POLITÉCNICA

escuela técnica superior de ingeniería y diseño industrial

NOTICIAS DE INVESTIGACIÓN

ETS I+D+I

BOLETÍN BIMENSUAL DE INVESTIGACIÓN DE LA ETSIDI

NÚMERO 8 MARZO – ABRIL DE 2019

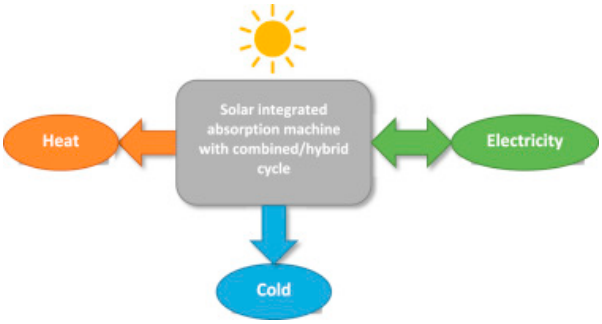
http://www.etsidi.upm.es/Investigadores/ActivYpublicacDeInvestigacion/BoletinETSIDI

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.

PUBLICACIONES

Theoretical study of direct vapor generation for energy integrated solar absorption machines.

Integrating the vapor generator/separator of an absorption machine and the solar collector field is proposed as a means to reduce the cost and complexity of solar cooling and heating facilities. In order to further enhance the competitiveness of these facilities, some previous work on hybrid and combined absorption cycles is analyzed so that the proposed integration can be configured using these cycles. As a result, a single machine could in addition to pump heat can produce electricity and even consume it for fulfilling the cold and heat demand from the user when solar is not enough, this avoiding implementing a vapor mechanical compressor.



The flow established inside the linear solar collector receiver tube is gravity driven and stratified under a counterflow regime. This configuration is numerically modeled in a steady-state 1D fashion, adapting established convective boiling correlations and including modifications for the mixture effects of the zeotropic dissolution NH3-LiNO3. used as working fluid for the absorption machine.

The results indicate that the proposal is viable with collector lengths compatible with industrial applications. A low sensitivity to the boiling heat transfer correlation chosen has been found.

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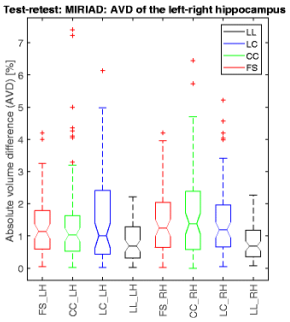
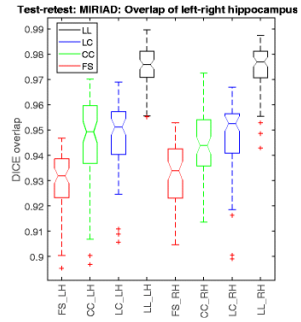
DOI: 10.1016/j.renene.2018.09.056

Longitudinal Neuroimaging Hippocampal Markers for Diagnosing Alzheimer's Disease.

Hippocampal atrophy measures from magnetic resonance imaging (MRI) are powerful tools for monitoring Alzheimer's disease (AD) progression. In this paper, we introduce a longitudinal image analysis framework based on robust registration and simultaneous hippocampal segmentation and longitudinal marker classification of brain MRI of an arbitrary number of time points. The framework comprises two innovative parts: a longitudinal segmentation and a longitudinal classification step. The results show that both steps of the longitudinal pipeline improved the reliability and the accuracy of the discrimination between clinical groups. We introduce a novel approach to the joint segmentation of the hippocampus across multiple time points; this approach is based on graph cuts of longitudinal MRI scans with constraints on hippocampal atrophy and supported by atlases. Furthermore, we use linear mixed effect (LME) modeling for differential diagnosis between clinical groups. The classifiers are trained from the average residue between the longitudinal marker of the subjects and the LME model. In our experiments, we analyzed MRI-derived longitudinal hippocampal markers from two publicly available datasets (Alzheimer's Disease Neuroimaging Initiative, ADNI and Minimal Interval Resonance Imaging in Alzheimer's Disease, MIRIAD). In test/retest reliability experiments, the proposed method yielded lower volume errors and significantly higher dice overlaps than the cross-sectional approach (volume errors: 1.55% vs 0.8%; dice overlaps: 0.945 vs 0.975). To diagnose AD, the discrimination ability of our proposal gave an area under the receiver operating characteristic (ROC) curve (AUC) = 0.947 for the control vs AD, AUC = 0.720 for mild cognitive impairment (MCI) vs AD, and AUC = 0.805 for the control vs MCI.





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A study evaluating the level of satisfaction of the students of health sciences about the use of 3D printed bone models.

This work presents a study carried out by taking a survey involving students that belong to the field of health sciences. The purpose of the survey was to evaluate the use of 3D models for the study of anatomy and how students found them useful or preferred them over original bone pieces from corpses. 250 students from various faculties of health sciences from University of Salamanca, Spain.participated in the survey. The results demonstrated that the 3D bone models are very well accepted by the students and fulfil the pedagogical objectives in a significant way. Furthermore, the results showed that the use of this material for university anatomy teaching is valued.

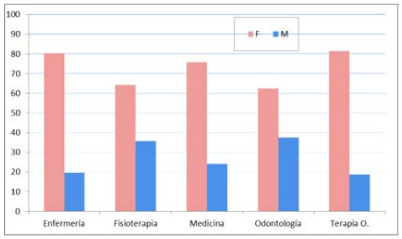

Gráfico 1: Sexo

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The importance of the new Apps technology in the study of anatomy by the students of medicine.

New technologies have been introduced as a teaching tool in medical schools for the learning of anatomy, providing a new methodology that facilitates the dissemination of scientific knowledge and facilitates their learning. Recently, smart phones have an ever-increasing presence in our personal and professional life, at universities and institutions and by all, teachers and students. The technological tools that are offered by smartphones and tablets have significantly transformed the teaching methods. Given a wide variety of educational applications available in the virtual stores of these systems, an analysis is useful which can summarize the features of these apps and shows their importance in learning. This work presents an analytical evaluation of the applications that are used in the teaching of anatomy for the students of medicine. The apps have been analyzed on the basis of their technological characteristics and anatomical content. In this work, we have proceeded to analyze five free apps for Android devices and thus guide the anatomy students of the Faculty of Medicine.

