



Book of abstracts of the
17th International Conference on
**Management and Innovative
Technologies**

MIT 2022

Piran, Slovenia
4th – 7th of September 2022

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Preface

The MIT Conference first began life in 1995. Since then we have been a bi-annual international gathering of industrial practitioners and academics from different disciplines and from all over the world.

The conference based in Slovenia has brought together a unique dialogue in the fields of management and innovative technologies.

Previous MIT conferences have seen world economic boom and subsequent collapse. Our conferences have explored technological innovation and technology management from multi-disciplinary perspectives. That has been the unique contribution of our previous sixteen conferences – bringing together academics and practitioners from different fields to exchange ideas, knowledge and experience that can impact significantly on cross-disciplinary research and also stimulate innovation in practice.

Human factors, “technosophy” (the wise application of technology) and sustainability have been key areas of interest for many of the conference’s contributors. In a year of continuing but recovery from Covid pandemic, global recession due to energy crises, financial and environmental challenges, our conference seems as relevant and important as ever.

This year, technologies of peacefulness were addressed as a cover topic of the conference, since only the application of technologies in a humane way will bring the world society to a higher and more sustainable level. In the beautiful setting of Piran, Slovenia, bordering with Croatia and Italy and within driving distance of many other countries, we are glad our conference sits as the borderland of different cultures, just as our programme sits at the border of different disciplines, interests and perspectives.

For the third time in a row our conference takes the form of a more interactive conference workshop. Based on feedback from participants who value the presentation of academic work but also seek further interaction around practical themes arising, our conference workshop is designed around dialogue and interaction, still very much rooted in academic research and industrial practice. It is a very compelling and potent mix!

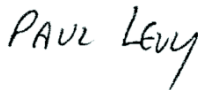
It is our hope that the conference will generate insights that will directly contribute to our emerge from economic crisis, in our respective sectors, industries, economies and as a world community. We welcome case studies and stories, as well as sessions which may lead to inter-disciplinary research.

Joško Valentinčič



Costel E. Cotet

Paul R. Levy



Frank Pude

Izidor Sabotin





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1

Diagnostic Methods for the Analysis of High-Speed Water Jet

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This study investigated the functionality of a newly developed micro hydrodynamic nozzle (HDN) and its ability of generating a modulated water jet (MWJ) used for the erosion of gelatine samples. The micro HDN presented in this paper was manufactured by the selective laser etching (SLE) method. The self-excited oscillations are generated as the water flows through an oscillation chamber located between the pressure feeding pipe and the outlet hole. At the input pressure of 2 MPa, the micro HDN generates the oscillating frequency of 44.4 kHz and the flow rate of 40.05 ml/min. The geometry of the manufactured micro HDN was verified by computed tomography (CT). The volumetric model of the nozzle was acquired using a Nikon XT H225 CT scanner by taking 1000 2D radiographic images during one scan. A 3D standard triangle language model was created from 2D radiographic images using the VG Studio Max software. The 3D STL model of the water nozzle enabled subsequent construction of a computational domain. CFD study performed on real 3D nozzle geometry showed the impact of manufacturing inaccuracy on the ability of the micro HDN to generate a MWJ. Presence of self-oscillation pulsations in the oscillation chamber in the nozzle was verified by MWJ visualisation using a high-speed recording systems consisted of a Photron Phantom v2011 CMOS high-speed camera (100 KHz, reduced resolution); 120W VERITAS high-energy pulsed LED lights (100 kHz repetition rate) driven by Veritas timing units: PTU 9 controller and DaVis software for image recording and analysis. A shadowgraph setup consisting of a LED light illumination was selected as a good observation method. Presence of MWJ oscillations was verified in range of 1 to 8 MPa. Erosion abilities of the MWJ were tested on gelatine samples. For this propose, erosion tests using the standard continuous water jet (CWJ) were also performed. The experimental assembly used for erosion tests consisted of an ErbeJet 2 water pump, a flexible hose of 2.2 m and micro HDN or CWJ nozzles. The tested nozzles were installed on the stationary aluminium frame. A linear axis equipped with a stepper engine allowed the traverse velocity changing. A pressure sensor ESI-GD4200 USB was installed on the pressure line to monitor the pressure during erosion tests. Data were acquired based on the ESI-USB interface. The erosion abilities of the MWJ and CWJ were tested at a constant flow rate of the pump generating pressures from 6 to 15 bars. Erosion effect of the MWJ was tested at three basic jet orientations of 0°, 45° and 90° with respect to the eroded material and direction of the nozzle trajectory. Finally, one configuration of the CWJ trajectory was selected. Based on the results of first erosion tests, the main erosion tests and nozzle trajectories were performed by direct motion of 2 mm/s at one level of SOD of 2 mm in a parallel plane above the gelatine sample surfaces. Eroded grooves depth created by the CWJ and MWJ was monitored using a HS camera and the shadowgraph method. Subsequently, the erosion depth was determined by image analysis. Results of experiments showed high potential of HDN in relation to material erosion as well as further application possibilities. More details of experiments and results will be presented during the oral presentation at the MIT conference.

