Abstract

A system and method for monitoring a rapid de-excitation system for synchronous machines (1) with indirect excitation, via an exciter machine (2) and a rotating rectifier bridge (8), comprising:

- means for measuring the current (13) and voltage (14) of the stator (4) of the synchronous machine (1);
- means for measuring the excitation current (15) of the exciter machine (2);
- estimation means (24) for obtaining the estimated excitation current (19) of the exciter machine (2) from the current (16) and voltage (17) values measured in the stator (4) of the synchronous machine (1);
- a module (28) for comparing the measured excitation current Imed (18) with the estimated excitation current Iest (19), in such a way that:
  - there is either incorrect operation if Imed > k + A, where k and A are real numbers determined on the basis of each machine;
  - or else there is correct operation.

Conclusions

- HSBDS supervision has been into commercial operation in four 20 MVA / 40 MVA hydro generators since September 2013, without remarkable troubles.
- Patents
  - P2012231071
  - PCT/ES2013/000160
  - WO2014/009576 A1
  - USA 14412303
Abstract

Synchronous machines with brushless excitation have the disadvantage that the field winding is not accessible for the de-excitation of the machine. This means that, despite the proper operation of the protection system, the slow de-excitation time constant may produce severe damage in the event of an internal short circuit.

A high-speed brushless de-excitation system (HSBDS) for these machines was developed in our Laboratory. First a laboratory 5 kVA prototype and after the test in a 15000 kVA machine in Alstom factory (Bilbao), 4 Hydro generator are in service with this HSBDS.

P20090468 PCT/ES2010/000058

The invention relates to a rapid deexcitation system for synchronous machines (1) with indirect excitation by means of an excitation machine (2) and rotating rectifier bridge (8) comprising:
- a deexcitation impedance (10) connected between the field winding (5) of the synchronous machine (1) and the rotating rectifier bridge (8);
- a controller (9) connected in parallel with the deexcitation impedance (10);
- a control circuit (11) of the controller (9) configured to:
  • keep the controller (9) closed such that the rotating rectifier bridge (8) directly feeds the field winding (5) of the synchronous machine (1) during normal operation of the synchronous machine (1);
  • open the controller (9) such that the deexcitation impedance (10) remains in series with the field winding (5) and with the rotating rectifier bridge (8) when the synchronous machine is to be deexcited.

Conclusions

- HSBDS has been into commercial operation in four 20 MVA / 40 MVA hydro generators since September 2013, without remarkable troubles.
- The sudden short circuit tests in a 15 MVA show that the I2t can be reduced 10 times.
- Patents
  P20090468
  PCT/ES2010/000058
Abstract
The present biodegradation process consists in the use of a fungus, Paecilomyces lilacinus IMI 117109, for the degradation of commercial ground tyre rubber. Prior to the biodegradation treatment, the tyre crushing is washed to eliminate possible contaminations that may interfere with the process. Subsequently the fungus is cultured in the presence of the tyre rubber in a liquid medium and shaking conditions. In a second step, the excess of liquid medium is removed. After the incubation period, the growth of the fungus in the material can be observed and its degradation is showed. This process of fungal biodegradation is an alternative to the degradation processes currently employed, allowing to reduce the accumulation of used tyre rubber and taking advantage of the products of its biodegradation for its reuse in the tyre industry or its use in other industrial processes.

Overview
The latest official data indicate that in Spain more than 250,000 tonnes of used tyres are generated annually and it is estimated that there are approximately 4 million tonnes more accumulated in landfills. The current legislation requires the elimination of tyre dumps and the management of the waste by those responsible for placing it on the market. During the last years biodegradation processes applied to polluting materials have been developed with a view to the subsequent use and reuse of their components. The biodegradation of rubber is a matter of great interest because it could be a complementary path to the existing tyre management.

The process of vulcanization suffered by natural rubber in tyres is responsible for its desirable mechanical and thermal properties but, at the same time, it makes more complex to reuse them. This process forms disulfide bridges between the polymer chains. Further steps during the manufacture of the tyres involve the addition of multiple additives, required for vulcanization or the acquisition of various properties in the final product. Such additives are mostly toxic, introducing an additional problem to the biodegradation process.

In this patent a biodegradation process for commercial ground tyre rubber (Fig. 1) is described using the fungus Paecilomyces lilacinus IMI 117109. Fungal growth is an unmistakable sign of the biodegradation process that is taking place in tyre grinding (Fig. 2).

Description and main features of the invention
1) Minimal culture medium
In order to carry out the biodegradation of the commercial ground tyre rubber the fungus is cultivated in a liquid medium of mineral salts in which the tyre crushing constitutes the only source of carbon for the microorganism.

2) Material cleanliness
Prior to the incubation of the tire with the fungus, the grind is washed under certain conditions: ratio of crushed weight / volume of sterile water used, temperature, agitation and time. This washing removes the organic residues and microorganisms that could interfere or displace the biodegradation reaction.

3) Two-phase cultivation
The cultivation of the fungus with the ground tyres in the medium of mineral salts is carried out in two phases. In the first one an excess of liquid medium and agitation is used. This phase is necessary for the activation and correct distribution of the fungus in the material. In the second phase, the excess of liquid medium is removed, leaving a static solid-wet culture, in which the fungus continues growing on the crushed.

4) Possibility of using other microorganisms
This biodegradation process can be applied employing other microorganisms as long as they possess the metabolic capabilities for the degradation of the ground tyre, adapting the culture conditions to the particular physiology of the selected microorganism.

Patent information
Title: Procedimiento de biodegradación fúngica de triturado de neumáticos.
Inventors: Ruibal Villaseñor, Constantino; García Ruiz, Ana María; Moreno Gómez, Diego Alejandro; Benavides Ruiz, Enrique
Applicant: Universidad Politécnica de Madrid
Publication number: ES 2 293 864 (A1) (B2)
CPC: C08J11/10; C12N1/14; Y02W30/702
Application number: 200703236
IPC: C08J11/10; C12N1/14
Priority date: 2007-12-05
Abstract

A completely innovative bioremediation procedure has been invented to concentrate and eliminate radionuclides from the radioactive water of nuclear pools. This method is based on the capacity of microorganisms to retain radionuclides when they are growing by forming biofilms on the colonized surfaces. Preferably the bioremediation is performed before the water is passed through demineralizing filters to prolong the life of such filters. As a result, there is less radioactive waste to be managed, thereby increasing the profitability of the method.

Main features of the invention

Currently the radioactive water of the nuclear pools is treated with a system of demineralising filters made from ion-exchange resins whose goal is to retain the dissolved substances and those in suspension that can be found in the water, such fission and corrosion products, etc., so that the water is much clearer and the radioactivity in the area surrounding the pools is significantly lower. As time passes, the life expectancy of the resins is lowered and it is necessary to store them in drums and to treat them as radioactive waste. The new bioremediation procedure, however, retains the nucleotides found in the radioactive water before they reach the resin of the demineralising filters, and as a result, increase their life expectancy, thus reducing the volume of radioactive material to be managed.

In this patented procedure, the radioactive water from the nuclear pools under treatment, goes through a bioreactor (Figures 1 and 2) that contains a metallic material, such as titanium or stainless steel, wound into a ball, or any other material that is non-corrosive or non-degradable in this environment and can be colonised by the microorganisms that exist in this type of water. As it goes through the bioreactor, the radioactive water to be treated comes into contact with the material of the ball placed inside, thus forming a biofilm (Figures 3, 4, and 5) that retains the radionuclides. The water then goes out from the opposite end of the continuous-flow entrance and, before going back into the pool, it goes through a system of demineralising filters.

Biofilms developed on the balls were analyzed by scanning electron microscopy and epifluorescence microscopy. DNA was extracted from the biofilms, was cloned and the microorganisms were identified by sequencing. The identified radioresistant organisms belong to the phylogenetic groups *Alpha-proteobacteria, Gamma-proteobacteria, Actinobacteria, Deinococcus-Thermus* and *Bacteroidetes*. These microorganisms are capable of retaining the radioisotopes present in the water of the pools by one or more of the following mechanisms: bioadsorption, bioabsorption, bioaccumulation, biosolubility, bioprecipitation.

By gamma spectrometry we also determined that biofilms have essentially retained activation radionuclides. Sometimes the sum of Co-60 and Mn-54 reached 98%. Cr-51, Co-58, Fe-59 Zn-65 and Zr-95 have also been retained by the developed biofilms.

It has been assessed that the scalable process can be economically profitable.

**TECHNOLOGICAL SECTOR TO WHICH THE INVENTION RELATES**

Nuclear power industry and management of radioactive water
**Abstract**

A portable device for collecting airborne particles with autonomous operation, comprising a container (1) having an inlet (2) of air from outside into the container (1), and an outlet (3) of air from inside the container (1) to the outside; so that between the inlet (2) and outlet (3) of air, the container (1) comprises, inside, a first module (7) for capturing airborne particles, which in turn comprises: a first means of filtering (4) for the air, allowing the passage of air and particles smaller than the pore size; and a first receptacle comprising, in turn, a first plate (5) covered with a tacky substance or other adhesive surface on its anterior major surface and configured to collect, at least, part of the particles present in the air (Fig. 1).

**Overview**

In addition to gases and inorganic particles, the air carries many biological particles such as pollen, fungi, bacteria and viruses. Some can trigger allergy symptoms in the population and be also the cause of airborne disease transmission like the flu, pneumonia and legionellosis. Crops and farm productivity are also affected by these airborne organisms, causing an important economic impact. The monitoring and detection of all this biological diversity in the air outdoor is a difficult task because of their particular characteristics regarding size, relative abundance, residence time in the atmosphere... Hence, the different biological particles are usually studied independently.

To solve these troubles, we have developed an equipment attachable to any kind of vehicle to collect all the biological particles present in the air (sorting by size if desired), and keeping the sample intact for further biochemical detection (e.g. DNA sequencing) or identification by microscopy.

**Main features of the invention**

1) **Autonomy and simplicity**

Collection is performed passively, promoted by the advance of the vehicle, forcing the air to pass through the equipment. The particles are harvested and retained inside the device on an adhesive surface. Therefore, electric power is not required and the operating time is unlimited.

2) **Modular structure**

The filtering (4) and collection (5) components have a modular organization (7), so it is possible to add or remove modules in order to increase the collection surface or select different size for the particles to harvest in each module (Fig. 2).

3) **Reusable: brand-new**

The prototype is made of metal and glass to be cleaned easily and sterilized in the autoclave, so the components can be used over and over to collect fresh samples.

4) **Built to be linked to any vehicle**

The cylindrical design, small size and light weight make it simple to attach to many platforms and different means of transport such as cars, buses, airplanes, UAVs, ships... (Fig. 3), increasing the options of collection times and the places where the air samples can be taken.

5) **Upgradable**

Additional features like lids to control the collection, a flow-meter coupled with a dataLOGGER to monitor the volume of air sampled, the use of disposable collection receptacles... can be easily integrated in the equipment to improve its performance.

**Patent information**

Title: Dispositivo captador de partículas presentes en el aire de carácter portátil y autónomo.

Inventors: Núñez Hernández, Andrés, Ana Maria García Ruiz, Diego Alejandro Moreno Gómez

Applicant: Universidad Politécnica de Madrid

Publication number: ES2558792

Application number: ES20150031836

IPC: B01D45/04; G01N1/22

CPC: B01D45/04; G01N1/22

Priority date: 2015-12-18
Abstract

It permits marking or recording motifs (301) on surfaces whereon there has been deposited previously a fluorescent polymer layer (300) through a procedure of plasma polymerisation (100) of molecules of a colourant. The procedure combines the special characteristics of the polymer layers making them suitable for being capable of recording diverse motifs (301) thereon, and the possibility of recording by laser (101) or other techniques. Among such characteristics should be mentioned the possibility of a notable visual effect, including for thicknesses of 100 nm, the use of layers non-observable when illuminated with visible light, the high optical quality (transparency) thereof, or the facility wherewith they may be processed by subsequent treatments, including diverse laser treatments.
Abstract

The Interferometric Detection Method is characterized by the use of two interferometric signals, which allows for the optical reading system to convert the changes caused by the optical transduction into a unique, sensitive variable of detection. Therefore, two interferometric measurements are used: a first interferometric optical reference, which represents the measured intensity modulated by a reference interferometer; and a second interferometric signal measurement observed in the sensing region of the signal interferometer. The sensing surface region is where changes caused by the biomolecular interaction takes place. A transduction function $f_{\text{TRANS}}$ is then constructed from the interferometric measurements, and analyzed to determine the biosensing response caused by the biological accumulation in the sensing observation region.

