POLITÉCNICA

escuela técnica superior de ingeniería y diseño industrial

NOTICIAS DE INVESTIGACIÓN

ETS I+D+I

BOLETÍN BIMENSUAL DE INVESTIGACIÓN DE LA ETSIDI

NÚMERO 9 MAYO – JUNIO DE 2019

http://www.etsidi.upm.es/Investigadores/ActivYpublicacDeInvestigacion/BoletinETSIDI

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.

1. EVENTOS.

8th Manufacturing Engineering Society International Conference (MESIC 2019)

Durante los días 19, 29 y 21 de junio de 2019 se celebró en la ETSDI el MESIC 2019. Congreso que auspicia la Sociedad de Ingeniería de Fabricación y que ha sido organizado en colaboración con la Escuela de Ingeniería Aeronáutica y del Espacio, la Escuela de Ingenieros en Topografía y el Centro Español de Metrología (CEM). El MESIC es un evento de periodicidad bienal que tiene como objetivo la presentación discusión y puesta en común de trabajos científicos y resultados de la investigación más puntera realizada en el ámbito de la Ingeniería de los Procesos de Fabricación. Las áreas de interés tratadas han sido:

- Avances e Innovaciones en Ingeniería de Fabricación
- Tendencias en Ingeniería de Fabricación
- Futuro e Industria 4.0
- Metrología y Calidad
- Tecnologías Asistidas por Ordenador
- Ingeniería de Fabricación y Sociedad.

Se han presentado 79 comunicaciones orales y 80 pósteres. Ha habido 194 asistentes, procedentes de Alemania, Bélgica, China, Colombia, Dinamarca, Francia, Grecia, India, Italia, Japón, México, Polonia, Portugal, España, Estados Unidos, Reino Unido y Suiza.

Se han celebrado tres conferencias plenarias a cargo de los siguientes ponentes invitados:

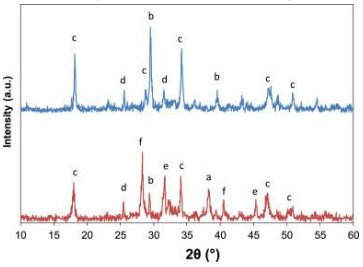
- Prof. Hans Nørgaard Hansen, Technical University of Denmark
  Digitalization and Industry 4.0 - a Danish perspective
- Prof. Richard Leach, University of Nottingham
  Estimating uncertainty for 3D point cloud measurement
- Prof. Genserink Reniers, Delft University of Technology
  Operational safety economics: a topic deserving more attention by academia and industry

Más información sobre el congreso: http://www.mesic2019.com/

2. PUBLICACIONES.

A mixed separation-immobilization method for soluble salts removal and stabilization of heavy metals in municipal solid waste incineration fly ash.

This work presents the results of a treatment process of municipal solid waste incineration (MSWI) fly ash using a solution of sodium carbonate as a stabilizing agent. The effectiveness of the treatment was evaluated by means of leaching test for waste characterization according to European Standard, with special focus on soluble chlorides and heavy metals (Zn, Cd, Pb and Cu). Chemical, XRD and DTA/DTG analysis were used to gain insight into the chemical changes induced in the fly ash by the treatment. In the fresh fly ash, the total dissolved solids and chloride concentration exceed the acceptance limits for hazardous waste whereas fresh fly ash was classified as hazardous waste concerning Pb. The carbonated fly ash was considered as non-hazardous waste according to all studied parameters. XRD and DTA/DTG analysis of treated fly ash showed that chlorine compounds have been transferred into the liquid phase during the stabilization process. The chloride removal from the ash was complete and fast irrespective of the sodium carbonate concentration and solid/liquid ratio in the stabilization process within the range studied. The treated fly ash was mainly composed by calcite and portlandite and the chemical analysis after the leaching test demonstrated that more than 98% of heavy metals remained in the treated fly ash. Therefore, the stabilization procedure of MSWI fly ash with a solution of carbonate ions achieved the separation of soluble salts and the leaching stabilization of heavy metals simultaneously in one step.



