5G and 6G, development of extended broadband (UWB) MIMO antennas, antenna certification, broadband antennas for radio astronomy New radio technologies: quantum communications, SiGe-integrated antennas, photonic antennas and integration with microwave systems, new communications in automotive systems 	<p>Private Funding</p> <ul style="list-style-type: none"> Contract for technical services for the development of a 20-100 MHz band monitoring antenna with ferrite cards INDRA-UC3M Chair in radiofrequency technologies Obtaining graphic material for vehicle identification 	<ul style="list-style-type: none"> Antennas and RF Computational electromagnetics Terahertz <p>GREMA conducts extensive research in various electromagnetic fields, such as numerical methods with broad coverage of techniques ranging from rigorous methods such as FEM and MoM to high-frequency asymptotic techniques, research activities in THz focused on filling the so-called "THz gap" by obtaining more power emitted by photomixers and photodiodes and/ or increasing the sensitivity of detectors. From a general antenna perspective, GREMA's research activities focus on ultra-wideband topologies, both as isolated antennas and in array configurations, taking into account the critical effect of mutual coupling between elements.</p> <p>Technological Offer (Patents)</p> <ul style="list-style-type: none"> Multifrequency stacked antenna with metamaterial

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
SIGNAL THEORY AND COMMUNICATIONS			
<p><u>Audiovisual Intelligence</u></p> <hr/> <p>PI: Fernando Díaz de María</p>	<ul style="list-style-type: none"> • Automatic detection of traffic incidents using machine vision • Detection and tracking of vehicles to improve mobility and road safety • Automatic recognition of people, places or objects • Recognition of events in audio • Automatic tracking of people, places or objects • Classification, analysis and indexing of images/video • Recognition and tracking of objects in images/video • Video coding 	<p>National Projects</p> <ul style="list-style-type: none"> • Robust machine vision techniques and their application to intelligent transport systems for improving road safety, mobility and traffic management <p>Regional Projects</p> <ul style="list-style-type: none"> • IDEALCV-CM - Improved Deep Learning for Computer Vision <p>Private Funding</p> <ul style="list-style-type: none"> • Deep learning techniques for improving automatic gas leak detection from infrared images • Detection of cylindrical or edge landmarks for an automated road maintenance and conservation system • Obtaining graphic material for vehicle identification • Developments of machine vision algorithms for road safety and other applications 	<p>Voice, audio, image and video processing, specifically in automatic content extraction, speech and speaker recognition, as well as state-of-the-art video coding. The group has applied these methods in several research projects such as voice interfaces, voice transcription for subtitling, automatic image and video annotation, and high-definition video coding (HDTV).</p> <ul style="list-style-type: none"> • Tracking objects/people • Video analytics • Vehicle make and model recognition • Vehicle type classification (car, truck, motorcycle, etc.) • Automatic recognition of places, people or objects • Audio event recognition <p>Hardware Equipment</p> <ul style="list-style-type: none"> • Video acquisition and playback hardware. • Hardware for audio capture, processing, effects, storage, and playback. • Computing farm for HPC (High Performance Computing) with sustained computing power of 4.5 Tflops. <p>Software Media</p> <ul style="list-style-type: none"> • Software for automatic indexing of multimedia information. • Audio and video editors. • Simulation software for electroacoustics and room acoustics.

R&D GROUP

LINES OF RESEARCH

RESEARCH PROJECTS

EXPERIENCE AND CAPABILITIES

MATHEMATICS AND PHYSICS

PHYSICS

Sensors, Remote Detection and IR Imaging Laboratory (LIR) – InfraRed LAB

PI: Juan Meléndez

- Detection of hazardous gases
- Early detection of drone threats
- Rescue and surveillance operations in adverse conditions
- Detection of aircraft leaks
- Support in firefighting operations
- Characterisation of targets and backgrounds of military interest

European Projects

- [High Temperature Characterisation and Modelling of Thermoplastic Composites](#)

National Projects

- [MEMORy - Methane Emissions Monitoring and Reporting](#)

Private Funding

- [Monitoring, analysis and testing activities for the simulation of high temperature events on composite structure](#)
- [H2020s SME Instrument GaSeS project, SENSIA](#)
- [Spectral optimisation of uncooled vanadium oxide infrared detectors for remote methane detection for the InnoEnergy supported company Vira Gas Imaging S.L.](#)

Infrared technology is key in the field of Defence and Security and is in a process of continuous innovation.

