Table of Contents

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DESIGN PROCESS OF COMPLEX AND RELIABLE TESTING EQUIPMENT FOR EXPERIMENTAL ROCKET ENGINES

All research and development would be virtually impossible without thorough and extensive testing phases. This applies to amateur rocketry as well, especially in regards to designing and manufacturing rocket motors of any kind. Despite a strong theoretical background, such a process usually requires multiple iterations, with each being subjected to numerous tests, providing enormous amounts of invaluable, empirical data. In order to perform such tests in a safe and reliable manner, as well as gather all necessary data, a remarkable testing equipment is necessary.

This presentation aims to show the design process, as well as elaborate on the final design and manufacturing choices for the most recent rocket motor test-bench, designed and constructed by the members of the AGH Space Systems student amateur rocketry team. An emphasis is put on the mechanical and electronic aspects of the system, its capabilities, and necessary tradeoffs.

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USING 3D PRINTING FOR SAFER RECOVERY OF SOUNDING ROCKETS

The paper deals with the behavior of rockets during landing. Tailcone printed in 3d printing can be designed in such a way that some energy is lost on its crushing. This will ensure the smoothest possible landing for the research payload and the rocket itself. By modifying the fill structure of the print as well as the percentage of its fill, we are able to absorb the amount of energy in a given period of time. Such technological processes are already used in vehicles where, in order to protect passengers, some parts of the car body are crushed during a collision.

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KALMAN ROVER - ELECTRONICS, SOFTWARE AND SCIENCE

The topic of the lecture will be presentation and general overview of current development of the Kalman rover project in terms of electronics, software and science. Most of the robot's functions, e.g. autonomous driving, manipulating the manipulator or soil testing in the on-board laboratory, are based on electronic systems and software that uses them. For this reason, members of these sections must work closely together. The electronics section will talk about the new, unified standard of printed circuit boards increasing the modularity and reliability of the system. The software section will talk about the progress of work on the advanced recognition of obstacles during autonomous robot driving, as well as about other modules responsible for intelligent navigation. The science section deals with methodology of research performed by the rover, such as the analysis of soil samples for the presence of traces of life or the study of the geology of the area. Every year, each of the presented functionalities is intensively used during international Mars rover competitions.

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MODELS OF NITROUS OXIDE IN HYBRID ROCKET ENGINE SIMULATOR

Hybrid rocket engines typically use nitrous oxide as self-pressurizing oxidizer, where the high vapor pressure at room temperature is used to force mass flow to combustion chamber. This allows to simplify hydraulics, removing the need for pump usage. To accurately anticipate parameters of hybrid rocket engine, knowledge of oxidizer tank dynamics is required. The simplest solution is usage of Equilibrium model (EQ), which is used in Novus Sim, program written by Cambridge University Spaceflight scientific circle. However, experimental data shows that EQ model incorrectly predicts initial stage of blowdown tests of self-pressurizing fluid. Three models of varying complexity have been proposed in the literature to account for this error.
This paper presents implementation of Zilliac & Karabeyoglu (ZK), Zimmerman (Z) models in Python language to integrate them with Novus Sim. Accuracy of EQ, ZK and Z models were compared to experimental data from literature and test done by PWr in Space scientific circle. Additionally, EQ, ZK and Z models influence on simulated thrust data was also examined and compared with experimental results.

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NEURAL CONTROLLER FOR UNMANNED AERIAL VEHICLES

The speech will describe the flight controller for unmanned aerial vehicle developed in AGH Solar Plane science club. The main task of the controller is to set the aircraft's control surfaces (using the servomechanisms) in such a way that the plane follows a predetermined trajectory. The system works on the basis of data collected in real time from various sensors, such as IMU, GPS or pitot's tube. Control algorithm is based on a recurrent neural network, which will be previously trained using data collected during manual flight. The project involves both the preparation of a dedicated board with sensors and microcontroller, integration with a test aircraft and the development of programs to collect data and AI models training. The speech will present the result of previous work, used tools and further directions of the system development.

