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NOTICIAS DE INVESTIGACIÓN

ETS I+D+I

BOLETÍN BIMENSUAL DE INVESTIGACIÓN DE LA ETSIDI

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Este boletín informativo electrónico de periodicidad bimestral tiene como objetivo informar de las actividades de investigación desarrolladas en la ETS de Ingeniería y Diseño Industrial y recopilar los resúmenes de los artículos publicados en la Web of Science (WoS) de los que son autores o coautores investigadores de la Escuela.

PUBLICACIONES.

Viability of using olive stones as lightweight aggregate in construction mortars.

This article presents the results of a research project which studies the feasibility of substituting -in cement mortars- the most commonly used lightweight aggregates in Spanish building constructions (i.e. expanded clay), by waste from the olive industry. Spain is the world's largest producer of olive oil and olives, being therefore the main producer of olive-stone waste. These olive stones are currently used as biomass. To determine the viability of substitution, an experimental plan was designed. The objective of this plan was to add three different olive stone formats (entire, crushed and calcined) in cement mortars, using similar percentages additions as the ones used by the manufacturers of lightweight expanded clay mortars. From the results obtained it can be concluded that it is feasible to replace expanded clay by olive stones waste, obtaining mortars with lower densities, up to 30%, and improved compressive strength, up to 20% compared to lightweight expanded clay mortars.

Figure 1. Outer surface of CaS (increased 2µm). Source: Self elaboration.

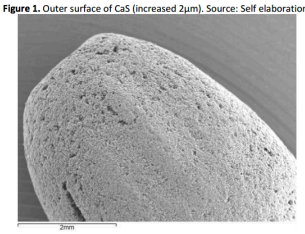


Figure 2. Outer surface of CaS were the rough and porous surface of CaS is seen (increased 50 µm). Source: Self elaboration.

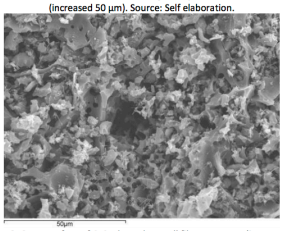
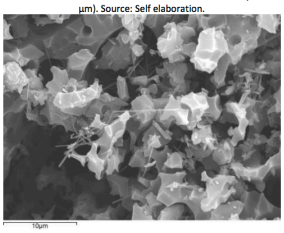


Figure 3. Outer surface of CaS where the small fibers are seen (increased 10 µm). Source: Self elaboration.



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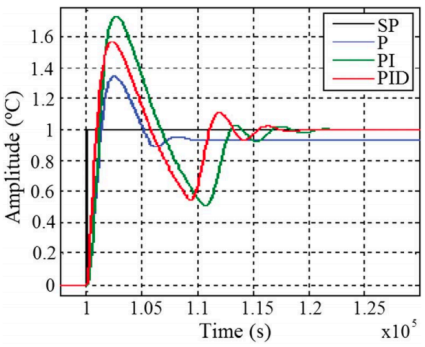
Identification model and PI and PID controller design for a novel electric air heater.

In this article, the software and hardware control architecture for a novel high-temperature three-phase electric air heating furnace is presented. It consists of a multiple-input single-output (MISO) nonlinear plant designed to heat air at flow rates in a range between 10 and 60 Nm(3)/h, from ambient temperature up to 1000 degrees C.

A divide-and-conquer (D&C) approach is applied. It consists in discretizing the air flow rates and working temperatures in intervals where the system behaviour is considered as single-input single-output (SISO) linear plant. Process identification techniques have been used to obtain empiric models for different operation ranges of the electric furnace. The controller parameters have been calculated using the Ziegler-Nichols tuning method.



The resulting output air temperature control is composed of a set of 12 PI and PID controllers. The switch among controllers as a function of air flow rates and temperatures is carried out using programming logic and gain scheduling technique, respectively. The resulting multiple controller has been tested under real conditions and the results are presented and discussed.

