POLITÉCNICA

BOLETÍN BIMENSUAL DE INVESTIGACIÓN DE LA ETSIDI

escuela técnica superior de ingeniería y diseño industrial

E T S I + D + I

NÚMERO 11

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

Computer Vision Algorithm for Relative Misalignments Estimation in CPV Modules

A key aspect in the performance of a concentrator photovoltaic (CPV) module is a proper alignment between the optics and the photovoltaic solar cell. This work proposes a novel method for measuring misalignments in CPV at different levels, considering misalignments between units at module level or misalignments between modules at tracker level. The method is based on images acquisition (using a CCD camera) and its processing. To validate the method, a CPV module has been measured and results have been compared with a proven method given by the Module Optical Analyzer (MOA).

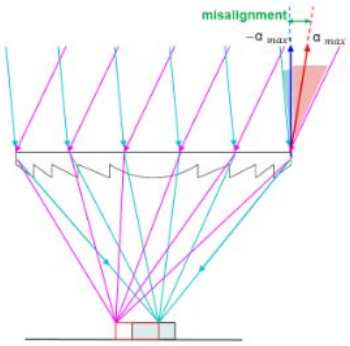

Fig 1. A misalignment between lens and receiver changes the maximum angle of incidence.

Fig 2. Image of the same receiver through the lens at different distances.

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DOI: 10.1063/1.5053548

Assessing the Suitability of Metal-Wrap-Through Solar Cells for Low-Concentration PV Systems

The suitability of metal-wrap-through solar cells has been explored through a set of solar cells developed and optimized by Fraunhofer ISE for LCPV operation. Flexural strength testing and finite element modeling give evidence of the feasibility of MWT cells as a receiver for low concentration PV systems. MWT cells encapsulated as receivers withstand mechanical stresses equivalent to very large thermal loads (higher than those defined in the qualification standard) and show no fatigue effects after a number of bending loading cycles equivalent to their expected lifespan. Dark I-V curve screening and the comparison of electroluminescence images monitor cell damage. Large losses are found under nonuniform concentrated light, which implies that a strong tradeoff still lies between acceptance angle and efficiency. A redesign of the MWT cell metal grid or via spacing might be required to reduce series resistance losses under realistic concentrated spot illumination profiles.

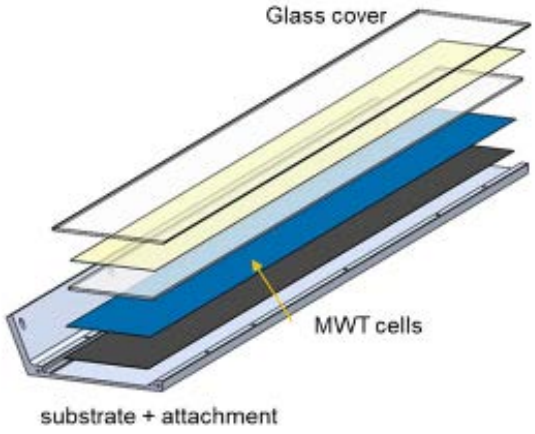

Fig 2. Receiver architecture

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From Component to Multi-junction Solar Cells for Spectral Monitoring

Concentrator photovoltaic usually embeds multi-junction solar cells, which exhibit high spectral sensitivity due to the internal series connection of the sub-cells. The use of so-called isotype or component cells with the same spectral response as the corresponding sub-cell, is widely applied for characterizing the spectral content of the impinging irradiance. These isotype sensors can be substituted by the multi-junction cells themselves, which are inherently spectrally tuned to any evolution of the multi-junction technology. To convert a multi-junction cell in a spectral sensor, it is necessary to add bias light within the spectral response of all but one of the sub-cells to saturate the corresponding junctions, so the non-saturated limits the current under any specified impinging spectrum. This paper shows indoor and outdoor side-by-side comparison of the so-called pseudo isotypes, based on a triple-junction solar cell, and genuine isotypes. The conditions to ensure an accurate spectral response, particularly for the bottom pseudo-isotype, are presented and discussed.