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COMPOSITE MATERIALS AND MATERIAL TESTING METHODS IN TRANSONIC SOUNDING ROCKET PROJECT: "3-TTK"

During the rocket's flight, the airframe and fins are exposed to high forces and temperatures caused by the aerodynamic drag – especially when the velocity approaches the speed of sound. Apart from that, with an increase in velocity, the fins are more susceptible to damage caused by the flutter effect. Because of the before mentioned factors, the materials the parts are manufactured of need to be highly resilient to compressive and bending loads and especially for fins, to shear loads, whilst retaining low mass.
All elements made of composite materials are manufactured by our science organizations' members, therefore to verify the mechanical properties – especially crucial for the parts that are critical to flights' success – a variety of material tests need to be performed. In this presentation, I will make an effort to introduce the audience to the process of choosing the suitable materials for each part, the process of manufacturing the samples, and material testing methods.

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APPLICATION OF INNOVATIVE MECHANICAL SOLUTIONS IN THE AUTONOMOUS PLANETARY ROBOT "KALMAN"

The subject of the paper will be the review of the mechanical improvements of the Kalman planetary rover - a project of the AGH Space Systems. Namely: a new robot frame, the development of a robotic arm, a modular gripper. Constant improvements also affected the mobile laboratory module and the rover's propulsion system.
Using the advantages of the previous frame, a completely new module was designed and manufactured. Guided by lightness and durability, a new frame with similar dimensions as before was obtained. Due to the loose mounting to the suspension, the stresses on the structure were reduced, significantly reducing the weight.
The mobile lab has been expanded to overcome the science challenges of the Rover Challenge. The running system has been extended with a mechanism to reduce misalignment. The honeycomb tires have been optimized in terms of weight.
The robotic arm has been redesigned to a new version made of aluminum to increase strength and stiffness. Much focus was paid to weight reduction, modularity and reliability of the structure. Backward compatibility of new and old manipulator dependencies is included.
In correspondence with the new arm, a new gripper is created with a simplified and reliable kinematic structure. The distinctive design reveals many advantages, it uses silicone molding and the idea of a replaceable jaw depending on the challenge.

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THE ROLE OF THE ITERATIVE PROCESS IN THE DEVELOPMENT OF SOUNDING ROCKETS OF THE AGH SPACE SYSTEMS STUDENTS' ASSOCIATION

The iterative process is a natural development method of a highly sophisticated projects. It allows for in-depth testing of individual subsystems and refining those that do not meet the constructors' expectations. Rockets designed by AGH Space Systems - PROtotype, Skylark, 3-TTK - although identical at first sight, testify to the role of the iterative process in space engineering. Each of the subsequent projects assumes the use of proven solutions and optimization of aspects that did not meet the expectations. Additionally, each iteration of the project is an opportunity to apply innovative technologies and implement new ideas. The B4 engine, designed to take part in the Spaceport America Cup 2019 rocket engineering competition, has more than 10 iterations behind it, which makes it the most thoroughly tested and optimized hybrid engine in the history of our association. In order to meet the growing operational and measurement requirements, the electronics subsystem is constantly being developed. The recovery system responsible for safely bringing the rocket back to the ground, as well as the mechanical structure integrating all subsystems into a flight-ready vehicle are also subject to continuous optimization. The presented approach allowed AGH Space Systems' projects to achieve numerous successes in the international arena.

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OPTIMIZING THE ENERGY CONSUMPTION OF THE SOLAR UAV PROPULSION KIT

Building a solar-powered unmanned aerial vehicle requires balancing the energy supplied to the aircraft and the energy consumed by it. This can be achieved by maximizing the efficiency of the panels on its wings and minimizing the energy consumption of the aircraft. Of all the devices that make flight possible, most of the energy is consumed by the engine.

The goal of the research was to select a motor-propeller combination that would draw the least amount of current during flight, thus allowing for extended flight.

Parameters such as efficiency, KV parameter, power and weight were considered while selecting the motors for testing. Propellers were selected using simulation in eCalc software. A series of dynamometer tests at constant thrust were performed to select the optimum propeller for each of the tested engines. Power consumption tests were then performed for each propulsion set with thrust ranging from 200 g to 1000 g.

A propulsion kit consisting of a Dualsky Eco 2826C v2 engine and a 16x8Z propeller was found to be the optimal solution to meet the requirements for solar UAV.