2

Modifying the geometry of sapphire waterjet nozzles with femtosecond laser pulses and the resulting changes of flow conditions and jet shape

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It is an industrial standard to use sapphire nozzles for generating high pressure waterjets for both cutting and surface processing operations. The geometry of the nozzle and especially the geometry of the nozzle inlet (in direction of flow) has a significant influence on the shape of the generated waterjet. In this paper the first results of a feasibility study on the use of femtosecond laser pulses to modify the “standard” nozzle inlet geometry are presented. In addition to the possibility of contour machining on the sapphires themselves, a comparison of the waterjet shapes that can be achieved in this way is shown as an example and the influence of these different jet shapes on a surface finishing process is also presented.

3

Augmented Reality Environment for Sensory input in the context of different illusions

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Today, the interaction of illusion and truth, which is always based on psychophysical phenomena, represent important research subject. An important role is played by the human behavior when performing different movements such as: artistic or sports performances, or assembly/disassembly (A/D) operations (production, ergonomics, training, health, service or recycling stages). When manipulating an object, the brain uses color visual stimuli to estimate the objects weight and scales muscle force by the muscular activity control system accordingly. The idea is to show that even when we visually perceive an illusion - for example, whether a black object (dumbbell for instance) is heavier than a white one, which are otherwise of the same weight, the motor system controlled by the motor area of the brain makes an adequate assessment of the stimulus - the weight of the object. The purpose of these psychophysical experiments being generally to substantiate the ability of the cognitive system to perceive and communicate truth - for example, in the perception of physical exercises, theatrical sketches or A/D operations simulation, in this paper, we estimated the co-contraction level of the biceps and triceps muscles on the elbow joint during repetitive movement tasks by lifting different colored objects. For this purpose, an AR environment was proposed, allowing to virtually change the color of the object by head-mounted display (HMD). In order to estimate the fatigue in the involved muscles and compare the co-contraction level when manipulating the objects with different colors, surface electromyography (EMG) activity of the biceps and triceps, the maximal force data and elbow joint angular displacement and angular velocities were recorded, analyzed and normalized as percentage of maximum isometric values. The results of the performed experiments show that the Median spectral frequency (MDF) extracted from normalized EMG decreased when subjects feel exhausted. The number of lifting movement while manipulating an object (dumbbell) with black color was lower than those with white color, which indicted that muscle feel exhausted faster with the black color stimuli for weight perception. The results also show that the visual stimuli based on the color of an object for weight perception, can modify the co-contraction of the muscle activity.

Keywords: visual stimuli, weight perception, augmented reality, muscle co-contraction, muscle fatigue.

4

Fuzzy logic approach to predict surface roughness in powder mixed electrical discharge machining of titanium alloy