The LIR-InfraRed LAB is an expert in optics and infrared technology. The group's scientific activity revolves around the study of the interaction of infrared light with matter, generating new principles of measurement and detection, specific processing, and quantitative theoretical and empirical analysis of radioactive phenomena.

Technological Offer

Gases

- Detection of the flame front through dense smoke using multispectral IR cameras to support firefighting efforts.
- Early detection of hazardous and explosive gases to protect people, buildings, and large events.
- Detection and localisation of gas leaks in critical industrial environments.

Early detection

- Unidentified drones and UAVs
- Remote detection to support rescue efforts in adverse conditions
- Radiometric characterisation of backgrounds for accurate target detection
- Border control

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
PHYSICS			
<p><u>Sensors, Remote Detection and IR Imaging Laboratory (LIR) – InfraRed LAB</u></p> <p>PI: Juan Meléndez</p>			<p><i>Aerial Safety</i></p> <ul style="list-style-type: none"> • Control of aircraft pressure systems • Control of aircraft fuel tank tightness <p>Scientific-Technical Services</p> <ul style="list-style-type: none"> • Design and development of IR technology-based technological solutions • Design and development of low-weight and -volume IR sensors for specific applications. <p>Equipment</p> <ul style="list-style-type: none"> • The LIR-Infrared LAB has the most advanced IR technology equipment in the country: capable of working in all IR bands. <p>Group's Video</p>

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
PHYSICS			
<p><u>QUEST: Quantum engineering, science and technology</u></p> <p>Manager: Jesús Iñarrea, Erik Torrontegui</p>	<ul style="list-style-type: none"> • Quantum technologies • Quantum control and sensing • Quantum computing • Open and multi-particle quantum systems 	<p>National Projects</p> <ul style="list-style-type: none"> • Optimising nanoscale quantum controls <p>Regional Projects</p> <ul style="list-style-type: none"> • Quantum Information Technologies Madrid <p>Private Funding</p> <ul style="list-style-type: none"> • Research into a new quantum sensing platform based on NV centres. Preliminary study of control strategies • Development of a high-precision predictive system in multivariable time series based on quantum machine learning algorithms • EPIQ University-Business Chair: Integrated electronic and photonic circuits for quantum technologies 	<p>A group at the forefront of knowledge in engineering, science and quantum technologies, ranging from basic science to the development of new applications, through experimentation and theoretical research into quantum systems. The high impact of its activities, combined with an extensive international network of collaborators, positions the QUEST group as a benchmark in the development of quantum technologies.</p>

R&D GROUP

LINES OF RESEARCH

RESEARCH PROJECTS

EXPERIENCE AND CAPABILITIES

SOCIAL SCIENCES

POLITICAL SCIENCE AND SOCIOLOGY DEPARTMENT

Political Analysis and Public Policy Management (Public Policy and Politics)

Manager: Antonio Natera

- Crisis management policy

European Projects

- [Developing an e-learning programme on good governance and anti-corruption](#)

National Projects

- [Culture of legality and fight against corruption](#)

Regional Projects

- [ON TRUST/CM. Inter-University Programme on the Culture of Legality - GIDYJ](#)
- [New paradigm for managing emergency transport services: ambulances](#)
- [Reactive security management in large-scale terrorist attacks: three approaches and an analysis of the management of 11-M](#)

A group with extensive experience in leading and developing competitive research projects on key issues and problems in contemporary political analysis. Over the last two decades, its members have also participated in various technical and political advisory projects in the field of applied political analysis and the management and evaluation of public policies and programmes.