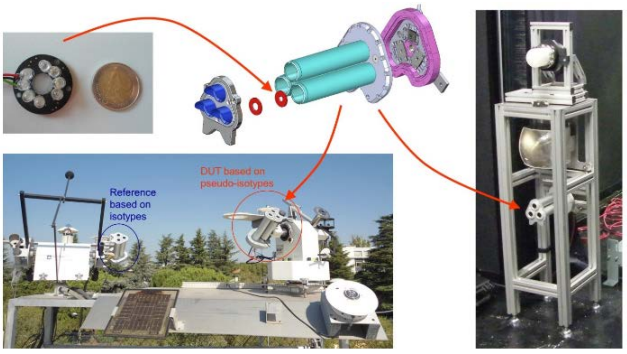

Fig 1. The picture on the top left shows the designed PCB […]. The pictures on the bottom left shows the instrument installed in the meteorological station at IES-UPM for a side-by side comparison with a reference device equipped with 3 isotypes. On the right, the picture shows the instrument installed in the Helios 3198 solar simulator at IES-UPM laboratories.

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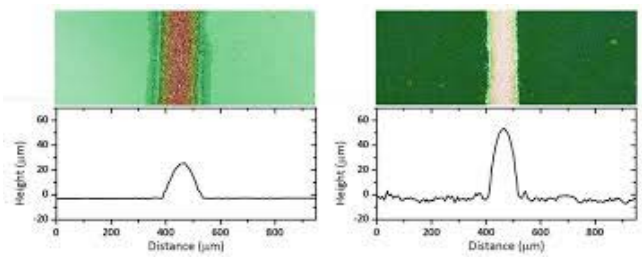
Laser-Induced Forward Transfer of silver-based pastes for metallization of photovoltaic devices

Laser-induced forward transfer (LIFT) is a fast, clean, non-contact metallization technique that allows the deposition of small volumes (down to picoliters) of a wide range of materials in a very precise and controlled way. In this work, we show a complete description of the metallization by LIFT using pulsed laser sources and a commercial silver-based paste. We include a description of the transference process and discuss the influence of the paste viscosity and the acceptor substrate roughness. To avoid the use of a standard paste-curing process in a furnace, a second laser process is used to cure the silver paste in a selective way, preventing any thermal damage in the materials below the paste or in other parts of the device.

In summary, we show that the use of a LIFT technique allows the metallization of wide areas with high aspect ratio lines, that can be cured selectively, and present very good mechanical properties, being suitable for its use in flexible electronics applications.



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Evaluation of isolated sewage treatment systems in Nicaragua.

For some time, interesting projects have been undertaken to treat wastewater in isolated rural areas through low-cost facilities, which allow improved quality access to service for most of the population without economic resources. The present work addresses the problem of access to family sanitation from a low cost technological perspective with the integration of actors: beneficiaries, local operators, National Institutions, University, and International Development Cooperation Organizations. This article presents the analysis of the technologies implemented, integrated and socially accepted in Local Projects and International Programs in Nicaragua: The Rural Cup and the Popular Ecological Toilet. After evaluating its operation from an applied approach, proposals for analysis are presented, highlighting recurrent issues in the implementation of low cost technologies such as the need to implement processes of dissemination, technology transfer and knowledge democratization.

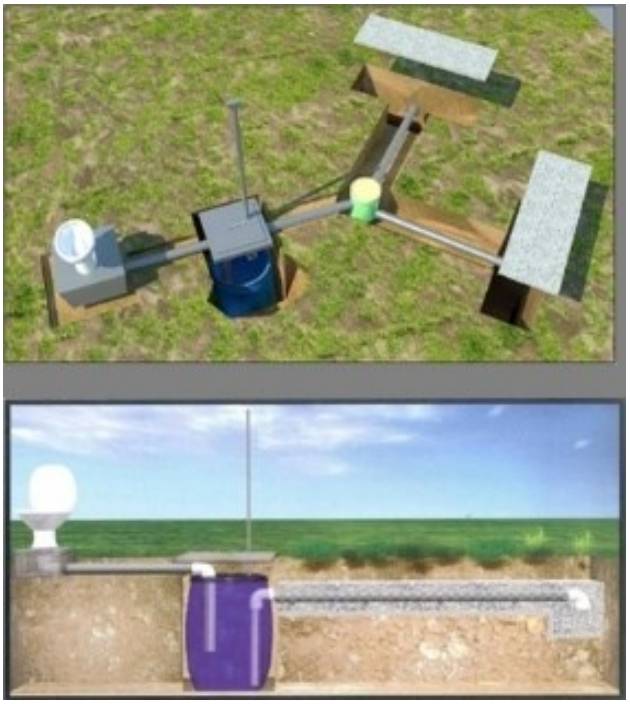

Fig 1. General scheme (plant and profile) of the Popular Ecological Toilet (ENSOME –PIENSA UNI, 2012)