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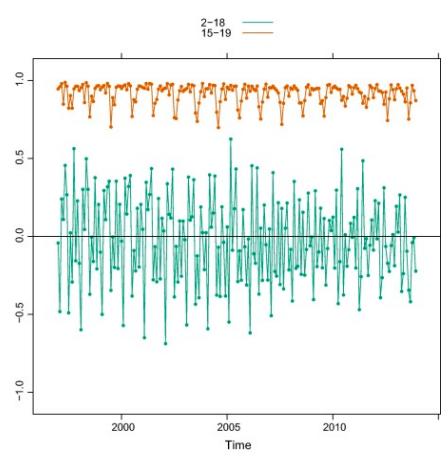
A multi-step scheme for spatial analysis of solar and photovoltaic production variability and complementarity.

Renewable energy resources are variable by nature. Due to this fact conventional electricity systems, which were designed for centralized generation, have to follow a different management approach when a big share of these technologies take part into the system.



This paper is focused on solar irradiation as source of energy for photovoltaic (PV) generation, but the proposed scheme can generally be applied to other renewable resources and different solar irradiation applications. A comprehensive methodology to analyze variability and complementarity of solar resource and PV production among sub-regions of a wide area is developed. The photovoltaic energy yield is defined as kWh per kW installed, which facilitates the comparison among sub-regions and allows a comparison with other renewable energies like solar thermoelectric or wind energy. The multi-step approach facilitates the spatial evaluation and comparison among areas and it could be applied to different time resolutions, from a short term analysis to climatological perspective as well as a climate change projections analysis.

The main steps of the method are the application of an objective clustering method for performing a regionalization of the whole domain, the analysis of the temporal variability of solar radiation and photovoltaic energy yield, and the intercomparison of the obtained clusters for examining their complementarity.

The whole process described in the article provides the information of how solar resource and the PV energy yield perform in a limited area and provide the tools to analyze the relationships between sub-areas and their variability. In this sense, this method can be applied for isolated or nearly isolated electric systems located in regions with a variety of climates, or for interconnected systems involving several countries.

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Analysis of the Influence of External Actuators on the Glenohumeral Joint Movements.

This work presents the simulation and analysis of the influence of MX-64 and RX-64 servomotors from Robotis (R) in human shoulder movements related to glenohumeral joint for the case of a subject with upper brachial plexus injury. The model of each motor was introduced in a 3D musculoskeletal model of the upper limb in order to compare their response and contribution in three different movements. The length change in muscles, range of movement and muscle force was obtained and compare for a healthy subject and a patient with upper brachial plexus injury. The results demonstrate the feasibility of using these servomotors in an exoskeleton for the rehabilitation process of the injury, although the RX-64 has characteristics that make it more suitable for a rehabilitation exoskeleton.

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Experiences on the Design of a Needle Insertion Surgery Robot: Kinematic Analysis.

In this work is presented the evolution of the concept of a needle insertion surgery robot. Five different prototypes were proposed, keeping the core concept of decoupling kinematics, and passing from a passive device to an autonomous robot. The kinematics of the mechanisms are presented. The different configurations for the inverse kinematics are introduced. The workspace of the final prototype is analyzed.

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Experimental Identification of Lu-Gre Friction Model in an Hydraulic Actuator.

In this work is presented the experimental identification of friction effects defined by the parameters of the LuGre model. The parameters are found by means of two experiments. The first one is performed with motions at constant velocity and the second one is performed under controlled force. These experiments allow to find separately the set of parameters that govern the steady state and the pre-sliding regime, respectively.

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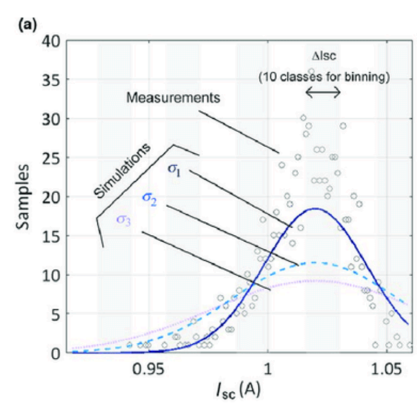
Experimental analysis and simulation of a production line for CPV modules: impact of defects, misalignments, and binning of receivers.