LABORATORY	DESCRIPTION	SERVICES
LABORATORIES		
<p><u>Aeronautical Structures Impact Laboratory - ImpactLab</u></p> <p>PI: José Antonio Loya, Jorge López Puente</p>	<p>Laboratory formed by a team of qualified professionals with extensive experience in providing innovative solutions to industry, relating to the Mechanical Behaviour of Components and the Calculation of Structural Elements.</p> <p>It has facilities for performing mechanical tests (with specific experience in the field of dynamic and impact testing) across a wide range of deformation speeds and temperatures.</p> <p>The laboratory has 6 pneumatic launchers (of different calibres, from 7 mm to 500 mm) for performing high-speed impact tests (up to 1,000 m/s) in a wide range of energies (up to 300 kJ). In addition, it has extensive experience in modelling solid mechanics problems using proprietary tools and commercial numerical codes.</p>	<ul style="list-style-type: none"> • Safety and defence of mobile systems subjected to impact loads. • Experimental testing of high-speed impact on aeronautical structures (using ice, bird and metal fragment projectiles, etc.) • Analysis of the behaviour of aeronautical and aerospace structural elements under impact • Development of specific methodologies for studying damage tolerance under different load conditions in aeronautical and aerospace structures made of composite materials • Analysis and modelling of lightweight structures subjected to impact loads • Conducting energy absorption tests

LABORATORY	DESCRIPTION	SERVICES
RESEARCH INSTITUTES		
<p><u>Duque de Santomauro Institute for Motor Vehicle Safety</u></p> <hr/> <p>Director: Vicente Díaz</p>	<p>The Duque de Santomauro Institute for Vehicle Safety (ISVA) operates in different areas of the automotive and transport sector:</p> <ul style="list-style-type: none"> • Major modifications laboratory • Traffic accident reconstruction laboratory • Postgraduate courses and continuing education for professionals in the sector • Calculations and testing • Technical assistance to industry: services and consulting • R&D projects in the automotive sector, especially related to road safety • Scientific research published in international publications, doctoral theses and research articles 	<ul style="list-style-type: none"> • Influence of the human factor on driving (safety). • Study of different aspects related to the activity of Technical Vehicle Inspection (ITV) facilities. • Investigation and reconstruction of traffic accidents. • Development of intelligent systems and their application to vehicles, traffic control and access. • Application of communication technologies in motor vehicles. • Development and application of sensors for vehicles. • Analysis of the structural behaviour of the vehicle under static, dynamic or impact loads. • Dynamic testing of vehicles.

LABORATORY	DESCRIPTION	SERVICES
INSTITUTOS DE INVESTIGACIÓN		
<p><u>Institute of Policy and Governance</u></p> <p>Director: Álvaro Ribagorda</p>	<p>IPOLGOB's activities focus primarily on the study of transformations in social and political processes and democratic governance in the contemporary world, as well as, in an applied dimension, the analysis of new leadership and public policy management trends.</p> <p>One of the areas in which the Institute's teams have gained particular recognition is the analysis, management and evaluation of public policies (with a special focus on security policies).</p>	<p>Research</p> <ul style="list-style-type: none"> • Public policies on security and emergency management <p>Within the framework of this programme, research into public policies on security, policing models, risk governance and crisis management is promoted.</p> <p>Research Projects</p> <ul style="list-style-type: none"> • Comprehensive Port Security Management (GISPORT) • Study of models for the prevention, management and evaluation of environmental disasters in coastal areas • Study of non-public agents and the connectivity of means for the prevention, management and evaluation of environmental disasters <p>Postgraduate Education in Security</p> <ul style="list-style-type: none"> • Master's Course in Security Management • Advanced Course in Security Leadership • Advanced Course of Specialist in Local Citizen Security Management • Special Training Programme for Security Directors <p>Within the framework of these studies, truly innovative security plan models have been designed at an international level, with UC3M pioneering their design and leading the way in research in Spain.</p> <p>Awards and Recognitions</p> <ul style="list-style-type: none"> • SEGURITECNIA Award for training in safety (2000) • National Award for Safety and Emergencies in the field of Training, Euroseg (2006)

uc3m

Universidad **Carlos III** de Madrid

Vicerrectorado de Investigación y Transferencia

Servicio de Apoyo al Emprendimiento y la Innovación