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Characterization and Correction of the Geometric Errors in Using Confocal Microscope for Extended Topography Measurement. Part I: Models, Algorithms Development and Validation

This work presents a method for characterizing and correcting the geometric errors of the movement of the lateral stage of Imaging Confocal Microscope (CM) in extended topography measurement. For an extended topography measurement, a defined number of 2D images are taken and stitched by correlation methods. Inaccuracies due to linear displacement, vertical and horizontal straightness errors, angular errors, and squareness errors based on the assumption of the rigid body kinematics are described. A mathematical model for the scale calibration of the X- and Y- coordinates is derived according to the system kinematics, the axis chain vector of CM, and the geometric error functions and their approximations by Legendre polynomials. The correction coefficients of the kinematic modelling are determined by the measured and certified data of a dot grid target standard artefact. To process the measurement data, algorithms for data partitions, fittings of cylinder centers, and determinations of coefficients are developed and validated. During which methods such as form removal, K-means clustering, linear and non-linear Least Squares are implemented.

Results of the correction coefficients are presented in Part II based on the experimental studies. The mean residual reduces 29.6% after the correction of the lateral stage errors

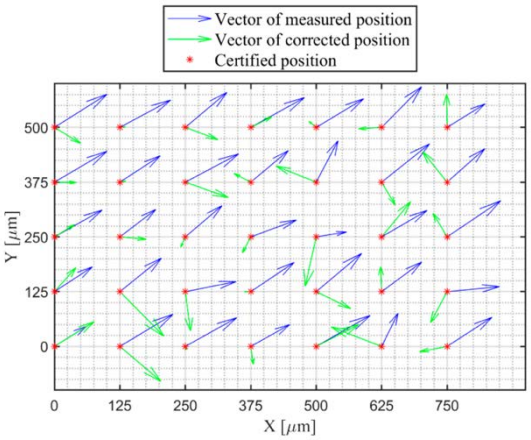

Fig 23. Comparison of the error vectors between the measured and corrected points of

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Experimental Determination of Electronic Density and Temperature in Water-Confined Plasmas Generated by Laser Shock Processing

In this work, diagnoses of laser-induced plasmas were performed in several Laser Shock Processing (LSP) experiments using the Balmer H ff -line (656.27 nm) and several Mg II spectral lines. A Q-switched laser of Nd: YAG was focused on aluminum samples (Al2024-T351) in LSP experiments. Two methods were used to diagnose the plasma. The first method, which required two di ff erent experiments, was the standard for establishing the electronic temperature through the use of a Boltzmann Plot with spectral lines of Mg II and self-absorption correction. The Stark width of the Balmer H ff -line was used to determine the electron density in each of the cases studied. The second method had lower accuracy, but only required an experimental determination. Two parameters, the electronic temperature and the electron density, were obtained with the aid of the H ff -line in a single data acquisition process. The order of magnitude of the temperature obtained from this last method was su ffi ciently close to the value obtained by the standard method (within a factor lower than 2.0), which is considered to be important in order to allow for its possible use in industrial conditions.