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It is well known that materials that are difficult to cut can be easily machined with advanced machining methods. It is important to make efforts to improve these processes, especially from the point of view of surface quality. The selected titanium alloy finds application in the aerospace industry, biomedicine, and many other fields of engineering due to its exceptional properties, such as resistance to high temperatures and corrosion. Machining of this material by electrical discharge machining (EDM) remains complicated and insufficiently researched, as evidenced by a large number of scientific papers on the subject. A possible technological improvement in EDM can be achieved by adding electrically conductive powder to the dielectric, resulting in a modified material removal process called powder mixed electrical discharge machining (PMEDM), which significantly affects the output performance of the EDM process for difficult to cut materials. Although there are a large number of publications on the subject of PMEDM, a clear answer to the question at which powder concentration in combination with the input process parameters the best surface quality is obtained is still disputed. Therefore, the main objective of this work is to make progress towards the creation of adaptive neuro-fuzzy inference system for the prediction of surface roughness in the PMEDM of titanium alloys. For the purpose of the research, the Central Composite Design (CCD) was applied. The selected varied parameters of PMEDM are discharge current, pulse duration, duty cycle and graphite powder concentration. The obtained values of the mean square error of the training and testing of the ANFIS model for determining the surface roughness are at a satisfactory level. Based on the experiments that were not involved in the creation of the model, the verification of the model was carried out, i.e. the evaluation of the ability to predict the surface roughness using new experimental data. The model error determined by the verification experiments with the PMEDM titanium alloy was about 10%. The ANOVA analysis was used to determine the order of influence of the input machining parameters compared to the published research results related to PMEDM titanium alloys. In addition to discharge current, which had the greatest influence on surface roughness as expected, pulse duration, duty cycle, and graphite powder concentration had less influence than expected.

5

Big data images-based encryption, storage, transfer and reading for various engineering applications

Authors: Gicu Călin Deac, Crina Narcisa Georgescu, Diana Popescu, Costel Emil Cotet

University POLITEHNICA of Bucharest (ROMANIA)

Big data are nowadays commonly found in industry, medicine, the military, social media, etc. Especially in intelligent manufacturing, considering various digital twinning applications, large volumes of data are generated and should be collected and recorded in real-time, then securely stored, transferred and processed. It becomes, therefore, a true challenge and a necessity to find solutions to reduce the time associated with each of these steps, reduce the hardware requirements, and use the big data in processes running independently but simultaneously in the cloud. In this context, a method implemented through an online system is proposed for ensuring fast and hardware-efficient encryption, storage, transfer and reading of big data by creating PNG images with pixels generated based on the values to store. Data encryption is made by using different variants depending on data type and uses an image encryption symmetric key at the values to be encoded, adding or subtracting the corresponding values of the pixel in the image encryption key. This encryption is impossible to break without the key image because each stored value is differently encrypted. The paper describes the technique and its main features, details the reference architecture of the system, and presents a case scenario for demonstrating the efficiency of the proposed approach.

6

Connecting engineering to the open metaverse

Authors: Gicu Călin Deac, Crina Narcisa Georgescu, Laurențiu Popa, Tiberiu Dobrescu, Costel Emil Cotet

University POLITEHNICA of Bucharest (ROMANIA)

Abstract

This paper describes the research carried out by the authors to design and implement an immersive virtual reality platform to support connecting manufacturing architectures to the open metaverse. The tools integrated with the collaborative platform make possible the interaction between users, accessing content remotely and exploring the virtual environment in an immersive and natural way, using reduced hardware and internet connectivity resources. This research implemented and analyzed different platform applications for intelligent factory digital twins of various equipment. Possibilities to expand the use of the platform for e-learning, virtual offices, exhibitions and tradeshow, clinical treatment, team buildings, virtual cinema and entertainment are also explored.

7

Enhanced nano- and micro-ice particles in ice abrasive blasting

Authors: V. Foldyna^{1*}, M. Jerman², A. Lebar², P. Dresar², I. Sabotin², S. Vinetic², J. Terzan³ & J. Foldyna¹

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In recent years, many papers have been published on the topic of water jet technologies. In general, pure water jet is applied for surface cleaning and cutting thinner materials. The abrasive water jet (AWJ) technology is more suitable for cutting harder and thicker materials, industrial applications or surface treatment. The most common abrasives used for AWJ cutting are minerals which are very efficient in material removal. However, it has some disadvantages, as the abrasive can remain in the cutting kerf. This limits the use of AWJ for medical, food, and aerospace industries. The mineral abrasives are substituted with ice particles in the technology of ice abrasive water jet (IAWJ).

This presentation is focused on the optimization of colloidal solution preparation of various nano- and micro-materials in water. Experimental determination of the optimal concentration of colloids is provided. Series of blasting with prepared nano-ice samples and cutting with IAWJ were performed. All of the results were compared with the properties of regular ice particles. A container for catching materials after proceeding with the experiment was made and some materials used in the experiment were selected as biocompatible or biodegradable, so that the ice jet technology remains clean. Samples of nano- and micro-materials were also examined by scanning electron microscopy after proceeding with the experiment to evaluate their reusability.