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SHRIMPS IN SPACE - THE PROCESS OF BIOLOGICAL SOUNDING ROCKET PAYLOAD DESIGN

In the last years the vision of people living on Mars and Moon has become more clear than ever. But to make extraterrestrial habitats independent from Earth, food production systems, such as aquaponics, are being widely investigated. In such systems, aquatic animals' excrements are a source of nutrients for plants.
SHREAMP (Space Habitat Research – Effectiveness of Anaesthetic Monitoring Payload) is a project focusing on the problem of transporting aquatic animals to space. Stress they can experience during rocket flight might negatively affect their health and the whole aquaponics system. The project aims at evaluating the possibility of sedating Neocaridina davidi shrimps for the time of flight and alleviating their stress.
SHREAMP is being developed in AGH Space Systems for two years. In 2021 it took second place at SDL Payload Challenge during Spaceport America Cup and its next iteration is being developed to fly for the first time during this years' edition of the competition.

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FEM SIMULATIONS OF COMPOSITE MATERIALS USED IN CONSTRUCTION OF SOUNDING ROCKET 3-TTK

During rockets flight its chassis is subjected to a lot of large stresses and harsh conditions, that are caused by, among other factors, resistance of atmosphere. This is why materials used for rocket construction have to be both extremely durable and as lightweight as possible. This is why composite materials are used. To verify which materials are appropriate for usage in a rocket, mechanical tests have to be conducted on laminate samples. Those tests can be performed not only in reality but also simulated with Finite Element Method. This kind of tests were simulated using Ansys Workbench and its module Static Structural. Those experiments were aimed to recognize which materials are best suited to be incorporated in a laminated structure of a rocket chassis. Thanks to this it was possible to verify the mechanical tests conducted in reality with theoretical material model, as well as obtain some very important results.

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PLASMA ORGAN - CONCEPT AND PROTOTYPE BUILDING

The aim of the project is to build an aerophonic instrument, based on acoustic resonator, stimulated by the plasma discharge. It will be achieved by the sudden polarization of the air inbetween the electrodes. Electrodes from the secondary wiring will be placed at the bottom of resonance pipes in such a way, that the air inside will vibrate. This work presents the process of building the prototype of high – voltage generators using flyback transformers taken from cathode-ray tube monitors. The generator control system powers the primary winding with the frequency of several hundred kHz, which allows the spark to jump between the electrodes of secondary winding. This signal is modulated with acoustic frequency, and as a result a sound is generated. While working on this project there has been an electronic board made, which allows to control twelve generators. There's also an MIDI interface implemented, so that the instrument can be connected to the keyboard or the sequencer.

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KN BioMedical Imaging

POSSIBILITY OF DETECTING WHITE MATTER HIPERINTESITIES IN MAGNETIC RESONANCE IMAGING USING HISTOGRAM FEATURES

The aim of the project is to assess the possibility of using maps of selected histogram features to detect white matter hiperintensities (WMH) in MR imaging.

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MULTI - INSTRUMENT BASED ON FOUR ELEMENTS - CONCEPTION, PROTOTYPE

The purpose of this project is to build a multi – instrument. It is composed of four self – made instruments, which use different centers of sound propagation. It is planned to use hydraulophone to generate sound by using water, plasma speaker as the substitute of fire, an octave pipe organ to produce sound from the vibrations of the air column, and gajaphone, which will use waves picked up in the ground. Ultimately, it is planned to use solutions enabling one person to play all of the instruments by themselves.
In this work, there are presented concepts of instruments operation, process of building hydraulophone, initial work on organ building and the functional plasma speaker generating acoustic frequencies with the usage of microcontroller.

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SUBJECTIVE AND OBJECTIVE ASSESSMENT OF ROOMS IN SMALL ROOM ACOUSTICS

Sound Quality (SQ) parameters are used as an objective measure of an acoustic signal. The correlation between SQ parameters and assessment of interior acoustics has not been defined yet, although their relationships with objective values are well known and described in the literature. As part of the project, impulse responses of a room in 3 dampness variations were analyzed. Using Beranek and Ando's methods, an assessment of the measured room was made – using subjective and objective parameters, including SQ parameters. The project aims to find the correlation and examine new possibilities of subjective assessment using sound quality parameters.