Theoretical calculation of the reflectivity as a function of the wavenumber and wavelength for the reference interferometer and for the signal interferometer. It is also represented the optical interrogation band, which is the spectral range from 808 nm to 864 nm used to obtain the optical power for both interferometers. The capital letters: A, B and C; represent three different situations. A is the area defined by the optical interrogation band and the interferometric profile of the Fabry-Perot Interferometer (FPI) used as reference. This area is, therefore, proportional to the optical power of the reference interferometer. C and B represent two different situations. C is the area defined by the optical interrogation band and the interferometric profile of the signal FPI when the biofilm thickness is 0 nm. B represents the area defined by the signal interferometer and the optical interrogation band for a biofilm thickness of 40 nm. As a conclusion, when the biofilm thickness is increased, the spectrometry profile of the signal FPI is closer to the reference FPI, producing a lower level of IROP signal.

Implementation to Point of Care (PoC) devices

Applications
Abstract
The patent describes and optical detection system for labelling-free high-sensitivity bioassays, which comprises the use of optical characterization techniques that allow vertical interrogation in micrometric and sub-micrometric domains and also at least one vertical-interrogation biophotonic interferometric or resonant cell. The system comprises, at least: (i) an optical measuring system that comprises one excitation source, for the detection of the signal and an optical head; and (ii) an element for the integration of multiple analytes, comprising, in turn, and at least, a plurality of biosensitive cells, a plurality of fluid connections connected with the cells, and a substrate on with not only the biosensitive cells but also the fluid connections. The system is designed to perform label-free high sensitivity bioassays, with sensing chips fabricated at wafer scale.

Description of the patent
The system consists of an optical interrogation system (optical head with a detector) and a variety of optofluidic sensing cells. The optical head interrogates vertically the optofluidic sensing cell and obtains three different optical responses in a single measurement: ellipsometry, reflectivity as a function of the angle of incidence, and reflectivity as a function of wavelength.

The optical information is taken using a single measurement, and can be combined and processed. This is interesting in particular for bioassays, because can reduce the uncertainty of the detection.

Sensing cell: arrays of Resonant pillars
The optical head allows measuring in sub-micrometric domains, even covering a single pillar. The calculated optical responses are for pillars of 500 nm, with two reflectors of Silicon Nitride, and a central cavity of Silicon dioxide. The bioreceptors cover all the surface of the pillars, enhancing sensitivity.

Sensing cell: Fabry-Perot Cavities
This sensing cell is designed to obtain a narrow resonance in order to increase the sensitivity of the measurement. The cell consist of a Fabry-Perot cavity, with two Bragg Reflectors, of Silicon and Silicon Dioxide, and a central cavity filled with fluid, where the biorecognition takes place. Values of limit of detection for refractive index sensing are in the order of $10^{-5}$.

Application number of the patent: EP2009081139.
European Patent approved
Method and system for estimating the forces and torques generated by the contact of a tire with the road in an instrumented wheel

Javier García De Jalón De La Fuente, María Dolores Gutiérrez López
(javier.garciadejalon@upm.es)

Abstract

The invention relates to a method for measuring the forces and the moments generated by the tire-road contact from the combination of unit deformation or strain signals measured in different angular and radial positions of the wheel. The angular positions in which the sensors are placed are those permitted by the geometry of the tire. The combination of deformation signals results in six or more signals that are independent of the angular position of the measuring sensors with respect to the tire-road contact point. The effect of temperature and loads that generate deformation signals that do not depend on said angular position of the measuring points, such as centrifugal forces, have been eliminated from the aforementioned signals. Said signals provide estimates of the loads by means of the resolution of two systems of linear equations with constant matrices and three unknowns each.

Theory

• The method proposed is based on bonding strain gauges to the rim and on using harmonic elimination techniques. The strain gauges are arranged in concentric circumferences (at least two) and in angularly equidistant radial lines (at least five).

Strain gauges & amplifier boards

• Strain gauges are sensors which can measure deformations, pressures and torques. These sensors have a resistance whose value changes when a deformation occurs. As a consequence, the value of the current changes.

Telemetry

• The current system is based on the WiFi technology. Every signal is broadcaster by wireless. The system is composed by three elements depicted in Fig.

Competitive Advantages of the Solution

• Provides real-time information to dynamic control systems, improving them.
• Price far less than competition that can make it viable to a wider spectrum of researchers and companies.
• Adaptability to a wide range of rims.
Medical devices based on intelligent materials and complex geometries patented and developed during last decade within UPM’s Product Development Laboratory

Abstract
The Product Development Laboratory (Laboratorio de Desarrollo de Productos) at ETSI Industriales, is the first “fab-lab” from Universidad Politécnica de Madrid. It was founded in 1997 by Prof. Pilar Lafont Morgado and has been running for 20 years providing support to research projects, teaching activities and industrial innovation tasks in all aspects linked to the development cycle of innovative products. Aspects including creativity promotion, intellectual property management, conceptual design, computer-aided technologies for product engineering and rapid prototyping usually by means of additive manufacturing technologies (3D printing) are key areas of expertise of the UPM’s Product Development Lab. Engineering applications in fields including energy, transport, space and health benefit from the combination of the advanced design and manufacturing technologies available and from the expert advice of Lab’s members.

Among the most interesting engineering fields, to which the Lab has been devoted during the last decade, it is important to highlight the Biomedical Engineering area. As human geometries are complex and as human materials are “intelligent” or multifunctional, additive manufacturing technologies capable of manufacturing very complex geometries are specially well suited to manufacturing devices for interacting with humans. The design, modeling and incorporation of “smart”, “intelligent” or multifunctional materials to such devices helps to enhance the diagnostic and therapeutic capabilities of such biomedical devices. In addition, the design using complex fractal-based geometries helps to promote biomimicry and biomimetic approaches towards improved performance. This poster presents some of the more remarkable patents of our group in the field of Biomedical Engineering, linked to biomedical devices for improved diagnoses and enhanced therapies, which take benefit from the combined use of bioinspired geometries and of smart materials and structures.

Diagnostic devices based on intelligent materials for improved diagnoses
Complete development of an instrumented splint for monitoring bruxism based on piezoelectric & piezoresistive smart materials with near field communication for e-Health approaches

Bruxism is a pathology consisting of the involuntary clenching of teeth, with impact on facial pain and increased teeth wear. Adequately monitoring bruxism constitutes a challenges towards improved control of patients’ evolution. Our device is based on smart sensors included within conventional splints for quantitative multi-axial measurements.


Active prostheses based on shape-memory materials for adaptative purposes
Complete development of an anuloplasty ring using shape-memory polymers for geometrical adjustment after implantation towards enhanced surgical prognosis

Mitral valve insufficiency can be treated with the help of passive anuloplasty rings, which provide mechanical support to the prolapsed tissue. However, surgery with conventional passive rings can be risky and devices for post-surgical adjustment of rings’ geometries are a key towards improved prognosis. Our device pursues such challenge.


Bioinspired tissue engineering scaffolds and culture platforms for studying cells
Fractal-based micro-textured and micro-structured

Based on biomimetic fractal geometries, which cannot be obtained using traditional design and manufacturing approaches, our tissue engineering scaffolds and cell culture platforms can activate special responses, helping to control mesenchymal stem cells’ fate.

Patents:
Abstract
The invention describes a tractor truck for tableting machine, of the type having an upper filling end by which a particulate material for compressed in a matrix of the compression machine and a lower discharge end of said particulate material to said matrix is introduced. At least part of the constituent elements of said carriage feeder can move relative to one another, thereby allowing to modify the geometry of at least one of said lower discharge end, said upper filling end and an intermediate portion of the carriage feeder between both ends. The invention also discloses the use of a tractor truck of this type, comprising the initial steps of determining the optimum geometry for a particulate carriage to be compressed and to apply this optimum geometry carriage to carriage feeder.

FEEDING CARRIAGE FOR COMPRESSOR MACHINE AND USE OF SAME
Publication number: 20160114549

Focus
- To improve the effectiveness of dosage when mixture ratios are strict.
- To develop a method making possible to estimate the best geometry for the feeding carriage.
- To extend the patent to Japan and USA (triadic patent).

![Graph showing percentage of ingredient I2 over number of tablets](image)

---

** ordinere, j., alba-elías f., gonzález marcos a., martínez l.

a etsii / upm (j.ordinere@upm.es)
b etsii / unirioja ((fernando.alba, ana.gonzalez, laura.martinez}@unirioja.es)
Abstract

The present invention allows increasing the net electric power supplied to the network by the solar thermal power plants of the cylindrical parabolic collector type by using the solar field in a more efficient manner, generating steam to drive the main ancillaries by means of steam turbines (turbo pumps), reducing electric consumption of the ancillary services and therefore increasing the net electric power of the plant.

On days when the solar radiation is greater than the designed radiation, part of the solar field must stop being used since the generator and the turbine would exceed its designated power. The present system proposes harnessing the unused portion of the solar field for generating steam to drive the main ancillaries of the plant, energy which would otherwise not be harnessed.

In addition, the overall operating performance of the ancillary service pumps is better when using steam to drive the pumps through a steam turbine (turbo pumps) instead of driving them with electric motors (motor pumps).

(1) Solar collectors
(2) Auxiliary burner of natural gas or another fuel.
(3) Steam generator. Thermo fluid heat and steam exchanger.
(4) Thermo fluid pump.
(5) Thermo fluid regulating valves.
(6) Main steam turbine
(7) Electric generator
(8) Condenser.
(9) Water supply pump supplying water to the steam generator.
(10) Main transformer
(11) Electric network
(12) Ancillary service transformer
(13) Steam turbine to drive the thermo fluid pump
(14) Steam turbine to drive the water supply pump supplying water to the steam generator
Abstract

The European Research & Innovation Office at UPM aims at giving support to UPM researchers to participate in the European research programs in order to increase the quantity and quality of European funded projects in which UPM participates.

The goal to be achieved by the European Office can be described as follows:

• to increase the weight of UPM participation in EU funded projects in terms of projects coordination.
• to facilitate first participations of newcomer researchers.
• to facilitate the collaboration of UPM researchers with the private sector.
• to increase the visibility of UPM at European Associations and Technology Platforms.

Services provided

For UPM researchers

- **Pre-award**
  - POSITIONING
  - PROPOSALS PREPARATION
  - TRAINING
  - COLLABORATION SCOUTING

- Support to the UPM researchers in their proposal preparation phase (completing consortia, revising the proposals, pre-checking with EC and NCPs the proposal ideas, etc.).
- Organization of H2020 information seminars, Post-doctorate course for European Project Managers, information and advice to interested researchers.
- Contact with relevant European projects participants to look for collaboration opportunities.

- **Post-award**
  - COST REPORTING
  - CONTRACT PREPARATION
  - TRAINING
  - AUDITING

- Contract negotiation and forms filling
- IPR issues
- Consortium Agreements
- Cost claims and audits
- Relation with the EU

For other organizations

It represents a single point of contact for partners searching for a specific technological capacity within the University.

Networks

- EIT Digital
- EIT Health
- EIT RawMaterials
Abstract
El objetivo de la Unidad de Cátedras Universidad-Empresa de la OTRI es promover la colaboración estable entre la Universidad y el tejido empresarial a través de un modelo concreto, las Cátedras.

¿Qué es una Cátedra Universidad-Empresa UPM?
Es un convenio que formaliza y hace pública la colaboración a largo plazo entre la universidad y una empresa para la realización de actividades diversas alineadas con los fines generales de la UPM en un área temática concreta.