Key words: Ice jet technology, micro-materials, nano-materials, blasting

8

Data acquisition using cloud databases - a viable solution or a headache**Authors: Parpala Lidia Florentina, Parpala Radu Constantin**

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Businesses are more and more attracted towards digitalization and cloud platforms. Also, Industry 4.0 leads to the need of accessing data from anywhere, anytime. In the context of emerging technologies like IoT, big data, machine learning, cloud database proved to be right solutions. Regarding industrial DAQ application there are still some limitations regarding data transfer to and from industrial equipment (data security, industrial communication standards, different data encryption, etc...). That is why it is necessary to find solutions to store industrial data into cloud databases. Beside the accessibility, cloud databases bring more benefits, such as: scalability, data recovery, higher data security. In this paper we will compare some of the cloud database solutions available on the market to see if they are a viable choice to store data provided by data acquisition equipment.

Many of the companies which have geographically distributed departments or production units also have disparate data centres. This situation leads to slow or even incorrect communication between different units of the company. Also, in the case of a custom developed server a company must pay from the beginning for the entire setup. The scalability of this solution is limited and the cost are huge for small applications. The solution is to migrate towards or to create from the beginning a cloud database that allows real time data access.

Most of the cloud database solutions on the market offer a free tier and the services are paid when they are used (pay-as-you-go). Also, in most cases, each new customer gets an amount of money (200-300\$) to try different services in the first month of usage. Is this solution viable in case of data acquisition for industrial applications?

This paper analyses different types of cloud databases and the communication between industrial DAQ software and cloud databases.

Table 1 Main solutions in the cloud database market

Solution	Microsoft Azure	Google Cloud	Amazon AWS	Oracle Cloud	SAP HANA	IBM Cloud
Databases	SQL and NoSQL databases supported	SQL and NoSQL databases supported	SQL and NoSQL databases supported	SQL and NoSQL databases supported	SQL and NoSQL databases supported	SQL and NoSQL databases supported
Products & Services	AI	AI	AI	AI	AI	AI
	Machine learning	Machine learning	Machine learning	Machine learning	Machine learning	Machine learning
	Analytics	Analytics	Analytics	Analytics	Analytics	Analytics
	Compute	Compute	Compute	Compute	Compute	Compute
	Blockchain	Blockchain	Blockchain	Blockchain	Blockchain	Blockchain
IoT	IoT	IoT	IoT	IoT	IoT	IoT

Keywords: databases, data acquisition, industry 4.0, cloud, machine learning, IoT

9

Multiple Criteria Optimization of Abrasive Water Jet (AWJ) Cutting using Entropy-CODAS Method

Authors:

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Abstract:

The paper shows multiple performance optimization of steel machining effects by the Abrasive Water Jet (AWJ). An innovative Entropy/CODAS method is implemented for the optimization of parameters in cutting like pressure, feed rate, and abrasive flow rate over cutting depth, cut surface roughness, and angle of cut kerf was conducted. The CODAS algorithm goes to the class of those based on measuring the distance between a scenario (in our case, it was processing parameters in terms of performance and quality indicators) - and a certain benchmark. A benchmark is a certain hypothetical set of processing parameters, imagined or determined from available data. For determine the best set of the process control parameters CODAS approach with some weights determining was done. To establish the initial parameters of weights it was proposed to calculate based on entropy. This technique simplifies manifold composite responses by obtaining one individual response.

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Plasma technologies for application in agriculture and medicine

Author: Ita Junkar

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Plasma technologies are commonly employed for different industrial applications; mainly for increasing coating stability. In recent years plasma technologies showed significant potential also in agriculture and medicine. In this field plasma became a powerful tool for a wide range of biological applications; from decontamination and sterilization of surfaces as well as food and tissues (decontamination of fresh food, improved wound healing) and for improving surface properties of biomaterials. Plasma presents intriguing approach for seed sterilization as it reduces the need to use chemical pesticides which are associated with environmental pollution. On the other hand, plasma technology showed improved effect on seed germination, viability, and resistance to certain stresses which in turn could enable us to avoid the use of chemical substances used for seed priming and increase the yield of various important crops. Plasma can also be used for rapid surface finishing of medical materials, as desired biological response (proliferation of desired cells, prevention of bacterial adhesion and biofilm formation, protein adhesion etc.) is mainly governed by specific surface properties (wettability, morphology, chemistry, crystallinity etc.) of biomaterial. Plasma treatment enables modification of surface features and could present a powerful tool for optimising surface properties of medical devices.