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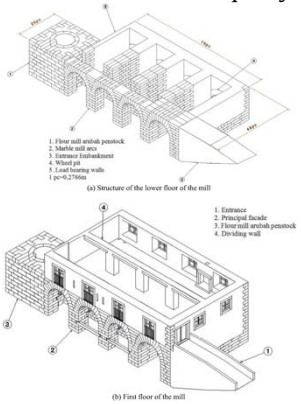
Virtual reconstruction and kinematic simulation of a marble sawmill through the integration of historical and archeological data.

One of the greatest difficulties researchers encounter when attempting to comprehensively recover the technological heritage of the past lies in the fact that many components (machines, tools, etc.) were fully or partially made with ephemeral materials (such as wood). For this reason, in this work, we use virtual reality tools based on 3D models and the kinematic simulation of mechanisms and machines in order to integrate information from archeological remains and information obtained from written records during research on the recovery of the technological heritage of the past. In order to demonstrate the adequacy and suitability of the proposed method, the buildings and machinery of the Fallen Mill at El Escorial (Spain) have been virtually reconstructed as a case study. This one consisted of two mills, one flour mill and one marble sawmill, and was built at the end of the sixteenth century but, following a long period of abandonment, only scarce physical remains exist today. The Fallen Mill was highly important to the construction of the Monastery of El Escorial as, on the one hand, it was the first flour mill at the Monastery and, on the other hand, the marble sawmill which made it possible to reduce the time expected for the construction of the high altarpiece in the Monastery's Basilica by half. The virtual reconstruction enabled an integrated compression of the architecture and technique used for both mills, providing users and researchers with an interactive environment for analysis, the discussion of alternatives, and detailed knowledge of this valuable technological heritage. With this and following centuries of abandonment, the Fallen Mill can be recovered for European technological heritage and makes clear the archeological importance of the existing physical remains of both mills.



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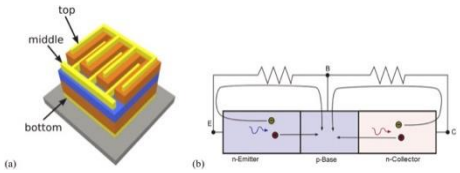
Novel heterojunction bipolar transistor architectures for the practical implementation of high-efficiency three-terminal solar cells.

Practical device architectures are proposed here for the implementation of three-terminal heterojunction bipolar transistor solar cells (3T-HBTSCs). These photovoltaic devices, which have a potential efficiency similar to that of multijunction cells, exhibit reduced spectral sensitivity compared with monolithically and series-connected tandem solar cells. In addition, the simplified n-p-n (or p-n-p) structure does not require the use of tunnel junctions. In this framework, four architectures are proposed and discussed in this paper: 1) one in which the top cell is based on silicon and the bottom cell is based on a heterojunction between silicon and III-V nanomaterials; 2) one in which the top cell is made of amorphous silicon and the bottom cell is made of an amorphous silicon silicon heterojunction; 3) one based on the use of III-V semiconductors aimed at space applications; and 4) one in which the top cell is based on a perovskite material and the bottom cell is made of a perovskite-silicon heterostructure.



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Discrete-time systems sliding mode switching hyperplane design: A survey.

As regards to variable structure control with sliding mode (VSC-SM), it is known that designing sliding surface is a critical task because sliding surfaces must guarantee that the steady state of the controlled system achieves some desired performance including global (or global asymptotic) stability. This problem has been extensively analyzed for a wide class of systems: scalar, multivariable, linear, nonlinear, time-variant, discrete-time system, etc. The main purpose of this paper is to present a thorough survey about the main approaches related to the design of discrete-time switching surfaces applied to VSC-SM. Research works covering the design of sliding surfaces for the aforementioned systems are considered and some illustrative examples are also included to explain some of the design methodologies.