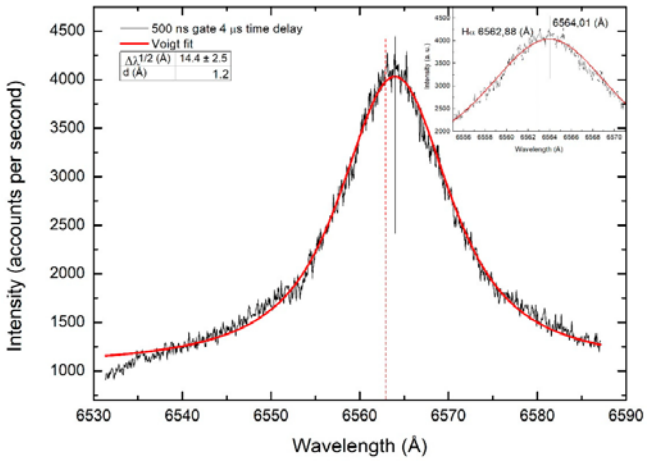

Fig 6. Voigt profile fitting to experimental H_-line emission of the plasma with a gate time of 500 ns at 4 _s delay time with a wavelength range from 6530 to 6590 Å.

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DOI: 10.3390/met9070808

Magnetic frustration in partially ordered double perovskites Ln(3)Ni(2)RuO(9) (Ln = La, Nd)

Ln(3)Ni(2)RuO(9) (Ln = La, Nd) oxides (prepared by a solid state metathesis route) adopt a monoclinic (P2(1)/n) A(2)BB'O-6 double perovskite structure wherein the two independent octahedral 2c and 2d sites are occupied by Ni2+ and (Ni1/32+Ru2/35+) cations, respectively. In contrast to the expected ferromagnetic behavior, Ln(3)Ni(2)RuO(9) oxides show a spin-glass behavior without long range magnetic order down to 2 K. These results reveal the importance of competing nearest neighbor (NN), next nearest neighbor (NNN) and third nearest neighbor (third NN) interactions between the magnetic Ni2+ and Ru5+ ions in the partially ordered double perovskite structure that conspire to thwart the expected ferromagnetic order in these materials.

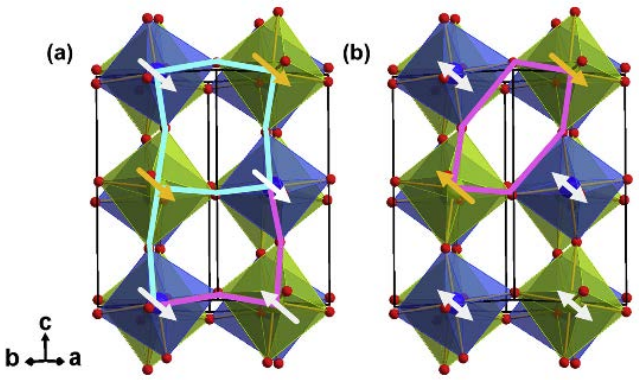

Fig 3. Schematic diagrams showing the interaction pathways over the crystal structure of Ln3Ni2RuO9

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Physical properties of gasoline-ETBE-isobutanol (in comparison with ethanol) ternary blends and their impact on regulatory compliance

Many developed countries promote biofuels to fight against climate change. The blend of ethanol and ethyl tert-butyl ether (ETBE) with gasoline is a common way to increase the renewable energy content of fuel. The use of bio-isobutanol instead of or in addition to ethanol can help solve some problems of ethanol.

Eighty five gasoline-isobutanol-ETBE blends (up to 100/100/30%v/v respectively) were tested. For each blend, the density, vapour pressure (RVP) and distillation curve were measured. The impact that the addition of isobutanol-ETBE blends has on gasoline standards was analysed and also compared with that caused by the addition of ethanol-ETBE blends.

Some chemical data of these fuels and the densities measured allow us to identify some advantageous properties for isobutanol blends in terms of oxygen content, energy density, stoichiometry, renewable energy content, etc. The excess of RVP for isobutanol ternary blends is lower than that of ethanol blends, being advantageous in terms of evaporative emissions. Apart from the oxygen content limit, the most restrictive parameters for isobutanol ternary blends are the evaporated percentages at 100 °C and 70 °C, and the RVP.

Nevertheless, the different performance of ethanol and isobutanol blends could help to meet fuel standards by using both bio-alcohols at once.