¿Qué beneficios ofrece?

- Acceso directo a los recursos humanos y a determinadas infraestructuras de la Universidad
- Apoyo a diferentes actuaciones dentro de ámbitos temáticos de su interés mediante:
  - Programas de becas para la realización de proyectos fin de grado o de máster
  - Trabajos de investigación
  - Promoción de jornadas de divulgación
- Relación con empresas de primer nivel
- Marco de financiación estable para la realización de actividades:
  - Cooperación en programas de formación
  - Patrocinio de actividades de difusión
  - Realización de estudios e investigaciones
  - Otras actividades enmarcadas en los objetivos planteados

¿Qué actividades realizan?

**ACTIVIDADES DE FORMACIÓN**
Programas de postgrado, becas, premios a proyectos fin de carrera, conferencias...

**ACTIVIDADES DE DIFUSIÓN**
Jornadas de divulgación técnica y tecnológica, publicaciones...

**ACTIVIDADES DE I+D**
Promoción de líneas de investigación, apoyo a la realización de tesis doctorales...

¿Qué duración tienen?
La duración mínima de una Cátedra es de 3 años.

¿Cuál es la financiación mínima?
Se establece un mínimo de 30.000 € anuales.

Cátedras UPM por centros

+ 70 Cátedras Universidad-Empresa en la UPM

Cátedras Universidad-Empresa en la ETSI Industriales

Abstract
La Unidad de Colaboración Público Privada de la OTRI nace con el objetivo de servir de instrumento de dinamización, apoyo y promoción de la transferencia del conocimiento generado en la UPM al sector productivo.

¿Qué servicios presta?
- Gestión directa de convocatorias de ayudas a la Innovación, difusión, apoyo a la presentación de propuestas, tramitación de solicitudes, alta de los proyectos concedidos, seguimiento de proyectos activos, apoyo en la justificación de las ayudas.
- Asesoramiento en la negociación, elaboración y tramitación administrativa de contratos, convenios y otros acuerdos relacionados con actividades de investigación e innovación.
- Promoción a través de la búsqueda de financiación para el desarrollo de proyectos de I+D+i en colaboración con empresas y otros agentes, así como la difusión de convocatorias públicas y privadas de ayudas a la I+D+i.
- Formación de investigadores en los procesos de búsqueda de financiación, presentación de propuestas, gestión y justificación de ayudas públicas.
- Documentación, elaboración modelos de Contratos / Convenios / Acuerdos / documentación administrativa.

Nuestra Visión
Ser un instrumento útil para el impulso del Triángulo del Conocimiento, facilitando la colaboración entre la Universidad y la Empresa en la generación de conocimiento, en su desarrollo y en la innovación, que permita introducir en el mercado nuevos productos y servicios generando riqueza y bienestar en nuestra sociedad.

¿Dónde debo dirigirme?
Unidad de Colaboración Público–Privada
http://www.upm.es/Investigacion/Apoyo/OTRI
juan.sanz@upm.es
Abstract

El objetivo de la Unidad de Propiedad Industrial e Intelectual de la OTRI es proteger los resultados de la investigación que tengan una componente técnica utilizando los mecanismos adecuados con el fin de tener tecnologías listas para ser transferidas.

¿Qué es la propiedad intelectual (PI)?

Es un concepto legal para proteger las creaciones de la mente humana que otorga el derecho a su titular a impedir a terceros la utilización sin su consentimiento. Se divide en dos categorías:

- **Derechos de autor**: Obras literarias y artísticas: libros, música, teatro, pintura, fotografía...
- **Propiedad industrial**: Patentes, Modelos de utilidad, Diseños industriales, Marcas

¿Por qué son importantes las patentes para los investigadores?

- Porque es una valiosa fuente de información que permite: comprobar si una invención es novedosa, evitar infringen los derechos de terceros, conocer la tecnología existente y utilizarla como base para la investigación.
- Porque permite proteger los resultados de la investigación y rentabilizarlos mediante la explotación propia (creación de una spin-off) o licencia a terceros.

¿Puedo patentar un programa de ordenador?

- Un programa de ordenador reivindicado como tal no es una invención patentable. En cambio, sí pueden concederse patentes para invenciones implementadas en ordenador que resuelvan un problema técnico de forma inventiva.
- El código fuente y el ejecutable del programa son objeto de derechos de autor y pueden inscribirse en el Registro de la Propiedad Intelectual.

¿Qué debo hacer cuando creo tener una invención patentable?

- **Evitar la divulgación** antes de la solicitud de patente que anule la novedad: conferencias, congresos, tesis, trabajos fin de carrera, artículos, etc.
- **Buscar el estado de la técnica anterior**
- **Buscar asesoramiento en la OTRI**

La PI de la UPM en cifras

Top 10 Universidades Públicas solicitantes de patentes (2005-2014)

- UPM
- UPF
- U. Sevilla
- UPV
- USC
- UGR
- UAM
- UCM
- UMA
- U. Vigo

+ 520 patentes prioritarias activas
+ 190 programas de ordenador registrados

Fuente: OEPM

Abstract
En la Unidad de Cultura Científica (UCC) trabajamos para difundir la investigación UPM a la sociedad. Nuestro objetivo es acercar la ciencia, la tecnología y el trabajo de los investigadores a la ciudadanía para, entre otras cosas, incrementar su impacto.

Comunicación: elaboración de noticias, audiovisuales, fichas divulgativas... sobre investigación UPM.

Divulgación: organización de eventos de ciencia con interacción directa entre investigadores y público.

Investigación y promoción: organización de cursos, convocatoria de premios y proyectos de divulgación científica.

En la UCC os ayudamos a difundir vuestra investigación
**INSIA-UPM:** INSIA, the University Institute of Automobile Research is a Centre belonging to Technical University of Madrid (UPM), part of the Higher School of Industrial Engineers, and is integrated into the UPM’s scientific and technological park. The INSIA is a reference point for the automotive industry and the transport sector and has over 25 years of experience at national and international levels. The main activities of the Institute are focused on Research and Development in the field of motor vehicles, safety and environmental impact for national and international projects. INSIA also offers technological support for companies and public bodies. INSIA provides technological services oriented to R+D, advising, testing, and certification. The Institute also runs Masters degree and Ph.d degree programs.

**Research Areas**
- Accidentology
- Biomechanics
- Passenger and goods Transports Safety
- Alternative propulsion systems
- ADAS
- Transport Studies
- Computational Mechanics

**Technology Services**

**Training**
Our goal is to satisfy the training needs of managerial staff in companies in the Automobile Sector, the needs of new graduates aspiring to work in sector companies and the needs of employees and researchers in the INSIA itself. Master’s in Automotive Engineering, Master’s in Hybrid and Electric Vehicle Engineering, Master’s Degree in Energy Efficiency in Building, Industry and Transportation, Formula Student, Specialised Courses.
GIVET group is made up of 70 people including researchers, technical staff, management staff and research personnel in training, who have been working for 25 years in R+D+i activities related to the traffic accidents and vehicles safety, automobile industry, transportation sector and more recently to the transportation environmental impact. An important part of our research staff is mainly affiliated with ETSI Industriales and INSIA. We develop our activities in INSIA-UPM, a reference center for the automotive industry and the transport sector at national and European level. The research staff represents Spain at the United Nations in various working groups and is integrated in several European networks of excellence such as ECTRI (European Conference of Transport Research Institutes). At the national level, it is part of the M2F platform (Move to Future) and Madrid Automotive Cluster.

**Research Areas**

**Accidentology**

**Biomechanics**
- Impact biomechanics applied to the improvement of passive safety of vehicles.

**Passenger Transport Safety**
- Passenger transports safety. Vehicles occupant protection systems and mobility of PRMS

**Goods Transport Passive Safety**
- Goods Transports Passive Safety Improvement. Vehicles and Protection Systems

**Transport Studies**
- Assessing and predicting the impact of road transport on safety and environment.

**ADAS**
- Intelligent Transport Systems and Driver Assistance Systems

**Alternative propulsion systems**
- Alternative propulsion systems and environmental impact of motor vehicles.

**Computational Mechanics**
- Computational mechanics applied to the research of the dynamic behavior of vehicles
Reproducing Astrophysical phenomena at laboratory scale.

Laser precipitation produces strong Radiative Shock Waves bringing matter to High Energy Density states equivalent to astrophysical objects. 


---

Adhesion of nanostructure tungsten (NW) COATING

Motivation: W is a proposed material for nuclear waste encapsulation.

The adhesion of W to the structural steel.

Aims: Investigate the adhesion as a function of:

- Steel roughness for bare substrate
- Presence of a Cr interface

Conclusions: M. Palos, R. Gonzalez-Amat et al. submitted to Jour. of Nucl. Met.

For NW samples deposited onto bare steel, the lower the roughness the higher the adhesion.

The Cr interlayer improves the adhesion and eliminates the dependence on the steel roughness.

Influence of grain boundaries on the radiation-induced defects and hydrogen in nano-W and coarse-grained W: experiments and ORNL simulations of light species diffusion.

Use more details to Poster Groups: Fusion Nuclear Observations and Synthesis of Fusion.


Influence of grain boundaries on the radiation-induced defects and hydrogen in nano-W and coarse-grained W: experiments and ORNL simulations of light species diffusion.

Use more details to Poster Groups: Fusion Nuclear Observations and Synthesis of Fusion.


Influence of grain boundaries on the radiation-induced defects and hydrogen in nano-W and coarse-grained W: experiments and ORNL simulations of light species diffusion.

Use more details to Poster Groups: Fusion Nuclear Observations and Synthesis of Fusion.


Influence of grain boundaries on the radiation-induced defects and hydrogen in nano-W and coarse-grained W: experiments and ORNL simulations of light species diffusion.

Use more details to Poster Groups: Fusion Nuclear Observations and Synthesis of Fusion.


Influence of grain boundaries on the radiation-induced defects and hydrogen in nano-W and coarse-grained W: experiments and ORNL simulations of light species diffusion.

Use more details to Poster Groups: Fusion Nuclear Observations and Synthesis of Fusion.


Influence of grain boundaries on the radiation-induced defects and hydrogen in nano-W and coarse-grained W: experiments and ORNL simulations of light species diffusion.

Use more details to Poster Groups: Fusion Nuclear Observations and Synthesis of Fusion.


Influence of grain boundaries on the radiation-induced defects and hydrogen in nano-W and coarse-grained W: experiments and ORNL simulations of light species diffusion.

Use more details to Poster Groups: Fusion Nuclear Observations and Synthesis of Fusion.


Influence of grain boundaries on the radiation-induced defects and hydrogen in nano-W and coarse-grained W: experiments and ORNL simulations of light species diffusion.

Use more details to Poster Groups: Fusion Nuclear Observations and Synthesis of Fusion.