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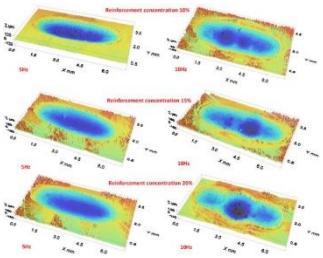
Tribological investigation of epoxy/seed particle composite obtained from residues of processing Jatropha Curcas L. Fruits

Natural particles e.g. in a form of wooden powder but also of fruits residues serve for decreasing costs and for an optimization of some mechanical characteristics in the area of composite materials. For this reason, in this study, a first mechanical characterisation (Hardness) and a tribological characterisation of an epoxy matrix filled with secondary commodities coming from the pressing process of Jatropha Curcas L. seeds was carried out. Three different materials have been used as reinforcement of the composite material: Whole seeds (SC), Seed shells (S) and Seed kernels (SKC). A ball-on-flat tribometer with reciprocating motion was employed with frequencies of 5 Hz and 10 Hz. The tribo test was carried out by using an 8 mm diameter steel ball of AISI 420C (X46Cr13) sliding on a flat specimen of the investigated composite materials without presence of lubricant (dry conditions). The flat specimens of the composite material were made with three different reinforcement concentration (10%, 15% and 20%) materials for any part of the JL seeds used (SC, S and SKC). With the purpose to assess the wear mass loss in the tribo-test a gravimetric analysis was accomplished. An electron microscope was used for the evaluation of particle topography in the worn area of the specimen, after tribo-tests, and in interfacial interaction in this area. 3D topography analysis was carried by using a Confocal Microscope in order to obtained qualitative information on the wear process. From a comparison of the tribological response to the various types of reinforcement, it has emerged that the lower coefficients of friction and wear rate are realized with a reinforcement constituted by the core of the seed (SKC). The gravimetric survey conducted revealed a greater resistance to wear in the composites made with the seed core (SKC). In fact, the lowest value, of the wear mass loss, of the whole series of experiments was obtained in the case of specimens with 20% of reinforcement seed core (SKC) and with 10 Hz of reciprocating motion of the ball on the specimen. This value was of 0.07 mg.



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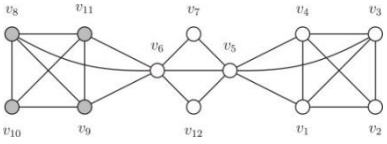
The maximum clique interdiction problem.

Given a graph G and an interdiction budget k, the Maximum Clique Interdiction Problem asks to find a subset of at most k vertices to remove from G so that the size of the maximum clique in the remaining graph is minimized. This problem has applications in many areas, such as crime detection, prevention of out-breaks of infectious diseases and surveillance of communication networks. We propose an integer linear programming formulation of the problem based on an exponential family of Clique-Interdiction Cuts and we give necessary and sufficient conditions under which these cuts are facet-defining. Our new approach provides a useful tool for analyzing the resilience of (social) networks with respect to clique-interdiction attacks, i.e., the decrease of the size of the maximum clique as a function of an incremental interdiction budget level. On a benchmark set of publicly available instances, including large-scale social networks with up to one hundred thousand vertices and three million edges, we show that most of them can be analyzed and solved to proven optimality within short computing time.



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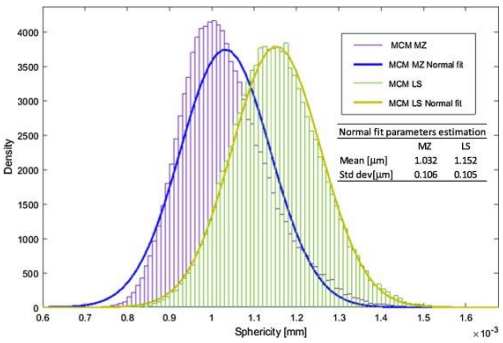
Sphericity measurement through a new minimum zone algorithm with error compensation of point coordinates.