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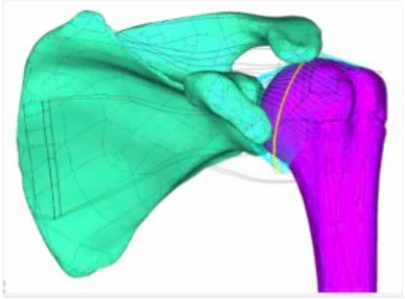
Finite element simulation and analysis of the behavior under load of a human shoulder.

Majority of musculoskeletal injuries located in the shoulder are often due to repetitive or sustained movements which occur in work routines in different areas. In the case of workers in the construction sector, repetitive routine and movements under load produce displacements and unnatural postures of the shoulder joint. For this reason, the objective of this study is to model in 3D the biological elements that form the shoulder joint for subsequent Finite Element Analysis (FEA). Three cases of different loads have been considered in this first study. With the analysis developed, and thanks to the linear and isotropic joint approach has been possible to evaluate the stresses in the elements: muscles, tendons and ligaments. The methodology used allowed to obtain an improved mesh of the shoulder joint to analyze real situations with FEM analysis with applications in the field of sports medicine, work, etc. Furthermore, the simplification adopted for the modeling of the joint muscles, as 1D elements in FEM, has made it possible to establish different positions of the human joint without having mesh again each one of the positions that can be studied. The results are consistent with the states of applied loads.



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Monitoring of the additive manufacturing process for the use of biomaterials in medical.

The main purpose of this work is to monitor the conditions of production of structures by fused deposition in the use of biocompatible materials. During the process of production by fused deposition or FDM, different external disturbances to the characteristics of the machine can affect to it, causing the final result differs from the desired one. These disturbances, such as temperature or chamber humidity, in the case of using biocompatible materials, can also cause them to modify or lose their properties; what will make the product unusable. Apart from these external disturbances, the conditions of the machine to which the material is subjected must also be considered, such as temperature, vibrations or extrusion speed. The compilation of all these data will allow to know the conditions to which the material has been submitted during the process and in this way to be able to verify the validity of the final product.

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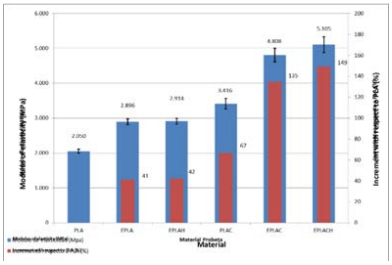
Composite material created by additive manufacturing techniques FFF and Robocasting for the manufacture of medical parts.

The purpose of this study is to create a new technique of additive manufacturing that allows creating pieces of composite material for the medical industry. This material gives the pieces' characteristics such as: lightness and resistance. In addition, with the use of this material the geometry of the pieces to be built is not limited as in the systems of traditional manufacture of composite material. For this reason, we will work with thermoplastic materials and epoxy adhesives on an additive manufacturing machine based on the FFF technique. The composite material has been obtained by a new manufacturing system. An adhesive extruder head has been designed which has been manufactured using the FFF technique. This new extruder is implemented in an AM RepRap machine next to the thermoplastic filament extruder. The joint printing of both materials, in alternating layers, generates a composite material that allows to increase the structural properties of the piece in the XY plane. The new additive manufacturing system allows to obtain mechanical improvements both in the modulus of elasticity and in the tensile strength. Increase the modulus of elasticity of a value between 50-80% depending on the thermoplastic filament used. In the same way the tensile strength has increased between 50-60%. The improvement in the strength / weight ratio makes this new additive manufacturing system allows to create medical pieces in which the lightness and resistance are its main characteristic such as orthopedic prostheses. The study shows that the use of FFF together with Robocasting, as a manufacturing process for end-use parts, generates an additional advantage that had not been considered until now. The combination of a thermoplastic and an epoxy resin opens a new path in the additive manufacturing since it allows creating pieces with new qualities without being conditioned by the design.



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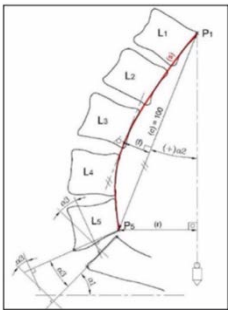
Postural morphological model for the characterization of raquis lumbar.



The individual's posture is the physical expression of his body. It is modified throughout life and it is determined by the particular anatomical characteristics that directly affect the biomechanics of the spine. The possibility to have a method for the systematic postural characterization of the lumbar spine is essential to be able to have an objective resource for the knowledge of body posture. The present study proposes the development of a morphological postural model of the spine in the lumbar region. The model is based on a system of measurement of objective and comparable parameters by means of X-ray analysis, in order to characterize its morphology in the sagittal plane. The systematization through geometric and mathematical models is very useful in the measurement and study of the lumbar spine in disciplines such as biomechanics, orthopedics, physiotherapy, sports, simulation or ergonomics and industrial design.

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On the Dental BioTribology: Comparison of Zirconia/Zirconia and Zirconia/Natural Tooth Friction Coefficients by Using a Reciprocating Tribometer.

In recent years the interest of tribology applied to dentistry is taking on a large scale due to its rapid expansion and growth. Intensive experimental research conducted on dental tribology allows to develop a more detailed understanding of all the phenomena that take part in the phenomenon of tooth wear. The purpose of this work is to investigate tribological performances in the tooth-to-tooth contact and material-to-natural tooth contact (zirconia vs. zirconia and natural tooth vs. zirconia). The tribological tests were carried out by using a reciprocating tribometer under lubricated conditions (artificial saliva). The normal force in these tests was 20 N, and the duration was of 60 min. The stroke length was 2 mm, according to the range of displacement used in scientific literature. The wear mass loss evaluation was evaluated by using a gravimetric method. A topographic analysis was carried with a 3D non-contact optical profiler in order to characterize the wear mechanisms present in the worn surfaces after each of tribo-tests. The results show that the minimum value of the COF is obtained in the case of Zirconia vs. Zirconia tribo-couple, corresponding to 0.49 +/- 0.03. In the case of the tooth-tooth couple this value is 0.52 +/- 0.03. The results on the wear mass loss show a very low wear rate when coupling in tribological condition natural tooth with a ceramic restoration (a mean value of 0.5 mg was found). This rate is even lower when the contact is between two artificial zirconia teeth.