An inherent characteristic of high concentrator photovoltaics (HCPV) modules is a tight mechanical tolerance caused by the narrow angular transmission of the optical system, typically below or close to 1 degrees. Misalignments in the modules caused during the assembly process in the production line will degrade not only the electrical but also the angular performance of the module. Moreover, dispersion in the electrical characteristics of the elementary units comprising a module would lead also to power loss. Quality control and data analysis on the production line is of great significance for adjusting the production line and preserving the angular tolerance and the electrical performance. This is particularly critical during the set-up and tuning of an automated production line. This paper presents the results of a pilot production line for HCPV modules carried out within

the European funded ECOSOLE project. Several quality controls were established, which are the binning of the photovoltaic receivers, the measurement of misalignments among the elementary units within every module, and the indoor electrical characterization of the modules. Collected experimental data during the tuning phase of the pilot line were used to validate a module performance model based on production parameters. Monte Carlo method is lately applied to the model to assess the influence of production defects of diverse nature and the adequacy of quality controls, in several manufacturing scenarios beyond the specific constrains of the ECOSOLE experience.

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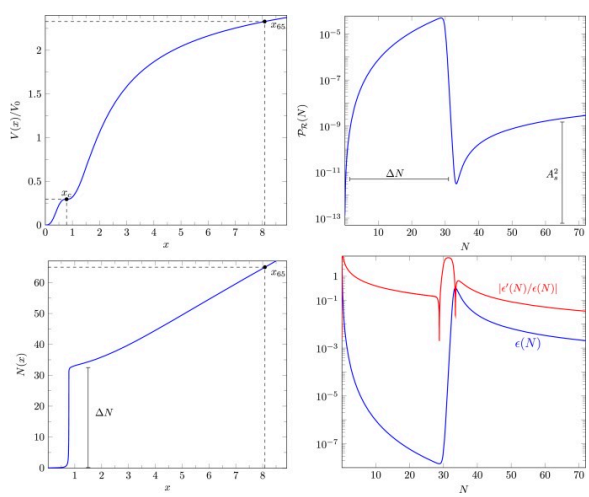
Primordial black hole production in Critical Higgs Inflation.



Primordial Black Holes (PBH) arise naturally from high peaks in the curvature power spectrum of near-inflection-point single-field inflation, and could constitute today the dominant component of the dark matter in the universe. In this letter we explore the possibility that a broad spectrum of PBH is formed in models of Critical Higgs Inflation (CHI), where the near-inflection point is related to the critical value of the RGE running of both the Higgs self-coupling lambda(mu) and its non-minimal coupling to gravity lambda(mu). We show that, for a wide range of model parameters, a half-domed-shaped peak in the matter spectrum arises at sufficiently small scales that it passes all the constraints from large scale structure observations. The predicted cosmic microwave background spectrum at large scales is in agreement with Planck 2015 data, and has a relatively large tensor-to-scalar ratio that may soon be detected by B-mode polarization experiments. Moreover, the wide peak in the power spectrum gives an approximately lognormal PBH distribution in the range of masses 0.01-100 M-circle dot, which could explain the LIGO merger events, while passing all present PBH observational constraints. The stochastic background of gravitational waves coming from the unresolved black-hole-binary mergers could also be detected by LISA or PTA. Furthermore, the parameters of the CHI model are consistent, within 2 sigma, with the measured Higgs parameters at the LHC and their running. Future measurements of the PBH mass spectrum could allow us to obtain complementary information about the Higgs couplings at energies well above the EW scale, and thus constrain new physics beyond the Standard Model. (c) 2017 The Author(s). Published by Elsevier B.V.

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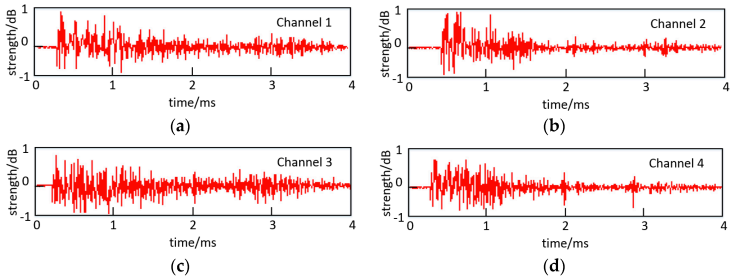
Positioning and Imaging Detection of Corona Discharge in Air with Double Helix Acoustic Sensors Array.