Sphericity is a relevant tolerance of form in many fields of engineering. Measuring sphericity is frequently accomplished through the fitting of the point coordinates obtained from coordinate measuring machines (CMMs) to a substitution sphere. This paper presents a new algorithm for sphericity of minimum zone tolerance. It faces its resolution through the flatness problem associated with the implicit formulation of the polar plane of the sphere. The polarity transformation allows the iterative resolution of the minimum zone sphericity through a simpler flatness problem. Its accuracy is compared with the least-squares solution and some well-known minimum zone algorithms from literature. Its performance reaches or surpasses them. Next, a new error compensation model of point coordinates for sphericity is developed. A model based on the regression of the error by each CMM axis is incorporated into the sphericity measurement model. The explained error propagated allows correcting the sphericity calculated by the CMM indication, but also facilitates the uncertainty estimation by the propagation of the unexplained residual error in the regression through the measurement model. The experimental verification by the Monte Carlo Method shows efficient results. The jointly proposed method of a new algorithm with error compensation and uncertainty estimation can effectively contribute to the improvement of sphericity measurement from point coordinates in precision and accuracy.



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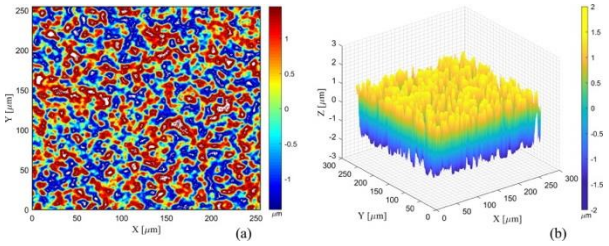
Confidence Distance Matrix for outlier identification: A new method to improve the characterizations of surfaces measured by confocal microscopy.

This paper proposes a statistical method for outlier identification for surface measurement data obtained by confocal microscopy. The implemented statistical method is Confidence Distance Matrix (CDM) which were widely used in statistics and many engineering areas, such as signal processing, sensor data fusion, information problems, etc. However, no investigations on identifying outliers in measured surface data using CDM have been found. This paper introduces and simplifies the mathematical model of CDM method. Algorithms for identifying random outliers using Monte Carlo method for uncertainty evaluation and for identifying outliers in a unique measured surface are developed and validated. For validation of the algorithms, a synthetic data SG_3-3 provided by National Institute of Standards and Technology and a data of artificial stochastic surface generated by our own algorithms are implemented. The difference of Sq of the data with outliers is 2.3342% and after deletion of outliers is 0.0037% with reference to the certified value. A type Cl spacing standard with dust dropped is measured and processed using CDM. The difference of Sa decreases from 29.65% to 3.52% after processing outliers with reference to the certified value Ra. A steel plate is measured and processed. Surface slopes and curvatures of the data in the two validations and two experiments are compared. All those parameters, the surface reconstructions, histogram of heights, and QQ plot of the measured surface data versus the data after deletion of outliers indicate our proposed method working well.



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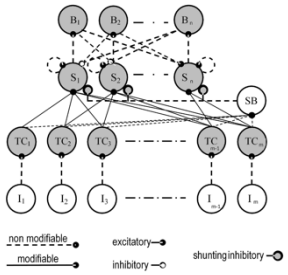
KLN, a new biological koniocortex based unsupervised neural network: competitive results on credit scoring.

Koniocortex-Like Network (KLN) model is a Bio-Inspired Neural Network structure that tries to replicate the architecture and properties of the biological koniocortex section of the brain. Based on its biological counterpart that behaves as a Winner-Take-All competitive system, this new structure is composed by different kind of artificial neurons that interplay naturally between them to create a model able to map autonomously the intrinsic knowledge included in a dataset into different classes. Biological properties of the human neural system as metaplasticity and intrinsic plasticity have been translated into this artificial model to create a self-organizing system applicable to multiple disciplines. This approach leads to a natural evolution of the network's dynamics until obtaining the desired results. The KLN has been previously tested on several synthetic and real datasets, in this article we check its capability to deal with a different type of information by applying it to credit scoring problem, in particular to the classification of credit data from the Australian Credit Approval Database.