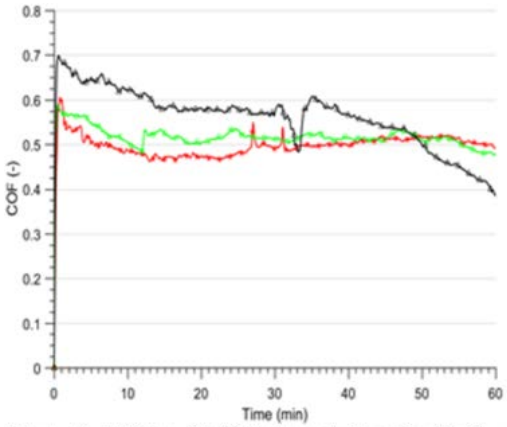

Figure 4: Friction Coefficient evolution for Teeth vs

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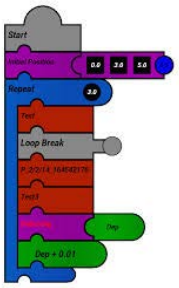
Hammer: Robot Programming Interface for Common People.

This video shows the main features of Hammer, a tablet-based end-user interface for industrial robot programming, in a real environment: a robotic cell created for the Hephestos European project. Hammer is an Android application that makes easier to program tasks for industrial robots like polishing, milling or grinding. It is based on the Scratch programming language, but specifically design and created for Android OS. It is a visual programming concept that allows non-skilled operators to create programs. The application allows to monitor the tasks while it is being executed by overlapping real time information through augmented reality. The application includes a teach pendant screen that can be customized according to the operator needs at every moment. The application is designed for online programming and reprogramming; easy use of learn-by-demonstration methods; easy connection with the robot control and sensors systems; and safety-system integration. It aims to be intuitive, easy to use, and simple. The application has four main parts: customized teach pendant, robot programming IDE and simulator, manual-guidance interface and augmented-reality-based-monitoring system.



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WOS: 000458872705002

Expert-Guided Kinodynamic RRT Path Planner for Non-Holonomic Robots.

In this paper, an Expert-Guided Kinodynamic RRT algorithm (EGK-RRT) is presented. It aims to consider how a human pilot would navigate a kinodynamic robot. One of the characteristics of this algorithm is the fact that, unlike the original RRT for kinodynamic systems, it generates deterministic control sequences which can be reproduced as long as the sequence of references (sampled states) are known. Here, the performance of the proposed algorithm is tested against the basic RRT, showing that the EGK-RRT greatly improves in terms of execution speed. In addition to this, the influence of using a visibility check and an inertia estimation in order to select the nearest neighbor is also analyzed, demonstrating that a combination of both factors leads to a better overall performance, both in execution speed and in quality of the generated path.

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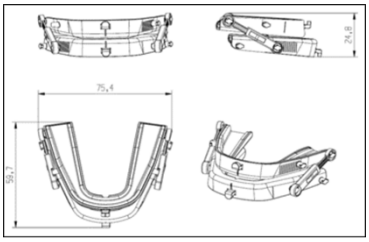
WOS: 000458872705150

Study, Design and Prototyping of Oral Appliances to Treat Obstructive Sleep Apnea.

The purpose of an Oral Appliances (OA) is treat Obstructive Sleep Apnea (OSA), primary snoring and associated symptoms. OAs is intended to decrease the frequency and duration of apneas, hypopneas, respiratory efforts related arousals (RERAs) and snoring events. Oral appliances (OAs) are devices intended to protrude and help stabilize the mandible mechanically during the night in order to reduce the collapsibility of the upper airway during sleep. A custom OA is fabricated using digital or physical impressions and models of an individual patient's oral structures. It is made of biocompatible materials and engages both the maxillary and mandibular arches. The perfect OA has not yet been designed. For these reasons, the objective of this paper is to present a new customizable and adjustable chairside OA. The device integrates the best characteristics of the previous designs and minimizes inconveniences and possible side effects. The design prerequisites were: effectiveness treatment of OSA and snoring, easy assembly and titration, safety, comfortable and not bulky, good retention, low cost, durable, easy cleaning and adaptable to the shape of adult dental arch.



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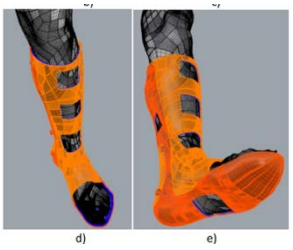
Design and prototyping by additive manufacturing of a functional splint for rehabilitation of Achilles tendon intrasubstance rupture.

Technology allows the realization of individualized immobilization splints by Advanced Manufacturing techniques based on additive manufacturing, industrial digitalization and reverse engineering. In this sense, good results have been achieved in the optimization of the design process, the reduction of manufacturing costs, the development of materials used and the environmental impact. However, its definitive implementation requires other factors of improvement that take into account the initial sanitary use for which they were designed. The present study aims to provide functional characteristics in the initial design to a splint for rehabilitation of partial Achilles tendon rupture. The result allows applying simultaneous rehabilitation techniques during the immobilization stage of the affected limb in order to minimize the possible muscular, joint and vascular complications derived from the application of the classic retention devices in this phase of the treatment.



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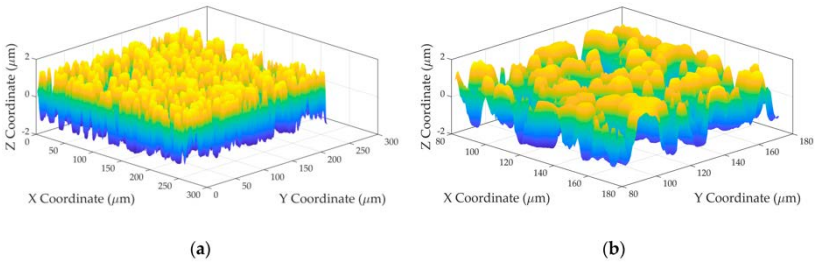
Procedure for Calibrating the Z-axis of a Confocal Microscope: Application for the Evaluation of Structured Surfaces.