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KN Komfort

CONSTRUCTION AND VERIFICATION OF A PARTITION FOR MEASUREMENTS OF AIRBORNE SOUND INSULATION OF SAMPLES WITH REDUCED-SIZE

In the adjacent reverberant rooms, located in the Department of Mechanics and Vibroacoustics, among others, airborne sounds insulation of materials is measured. The technical parameters of the laboratory (the size of the test opening) allow the measurement of samples with dimensions of 1 m x 2 m, which is often problematic due to the lack of market availability of materials with such a large surface (e.g. soundproofing casings). For this reason, a partition was built that allows measurements of samples with a smaller surface area. Students from KN Komfort designed and made a partition, the dimensions of which allow to carry out measurements without disturbing the results in the designated scope of its application. As part of the student project, a partition design was created, modelled using computer software and a test model was made. After the initial verification and corrections, an appropriate partition was built and a series of verification measurements was carried out to determine the scope of its application and possible uncertainties resulting from the reduced dimensions of the samples.

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Section III. Automatics and Robotics

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EXPERIMENTAL MODEL OF THE ROBOTIC MOBILE PLATFORM

Widespread introduction of robotic mobile platforms for the movement of components and materials in the technological process necessitates their development and improvement. Expanding the capabilities of robotic mobile platforms and improving their performance requires extensive experimental research to improve the kinematics scheme and control system. Therefore, the purpose of the presented work is to develop an experimental model of a robotic mobile platform for research works in the process of its design with the possibility of application in the educational process of the CAD Department. To achieve this goal, the following tasks were solved in the work: development of the structure of the mobile platform and determination of the functions of its components; development of a kinematics scheme; development of a control system taking into account the peculiarities of the mobile platform functioning. Unlike many known intellectualized prototypes, a mobile platform for moving on a marked surface by orthogonal routes was proposed. At the same time, reducing the cost of the control system and simplifying the planning of orthogonal routes while maintaining the operational capabilities of the platform provides prospects for its application to industrial processes. The kinematics scheme and control system offered in work provide tracking of the set trajectory of movement on the marked surface. To ensure the required speed and accuracy of positioning of the platform, the change of speed of the drive stepper motors and the system of optical sensors are used. The developed control system of two servo drives provides change of the direction of movement on 90 degrees and precise steering. In the educational process, the developed experimental model of the platform provides: study of the principles and features of the control system of drive stepper motors; study of control system for servo drives using pulse-width modulation; study of the features of the implementation of the tracking system based on reflective optical sensors; determining the dynamic characteristics of the platform and studying the accuracy of its positioning.

Research supervisor of the paper:
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PRINCIPLES COMPARISON OF COMPLEX CONTOUR OBJECTS APPLICATION ON THE SURFACE OF DIFFERENT MATERIALS BY MECHANICAL ENGRAVING METHOD

This study was conducted to compare the principles of applying complex contour objects on the surface of different materials by mechanical engraving, which will help select the best engraving material for further use in the industry.
In total, three samples of different materials were selected for the study: metal (aluminum), plastic (plexiglass), and wood (beech). A complex contour image (logo of Lviv Polytechnic National University) is applied to each of the samples by the method of mechanical engraving (milling) with the same settings of milling depth and image size.
As a result of the study, we obtained three experiments on applying images on the surface of aluminum, plexiglass, and beech. All experiments preserved the detail of the image. The overall appearance of the experiment on the metal is better than on other materials, due to the properties of the metal itself, its luster, and color. In turn, the experiment on plastic looks as well, but to achieve this result requires additional post-treatment. The experiment on wood looks mediocre, and this is because the depth of image milling for wood is expected to be greater.
Due to the study, metal in these settings is the best material for such type of processing as mechanical engraving.

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STATISTICAL MODEL OF TEXTUAL INFORMATION

Statistical analysis of the text has a long history. In 1887 a method of solving controversial problems of authorship was proposed. Subsequently, this problem has been studied in many works. The features that make text different from other forms of data was discussed. A practical overview of relevant statistical methods was offered.

Many approaches to statistical data analysis have been developed for machine classification of texts based on semantic analysis in order to establish common themes of dissertation research.

This article provides a statistical analysis of Ukrainian and English scientific texts, as well as compares their characteristics obtained as a result of the study.

The classical approach of statistical analysis is implemented by a two-stage algorithm. In the first stage, the most probabilistic model is searched by experimental sampling of data and its parameters are calculated, and in the second stage, the null hypothesis of distribution is analyzed using the agreement criterion.