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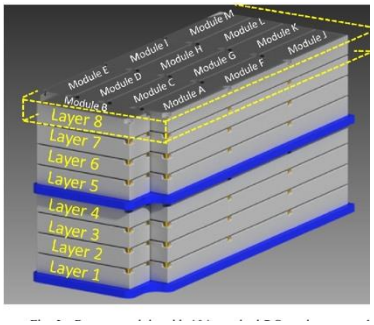
Battery-Pack Capacity Optimization Layout for Electric Motorbike Competition

This paper presents an experimental procedure to optimize the battery pack capacity of an electric motorbike designed to run on the MotoStudent International Competition of 2016. The optimization process has been realized by means of experimental tests, which have been carried out in a load bank testbench. This automated testing station was designed specifically to test the battery cells of the motorbike battery-pack. As a result of the optimization process the maximum difference between the highest module and the lowest module of the motorbike battery pack has been substantially reduced compared to a randomly located configuration.)



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Comparison of artificial neural network and multiple regression for partial discharge sources recognition.

This paper compares the capabilities of the artificial neural network (ANN) and multiple linear regression (MLR) for recognizing and discriminating partial discharge (PD) defects. Statistical fingerprints obtained from a several PD measurement were applied for training and testing both the ANN and MLR. The result indicates that for both the ANN and MLR trained and tested with the same insulation defect, the ANN has better recognition capability. But, when both ANN and MLR were trained and tested with different PD defects, the MLR is generally more sensitive in discriminating them. In this paper, the results were evaluated for practical PD recognition and it shows that both of them can be used simultaneously for both online and offline PD detection.

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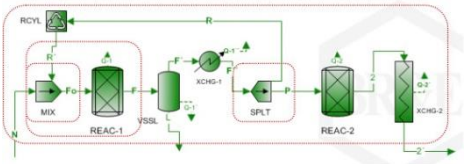
WOS: 000468867400087

Power-to-SNG technologies by hydrogenation of CO2 and biomass resources: A comparative chemical engineering process analysis.

Power to Synthetic-Natural-Gas (SNG) technology consists of two main steps: water electrolysis and methanation; the primary energy input is usually surplus power from renewable energy sources, while the electrolytic hydrogen and carbon oxides from different COx sources are converted into methane that can be fed in the natural gas grid. We focus on methanation technology, where the main criteria are the complexity of process setup and reactor sizes to achieve production and SNG quality for gas-grid injection. The processes are simulated using a plug-flow model for the reactors and a pseudo homogeneous kinetic law describing the reaction of CO2 (that is rate limiting). The results show that feeding biogas or syngas (instead of CO2) for methanation has remarkable effects regarding the operation and design of the processes; it is concluded that Power-to-SNG technologies that use methane rich streams are favorable in terms of biogas upgrading, H-2 requirements, reactor volumes and process simplicity, as far as these resources are available: e.g., using a typical composition (60% CH4) the required inputs are 0.96 kmol of biogas, 1.54 kmol of H-2 and 0.26 m(3) of reactors (two adiabatic beds with recirculation, R/F = 0.695) per kmol/min of pipeline quality dry gas product (95% CH4), which means 60% hydrogen saving, less than 26% reaction volumes and near 62% reduction of process throughput, when compared to the methanation process that uses pure CO2; conversion of syngas can be also favorable, but it requires high recirculation due to the large proportions of COx; e.g. for syngas (47.3%H-2-25.9%CO-17.2%CO2-9.6%CH4), the required values mean a 53% hydrogen saving and less than 25% reaction volumes, but only 11% reduction of process throughput.