Grupo de Investigación en Ciencia y Tecnología de sistemas avanzados de fisión nuclear

Principal Researcher: carolina.ahnert@upm.es  http://www.din.upm.es

Composition: 27 members

- ETSI Navales (2 Prof)
- ETSI Industriales (6 Prof., 8 PhD)
- ETSI Minas y Energía (1 Prof., 10 PhD)

Teaching:

Master: “Nuclear Science and Technology”, “Energy Engineering”, and “Naval and Oceanic Engineering”
Doctorate “Sustainable Energy, Nuclear and renewable”

Research lines

- Computational analysis of advances nuclear fission systems
- Thermohydraulics for nuclear power plants
- Propulsion systems for naval and space applications
- Nuclear safety and radiological protection
- Decision support systems for emergency preparedness and response
- Severe accidents
- Neutron detection and dosimetry
- Scientific methods for history and communication in nuclear energy

Aula José Cabrera Gas Natural-ETSII
Interactive graphical Simulator

SEANAP System development (Sistema Español de Análisis de Núcleos de Agua a Presión)
Ascó I, Ascó II, and Vandellós Nuclear power plants

Boiling Water Reactor Fuel simulation with CFD codes (Iberdrola)

Uncertainty analysis in Modelling (OECD/NEA - CSN)

Integration of atmospheric dispersion models with river and lake catchment models in the JRODOS decision support system for nuclear accidents PREPARE project (EURATOM)

Nuclear safety Chair “Federico Goded” CSN-ETSII
Nuclear Safety Chair “Juan Manuel Kindelán” CSN-ETSIM

Cofrentes NPP hydrogen risk analysis and PAR installation (Iberdrola)
AP1000 containment analyses (Proyecto PYGAS, MINECO)
Almaraz and Trillo NPP containment thermal-hydraulics (CNAT)

Study of neutron detectors for Radiation Portal Monitors $^{10}$Be+$^{75}$Zn(S(Ag)) as an alternative to $^{3}$He (with ETSICCP-UPM)
Grupo de Fusión por Confinamiento Inercial y Tecnología de Fusión

josemanuel.perlado@upm.es, http://www.denim.upm.es

Structural Materials Irradiation Damage: Molecular Dynamics Simulations

Accurate interatomic potentials (IP) are key in Molecular Dynamics calculations. An original IP, Concentration Dependence Model (CDM) version describes adequately point defects in Ferrite-Steel. Linear dependence of vacancy formation energy on Cr Concentration were observed for concentrations \( 0 \% \) but almost constant for those \( < 6 \% \). (Cid, J. et al., Europhys. Lett. 80 (2007) 62-68)

Two main goals are actually proposed:
- Stability of Vacancy Loops close to Surface in \( \gamma \)-Fe
- Cr segregation to defects created by irradiation in FeCr alloys.

Irradiation of NPs with fs lasers

A light-controlled synthetic procedure allows obtaining selected plasmonic oligomers by irradiation with low fluence near-infrared femtosecond laser pulses.

Optical extinction spectra and local field enhancement of single AuNPs, rod dimers and trimers
The Centre for Automation and Robotics (CAR) is a joint research center of the Spanish Council for Scientific Research (CSIC) and the Universidad Politécnica de Madrid (UPM). The main objective of CAR is to develop applied research which aims at offering useful results for the society in the field of Robotics and Automation. CAR is very well positioned in order to lead its ambitious research program, putting research on the following scientific-technological areas:

- Control Engineering,
- Artificial Perception, and
- Robotics.

The work carried out at CAR is funded by research agreements with private companies and by competitive institutional programs, both national and international, such as the European Commission, National Plan for R&D+I, Madrid Regional Government and AECID, among others. These activities lead to a large number of collaborations with private companies and other research centers. The research activity of CAR is strategically linked to the training of UPM postgraduate students. It includes Master's Degree and Doctorate Degree Programs in Automation and Robotics. More than 120 researchers are integrated the CAR, which are members of the following groups:

- AUTOPIA- Automated Driving of Vehicles.
- Computational Cognitive Robotics.
- Robots and Intelligent Machines.
- Service Robotics.
- Robotics and Cybernetics.
- Intelligent Control.
- Intelligent Automation of Manufacturing Processes
- Computer Vision.
- Artificial Perception.
- Autonomous System.
- Intelligent Systems Localization and exploration.
Our Vision: The CVAR Group at U.P.M. is focused on providing UAVs with their maximum degree of autonomy for their use in civil and industrial applications. For this purpose we use Vision as a powerful sensor that provides a huge amount of valuable information for UAVs and their localization related to its environment, in a similar way as vision does for human beings.

Our Mission: Being at the front end of the technology in Image Processing and Control techniques in order to achieve technology transfer of U.A.S. into demanding civil applications.

Our Values:
- Being permanently updated with the latest cutting edge technology and R&D in many related fields is essential for complete innovative solutions
- Having challengeable aims and testing the proposed solutions are two essential components for improving our research and products
- International cooperation is important for enriching the knowledge and the solutions

Industrial inspection using LIDAR, RGB and IR cameras

Autonomous Guidance and Navigation

See & Avoid

Natural environments monitoring

Own open source Sw framework, including some of our Sw moduls. www.aerostack.org

Some vehicles of our Unmanned Aerial fleet
FUZZY LOGIC & CONTROL

The research started in the early 90's in order to apply fuzzy logic technology in control systems. A lot of theory and industrial applications has been developed since then by the research group. Design methods of fuzzy controllers based on their analogy with PID control, state estimation using fuzzy logic, variable structure control, of fuzzy modeling are examples of the developed know-how.

On the other hand, applications of fuzzy logic have been demonstrated in a wide number of fields, from process control to robotics, in cases where controllers can be designed based on expert knowledge.

SOCIAL ROBOTS

FOR THE ELDERLY, HOSPITALS, MUSEUMS AND TRADE FAIRS

The research started in the 90’s in order to cover the emerging field in mobile robotics. Since the initial work on navigation control, planning and mapping, with the beginning of the new century the focus switched to guide robots with richer interaction and navigation capabilities, including SLAM.

This kind of social robots are being widely investigated in the robotics field and are appropriate for a number of applications such as medical and elderly assistance, tour guide, commercial exhibitions or entertainment.

RELATED PROJECTS:
- EXEX: Intelligent System for Extrusion Control (1995-1998), funded by Veka Iberica S.A.
- SINCRO: Intelligent System for the Ceramic Process Control using FMEA Methodology (1995-1996), funded by ENUSA.
About the Autonomous Systems Laboratory

- UPM-ASLab performs research on Autonomous Systems, i.e. systems that operate by themselves without the need of external intervention and guidance. Autonomous systems are useful in many real-life situations for economical, technical or safety reasons.
- We develop science and technology for the construction of systems for the real world, so they will free humans from supervising them once they’re up and running. They will self-manage to fulfil objectives.
- We address needs in the wider domain of technical systems. We focus our work on the domains of robotics and chemical processes, but trying to get results of universal applicability.

Getting in contact: info@aslab.org

Automática y Robótica: Ricardo.Sanz@upm.es Ingeniería Química: Manuel.Rodriguezh@upm.es

One project under way in more detail

- Developing an autonomous robotic system for emergencies.
- Funded projects by the Spanish government.
- Participants:
  - IXION (project leader)
  - UPM (Computer Vision and Autonomous Systems groups)
  - Universidad Carlos III de Madrid.
- ADVISE - Sistema Autómomo de Vigilancia y Seguridad basado en multirotores
  Development of an aerial robotic system of less than 2kg, integrated within a security system, to perform perimetral surveillance tasks automatically and autonomously, both indoors and outdoors, using an embedded and configurable HW / SW system.
- SALINE - Sistema Autónomo para La Intervención en Emergencias
  Provide a high degree of autonomy to a cooperative group of vehicles without pilot (UGV-UAV) capable of acting in dangerous or emergency environments. The limited ability to operate autonomously hinders entry into the market. This is the core point of innovation, by providing a system with greater capacities of perception and reasoning, to produce improved autonomy robots.

- The responsibilities of UPM-ASLab in this project are to:
  - Build a cognitive autonomous mission layer to handle high-level mission specifications.
  - Develop reaction capabilities to handle unexpected events during mission execution.
  - Provide a cognitive, seamless integration of human operators with the autonomous system.

Ongoing Work

- Focus on control and artificial intelligence to improve system robustness and resilience.
- How to represent and reason about systems engineering knowledge to provide run-time, engineering-based adaptation of systems.
- Exploring the use of SysML as a language to break the engineering/runtime gap.

Past Research Projects


Some Recent Publications


Get in contact: info@aslab.org
Bio-inspired robotics

Robotics for agriculture applications

Robotics for security and urban search & rescue

Cooperative robotics

Greenhouse farming

Search & rescue

Precision agriculture

Surveillance and security
DIVERBOT: UNDERWATER HUMANOID ROBOT FOR WORKS ON SEABED

Telecyborgs, Telemanipulation and Remote Handling

Telecyborgs covers all technologies that allow a human operator to remotely control a robot. The most advanced telecyborg systems are based on multimoal interfaces that include haptic interaction, stereoscopic visual perception and voice communication. The role of the human operator varies from mere task monitoring to guiding a robot for the execution of the manipulation task.

Traditionally, telecyborgs have been applied in nuclear, space and underwater applications. New fields of telecyborgs, such as teleurgery, inspection and maintenance, and security among others are currently growing.

PROJECTS & PATENTS FOR UNDERWATER ROBOTTICS

Telecyborgs, Telemanipulation and Remote Handling

This project presents an underwater humanoid robot called diverbot developed to work on seabed. The robot has 23 DOF and can navigate as ROV moved by its propellers and change its configuration from ROV to humanoid deploying an anthropoid arms to crawl or climb on the seabed. The concept of a robot that change form ROV to humanoid is essential in order to work on the seabed since short distance navigation from the surface without colliding with obstacles is impractical due to the effects of underwater sea currents. On the other hand, traveling on rough terrains is not easy without using four limbs to keep its balance. Therefore, the invention of a telecyborg that works in the seabed has been the main motivation for the development of a transformer robot that can navigate until the proximity of the object and then unfold as humanoid robot for working.

The present invention relates to a modular underwater robot with a plurality of arms which is transformable in ROV to work seabed and marine constructions, it is a robot with anthropoid arms to crawl or climb on the seabed. The concept of a robot that change from ROV to humanoid for working is patented.

The authors would like to thank the financial support of Spanish Government CICYT Project Ref. DPI2014-49527-EXP Universidad Politécnica de Madrid Project Ref. AL14-PID-15 and also to Comunidad de Madrid who funded the project P2013/MIT-2784.

Expertise and Experience

- **Anthropoid Arms**: Development of underwater humanoid robots and manipulation tasks.
- **Stereoscopic Video Camera**: Development of underwater humanoid robots for inspection and maintenance tasks.
- **Telecyborgs**: Development of underwater humanoid robots for emergency response tasks.

Recent projects:
- **Modular Underwater Robot**: Development of a modular underwater robot with a plurality of arms which is transformable in ROV to work seabed and marine constructions.
- **Transformer Robot**: Development of a transformer robot that can navigate until the proximity of the object and then unfold as humanoid robot for working.

References:

**Devices and Method for Measuring Fluid Streams by a Stereoscopic Parallel Mechanism Actuated by Drag Force**

This is a patent for a device that measures current speed and direction of a fluid according to the drag force it exerts on a solid body. The device comprises a stereoscopic parallel mechanism comprising a fixed platform (7) and a movable platform (2) that are connected by two kinematic chains. The platform (7) is provided with an optical measurement unit (3) which measures the relative orientation of the platform (7) and the fluid stream (3). The device is used for measuring water or air currents, as a support vessel in navigation and measurement of fluid streams in channels or pipes.
Mission

The mission of the Centro de Electrónica Industrial is to create knowledge, develop applications, transfer technology and educate engineers and researchers, in close cooperation with industrial partners in the field of industrial electronics. The goal of the Center is to foster the synergy around the industrial electronics in different terms:

- **Providing research areas**: electrical energy conversion through electronics, embedded digital systems and power quality service.
- **Industrial program focused**, but not limited, to aerospace, industrial, telecom and automotive industry.
- **Post-grad program**. The master and doctorate program on Industrial Electronics bridges the industrial sector with the students.
- **Encourage of the interaction of the different companies involved in research activities in the CEI-UPM**. The common and complementary research lines of the companies can be identified in order to create new research activities providing new solutions to the industry.

Grupo de Electronica Industrial (GEI)

1. AC-DC and DC-DC power converters
2. Device modelling
3. Energy Harvesting
4. Smart Grids
5. Internet of Things and Wireless Sensor Networks
6. Reconfigurable FPGA Based Systems
7. Embedded Intelligence
8. Neural Networks
9. Art and Technology

Grupo de Ingeniería de Radio (GIRA)

1. RF and Microwave circuits
2. High Frequency Amplifiers
3. Digital Signal Processing
4. Communication networks
5. MIMO techniques for communications
Presentation

- The Laser Centre UPM focus its activity in the following areas:
- Applied research and technological transfer in the field of laser material processing.
- Services for industry include laser plant technology implementation, process scalability, automation and numerical modelling of laser based processes.
- Teaching and training activities include personalized courses and modules in laser technology at any level. In particular Laser Safety training is one of the activities in which the Center is strongly active.