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DESIGN OF CONTACTLESS INFRA-RED DEVICE WITH TEMPERATURE SENSOR MLX90614 BASED ON ARDUINO

In recent decades, electronics and microelectronics are developing at a rapid pace, which allows you to create compact and efficient monitoring systems. Many sensors allow you to measure various indicators, convert them into signals, and display them digitally. Health monitoring systems that allow you to perform measurements contactless and quickly with the integration of communication allow not only to take measurements but also to track the complete history of measurements. This article presents an Arduino-based device using the MLX-90614 temperature sensor for non-contact body temperature measurement. Open-source. The article also presents the results of an experiment on the problems of non-contact temperature measurement in different situations to improve the accuracy of the data. There are also examples of modernization with the implementation of new sensors and the use of artificial intelligence for the device and further steps to improve performance. The result showed that the measurement data can be transferred to a remote computer using the cloud - the Internet of Things (IoT). This indicates that the application is possible not only indoors but also in the field. Ease of use and maintenance and unit cost are the main benefits of this device. The purpose of this article is to show the process of device creation and application not only for the diagnosis of COVID-19 but also for other types of diseases, the dependence of the accuracy of the results on the conditions, and prospects for development.

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THE USE OF ARTIFICIAL INTELLIGENCE IN THE TECHNOLOGICAL DESIGN OF OBJECTS AND SYSTEMS

The rapid development of the information sphere and special design, as a part of this system, needs new developments and implementation of new technologies. One of the promising areas of research that will be useful in the computer modeling field – is artificial intelligence and optimization methods for artificial intelligence.

At the moment, the most relevant tools and methods of optimization are algorithms, the main purpose of which is to process a large array of data and output of calculated and analyzed data selection. There are three main algorithms used in computer design, to simplify model optimization.

Machine technology learning and neural networks are one of the areas, where we can use such methods, as algorithms of first-order optimization and their modifications. Neural networks, as a part of AI, allow us to calculate a large array of optimization equations and derive their solutions, along with the coefficient of value, which is an indicator of compliance with these decisions to the optimization level set. Therefore, these methods allow you to calculate components of the optimization equation and derive the array of its solutions and the coefficient of their values.

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DEVELOPMENT OF THE ACTIVE NOISE REDUCTION SYSTEM

Today, the problem of noise pollution is becoming increasingly important, which is why the work is devoted to the study of methods of active noise reduction.
In the course of the work the analysis of means and methods of active noise reduction was carried out, also the design of active noise reduction system was performed in order to study the efficiency of such systems depending on the angle of incidence of active noise reduction wave to the noise wave. The system implements the function of signal rotation by phase and developed a user interface.
Two speakers and a Svan 958A noise meter were used to study the effect of active noise reduction. The experiment was performed as follows, the speakers were set at a certain angle relative to each other and at a certain distance. As a result of the experiment it was found that when the speakers are located opposite each other, the greatest noise reduction effect is achieved, which was to be expected. Experiments have shown how the angle of incidence of waves affects the level of noise reduction.

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OPTIMIZE THE TRANSFER OF POINT CLOUD TO THE SERVER USING LASZIP

Laser 3D scanners (Lidars) consist of components responsible for determining distance, positioning, spatial orientation, creating a cloud of points, and the signal emitter and receiver.

Since creating an array of data requires significant resources for processing and storage of data, it is rational to take advantage of the unlimited possibilities of cloud services. Thus, the system receives many benefits. It is more profitable to use cloud capacities than to keep your own ones. Such storage gives users instant access to a wide range of resources and applications hosted in another organization's infrastructure through a web service interface.

In order to optimize data transfer and use fewer resources, you need to compress data. Such operations can be performed using algorithms designed specifically for LAS data.

LASzip is completely lossless compression scheme for LiDAR in binary LAS format versions 1.0 to 1.3. Our encoding and decoding speeds are around one to three million points per second and our compressed files are only 7 to 25 percent of the original file size. Compression and decompression happen on-the-fly in a streaming manner and random access is supported with a default granularity of 50,000 points. A reference implementation unencumbered by patents or intellectual property concerns is freely available with an LGPL-license, making the proposed compression scheme suitable to become part of the LAS standard.