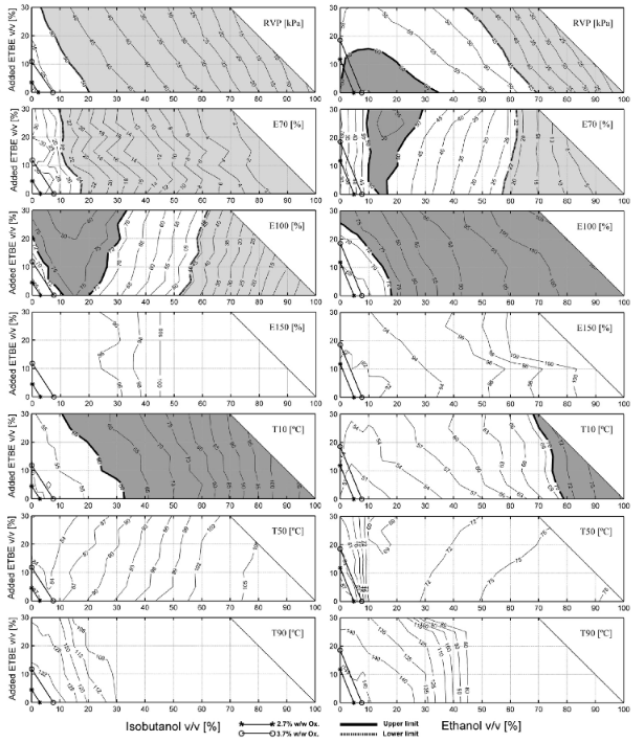

Fig 1. RVPand other parameters related to distillation profile for UNE EN 228 (E70,E100andE150) and ASTM D4818 (T10,T90andT50) of ethanol TBs [16] (right) and isobutanol TBs (left)

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Experimental Validation of an Escalator Simulation Model

Today's escalator mechanical systems are based on 100-year-old conventional designs. A sustainable innovation is possible but the industrial inertia of making a prototype for each design has to be changed. This document describes a methodological approach for comparing and validating simulation models through measurements performed on a prototype of a recently patented design. The methodology is based in the adjustment of parameters and the synchronization of cyclic signals in time, allowing the comparison of measurements and simulated outputs. Results shows a high level of correlation between the signals in the time and frequency domains, thus validating the dynamic model and the methodology here presented.

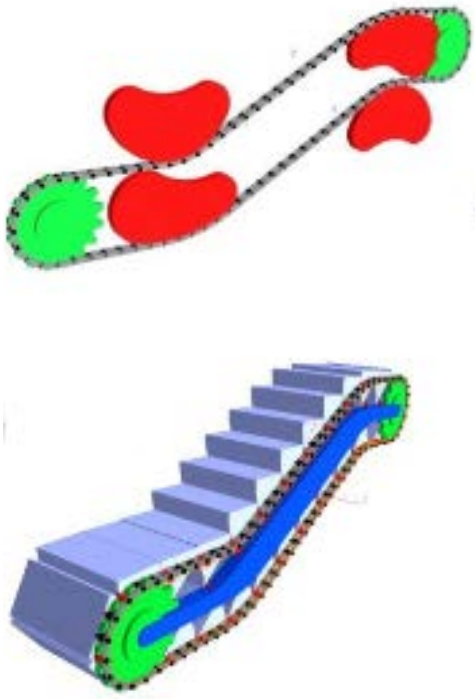

Fig 1. Escalator model developed with the Simpack CHAIN module

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(PDF)

Identification and mapping of asphalt surface deterioration by tyre-pavement interaction noise measurement

This paper proposes a novel approach to detect the pavement surface deterioration using tyre/road noise produced from a sensorized test-vehicle during a regular driving. The acoustic data have shown to be relevant on automatic asphalt-damage classification. In this proof of concept, four classes of bituminous road-surface states were classified, showing very promising results. The application of this technique will allow automated inspection, geolocation and prioritization of roads or street areas that may need maintenance and repair, in addition to informing drivers or autonomous vehicles about road safety conditions in order to prevent accidents.

With this approach any vehicle can easily become an asphalt status tester with the installation of a microphone, enabling the possibility to transform any fleet of vehicles into a networked signal acquisition system that may form part of the decision support of administrations in the management and maintenance of road infrastructures, at a very low cost.

Fig 2. [One of the four] Proposed classes of asphalt deterioration for automatic detection in this proof of concept.

Fig 4. Testing Car

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