In 2017 a service for external users of Laser Micromachining and Microscopy will be offered through UPM Scientific Services. Other facilities for mechanical (fatigue, tribology, corrosion), electrical and optical testing of materials will be offered shortly.

Laser Centre UPM is reference lab in Appolo’s HUB: A disruptive european initiative for equipment and process assessment in laser applications born under FP7 Appolo project.
Main R&D Facilities:

Representative Laser Processing Developments:

Representative R&D Results:
Grupo de Investigación en Manufactura Avanzada con Láser
Advanced Laser Based Manufacturing
gi.mal@upm.es, http://www.upmlaser.upm.es

Presentation

• UPM Advanced Laser Based Manufacturing Research Group focus on the development and industrial transfer of advanced process using state-of-the-art pulsed laser sources and irradiation systems. The group develops its activity at UPM Laser Centre (www.upmlaser.upm.es).
• With a wide experience in micro and nanofabrication applications using laser technology, the group has current activity in strategic industrial sectors like energy (specially photovoltaics), aerospace, electronics, automotive, biotechnology, regenerative medicine, etc.
• Some members of the group collaborate in frontier problems in physics, like quantum optics and quantum computation.

R&D activity examples

An international reference in laser process for PV industry: more than 10 years helping green energies development

Fundamental studies in laser-based processes

The group has an important experience in fundamental research and modelling of laser-matter interaction processes. This group of images shows high speed imaging of Laser Induced Forward Transfer processes.

In collaboration with:

FP7 APPolo Project: filling the gap between equipment suppliers and end users in laser technology

Our group is responsible of UPM participation in FP7 Appolo project, a disruptive project in laser technology to fill the gap between laser equipment suppliers and end users in different industrial strategic sectors for Europe. UPM focus its activity on new competitive metallization techniques for PV and flex electronics using ultrafast laser technology, together new laser processes for thin film PV based on CIGS and Perovskites.

Entrepreneurship: from lab to society…and the winner is...

Members of our group are promoters and founders of Innofluence (www.innofluence.es) winner of the Actúa UPM competition in its XII edition. Business model is based in the development of Laser based machines for tissue engineering and cell culture.

What’s new: Laser Direct Write techniques for biomedicine

Lasers as a disruptive tool for fundamental studies in immunology. In collaboration with:

In collaboration with:

Entrepreneurship: from lab to society…and the winner is...

Members of our group are promoters and founders of Innofluence (www.innofluence.es) winner of the Actúa UPM competition in its XII edition. Business model is based in the development of Laser based machines for tissue engineering and cell culture.

What’s new: Laser Direct Write techniques for biomedicine

Lasers as a disruptive tool for fundamental studies in immunology. In collaboration with:

In collaboration with:

Entrepreneurship: from lab to society…and the winner is...

Members of our group are promoters and founders of Innofluence (www.innofluence.es) winner of the Actúa UPM competition in its XII edition. Business model is based in the development of Laser based machines for tissue engineering and cell culture.

What’s new: Laser Direct Write techniques for biomedicine

Lasers as a disruptive tool for fundamental studies in immunology. In collaboration with:

In collaboration with:

Entrepreneurship: from lab to society…and the winner is...

Members of our group are promoters and founders of Innofluence (www.innofluence.es) winner of the Actúa UPM competition in its XII edition. Business model is based in the development of Laser based machines for tissue engineering and cell culture.
Presentation

CEMIM is part of the Foundation for the Promotion of Industrial Innovations (F2I2) and it’s closely related to the Department of Mechanical Engineering of the Technical University of Madrid (UPM).

The main goal of CEMIM is to promote the transfer of knowledge between the university and industry levels i.e. the application of research results to industry.

The office staff is composed by professors of the Department, PhDs and senior and junior researchers. The academic training is also a primary goal supervising several PhD Thesis, Master Theses (TFM) and Bachelor Theses (TFB).

CEMIM participates in many projects from a wide range of fields. The main works can be classified in:

- Railway aerodynamics
- Vibration and acoustic
- Numerical Models for Structural Analysis
- Tunnel ventilation

The CEMIM participation includes different project phases like initiation, measurements, planning, design and control during the execution.

Vibrations and Acoustics

- Noise and vibration problems related to road and railway traffic
- Identification of vibration sources inside a residential building
- Acoustic barrier verification measurements
- Design of the solar collector structure

Numerical models for structural analysis

- Optimization of structural designs
- 3D noise Map of head-shaft of Metro North (Dublin)

Tunnel ventilation

- Coordination and consultation on tunnel ventilation and fire safety during design, execution and operation
- Design of the ventilation system of an underwater tunnel (Denmark)

Railway aerodynamics

- Estimation of pressure variations caused by trains traveling in open air or in tunnel
- High speed train head-wave measurement

- Development of a measurement system and in-situ test
- Air flow measurements at the begins

- Isolation design
- INDEA Materials (Madrid), Isolation of microscopy room

Developing

- Numerical simulation and design
- Verification test

Understanding

- Initial measurements
- Interpretation
- Developing
- Validation

Earthquake Engineering

- Dynamic characterization of the dish (upper light structure) and vibration isolation caused by human activity. Centro Comercial “Las Arenas” (Barcelona)
- Bridge seismic isolation design
- Seismic analysis of masonry mIH walls (Lorca earthquake)

Other consulting activities:

- Risk analysis
- Development and specification of control algorithms for the tunnel ventilation
- Training of tunnel operation staff
CITEF develops innovative services and products in the railway sector:

**Verification and Validation - V&V**
- Methodology development and application
- OCC
- ERTMS / CBTC / PTC
- Automation
- Safety Software Development

**R&D**
- National & European Projects
- Patents
- Publications

**Training Simulators**
- Driving
- Traffic Control
- Collaborative Training
- Maintenance

**Studies and Developments**
- Railway Dynamics
- Ventilation and Evacuation
- Operation
- Power and Energy Consumption
- Operation and Maintenance Improvements
- Bespoke Developments

CITEF is a fully independent entity that uses a client-partner model to collaborate with the majority of the rail companies:
- Rail and Metro Operators
- Infrastructure Administrators
- Public Authorities
- Rolling Stock Manufacturers
- Manufacturers of Signalling Systems
- Manufacturers of Communication and Integration Systems
- Manufacturers of Railway Electrification Systems
- Civil Construction Companies
- Engineering and Consultancy Groups

CITEF’s activity has a clear international scope. South America and Europe are the main areas of our activity, which in recent years has expanded to Asia:

Portugal, United Kingdom, Germany, Italy, Turkey, Bulgaria, Australia, Nueva Zeeland, Japan, USA, Mexico, Panama, Venezuela, Chile, Argentina, Egypt, Russia, Brazil, Singapore, China, Israel, Peru, Ecuador, Colombia, India, Denmark, …
The existence of microorganisms in spent nuclear fuel pools has been demonstrated recently in nuclear power plants by using conventional techniques. These microorganisms are identified radioresistant microorganisms belonging to the phylogenetic groups Alpha proteobacteria, Gammaproteobacteria, Actinobacteria, Bacteroides-Thermotoga and Firmicutes. They show resistance to high generation retention activation radionuclides. Sometimes the sum of Co-60 and Sr-90 reached 50%, 51, Co-60, 59, Zn-65 and 2-5% have also been reported. It is not assumed that the steel fuel cladding can be economically profitable. These findings are very interesting for the nuclear power industry.

MIC is a pipeline of biogs in a waste-treatment plant.

Schematic representation of the workflow in the AIRBIOTA-CM Program.

BIOENGINEERING AND MATERIALS (BIO-MAT)

BIODETERIORATION OF CULTURAL HERITAGE: PRESERVATION AND CONSERVATION

The Historical and Cultural Heritage includes all property, both tangible and intangible, accumulated over time. The protection of intangible heritage (language, customs, music, etc.) is very relevant because of its ephemeral nature. The tangible heritage (monuments, buildings, manuscripts, documents, photographs) comprises a wide range of highly heterogeneous materials: stone, paper, wood, metal, polymer. All these materials have a natural tendency to deteriorate. In addition, living organisms, especially microorganisms, are able to grow on these materials modifying their properties and contributing to their biodegradation. Knowledge of these biodegradation processes is what enables the development of the strategies for the conservation and prevention of the tangible heritage in order to extend its life and preserve it for posteriority. Regarding the Cultural Heritage, the BIO-MAT Group characterizes the materials, identifies the microorganisms and studies the biodegradation mechanisms to establish the most appropriate intervention strategies for conservation and prevention.

We have studied the biodeterioration of buildings and monuments as the Lions Fountain at the Alhambra Palace (Granada, Spain) and the excavations made to the Council of the Alhambra were fulfilled, which led to the complete restoration of the fountain.

The Lions Fountain at the Alhambra Palace before restoration.

We also study different paintings in paleolithic caves such as Covalecas and La Isla (Romanes del la Victoria, Cantabria) and the Cave of Matredones (Caceres) are some good examples of the prior destruction of the heritage that must be preserved for future generations. Our studies of molecular biology in these unique sites led to identify the main types of bacteria and fungi involved in the biodeterioration process.

Recently, we have analyzed the biodeterioration state of films from the Cubin Foundation for Cinematographic Industry and Arts was a evaluated. A significant fungal colonization was found in both sides of the films mainly from Acremonium sp. and Doldiasporum sp., which were still alive the films under study were at risk of further deterioration due to the storage under inappropriate conditions.

References

BIODETERIORATION OF RADIOACTIVE WATER IN NUCLEAR POWER PLANTS

The microorganisms of spent nuclear fuel pools have been demonstrated recently in nuclear power plants by using conventional microbiological techniques. Subsequent studies have revealed that these microorganisms are able to colonize the stainless steel pools with forming biofilms. Moreover, it has been observed the ability of these biofilms to retain radionuclides, which suggests the possibility of their use for radioactive water decontamination purposes. Our research group develops a decontamination system on a pilot scale, in order to assess whether the process is scalable to an industrial level. This bioreactor was designed and manufactured, both compatible with severe and radiation protection standards in the controlled zone of a nuclear plant. This bioreactor was installed in the Cofrentes Nuclear Power Plant (Valencia) next to the spent nuclear fuel pools and preceding ion exchange reactors. This configuration allowed the bioreactor to receive water directly from the pools allowing in situ analysis of radionuclide removal. We analyzed the microbial biofilm Biodeterioration by using molecular biology techniques such as cloning, and identified radioresistant microorganisms belonging to the phylogenetic groups Alpha proteobacteria, Gammaproteobacteria, Actinobacteria, Bacteroides-Thermotoga and Firmicutes. Development and characterization of biofilms on stainless steel and titanium in spent nuclear fuel pools. Journal of Industrial and Biological 2007, 6, 443-451.


BIOENGINEERING AND MATERIALS (BIO-MAT)

BIODETERIORATION OF CULTURAL HERITAGE: PRESERVATION AND CONSERVATION

The Historical and Cultural Heritage includes all property, both tangible and intangible, accumulated over time. The protection of intangible heritage (language, customs, music, etc.) is very relevant because of its ephemeral nature. The tangible heritage (monuments, buildings, manuscripts, documents, photographs) comprises a wide range of highly heterogeneous materials: stone, paper, wood, metal, polymer. All these materials have a natural tendency to deteriorate. In addition, living organisms, especially microorganisms, are able to grow on these materials modifying their properties and contributing to their biodegradation. Knowledge of these biodegradation processes is what enables the development of strategies for the conservation and prevention of the tangible heritage in order to extend its life and preserve it for posteriority. Regarding the Cultural Heritage, the BIO-MAT Group characterizes the materials, identifies the microorganisms and studies the biodegradation mechanisms to establish the most appropriate intervention strategies for conservation and prevention.

We have studied the biodeterioration of buildings and monuments as the Lions Fountain at the Alhambra Palace (Granada, Spain) and the excavations made to the Council of the Alhambra were fulfilled, which led to the complete restoration of the fountain.

The Lions Fountain at the Alhambra Palace before restoration.