Corona discharge could be a serious hazard to the outdoor insulation of a high-voltage (HV) system and also is an important detection issue for insulation status diagnosis. In this study, a double-helix-ultrasonic-array (DHUA) sensor was developed for corona positioning, which showed a good sensitivity to the ultrasonic signal originating from corona discharge and a satisfied directional response in static beam patterns. Based on the matting-based image fusion method, the acoustic intensity matrix was fused to a visual scene in real-time. This ultrasonic visualization technology was then evaluated with a simulation test and performed in a real air insulated substation (AIS), and showed a satisfied performance in terms of sensitivity and spatial location resolution.



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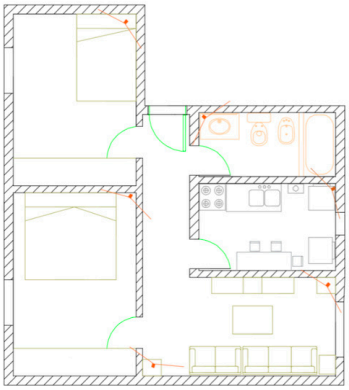
Home Camera-Based Fall Detection System for the Elderly.



Falls are the leading cause of injury and death in elderly individuals. Unfortunately, fall detectors are typically based on wearable devices, and the elderly often forget to wear them. In addition, fall detectors based on artificial vision are not yet available on the market. In this paper, we present a new low-cost fall detector for smart homes based on artificial vision algorithms. Our detector combines several algorithms (background subtraction, Kalman filtering and optical flow) as input to a machine learning algorithm with high detection accuracy. Tests conducted on over 50 different fall videos have shown a detection ratio of greater than 96%.

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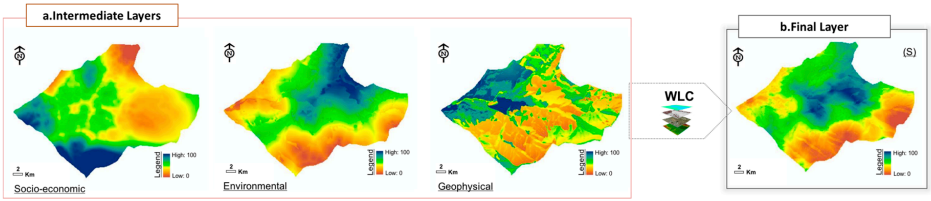
A Multicriteria GIS-Based Assessment to Optimize Biomass Facility Sites with Parallel Environment-A Case Study in Spain.

Optimizing a biomass facility site is a critical concern that is currently receiving an increased attention because of geographically spread biomass feedstock. This research presents a multicriteria GIS assessment with Weighted Linear Combination (WLC) (most suitable areas) and a sensitivity analysis (implementation strategies) applied to various disciplines using suitable criteria to optimize a biomass facility location in the context of renewable energies respecting the environment. The analyses of results with twelve criteria show the most suitable areas (9.25%) and constraints in a case study in Extremadura (Spain), where forest and agriculture are typical for land uses. Thus, the sensitivity analysis demonstrates the insight of the most influential criteria for supporting energy planning decisions. Therefore, this assessment could be used in studies to verify suitable biomass plants sites with corresponding geographical and spatial circumstances and available spatial data necessary in various governmental and industrial sectors.



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Thermal, dielectric, and surface analysis of NaDP doped glycine phosphite single crystals.

Transparent, unidirectional single crystals of sodium dihydrogen phosphate-doped glycine phosphite (NaDP-GPI) are grown by the Sankaranarayanan-Ramasamy method. The good quality crystal is obtained under controlled thermal conditions. The functional groups and melting temperature of NaDP-GPI single crystals are analysed. The phase transition temperature of NaDP-GPI is calculated from the dielectric studies. The mound-like patterns are observed on the surface of the crystal. The growth process under the controlled thermal condition was observed by optical studies. The obtained results are discussed in detail.

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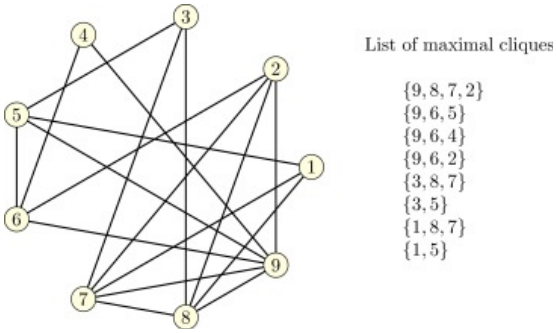
Efficiently enumerating all maximal cliques with bit-parallelism.