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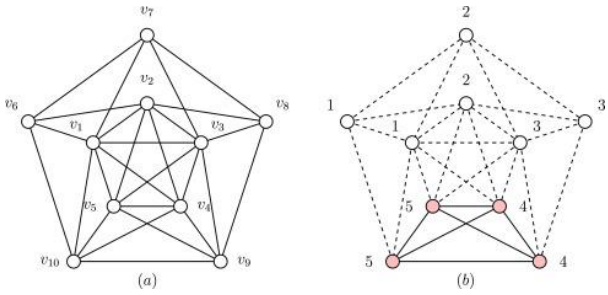
A new branch-and-bound algorithm for the maximum edge-weighted clique problem.

We study the maximum edge-weighted clique problem, a problem related to the maximum (vertexweighted) clique problem which asks for finding a complete subgraph (i.e., a clique) of maximum total weight on its edges. The problem appears in a wide range of applications, including bioinformatics, material science, computer vision, robotics, and many more. In this work, we propose a new combinatorial branch-and-bound algorithm for the problem which relies on a novel bounding procedure capable of pruning a very large amount of nodes of the branch-and-bound tree. Extensive computational experiments on random and structured graphs, encompassing standard benchmarks used in the literature as well as recently introduced real-world large-scale graphs, show that our new algorithm outperforms the state-of-the-art by several orders of magnitude on many instances.



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Particle technology as a uniform discipline? Towards a holistic approach to particles, their creation, characterisation, handling and processing!

Can particle technology, in spite of its multiplicity, be regarded, and scientifically taught, as a uniform discipline?" wondered H. Rumpf, one of the founding fathers of particle science, in a programmatic speech which he gave 40 years ago. Given his passion for particle science, he of course answered his question with "yes". Now, 40 years later, working parties of the European Federation of Chemical Engineering, all working on particle technology, managed to organize their second joint event called 'International Conference on Processing, Handling and Characterization of Particulate Materials - PARMAT', in the framework of which this issue of CHERD was edited.

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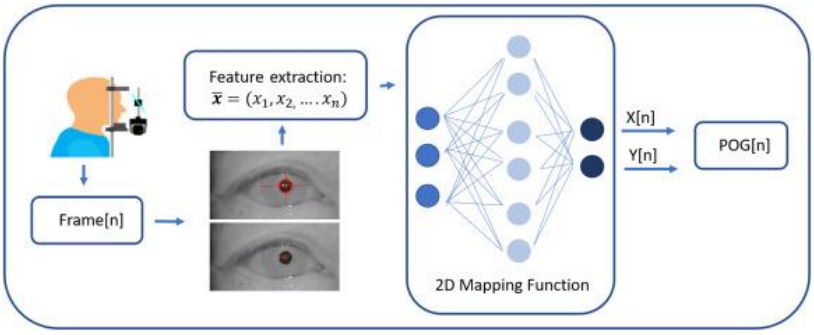
Video-oculography eye tracking towards clinical applications: A review.

Most neurological diseases are usually accompanied by a broad spectrum of oculomotor alterations. Being able to record and analyze these different types of eye movements would be a valuable tool to understand the functional integrity of brain structures. Nowadays, video-oculography is the most widely used eye-movements assessing method. This paper presents a study of the existing eye tracking video-oculography techniques and also analyzes the importance of measuring slight head movements for diseases diagnosis. In particular, two types of methods are reviewed and compared, including appearance-based and feature-based methods which are further subdivided into 2D-mapping and 3D model-based approaches. In order to demonstrate the advantages and disadvantages of these different eye tracking methods for disease diagnosis, a series of comparisons are conducted between them, addressing the complexity of the system, the accuracy achieved, the ability to measure head movements and the external conditions for which they have been designed. Lastly, it also highlights the open challenges in this research field and discusses possible future directions.



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