We also study different paintings in paleolithic caves such as Covalecas and La Isla (Romanes del la Victoria, Cantabria) and the Cave of Matredones (Caceres) are some good examples of the prior destruction of the heritage that must be preserved for future generations. Our studies of molecular biology in these unique sites led to identify the main types of bacteria and fungi involved in the biodeterioration process.

Recently, we have analyzed the biodeterioration state of films from the Cubin Foundation for Cinematographic Industry and Arts was a evaluated. A significant fungal colonization was found in both sides of the films mainly from Acremonium sp. and Doldiasporum sp., which were still alive the films under study were at risk of further deterioration due to the storage under inappropriate conditions.

References

BIODETERIORATION OF CULTURAL HERITAGE: PRESERVATION AND CONSERVATION

The Historical and Cultural Heritage includes all property, both tangible and intangible, accumulated over time. The protection of intangible heritage (language, customs, music, etc.) is very relevant because of its ephemeral nature. The tangible heritage (monuments, buildings, manuscripts, documents, photographs) comprises a wide range of highly heterogeneous materials: stone, paper, wood, metal, polymer. All these materials have a natural tendency to deteriorate. In addition, living organisms, especially microorganisms, are able to grow on these materials modifying their properties and contributing to their biodegradation. Knowledge of these biodegradation processes is what enables the development of strategies for the conservation and prevention of the tangible heritage in order to extend its life and preserve it for posteriority. Regarding the Cultural Heritage, the BIO-MAT Group characterizes the materials, identifies the microorganisms and studies the biodegradation mechanisms to establish the most appropriate intervention strategies for conservation and prevention.

We have studied the biodeterioration of buildings and monuments as the Lions Fountain at the Alhambra Palace (Granada, Spain) and the excavations made to the Council of the Alhambra were fulfilled, which led to the complete restoration of the fountain.

The Lions Fountain at the Alhambra Palace before restoration.

We also study different paintings in paleolithic caves such as Covalecas and La Isla (Romanes del la Victoria, Cantabria) and the Cave of Matredones (Caceres) are some good examples of the prior destruction of the heritage that must be preserved for future generations. Our studies of molecular biology in these unique sites led to identify the main types of bacteria and fungi involved in the biodeterioration process.

Recently, we have analyzed the biodeterioration state of films from the Cubin Foundation for Cinematographic Industry and Arts was a evaluated. A significant fungal colonization was found in both sides of the films mainly from Acremonium sp. and Doldiasporum sp., which were still alive the films under study were at risk of further deterioration due to the storage under inappropriate conditions.

References
Main research areas

Consolidated Group with a broad knowledge of Applied Statistics:
Linear Models, Quality Control, Multivariate Analysis, Simulation Methods, Time Series, Bayesian Methods, Qualitative Data Analysis, Regression Trees

Collaboration with:

<table>
<thead>
<tr>
<th>CSN</th>
<th>ENCE</th>
<th>Iberdrola Renovables</th>
<th>Ministerio de Fomento</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministerio de Industria</td>
<td>Red Eléctrica</td>
<td>Unión Fenosa</td>
<td>VIESGO</td>
</tr>
<tr>
<td>Institute for Energy and Transport, European Commission Repsol</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dimensionality reduction techniques for Multivariate time series models

Applications:
- Electricity prices in liberalized energy markets.
- Wind Power production
- Air quality data: Analysis of data from monitoring networks that measure concentrations of different pollutants. Concentration of pollutants.
- Evolution over time of scram rates in nuclear power plants.

Volatility modelling. Extraction of common and specific components in volatility

Applications:

Data Mining: Models based on Classification and Regression Trees

CART, Random Forest, Bagging
BART (Bayesians)
Dynatree (Dynamic Bayesians)
Ctree Multivariate (Multivariate)

Applications:
- Modeling electric energy prices
- Analysis of sensitivity of computer codes

Econometric models for macro analysis of traffic accidents

Applications:
- Estimation of ARIMA and structural dynamic models from data.
- Monte Carlo simulation for theoretical comparison of the models.
- Use of Bayesian methods with MCMC computational techniques.

State space models and their estimation in the field of civil engineering

Applications:
- Analysis of time series of vibration data recorded in civil engineering structures
- Estimation of state space models using the Expectation – Maximization algorithm
- Estimation of mechanical properties of bridges, buildings, ...

Treatment of censored data

Applications:
- Right Censorship
- Left Censorship
- Reliability

Forecasting electricity demand in Spain

Applications:
- The developed model considers the effects of maximum/minimum temperature, non-working days, public holidays, time-change days, etc.
- The model developed is currently used to forecast the peninsular electricity demand.
- Twelve local models (Balearic and Canary Islands, Ceuta and Melilla) is being tested.

Simulation of processes with stochastic components using the Monte Carlo Method

Applications:
- Vehicle safety and traffic. Transferability
- Comparison of models
- Academic performance
- Probabilistic security analysis
Dynamics of Spanish gas prices and Brent Oil effects. A quantitative approach

Objectives

In competitive markets, with multiple sellers and buyers, prices are mostly driven by supply and demand with price itself providing signals to ensure market equilibrium. The case of Spain is a good example, where gas supply conditions comprising a substantial amount of long-term contracts together with limited connectivity with France, may explain the slower pace of implementation of a liquid gas hub in the country. Moreover, the fact that globally the relationship between natural gas and crude oil prices is not certain, not only because both commodities are rivals in production but also because gas markets are regionally segmented, raises questions about the view of steady state growth of natural gas prices.

The objective of the study is primarily to evaluate the underlying relationship between oil and natural gas in Spain and provide quantitative information on this relationship for a stated period of time. The selected period, 2002 – 2014 is a highly representative time window to also assess the progress of liberalisation in the Spanish gas market. Furthermore, the aim of the thesis is to assess the resilience of traditional oil-indexed structures and as a consequence to advance the degree of penetration of liquid hub pricing into Spain over the referred period. In this sense the study concentrates on two key areas providing insight on the oil-gas relationship. Firstly and similarly to financial asset prices, we analyse the scope for the order of integration of both series allowing for the possibility of structural breaks. The results will provide evidence and similarities about the true nature of the price series within an integrated unit root testing framework but also about whether significant changes - upwards or downwards - in the long run path of oil and natural gas series coincide. Secondly, the thesis examines the changing patterns of volatility in the oil and Spanish natural gas sectors. This property often manifests as volatility clustering and suggests that the conditional variance of the return series may not be constant. This time-varying property implies that shocks to the series affect volatility for several, if not many, periods into the future. Knowledge about the persistence of volatility can enable researchers to obtain more efficient parameter estimates, as persistence suggests that current volatility can be predicted.

Understanding gas price setting characteristics in Spain.

Currently, the majority of Spanish gas companies’ long term contracts for gas purchase are largely indexed to oil and oil products although indexation to other indices like NBP, Coal and even SMP can also be found. In this sense a thorough understanding of gas price dynamics is needed to understand potential influences and effects of other variables in gas prices, especially of oil and oil products. Descriptive statistics for all the variables selected are analysed, this possibly advancing a similar behaviour among these variables and gas prices. It is interesting to realize that in spite of a well-connected LNG market worldwide, Spanish gas prices might show very limited response to other than crude oil-related fundamentals.

Beyond Smart Cities: Circular Economy and Demand-driven Innovations in Urban Sewage Management

The focus of this research is aimed at detecting fast track demand-driven innovations in wastewater management using real-time monitoring (sensing, detection, pollution control and prevention) in an urban context (smart cities) in order to control pollution components and sources (diffuse and punctual pollution) of urban sewage (chemical and biological). This research will try to analyze matching types between demand-driven challenges and Key Enabling Technologies (KET, such as nanotechnology and ICT solutions (sensors, big data, satellites, drones, among others). Real-time monitoring of wastewater is the first step to reuse water and to plan intelligent infrastructures (green infrastructure locations, reduction of urban sewage final treatments costs, high quality sustainable drainage systems) in smart cities, which is critical in an urban context and for water-dependant industries with a high pressure over water resources since they are the largest consumers. Results of this research could help establish industry-smart city-water-tourism interactions in order to boost a circular and green economy which can lead to sustainable growth in cities creating highly skilled jobs and new sustainable business models.

Energy planning in isolated environments

An Isolated Energy System is defined by a country’s inability, due to smallness and/or remoteness, to interconnect with other electricity generators and consumers through a wider transmission grid outside its national borders. Small islands or Isolated Systems tend to have common problems related to fuel dependence and waste treatment. Our objective is to strategically design policies and procedures to reduce energy problems in these territories and improve waste management in a circular economy. Large engines lack optimum performance when consumer demand for electricity is low. As a result, energy costs more to produce at night than during the day when the system is in higher demand.

Energy efficient solutions in the Canary Islands?

- Self-supplier of sustainable fuel.
- Electric grid improvement with the installation of small power plants in various grid points, which allows the installation of different technologies.
- Improve waste management at lower costs and landfill rehabilitation.
- Electricity generation, reduction of greenhouse gas emissions, and lower costs.

Regulatory proposals for the development of renewable energy self-consumption in Spain

COP22 called for political commitment to combat climate change by using low-carbon energy sources. The European Commission recognizes that industrial and domestic sectors have the possibility of consuming their own electricity, due to the level of development and innovation of most Member States. The rise in electricity prices, together with the decrease in the cost of renewable generation technologies, results in estimations foreseeing up to a 75% increase of the self-consumption rate in European households. However, the lack of regulation on this issue at European level has derived in different regulations being approved across Member States. In Spain, Royal Decree 950/2015 has been considered too restrictive, in the sense of precluding the financial feasibility of self-consumption systems’ deployment, whereas other European countries with poorer renewable energy resources are experiencing a higher growth in this field.

Research question

What regulatory approaches could be adopted in Spain in order to foster power self-consumption among domestic customers?

The objective is to analyse the current situation associated to power self-consumption both at European and national level, in order to develop regulatory proposals that help fostering its development and use among domestic customers in Spain, ensuring the economic feasibility of the power sector.
Introduction

UPM's Research Group in Machines Engineering was founded in 2007 and is devoted to research, innovation and teaching tasks in most fields of Mechanical Engineering and especially focused in the complete life-cycle of innovative machines and products. Areas including systematic machine and product development, performance optimization, design and modelling of advanced materials for machines and products, understanding and modeling complex contact phenomena and aspects linked to machines' and products’ safety and maintenance are part of our daily activities. Three laboratories support our research, innovation and teaching activities: the UPM's Product Development Lab, the UPM's Machine Safety Lab and the UPM’s Composite and Nanocomposite Materials Lab.

Currently we participate in 2 EU-funded projects within Horizon 2020 (Tomax & Ubora), in 2 National competitive projects (Housses & Fuel Economy) and collaborate actively with enterprises such as: Repsol, Talgo, Abengoa, Grupo Cobra and with institutions such as: Industry Ministry of Spain, ENAC, AENOR, KNMF-KIT and Comunidades autónomas . We count with 4 PhD students and apply these research and innovation advances to the teaching – learning practice in more than 10 subjects from UPM's Mechanical Engineering Department, directing more than 25 MSc & Final Degree Theses per year.
The research group use Operation Research methods such as Optimization and Simulation techniques, nevertheless some qualitative methods are also used for helping companies.