The maximal clique enumeration (MCE) problem has numerous applications in biology, chemistry, sociology, and graph modeling. Though this problem is well studied, most current research focuses on finding solutions in large sparse graphs or very dense graphs, while sacrificing efficiency on the most difficult medium-density benchmark instances that are representative of data sets often encountered in practice. We show that techniques that have been successfully applied to the maximum clique problem give significant speed gains over the state-of-the-art MCE algorithms on these instances. Specifically, we show that a simple greedy pivot selection based on a fixed maximum-degree first ordering of vertices, when combined with bit-parallelism, performs consistently better than the theoretical worst-case optimal pivoting of the state-of-the-art algorithms of Tomita et al. [Theoretical Computer Science, 2006] and Naude [Theoretical Computer Science, 2016].

Experiments show that our algorithm is faster than the worst-case optimal algorithm of Tomita et al. on 60 out of 74 standard structured and random benchmark instances: we solve 48 instances 1.2 to 2.2 times faster, and solve the remaining 12 instances 3.6 to 47.6 times faster. We also see consistent speed improvements over the algorithm of Naude: solving 61 instances 1.2 to 2.4 times faster. To the best of our knowledge, we are the first to achieve such speed-ups compared to these state-of-the-art algorithms on these standard benchmarks.



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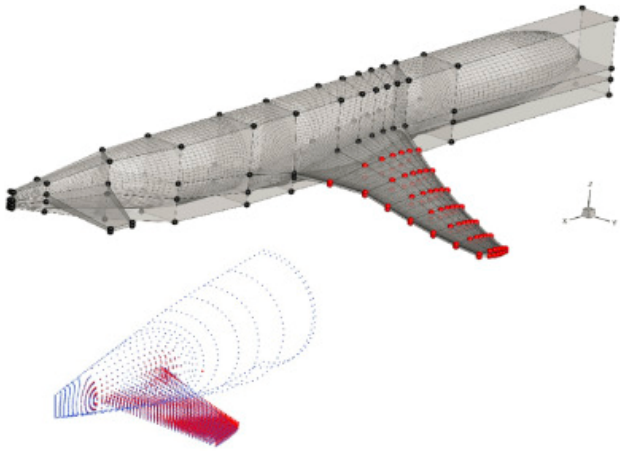
A review on design of experiments and surrogate models in aircraft real-time and many-query aerodynamic analyses.



Full scale aerodynamic wind tunnel testing, numerical simulation of high dimensional (full-order) aerodynamic models or flight testing are some of the fundamental but complex steps in the various design phases of recent civil transport aircrafts. Current aircraft aerodynamic designs have increase in complexity (multidisciplinary, multi objective or multi-fidelity) and need to address the challenges posed by the nonlinearity of the objective functions and constraints, uncertainty quantification in aerodynamic problems or the restrained computational budgets. With the aim to reduce the computational burden and generate low-cost but accurate models that mimic those full order models at different values of the design variables, Recent progresses have witnessed the introduction, in real-time and many-query analyses, of surrogate-based approaches as rapid and cheaper to simulate models. In this paper, a comprehensive and state-of-the art survey on common surrogate modeling techniques and surrogate-based optimization methods is given, with an emphasis on models selection and validation, dimensionality reduction, sensitivity analyses, constraints handling or infill and stopping criteria. Benefits, drawbacks and comparative discussions in applying those methods are described. Furthermore, the paper familiarizes the readers with surrogate models that have been successfully applied to the general field of fluid dynamics, but not yet in the aerospace industry. Additionally, the review revisits the most popular sampling strategies used in conducting physical and simulation-based experiments in aircraft aerodynamic design. Attractive or smart designs infrequently used in the field and discussions on advanced sampling methodologies are presented, to give a glance on the various efficient possibilities to a priori sample the parameter space. Closing remarks foster on future perspectives, challenges and shortcomings associated with the use of surrogate models by aircraft industrial aerodynamicists, despite their increased interest among the research communities.

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