11

Concept development of the smart sandblasting cell

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The LASIM laboratory and the company IMP Armature, d. o. o., developed the concept of a distributed smart factory using the example of a sandblasting cell. The development of the concept was based on the close cooperation of both partners, the key being the holding of several workshops with smart factory experts from the LASIM laboratory and the full spectrum of experts from the company IMP Armature d.o.o. (sandblasting cell workers, department managers, IT experts and experts in the field of lean production). The result is a defined way to digitize the sandblasting plant with IIoT technology and manage processes with a local digital twin. This concept will serve the company as an important guideline for the digitization of remaining production processes

12

Customer satisfaction assessment of entrepreneurial training

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According to the Romanian National Agency for Employment, the unemployment statistics as of August 31, 2016, out of the 10 counties with the highest unemployment rate, 3 are from the South Muntenia region (SMR), representing 30%, and out of the 7 counties with the highest share of unemployed unpaid in the total number of unemployed, 2 counties are from the SMR (28.57%). Also, the information contained by the National Commission for Forecasting, in the report The projection of the main economic and social indicators in territorial profile until 2017, shows that the unemployment rate forecasted in 2016 on SMR is 6.6%, and in 2017 it is 6.4%, being overtaken only by South-West Oltenia. Following the history of sustainable development indicators, relevant for the project, according to the latest reports published by the National Institute of Statistics (INS), in 2012 the turnover from innovation is 5.75% of the total turnover, and innovative enterprises that introduced new or improved products in 2012 were 149 out of 1216 (12.25%).

So, the University POLITEHNICA of Bucharest initiated the Bizzsmart project in 2018 Increasing the occupation by supporting and developing innovative entrepreneurship in the South - Muntenia Region. During the project, one of its activities was to provide for at least 171 people participating in the continuous professional training program in the field of entrepreneurship education.

Within BIZZSMART, the process of evaluating the satisfaction for the training activities started it from the moment when the members of the target group have access to the training services, through their participation in the training courses, until the moment when the training activity has been completed.

Through the satisfaction analysis questionnaire, it aims at the continuous improvement of the training program. We also envisaged a more correct understanding of the needs and expectations of the learners, the identification and elimination of the causes of nonconformities, the processing and analysis of the information provided by the trainees, for the objective assessment of the quality and the improvement of the training process.

The evaluation questionnaire included 13 questions designed to collect data on different aspects of the entrepreneurship training program, some focused on collecting data on the effectiveness of the training session in achieving the specified objectives (e.g. volume of knowledge, course support materials, teaching methods, usefulness of the topics carried out, encouraging participation in discussions, etc.) and others on the collection of data on how to organize it (e.g. facilities used, location, table, etc.).

The answers indicate that an average of over 90% of respondents agreed that the objectives of the training course have been achieved and that they are very pleased with the quality of the learning and teaching experience provided during the training sessions.

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Cross pandemic students' digital skills needs

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The pandemic of COVID 19 is perceived by the literacy as digital improving skills toward the change off lifestyle and workflow. Nevertheless, beyond the personal attitude regarding those changes, the digital skills perceived usefulness and use rose as a direct result. The digital skills, covered in The Digital Economy and Society Index, published by EU Commission since 2014, are divided into private life, employee and learning scope of usage. The analyses also comprise the human capital, connectivity, integration of digital technology, and digital public services. This article presents the findings of a cross-pandemic research, in the period of 2019-2022, regarding the digital skills perceived usefulness, profiling depending on the scope of usage and the intention to enhance the digital skills by assisted training.

The paper presents the research results of an enquiry made in the period 2019-2022 among the students regarding perceived usefulness, use and training intention for digital skills enhancements. It covers the bachelor and master's degree programs, with the Computer Science, Social Sciences and Engineering as field of study. The study was made using 266 answers from the above-mentioned categories.