<table>
<thead>
<tr>
<th>Super cloud computing architecture to solve combinational problems.</th>
<th>Study on information transition to facilitate sustainable consumption: multi-stakeholders viewpoints.</th>
<th>International Manufacturing Network-Operational Issues and reshoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Traditionally, applications for solving combinational problems are based on desktop applications.</td>
<td>• From both practical and theoretical studies, it is necessary to strengthen information transition and provide a facilitator to bridge the gap between consumers’ attitude and behavior.</td>
<td>• Globalization is not a new phenomenon. However, companies are facing challenges with international manufacturing, and in recent years, there has been a growing interest in the phenomenon of reshoring or back shoring.</td>
</tr>
<tr>
<td>• Using the new paradigm of software as a service (SAAS) platform has been built for solving combinatorial optimization problems. The following problems are solved using MILP and Ant Colony Optimization (ACO).</td>
<td>• This study focused on the in-depth understanding of how to provide a facilitator within Attitude-Facilitator-Infrastructure (AFI) framework in order to provide incentives for promoting sustainable consumption.</td>
<td>• From these perspectives, this research intends to contribute in the area of international manufacturing strategy by investigating the operational issues of manufacturing network that have implications on networks</td>
</tr>
<tr>
<td>• The Vehicle routing problem (VRP).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Fleet assignment problem (FAP).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Tactical planning staff problem (WFP).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health care optimization</th>
<th>Coslada Smart logistics Competition.</th>
<th>Optimization and Simulation for aero structure plant.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• A mixed integer programming and simulation model was developed for the operation rooms schedule.</td>
<td>We organize this competition to:</td>
<td>• We implement a discrete model to build the schedule for the Job Shop scheduling problem with operators and a simulation model for the Fan Cowl manufacturing.</td>
</tr>
<tr>
<td>• We are working in the modeling and simulation of the Urgent Care centers.</td>
<td>• Spread the concept of Smart City among students and citizens for those who are not aware of it yet, provide information on the state of the art in this sector and on the initiatives that are taking place in other countries.</td>
<td>• A discrete and continuous approach was designed for the production schedule of aero structures with shared resources.</td>
</tr>
</tbody>
</table>

**Members.**

- Miguel Ortega Mier
- Alvaro Garcia Sanchez
- Tamara Sanchez Borreguero
- Raul Pulido Martinez
- Ahmed Sayem
- Luis Miguel Arreche Bedia
- Joaquin Delgado Hipolito
- Eva Maria Ponce Cueto
- Francisco Javier Diego Martin
- Jose Angel Gonzalez Manteca
- Luis Miguel Arreche Bedia
- Joaquin Delgado Hipolito
- Eva Maria Ponce Cueto
- Francisco Javier Diego Martin
- Jose Angel Gonzalez Manteca
Research Team

The research group includes 19 members from different disciplines. They belong to 3 Schools in UPM (ETS Industriales, ETSI Topografía, Geodesia y Cartografía and ETSI Aeronáutica y del Espacio) and to the University UNED. Moreover, the group is part of the ‘Global Change and New Energies’ from CII Moncloa Cluster. Some members of the group also take part in GeoAlerta, a UPM Cooperation Group.

Our work

The group has a structural laboratory located in the ETS Ingenieros Industriales (UPM) whose equipment is composed of a seismic simulator, dynamic actuators, data acquisition systems and different equipment to perform dynamic tests.

Collaborations. Social implication

The group collaborates with different national and international agencies, focusing mainly in the Latin America countries, where many research projects are being developed.

Likewise, education has a crucial importance in the group. For this reason, the members actively participate as professors in the Master Degree ‘Ingeniería Sismica: Dinámica de Suelos y Estructuras’ of the UPM. The aim is to form researchers and trained professionals that can be recruited by either Research Groups or R&D Departments from companies.

The work developed by the group has deep social implications. For instance, after Haiti Earthquake or Lorca Earthquake, members of the group participated in post earthquake evaluation of damage and in the development of seismic upgrading strategies. In order to disseminate the knowledge produced by the group, the members regularly publish in top international journals.

Testing facilities

The group has a structural laboratory located in the ETS Ingenieros Industriales (UPM) whose equipment is composed of a seismic simulator, dynamic actuators, data acquisition systems and different equipment to perform dynamic tests.

Research Lines

1.- Passive control of structures subjected to seismic loading

Special systems able to dissipate large amounts of energy under seismic actions are investigated in order to avoid or minimize damage in the main structure under a large earthquake. The basic system is based on installing energy dissipation devices or dampers in the building. The research on this topic encompasses both the development of new energy dissipation devices and the proposal of new mathematical models and methods to design structures with passive control systems. Energy dissipation systems is a growing technology already used in Japan and USA but scarcely in Europe.

2.- Seismic hazard, vulnerability and seismic risk

Seismic hazard (P): studies on this topic deal with the probability of occurrence of large ground motion in certain area in a time period. They have been applied for:
- Defining the Spanish seismic hazard map
- Locate a nuclear waste warehouse:

3.- Numerical simulations for dynamic analysis of structures

Numerical simulations are performed on numerical models calibrated with the experimental results of scaled structures tested in shaking tables.

4.- Analysis and vibration control of structures

Human activities such as walking, dancing, jumping, running and aerobic exercises are regarded as the most severe sources of dynamic excitation on structures. Therefore, there is a concern among researchers to evaluate the dynamic behavior of structures under human activity effects.

5.- Seismic retrofitting of structures

A large number of current structures were built in seismic areas using old standards. They were design using seismic design methods based merely on forces (force-based approach) without taking into account ductility considerations. Currently, this type of structures are of particular concern since they are very prone to suffer severe damage or even collapse under large earthquakes. We investigate on the seismic upgrading of this type of existing structures using modern techniques. This research line includes conventional and advanced technologies based on passive control.

6.- Seismic behavior of structures using shaking table test

The group has a large experience in conducting shaking table tests to study the seismic response of structures under seismic loading. One example are the recent experiments conducted on waffle-flat plate systems with and without energy dissipation devices, subjected to seismic simulations on increasing intensity.

The group collaborates with different national and international agencies, focusing mainly in the Latin America countries, where many research projects are being developed. Likewise, education has a crucial importance in the group. For this reason, the members actively participate as professors in the Master Degree ‘Ingeniería Sismica: Dinámica de Suelos y Estructuras’ of the UPM. The aim is to form researchers and trained professionals that can be recruited by either Research Groups or R&D Departments from companies.
ADVANCED INSTRUMENTATION & ELECTRONICS

Data Acquisition & Processing Architectures
Structural Health Monitoring
Sensing Technologies

APPLIED ACOUSTICS

Noise Control
Sound Quality
Neuroacoustics
Instrumentation & Metrology
Noise Pollution

APPLICATIONS

Big physics
Aeronautics
Defense
Medical Devices
Industrial Automation
Industry
Neurological Disorders
Vehicles
Smart cities
Transport
**Main Lines of Research:**

- **Digital Manufacturing & Knowledge Based Engineering**
  
  Collaborative systems development using IT integrated applications to define, simulate and control resources and manufacturing.

- **Manufacturing Performance Measurement & Optimization**
  
  Development of methods and IT architectures for the measurement and improvement of manufacturing systems.

- **Manufacturing Processes and Micro Manufacturing**
  
  Development and optimizing automation of manufacturing processes.

**Main Lines of Research:**

- **Digital Manufacturing & Knowledge Based Engineering**

  Collaborative systems development using IT integrated applications to define, simulate and control resources and manufacturing.

- **Manufacturing Performance Measurement & Optimization**

  Development of methods and IT architectures for the measurement and improvement of manufacturing systems.

- **Manufacturing Processes and Micro Manufacturing**

  Development and optimizing automation of manufacturing processes.

**Results**

- **Quality University**

  Operations, Modelling strategies, Analysis and evolution of parameters, Life span improvement, less costs

- **Design and Prototype Manufacturing of a 4 axis single point micro cutting machine**

  High precision, high speed "C" axis, 4 Axis Micro machining single point cutting process, Force analysis

  Artificial Vision System

  Microshaping CNC control

  Double X-Y Bed System

  A second bed system uses piezo electric actuators to give the system extra precision.

**Performance Measurement Integrated Information Framework in e-Manufacturing**

- **Application**

  Performance measurement integrated information framework in e-Manufacturing.

**Architecture of the Proposed Solution**

- **Concept Structure on the PLM System**

  Product-Process-Resources

  Continuous improvement in manufacturing using a multi agent platform that introduces product life management (PLM) and case based reasoning (CBR).
The requirements for an efficient mean of transportation are met in high-speed trains, what has attracted much attention from researchers to develop lighter and faster trains. A consequence of this is the introduction of new aerodynamic problems that were neglected before. Our group has been working for more than 10 years, also collaborating with top companies in this area (CAF S.A.) in the analysis of the flow characteristics and aerodynamic optimization of high-speed trains. These studies involve zero-yaw wind, crosswind stability, entry in tunnels and pressure waves inside tunnels, trains passing by each other, ballast uprise or flow analysis of the flow characteristics and aerodynamic optimization of high-speed trains. Moreover, wind tunnels have been used for validation of scaled models aerodynamic studies.

Bubble Dynamics: Biomedical Applications (J. Jiménez)

Gas-filled microbubbles stabilized against dissolution by lipid, polymeric or albumin shells, irradiated by an ultrasound field, enhance the acoustic backscattering from blood-filled regions and hence improve diagnostic ultrasound imaging. They may be also used for targeted therapeutic gene and drug delivery.

Recent application:
The subharmonic response in the signal scattered by contrast microbubbles is very sensitive to ambient pressure variations. This dependence, provides a non-invasive procedure for local blood pressure estimations.

To fulfil the above applications, the dynamic and sound emission of encapsulated gas bubbles must be investigated by including in the analysis elastic and viscous properties of the encapsulating layer.

Wind Energy: Wake Meandering (E. Migoya, A. Crespo)

A stochastic simulation has been implemented to take into account the meandering wake. Changes in the wind characteristics due to large scale turbulence have been retained and incorporated simultaneously to UPMPARK. Kaimal and Von-Karman spectrum could be employed using as datum average and variance incident wind speed, average incident wind direction and scale parameter of turbulence.

A numerical study of the effect on the flow pattern and platelet activation of blood clot deposition over stent struts of a stented coronary bifurcation is presented. Afterwards, the influence of the presence of thrombi depositions on parameters as Oscillatory Shear Index (OSI) is analyzed.
Grupo de Investigación en Modelado y Simulación en Ingeniería Mecánica
simula.dimec.etsii.upm.es
Grupo de Investigaciones Termoenergéticas GIT

mval@etsii.upm.es

GIT context
- Founded in 2006 by Prof. José Mª Martínez-Val
- Composed by researchers from ETSII-UPM, ETSIME-UPM & ETSII-UNED (Departments of Energy) related to topics as Heat Transfer, Thermal Engines, Fluid Mechanics and Nuclear

Aim
- Sustainable development in the field of energy generation and energy efficiency

Current research lines
- Decarburation of natural gas for its exploitation without Greenhouse gases emission (near 1500 K)
- Concentrated solar thermal power: cost reduction through simplification of the designs (new Fresnel concepts) and gas-hybrid concepts (near 700 K)
- Solar cooling by absorption cycles (500 K)
- Concentrated photovoltaics, thermal behavior to improve solar cell performance (near 350 K)
- Near Zero Consumption Buildings (near 300 K)
- Cryogenics for superconductors (below 30 K)

Temperature the key point... how to measure and control it?
- ATP Test Station placed in Getafe, Madrid
- Testing and calibration services of thermal refrigeration and legal metrology

DECARGAS project
- Cracking methane without CO2 emission
- 78% conversion rate, obtaining H₂ high purity
- 2nd prize in Innovatech competition 2016

FUTURO SOLAR project
- New concentrated solar thermal receiver concept
- Built in Tecnogetafe
- 300 kWth
- Supported by CDTI Grant

SUNDIAL project
- Evolution of FUTURO SOLAR project
- To be Built in Tecnogetafe before summer 2017
- 30 kWth
- Supported buy own founds
- 3rd prize in Innovatech competition 2016

BEST PATHS – Transmission of Sustainability project
- European Union’s 7th Program for research, technological development and demonstration under grant agreement No 612748. October 2014 – September 2018
- The focus of the demonstrations is to deliver solutions to allow the transition to High Voltage Direct Current (HVDC) lines
- Integrate superconducting high power links within AC meshed network
Optics, Photonics and Biophotonics

Research Lines:
- Photonic transducers: Label-free Biosensing
- Optical read-out platforms: Point-of-Care devices
- Packaging and KITs: Multiplexing easy to use
- Fluidic chips: Lab-on-a-chip
- Surface functionalization: Cells-on-a-chip

Experimental techniques:
- Micrometric high resolution UV-VIS-NIR Spectrometry
- Micrometric UV-VIS Spectrometry
- Sub-micron ellipsometry and reflectometry
- Photo-lithography and nano-imprinting (up to 6’’)
- Thin films deposition
- Continuous flow of liquids

Applications:
- Clinical detection: Label-free biosensing
- Environmental detection: Chemical and pathogens
- Chemical detection:
- Medicaments screening: Analysis of fluid components
- Disposable biochips: High Throughput Screening

Spin-off:
- Bio Optical Detection www.biod.es: Industrial exploitation

Our technology for Photonic Transducers

Optical read-out platforms: Point-of-Care devices
Packaging and KITs: Multiplexing easy to use
Fluidic chips: Cells-on-a-chip
Surface functionalization: Bio-receptors and applications

Applications and Industrial exploitations

Bio-applications and industrial exploitations

Bio-optical detection
POLCA: basic data.