This work describes a method for the metrological characterization of structured surfaces using a confocal microscope. The proposed method is based on the calculation of texture parameters established in ISO 25178-2:2012. To ensure the traceability of these parameters, a procedure for the calibration of the Z-axis of the confocal microscope is proposed. The calculation of uncertainty associated with each parameter employs the Monte Carlo method, as well as the concept of a virtual instrument. The validity of the algorithms has been verified through the use of synthetic data provided by the National Institute of Standards and Technology (NIST) and physical standards, with minimum differences being obtained between the certified values and calculated or measured values. Finally, using the proposed method, the topography of a structured surface manufactured by laser machining is evaluated, obtaining the most used roughness parameters, as well as their measurement uncertainties and possible correlations. In general, it can be affirmed that it is possible to obtain metrologically reliable results with the proposed method.



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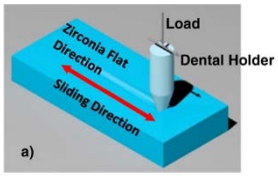
Experimental Comparison on Dental BioTribological Pairs Zirconia/Zirconia and Zirconia/Natural Tooth by Using a Reciprocating Tribometer.

The application of tribology in dentistry is growing rapidly, intense research has been conducted to develop an understanding of dental tribology for better selection of artificial materials and dental implant design. Dental biotribology, has been one of the most important branches in biotribology in recent years. The aim of this research is to investigate the tribological performances in the tooth-to-tooth contact and material-to-natural tooth contact (zirconia vs. zirconia and natural tooth vs. zirconia). The presented research was carried out by testing the above mentioned tribological pairs with the use of a reciprocating tribometer under lubricated conditions (artificial saliva). The normal force used in the tests was 20N the time for each test was of 60min. The stroke length was 2mm, according to the range of displacement used in scientific literature. The wear mass loss evaluation was evaluated by using a gravimetric method. In order to characterize the wear mechanisms, present in the worn surfaces after each of tribo-tests, a topographic analysis was carried with a 3D non-contact optical profiler. The results show that the minimum value of the COF is obtained in the case of Zirconia vs. Zirconia tribo-couple. The results on the wear mass loss show a very low wear rate when coupling in tribological condition natural tooth with a ceramic restoration (a mean value of 0.5mg was found). This rate is even lower when the contact is between two artificial zirconia teeth.



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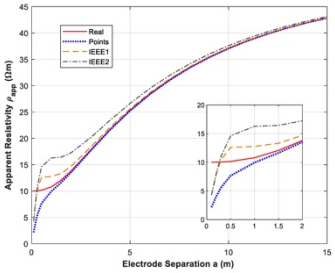
Wenner Soundings for Apparent Resistivity Measurements at Small Depths Using a Set of Unequal Bare Electrodes: Selected Case Studies.



The possibility of using a set of unequal electrodes, within limits, in a Wenner arrangement for the measurement of apparent resistivity at small depths is explored in this paper. A procedure in which only a simple preliminary calibration is necessary to obtain the best measurements of the apparent resistivity is proposed. On the basis of some case studies, a comparison with the usual procedures to obtain the apparent resistivity from resistance measurements is carried out. The results showed that when an unequal set of electrodes was used, the procedure proposed here was the only one that guaranteed the best apparent resistivity values for any value of electrode separation in the Wenner arrangement, especially for those associated with small depths.

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Discriminating Alzheimer's disease progression using a new hippocampal marker from T1-weighted MRI: The local surface roughness.

Hippocampal atrophy is one of the main hallmarks of Alzheimer's disease (AD). However, there is still controversy about whether this sign is a robust finding during the early stages of the disease, such as in mild cognitive impairment (MCI) and subjective cognitive decline (SCD). Considering this background, we proposed a new marker for assessing hippocampal atrophy: the local surface roughness (LSR). We tested this marker in a sample of 307 subjects (normal control (NC)=70, SCD=87, MCI=137, AD=13). In addition, 97 patients with MCI were followed-up over a 3-year period and classified as stable MCI (sMCI) (n=61) or progressive MCI (pMCI) (n=36). We did not find significant differences using traditional markers, such as normalized hippocampal volumes (NHV), between the NC and SCD groups or between the sMCI and pMCI groups. However, with LSR we found significant differences between the sMCI and pMCI groups and a better ability to discriminate between NC and SCD. The classification accuracy of the LSR for NC and SCD was 68.2%, while NHV had a 57.2% accuracy. In addition, the classification accuracy of the LSR for sMCI and pMCI was 74.3%, and NHV had a 68.3% accuracy. Cox proportional hazards models adjusted for age, sex, and education were used to estimate the relative hazard of progression from MCI to AD based on hippocampal markers and conversion times. The LSR marker showed better prediction of conversion to AD than NHV. These results suggest the relevance of considering the LSR as a new hippocampal marker for the AD continuum.

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Fluid Film Pressure Description in Finite Turbulent Lubricated Journal Bearings by Using the Warner's Theory.

The purpose of this paper is to propose a method for the analytical description of the non-steady fluid film for the liquid-lubricated finite journal bearings operating in a fully developed turbulent regime. The analytical description takes in account a symmetrical rigid rotor supported on two lubricated journal bearings under the classical assumptions of the Reynolds theory. The proposed methodology represents an extension of the Warner's approach and allows to solve analytically in approximate way the equation governing the distribution of pressure in the bearing oil gap and then to obtain the analytical expressions for the unsteady fluid film forces giving particular attention to their continuity in the entire definition domain, introducing original analytical functions called "jump function". The proposed model allows not only to minimize the computation time without any significant loss of accuracy in the nonlinear dynamic analysis of rotors on turbulent journal bearings but also permits a better readability of the parameter effects on the system unsteady behavior.

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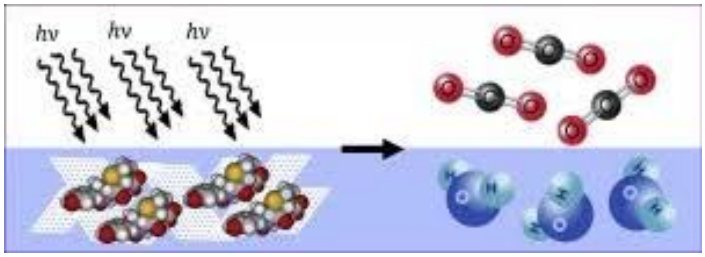
3D printed floating photocatalysts for wastewater treatment.