The common digital skills, which correspond to the foundation digital skill, have a large use rate among the respondents. In this case are situated: using operating systems, office software and electronic communications and correspondence. In the private life, the specific digital skills are social networks and content platforms, online payment and banking systems, and smart technologies. Furthermore, as employee, the students indicate as necessary to perform their activity Online payment and banking systems, integrated customer and resource management systems, business planning systems, remote access systems to resources, dedicated programs for software production. In addition of foundation digital skill, in the student life they considered as useful remote access systems to resources, dedicated programs for software production, and smart technologies. The use rate threshold of 0.5 is enhancing that all digital skills defined in the study, are used by at least 50% at least for one scope.

Distinction between the use of the digital in the private life, as an employee or in the learning process, makes possible a deeper analysis to emphasize the influence of the intention of training in a certain skill on the respondent attitude regarding the private life or the professional development. The study revealed that all digital skills perceived usefulness rose from 2019 to 2022 with an average of 9.18%, starting with an average value of 53.59% in 2019. Also, the trends for declared use of digital skills also indicate a rose from the 2019 average value of 48.55% to 52.88 in 2022. It should be noted that all digital skills grown in this period. Nevertheless, even was expected that the training behaviour wasn't change significantly in this period, the average intention to participate for a training session, is 38.23% in 2019 and 39.90 in 2020. However, the decision to participate in the next 6 months is almost steadily between 35.75% and 39.90%. The self-estimation of the training session price was also very slow rising, from 165.93 EUR to 174.52 EUR in 2022.

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Data stewardship in the academic ecosystem

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Data management is currently a key skill for the advancement of science. Findability of different research outputs, FAIR data and software help researchers improve visibility, increase impact of the research activity and trustworthiness in the scientific activity. Data stewardship and support are needed in the academic ecosystem

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Tailoring of cellulose nanomaterials' properties according to application

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Cellulose nanomaterials are a class of bio-based sustainable materials of the future. They are isolated from cellulose, the most abundant polymer on Earth in two forms: cellulose nanocrystals (CNCs) and cellulose nanofibrils (CNFs), which differentiate in size of the fibrils and amount of amorphous and crystalline domains. CNCs are, with their high mechanical strength, often used as a reinforcing agent in various polymer matrices. However, their inherent hydrophilicity prevents their wider use in hydrophobic polymers, such as chitosan and PLA. The issue can be solved by their surface modification, such as esterification, carbamation, silylation, etc. In this study, CNCs were acetylated to different degrees of substitution and incorporated into chitosan-based films. Mechanical and barrier properties of such films were evaluated at different environmental humidity. Furthermore, another technology was used to bring such foils closer to wider use. Plasma treatment was applied to hydrophobize the surface of the films. Again, the mechanical and barrier properties were studied, as well as stability of the newly obtained hydrophobic effect.

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Natural biocomposite materials for fashion: material properties and biodegradability

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Fashion industry is being among the top three biggest polluters in the world. That is why new alternatives replacing harmful synthetic materials and chemicals used in textiles are being introduced in an exponential pace. One of those alternatives could come from biomass, especially utilizing its polysaccharides building blocks, for biotextiles and biocomposite materials. The main goal of developing these solutions is the safe return of carbon to ecosystems by complete assimilation of the degraded products as a food source for soil or aquatic organisms in order to achieve the desired state of the zero waste focused circular economy. [1] Despite excellent impact of biodegradable materials on the environment, they are still not widely used especially not in textile sector since it remains a challenge to create material that is mechanically strong enough during use and at the same time biodegradable at the end of its cycle since it requires a perfect balance between degradability and durability. [2] In this study the goal was to develop a plant based polysaccharide biomaterial more durable and especially more water repellent. Four different additives were added to the base mixture of biocomposite consisting of starch, agar, glycerol, cellulose pulp, nanocellulose and vinegar. Additives hydroxypropylmethylcellulose, fitokeratin and candelilla wax were added separately at three different ratios. Material was dried under constant air flow at room temperature. Firstly thickness of each sample and mechanical properties were measured. Wettability of the samples with contact angles and slide angles was performed. Additionally a biodegradability test was executed in garden soil in a controlled environment at 20°C. Water was added to the soil when needed to achieve constant moisture. Pictures of samples before the experiment and in between the experiment were conducted for 40 days and the biodegradation was determined with the image analyzing software. The conducted experiments proved the improved water repellent properties and full biodegradability within 40 days in soil. Keywords: natural biocomposite, biopolymers, biodegradability, hydrophobic biomaterial, fashion

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