- Founded in 2005
- Associated Unit to Instituto de Ciencia y Tecnología de Polímeros (CSIC) since 2008
- 11 permanent members (from Universidad Politécnica de Madrid and Universidad Complutense de Madrid)
- 2 PhD students
- The Group has received competitive financial support of Spanish Public Institutions (MEC, MICINN, MMA, MAEX, MINECO, CAM, ...)
- The Group has participated in initiatives of UE-H2020 (EIT Raw Materials)
- The Group has received financial support of private and public companies (Repsol Química, Ecoembes, EPCOS, BEFESA, Metro Madrid, ...)
- Collaborations with Universities and Research Centers from African, American, Asian and European countries.

Main research lines

- Biopolymers based composites and nanocomposites
- Mechanical recycling of waste urban and agricultural plastics.
- Applications of recycled materials (packaging, tube shelters for restoring mediterranean forests, ..)
- Development of organic materials for photovoltaic devices including carbazole-based polymers and self assembled structures.
- Design and synthesis of artificial receptors for catalysis and chiral discrimination of target molecules
- Self-diffusion, rheology and chain dynamics in supramolecular networks
- Dynamics of Rod-Coil-Rod Triblock Copolymers with potential use as nanostructured soft materials with functional domains in organic electronics and biomaterial applications
- Biosensors for redox processes based on electrodes modified with organometallic macromolecules
- Nanoparticles deposition on polymeric and dendrimers
Project Management and Quality Research Team

gi.pyc@upm.es, http://biba.etsii.upm.es/pmq/

MEMBERS’ PROFILE
Transference of knowledge
IPRs accredited
ISO committees
Well Age & Gender balanced
Academic & Professional expertise

DISSEMINATION
Conference attendance
JCR journal papers
Patents
Books

AREAS OF INTEREST
Diagnosis & Quality in Education
Business Analytics & Big Data
PM Sustainability
PM Competences
Industrial processes
Environmental Assessment & Recovery
Waste management in construction
Improving PM Methodologies
(... → Society challenges)

COMMITMENT WITH
PhD STUDENTS
Prizes & Challenges
PhD monographs
Master thesis

EDUCATION & TRAINING
ENVIROMENTAL BEHAVIOR
PROJECT MANAGEMENT
INFORMATION TECHNOLOGY
SOCIAL RESPONSIBILITY

INNOVATION, MANAGEMENT, SUSTAINABILITY, ENTERPRISE
About us

We are a multidisciplinary group of 17 people who belong to School of Industrial Engineering and School of Mining and Energy Engineering. In addition, we are part of the Global Change cluster and New Energies of CEI Moncloa. Our work is focused on three main research lines: AIR QUALITY, IMPROVEMENT OF INDUSTRIAL PROCESSES TO PREVENT POLLUTION and WASTE MANAGEMENT.

Air Quality

- Development of emission inventories: Madrid City
- Fleet composition studies
- Assessment of policies and measures through air quality modelling: Air Quality
- Integration of traffic simulation and emission computation models
- Estimation of air quality and GHG emissions, both direct and indirect
- Microscale exposition and pedestrian modelling – derived microscale exposition
- Testing new sensors and microscale modelling technologies
- Photocatalytic technologies on urban pavements: LIFEPHOTOSCALING (http://www.life-photoscaling.eu)
- Exposure and air quality-related impact assessment: health and vegetation
- PM$_{2.5}$ related premature deaths
- What exposure to O$_3$ fluxes
- Assessing efficiency in real conditions
- Improved cookstoves and indoor air quality
- Mobile phone data (CDR) – derived mesoscale exposition and pedestrian modelling – derived microscale exposition

Improvement of Industrial Processes

Clean Combustion Technologies

Coal is one of the main sources of energy employed to generate electricity, and its use represents the most competitive form of energy to increase the standard of living in large parts of the world. Coal extraction globally results in the associated production of around 10 – 40% of waste coal, where higher values of waste coal correspond to underground than opencut mining. Waste coal production mainly vary on quantity, calorific value or energy content, ash, volatiles and different forms of sulfur content. It is principally obtained during coal mining and coal washing activities, resulting in about 15% and 85% of the total waste coal produced respectively, depending on the coal country producer and technology used for. As a result, large amounts of waste coal with important energy content remains available and are piled throughout coal country producers, that can be used in 'clean combustion technologies'. One of the most attractive technology is integrated gasification in combined cycle and pre-combustion CO$_2$ removal process.

Life Cycle Assessment (LCA)

The Life Cycle Assessment (LCA) is a methodology used to quantify the potential environmental impacts of processes, products and services. It can be used as a corporate or governmental strategic planning instrument, especially oriented to design, supply and promote sustainable products (eco-friendly). This section contains some examples of LCA studies carried out in the TAR-Industrial research group, in order to show the usefulness of LCA methodology as an effective tool in decision-making process.

- Carbon footprint (CF) of a brand of ecological wine
- Comparative LCA of conventional kerosene and bio-kerosene
- LCA of a diesel produced in a Spanish refinery
- CF of municipal solid waste (MSW) treatment stage
- CF of MSW transport fleet
- CF of MSW transport fleet
- Evaluation of the environmental impact of Madrid taxi fleet under different renovation scenarios
- LCA of urban waste containers

Waste Management

FARM Project on metals recycling from MSW energy recovery waste

The aim of the project is to develop an integrated process for the concentration and recycling of metals present in the ash and slag produced by the recovery of energy from Municipal Solid Waste (MSW), including metals considered to be of strategic value. In order to reduce the quantity of such metals being sent to landfill, whilst also reducing the dependency of EU Member States on the importation of these materials.

The project enables the combination, on an experimental scale, of processes based on the application of metallurgical and pyro-hydrometallurgical techniques. Our group has developed the metallurgical process.

Carbon Dioxide Capture and Valorisation: Sustainable Process Development and Integration

This project coordinates three of the best Spanish teams in Separation Processes (UC), Applied Electrochemistry (UIA) and Environmental Technology (UPM) to develop sustainable carbon capture and valorization processes and its application to the municipal waste management (MSW).

Carbon Dioxide adsorption in chemical activated carbon from sewage sludge

Sewage sludge is a potential feedstock for producing activated carbons due to its carbonous content. Producing activated carbon from sewage sludge allows to use waste, otherwise difficult to deal with, to obtain added value adsorbents.

Removal of siloxanes and other VOC in MSW landfill gas

The presence of some trace amounts of certain substances like siloxanes in the landfill gas can cause severe problems in the combustion engines.

Gasification of Biowastes

Gasification technology has many advantages: no strict limits on the size and types of feedstock, the product gas can be utilized in various ways, compared with pyrolysis and direct combustion, and the utilization of gaseous fuel causes lower environmental impact. Our group has been working in waste water sludge gasification for the past 8 years.
Abstract
The UPM Research Group “Theory and Applications of Constructive Approximation” (TACA) is formed by mathematicians, physicists and engineers who collaborate in several research lines, by applying mathematical approximation methods to actual problems in Engineering. Here we present the most recent advances obtained by the members of this multidisciplinary group.

Channel estimation in wireless communications
In wireless communications, the channel filter $h$ is usually time-varying, and we need to estimate it at the receiver. From the scheme given in the Figure, we give procedures to approximate $h$ when a Discrete Cosine Transform (DCT) is considered as the transform $T$ at both the transmitter and the receiver:

- In [1] we present an algorithm which achieves an accurate estimation of symmetric channel filters $h$ by means of a small number of training symbols $X_k$, when using type-I DCT (DCT1).
- In [2] a procedure is given for estimation of any kind of filter, for either DCT2 or DCT4.

Darboux transformations
- The Darboux transformations provide, joint with other applications, a method for obtaining solutions of some integrable systems. In [3], the concepts of Darboux factorization and Darboux transformations for arbitrary Hessenberg banded matrices are analyzed. Specifically, the existence of this kind of factorization is studied, and some sufficient conditions for the uniqueness are determined.
- In [4] the relation between the Darboux transformation and the solutions of the full Kostant Toda lattice is analyzed. The discrete Korteweg de Vries equation is used to obtain such solutions.

Quadrature formulas
A new class of numerical quadratures is defined intended to approximate the value of the integral and the error committed at the same time [5]. The quadratures so defined are suboptimal in the sense that exactly integrate polynomials of nearly the highest degree. It is proven that they exist in cases where the corresponding optimal rules do not. Besides, the quadrature weights are positive and the nodes of the quadrature are simple and belong to the interval of integration. These properties are proven for sufficiently large number of nodes and wide classes of weight functions.

Minimizing energy consumption in Railway Rapid Transit networks
Railway transportation is the cheapest land transportation mode. In spite of this and because this mode of transport accounts for almost 40% of the total demand for mobility, it is becoming increasingly important to adopt measures that make it more environmentally friendly and, among them, those that are focused on minimizing energy consumption. In [6] we tackle the problem of approximating the real cost of minimizing energy consumption in railway rapid transit networks, so that, estimations of the price to be paid for being ecological and accomplish the with environmental standards are given. This is done using a mathematical integer linear program.

References
Research on...

- The group Thermodynamics Applied to Industrial Engineering (TAII) analyzes, models and optimizes energetic systems. We study conventional and renewable electricity generation plants as well as experimental designs and small systems. We maximize energetic and exergetic efficiencies and complete the analysis with economic and environmental studies, in a 4E Methodology approach. As well as commercial software, we have our own Group-developed software: PATITUG and CICLOGRAF, that combine outstanding thermodynamic performance and flexibility for process analysis.

- Among the variety of processes analyzed, we have selected two very different examples:
  - Trigeneration system (power - H₂ - process heating) and CO₂ sequestration based on chemical-looping combustion (CLHG) (Figures 1, 2 and 3).
  - Integrated Solar Combined Cycle Systems (ISCCS) (Figures 4, 5 and 6).

![Figure 1. Chemical looping cycle for trigeneration with CO₂ sequestration.](image1)

A concept for highly efficient power generation with nearly zero greenhouse emissions.

![Figure 2. Optimal design parameters. Exergetic efficiency vs. compression ratio.](image2)

![Figure 3. Exergy balance of CLHG cycle.](image3)

![Figure 4. Hybrid cycle scheme (ISCCS). Including Brayton cycle and bottoming Rankine cycle with Parabolic trough solar collectors.](image4)

![Figure 5. 4E Methodology results. Energetic (η) and exergetic (ψ) efficiencies, CO₂ emissions avoided and Levelized Energy Cost (LEC).](image5)

![Figure 6. Exergy Grassmann Diagram of ISCCS.](image6)
MEETING VENUE

Salón de actos. Escuela Técnica Superior de Ingenieros Industriales.
Universidad Politécnica de Madrid.
C/ José Gutiérrez Abascal, 2. 28006 Madrid.
For further information: 91 336 30 89.
irm@etsii.upm.es

How to get:

- **Buses:** 7, 12, 14, 27, 40, 45, 147, 150, 250 and Circular.
- **Subway Stations:** Nuevos Ministerios, Gregorio Maraño and República Argentina.

---

SPONSORED BY

- SAE
- F²I²
- INDUSTRIALES ETSII UPM
- POLITÉCNICA