Organic contaminants, specifically contaminants of emerging concern (CECs), have a great environmental impact, since the removal of these pollutants is of great difficulty by conventional treatments and the presence of these pollutants in the aquatic medium, even at low concentrations, is extremely hazardous to human health. Advanced oxidation processes and, specifically, TiO2-photocatalytic process is considered an option with positive results for an efficient treatment. However, the photocatalyst must be accessible to the UV radiation, for the activation of the TiO2. For this reason, it is recommendable to use a floating photocatalyst (with lower density than water) if the UV light comes from the solar radiation, because it will be on the water surface. In addition, this characteristic of the catalyst can entail an increase of the process efficiency if the pollutant is mainly located on the surface of water. In this context, the goal of this work is the preparation of floating photocatalysts for the removal of CECs from wastewater. TiO2 is deposited in low-density-polyethylene (LDPE), support with lower density than water and high stability and resistance to degradation. LDPE-TiO2 mixtures were prepared by different methods: mixing TiO2 and LDPE in a hot-cylinder-mixer or using o-xylene or an anionic surfactant as dispersing agent, in order to increase the dispersion of TiO2 before extrusion. Filaments obtained were printed as meshes in a Fused-Deposition-Modelling 3D-printer. The printed photocatalysts improved the activity in comparison with the plate obtained in the cylinder, used as benchmark. Thus, this study opens the doors to the in-situ treatment of CECs, using floating photocatalysts and solar radiation as the sole reagent, a very economical, efficient, easily implantable and environmentally compatible process.



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Evaluation of the Applicability of 3d Models as Perceived by the Students of Health Sciences.

The methodology and style of teaching anatomy in the faculties of Health Sciences is evolving due to the changes being introduced as a result of the application of new technologies. This brings a more positive attitude in the students, enabling an active participation during the lessons. One of these new technologies is the creation of 3D models that reliably recreates the anatomical details of real bone pieces and allow access of anatomy students to bone pieces that are not damaged and possess easily identifiable anatomical details. In our work, we have presented previously created 3D models of skull and jaw to the students of anatomy in the Faculties of Health Sciences of the University of Salamanca, Spain. The faculties included were odontology, medicine, occupational therapy nursing, health sciences and physiotherapy. A survey was carried out to assess the usefulness of these 3D models in the practical study of anatomy. The total number of students included in the survey was 280.The analysis of the results presents a positive evaluation about the use of 3D models by the students studying anatomy in different Faculties of Health Sciences.

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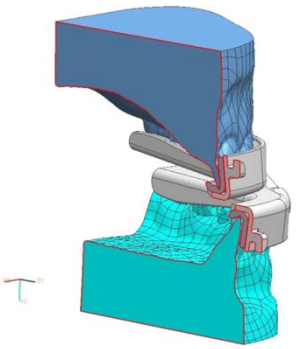
Oral appliance for Obstructive Sleep Apnea: Prototyping and Optimization of the Mandibular Protrusion Device.

Obstructive Sleep apnea is a public health problem. This disease is associated with daytime sleepiness, increased motor vehicle accidents, heart failure and stroke. Treatment options include weight loss, positive airway pressure, pharyngeal and orthognatic surgery. However, selected patients have good response to oral appliances devices that intended to protrude and stabilize the mandible mechanically during the night in order to reduce the collapsibility of the upper airway. Selection of patients includes primary snoring, mild, moderate and positional apnea. The perfect mandibular advance device has not yet been designed. For these reasons, the objective of this paper is to present a new thermoadjustable chair-side oral appliance. Device integrates the best characteristics of custom made and boils and bite previous designs and minimizes inconveniences and possible side effects. The device is a titratable mandibular advancement appliance. It consists of two independent prefabricated trays adaptable to the shape of adult dental arch and linked to each other by a protrusion mechanism. Each tray contains a hard outer shell and a soft thermoplastic resin inner body. The position of the jaw can be adjusted by moving an aluminum rack into, or out from, the guide so the ratchet may get locked into a certain position ensuring the length of the mechanism. The protrusion mechanism is fixed to the splint using small rings that are articulated over a t button. Our prototype satisfies the requirements of an effective oral appliance, in terms of retention, comfort, safety and efficacy. It is easy to fit, durable, low cost, quickly titratable, not bulky and easy cleaning. Thermoplastic appliances are specially used like a predictor of treatment response in apnea patients. The device described is a cost-effective introduction to mandibular advancement technology. A qualified dentist or trained sleep doctor could mitigate dental side effects and reduce their incidence.



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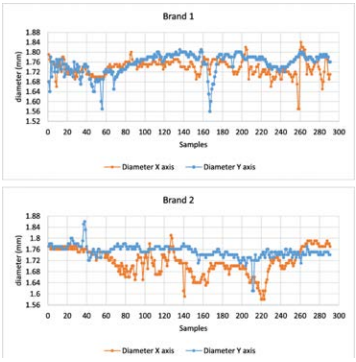
Monitoring an Analysis of Perturbations in Fusion Deposition Modelling (FDM) Processes for the Use of Biomaterials.

During an FDM production process, there are different external disturbances to the characteristics of the machine that can affect to the production process. These disturbances will cause the final result differs from the desired one. Moreover, these disturbances, such as temperature or chamber humidity, are extremely important in case of using biocompatible materials. The use of these kind of materials with not controlled environment, can cause them to modify or loss of their properties; what will make the product unusable. Apart from these external disturbances, the conditions of the machine to which the material is subjected must also be considered, such as temperature, vibrations or extrusion speed. The monitoring of all these data will allow to know the conditions to which the product was exposed during the process. In this way, it will be able to verify the validity of the final product. For these reasons, the purpose of this work is to monitor the conditions of production of structures with biocompatible materials by fused deposition modelling (FDM) technique. This monitoring will allow us to obtain a report that guarantee the technical and geometrical characteristics of the model and the biomaterial properties. The parameters chosen to be monitored are: Diameter of filament use, temperature in extrusion nozzle, ambient temperature in closed chamber, ambient humidity in closed chamber. The obtained results, after collected and analysing the data, present variations of up to 3% in the temperature of the nozzle of the extruder with respect to set temperature. In the case of the filament diameter the difference with respect to the value provided from the filament supplier is of 13,7%. In addition, the results show how the ambient humidity in closed chamber has changed by 2 percentage points and the ambient temperature in closed chamber has been increased 6,52 degrees C with respect to the set values.



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Clear sky solar irradiance models: A review of seventy models.

Clear sky solar irradiance parametric models seek to simplify the atmospheric attenuation with relatively simple parameterizations in order to estimate solar irradiance under clear sky conditions, avoiding the use of computationally expensive radiative transfer models. These models are particularly useful when estimating solar irradiation with satellite retrievals. Due to the great number of clear sky parametric models, it is somehow complicated to decide the choice of model to be selected. This article continues the work of previous reviews of clear sky models adding new models up to seventy described models for diffuse, beam and global components. A model benchmark is performed with ancillary solar irradiance data from two meteorological stations belonging to the Baseline Surface Radiation Network (BSRN) and also ancillary aerosol data from the Aerosol Robotic Network (AERONET). Results show great differences in performance between models, leading to priorize the use of only a few of them.

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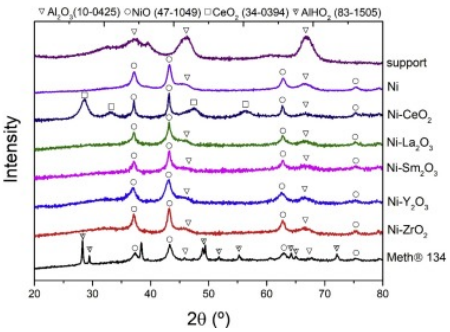
Metal-oxide promoted Ni/Al2O3 as CO2 methanation micro-size catalysts.

The Power-to-Gas concept has the challenge to convert the excess of renewable electricity to synthetic natural gas, composed mainly by methane, through CO2 methanation. The superior heat transfer capacity of micro-structured reactors offers a suitable alternative for an efficient control of the reaction temperature. In the present work, the strategy of adding large amount of metal oxide promoters (15 wt.%) to nickel supported on micro-size catalysts (d(p) = 400-500 mu m) is presented. The addition of CeO2, La2O3, Sm2O3, Y2O3 and ZrO2 was clearly beneficial, as the corresponding metal-oxide promoted catalysts exhibited higher catalytic performance than Ni/Al2O3 and the commercial reference Meth (R) 134 (T = 200-300 degrees C, P = 5 bar.g). This increase of catalytic activity is attributed to the higher amount of CO2 adsorbed on the catalyst. Among the selected promoters, La2O3 showed the highest catalytic activity (X-CO2 = +20% at 300 degrees C) due to the enhancement of nickel reducibility, nickel dispersion and the presence of moderate basic sites. In addition, Ni-La2O3/Al2O3 was stable for one week, while the unpromoted catalyst exhibited a slight decline in its activity. Accordingly, the technical catalyst proposed in this study could be used directly in compact reactors for CO2 methanation with much higher activity than the commercial reference.



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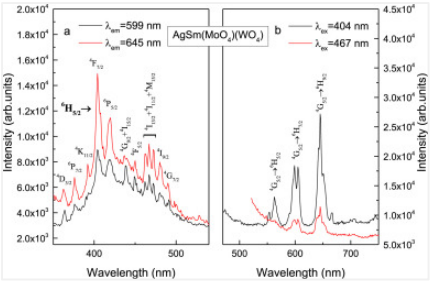
Characterization and photoluminescence properties of AgLn(MoO4)(WO4): Novel silver based scheelite-type compounds.

Novel silver based rare earth tungstate-molybdate, AgLn(MoO4)(WO4), with scheelite-like structure have been synthesized by ceramic method. The crystal structure, luminescence properties and fluorescence lifetime of a series compounds were investigated systematically. Some special characteristic emission bands were observed which can be attributed by the energy transfer between Ag+ and Ln(3+) ions. Especially, AgDy(MoO4)(WO4) and AgHo(MoO4)(WO4) phosphors can emit white light under near-UV excitation, with chromaticity coordinates at about (0.3605, 0.3652) and (0.3559, 0.3479) respectively. Fluorescence lifetime of Eu3+ and Tb3+ were measured in both room temperature and liquid nitrogen temperature. In excitation spectra, the evident blue shift of charge transfer (CT) band in the case of liquid nitrogen temperature indicates that the effective W-O and Mo-O covalence bond is lower at liquid nitrogen temperature which can be caused by the lower wave function overlaps of W-O and Mo-O. Furthermore, low temperature showed positive effect for longer fluorescence lifetime.



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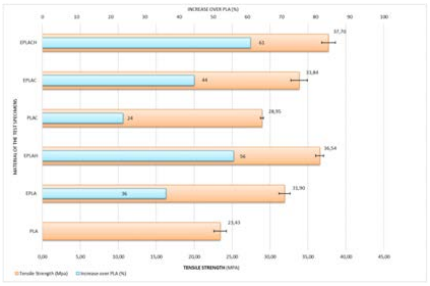
Novel Technique Based on Fused Filament Fabrication (FFF) and Robocasting to Create Composite Medical Parts.

The purpose for this study is to obtain a new composite manufacturing system based on Additive Manufacturing techniques that allows the creation of parts for the medical industry. These pieces will be resistant, lightweight and may have geometries more complex than those created with traditional systems of composite material. The new system is based on the union of two heads on a 3D Rep-Rap printer. One of the heads is an extruder head of thermoplastic Fused Filament Fabrication (FFF) and the other is a dosing head, based on the Robocasting technique, designed to be assembled on the 3D printer. Thermoplastics material and epoxy resin will be used. The alternate printing of both materials generates a piece of composite material. This new technique will allow to increase the structural properties of the piece in the XY plane. The new additive manufacturing system allows to obtain mechanical improvements both in the modulus of elasticity and in the tensile strength. Increase the modulus of elasticity of a value between 50 and 80% depending on the thermoplastic filament used. In the same way the tensile strength has increased between 50 and 60%. The improvement in the strength / weight ratio allows to this new additive manufacturing system to create medical pieces in which the lightness and resistance are its main characteristic, such as orthopedic prostheses. The results show that the use of FFF together with Robocasting, as a manufacturing process for end-use parts, generates an additional advantage that had not been considered until now. The combination of a thermoplastic and an epoxy resin opens a new path in the additive manufacturing since it allows creating pieces with new qualities without being conditioned by the design.



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DOI: 10.1007/s10916-019-1246-0

Experimental Description of the Aging of the Coconut Shell Powder/Epoxy Composite.

The Substitution of synthetic filler with fillers prepared from renewable sources is a current trend in the field of composite materials. Natural plant sources provide a very interesting alternative to synthetic reinforcements. They are economically acceptable and the resulting materials provide satisfactory mechanical characteristics. The paper focuses on the description of adhesive properties of epoxy resin filled with coconut microparticles - coconut shell powder (CSP) in the range 0-100 mu m and a description of aging of these composites. Aging can be considered as one of the key factors that affects the application area of composite materials. Adhesion and cohesion characteristics were described by shear tensile strength on steel adherents and tensile strength. The morphology of the particles used and the interfacial interaction were described by electron microscopy. The presence of the used particles does not significantly reduce the adhesion characteristics of the used epoxy resin.

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Measurements of the Friction Coefficient: Discussion on the Results in the Framework of the Time Series Analysis.

Tribology studies the interaction between surfaces in relative motion with a particular focus on the principles of friction, wear and lubrication. The measurement of the friction coefficient (COF) is extremely sensitive to experimental friction force fluctuations thus making COF direct measurement not a trivial task. In this manuscript, a novel approach toward the understanding of the friction coefficient behavior during reciprocating tests is proposed. The proposed procedure represents a first approach for a deep investigation about measured COF distribution during tribological tests. It is based on the analysis of COF data measured during the tests in the framework of time series analysis and it was applied to several real tests in dry-friction showed as example of application. Output parameters (i.e., friction, traction force) were investigated to detect trends, connected to running-in period of the tribo-couple, seasonal, connected to the periodicity induced from reciprocating motion, and residual components. After "smoothing" the COF data set by removing the trend and seasonal components, the residual component was analyzed to check the stationary of the COF data set which represents the most characteristic interval in friction measurements.

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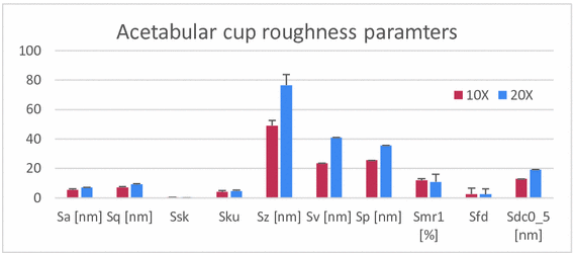
Dimensional Characterization of Prosthesis Bearings for Tribological Modelling.

Prosthesis bearings are precision mechanical systems from which performance improvement represents a direct contribution to patient's wellbeing. Spherical shape of hip prosthesis bearing approaches natural ones, but their performance become degraded in service, and the lubrication and wear mechanisms are outstanding fields of research. Because tribological phenomena are complex, attempts of modelling the bearing requires precise consideration of the boundary conditions that the real prosthesis have. Detailed experimental characterization of two ceramic hip prostheses is accomplished. Shape and roughness are measured by accurate point coordinate metrology with proper methodology through contact probing by a coordinate measuring machine, and optical measuring through confocal microscopy. The results quantify the deviation from the ideal shape and significant roughness parameters of bearing surfaces. Their influence is discussed in the spotlight of their relationship with the tribological behavior of the prosthesis. Future works direction are envisioned so geometrical boundary conditions can play an important role in prosthesis performance understanding and improvement.



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Efficient PD Monitoring of HV Electrical Systems Using HFCT Sensors.

The evaluation of the insulation condition of high voltage (HV) electrical grids by means of non-invasive and on-line partial discharge (PD) monitoring is currently a common practice in the maintenance programs of electrical utilities. Several difficulties must be undertaken when on-line temporary measuring or monitoring applications are applied, the most important are: high levels of background noise and the appearance of interferences, the simultaneous presence of different PD sources, the requirement of locating the insulation defects emplacement and the challenge of identifying them. An on-line PD electromagnetic method that implements non-invasive high-frequency current transformers (HFCT) as sensors for PD temporary measuring or monitoring is explained in this article. The application of the proposed method and the use of powerful signal processing tools enable the performance of accurate diagnosis with regard to the insulation condition of HV electrical installations. The signal acquisition of the HFCT sensors used is synchronized to discriminate whether an eventual PD source detected is located in a certain element of the HV installation. The effectiveness of the measuring or monitoring method and of the signal processing tools proposed is demonstrated through experimental measurements, where PD type pulses were measured simultaneously in a HV installation configured in a laboratory setup.

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Generation of Reproducible Reference Insulation Defects in Experimental Tests Cells for Controlled PD monitoring.

Partial discharge (PD) monitoring applications enable the performance of appropriate diagnosis regarding the insulation condition of high-voltage (HV) electrical grids. During the last decade on-line PD monitoring systems have been increasingly implemented by utilities and large electricity consumers in HV installations. Therefore, the evaluation of their performance is interesting in order to check whether they are generally effective with respect to their functionalities. For the characterisation of the PD monitoring instruments and of the requirements of acquisition time (number of cycles per second), the performance of laboratory tests with real insulation defects is required. As these are monitoring tests, they entail a long time (at least one day), and during this time the monitored insulation defects must behave in a stable manner. The main scope of the study presented is to design, manufacture and characterise the behaviour of three test cells, each integrating a characteristic insulation defect, with the aim of using them in laboratory monitoring tests lasting at least one day. The considered insulation defects are as follows: an internal cavity in a solid dielectric, corona effect and a surface defect. The measurements carried out with the designed test cells have shown that they are suitable for their implementation in PD monitoring tests of long duration.

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Design of a Functional Splint for Rehabilitation of Achilles Tendon Injury Using Advanced Manufacturing (AM) Techniques. Implementation Study.

The use of conventional immobilization splints can cause a lot of mishaps and discomfort in patients. In addition, it is common the generation of muscle, joint and vascular complications arising from the application of classic restraint devices in this phase of treatment. Currently, it is being observed that these problems could be solved with the use of Advanced Manufacturing techniques based on Additive Manufacturing (AM), industrial digitalization and reverse engineering for the realization of individualized immobilization splints. The present study proposes to give these splints a functional character in their design adapting them to a specific pathology, in this case to the partial rupture of Achilles tendon. It also provides a comparison against the use of conventional plaster splints as an improvement factor for their definitive implementation considering the initial sanitary use for which they were designed. In this way, there have been created therapeutic windows that allow the application of rehabilitation techniques, being the treatment that would be carried out developed in parallel. The designed splint has been made in FilaFlex and Polycarbonate, materials that guarantee comfort and resistance at the same time. In addition, an optimization in terms of material has been executed, lightening the splint and reducing environmental impact and manufacturing costs. As a result of this preliminary study, a prototype on scale printed in PLA has been generated.

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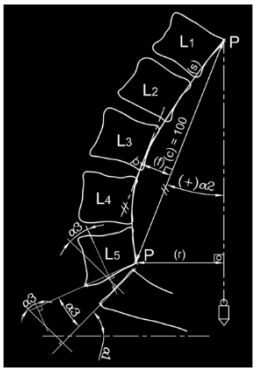
Geometric Model for the Postural Characterization in the Sagital Plane of Lumbar Raquis.

The individual's posture is the physical expression of his body. It is modified throughout life and it is determined by the particular anatomical characteristics that directly affect the biomechanics of the spine. The typing of the spinal curvature is important for the knowledge of body posture. The possibility of having a method for the systematic postural characterization of the spine is an essential objective resource in order to obtain normal or control patterns of the spinal morphology of the population. A widely accepted methodology of morphological characterization of the spine is a necessary requirement for the establishment of preventive criteria for spinal pathologies based on epidemiological population studies. It also represents a necessary requirement for the classification of individuals, based on the biomechanical, orthopaedic or ergonomic criteria necessary for disciplines such as sports, industrial design or sports performance. The present study proposes the development of a morphological postural model of the spine in the lumbar region. The model is based on a system of measurement of objective and comparable parameters by means of X-ray analysis, in order to characterize its morphology in the sagittal plane. The comparison of the results in a population of 47 individuals allowed the possibility to carry out a statistical study on three morphological parameters: sacral angle (1); reversal angle ((2)) and degree of lordosis (D-L). The statistical hypothesis that the results behave according to a normal distribution with $p<0.05$ is relevant and allows the systematization and postural modelling of the individual.



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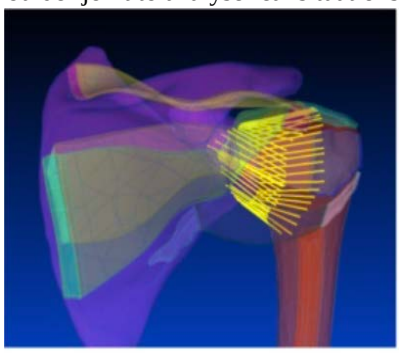
Behavior under Load of A Human Shoulder: Finite Element Simulation and Analysis.

Most musculoskeletal injuries occur during the work routines in different areas, due to repetitive and sustained movements, they are often located in the shoulder. For workers in the building sector, the repetitive movements and displacements occur under load and unnatural postures of the shoulder joint. For this reason, this study aims to model in 3D the biological components which form the shoulder joint for the later finite element analysis. Three cases with different loads have been considered for this study. Due to a linear and isotropic joint approach it has been possible to evaluate the tensions in the main components of the shoulders: muscles, tendons and ligaments. The methodology used allowed obtaining an improved mesh of the shoulder joint to analyse real situations with finite element method analysis with applications in the field of sports medicine, work, etc. Furthermore, the simplification adopted for modelling the joint muscles, as 1D elements in the finite element model has made it possible to establish different positions of human joint without mesh again each of the studied positions. The results are consistent with the states of applied loads. In fact, the maximum stresses in bones are in the insertion areas of the ligaments. Due to the static positions of the joint under study, the muscles do not support high stresses. According to the stresses distribution, the maximum values are in the zones of tendons. From the result analysis, it is observed how the stresses distribution in the cartilage area maintains coherence with reality since the maximum stresses appear in the lower half of the cartilage. In this area in which the Humerus-scapula contact is greater, the compression tensions are greater.



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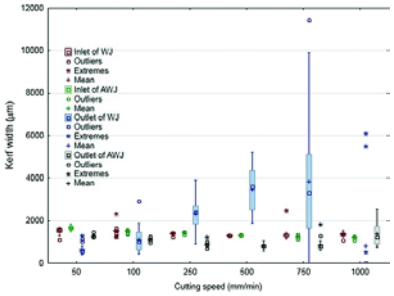
Research on Water Jet Cutting of Polymer Composites Based on Epoxy/Waste Fibres from Coconut Processing.

This paper deals with a machining of polymer fibre composite materials reinforced with a waste from coconut processing by means of an unconventional technology, i.e. an abrasive water jet (AWJ) and a water jet (WJ). Short and long fibres from the waste/a by-product from the coconut processing were used as the reinforcement within the research. The composite material was made by a vacuum infusion method. These composite materials are difficult to cut by another cutting method. They are used as a design upper/view element which is applied on a basic material, e.g. chipboards. These materials have to be cut precisely according to requirements of a shape and dimensions of a final product, e.g. for furniture industry. The paper deals with a study of an influence of the abrasive water jet and the water jet at their impact on a surface of the machined polymer fibre composite material. SEM analysis proved that a considerable destruction of the material occurred at the water jet outlet, i.e. on a bottom side of the cut, under unsuitable cutting conditions and at an absence of the abrasive grains which is an undesirable factor for following applications of these materials.



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ORTE Exoskeleton: Kinematic Analysis and Dynamic Modeling.

ORTE is a robotic platform developed to restore the mobility to the shoulder complex and elbow joint of upper limb impaired patients. ORTE pretends to be an effective and objective tool for the rehabilitation staff. This work presents the kinematic analysis and dynamic modeling of ORTE, a 6 Degrees-of-Freedom upper limb rehabilitation exoskeleton. The dynamic model of the mechanism is used to find the required torques to perform a set of different trajectories of daily living activities as eating or taking an object. This allows the optimal selection of actuators for this rehabilitation system.

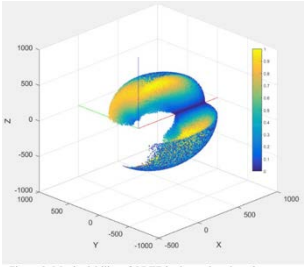

Figure 2: Manipulability of ORTE in the analyzed workspace

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