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DESIGNING A MODEL OF A SACRED OBJECT AND RESEARCH OF ITS ACOUSTIC CHARACTERISTICS

The work is dedicated to the design of a model of a sacred object and the study of its acoustic characteristics. At the first stage firecrackers were used as a pulsive source of noise. At the first stage, experimental studies of reverberation time were conducted using firecrackers as a pulsed source of noise. Svan958A, a noise spectrum analyzer was used to register the echo time of the room on excitation by impulse noise. After that, the analysis of the registered files was carried out and the reverberation time was determined. The 3D model of the church in SketchUP system was created to determinate the capacity of such a complex object, and it was counted out that the volume is 4070 m3.
So, conducted studies of the reverberation time of the church have revealed that the problem of sacred objects is their large volume, which on the other hand leads to an increase in the time of reverberation. The experiments have shown that distribution of echo time by room is uniform, but it is too high and the quality of speech transmission is low.

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DEVELOPMENT OF DASHBOARDS FOR THE COLLECTION AND VISUALIZATION OF ENGINEERING DATA ON THE EQUIPMENT OF THE PETROLEUM INDUSTRY

To solve an assignment there was carried out research about data on the equipment of the petroleum industry for visualization in the plugin Kibana, considered the possibility of analyzing the data and creating visualizations. For creation a dashboard, there was carried out research about visualization based on the scripted fields and Vega visualization. A dashboard was built to analyze the progress of migration and data cleansing according to specified standards. As a result, an information panel was developed that displays the progress of data migration from one system to another. This will help you find errors faster, convert the format of the data immediately, easily analyze the data and prepare reports.

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DEVELOPMENT OF SUBSYSTEM FOR DETERMINATION RECOMMENDED TIME OF REVERBERATION DEPENDING ON THE VOLUME OF THE ROOM

The paper analyzes the literature sources for the recommended reverberation time for different types of rooms depending on the function that this room should perform and its volume.
Based on the research, in MatLab was developed a mathematical and software subsystem with a user-friendly interface that allows you to determine the recommended reverberation time depending on the function that the room will perform and its volume.
The input parameters of the subsystem are the volume of the room for which it is necessary to find the reverberation time and its type. By setting these parameters, we get as the result recommended value from the literature and the average value. In addition, the system provides an assessment of the language intelligibility index, for better understanding translated into the scale "Excellent - Bad". The program implemented in such a way that when you change any parameter, all other related fields will be listed automatically.
Thus, the developed subsystem allows at the design stage to determine what should be the time of reverberation and, according to the results, to select such finishing materials that would ensure its compliance with these requirements.

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DEVELOPMENT OF A DEVICE CONSTRUCTION FOR INTELLECTUAL MEASUREMENT OF ROOMS

To improve our living conditions and comfort of work, people have long been conducting various studies. It is known that depending on many factors, one place in the room will be more suitable for comfortable work. Basically, to find such a place there, you first need to analyze the geometry of the room and conduct various simulations.
To measure the geometry of the room, we need a device that is able, firstly, to measure the distance to the object / obstacle, and secondly, to move in space to change the purpose of measurement.
According to the above, if we consider a stationary device that will perform the work without direct movement around the room, it must rotate the measuring element in two planes, which will allow obtaining a grid with the coordinates of obstacles (walls) in a spherical coordinate system. This can be ensured by using a servo motor that rotates 180 degrees - vertical rotation, and a stepper motor - circular rotation in the horizontal plane.
It is optimal to transfer the received data using Bluetooth or other means of wireless data transfer, or to store data on an external storage device, and then to carry out processing of the measured data by means of the computer.

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DEVELOPMENT OF SOFTWARE FOR AUTOMATED DATA PROCESSING OF ROOM MEASUREMENTS

Today on the market you can find a large number of software, including for 3D-scanners of the premises, which allows you to get a model of the room and assess the characteristics of surfaces. Based on the obtained data, it is possible to assess the optimal lighting conditions and acoustic quality of the premises. Usually the products are quite expensive.
There are two common methods of presenting a digital model - in the form of an irregular grid - triangulation (TIN-surface) and regular grid (GRID-surface).
Since scanning devices detect points with a constant angular pitch, we obtain data that is easy to represent as a GRID surface, before converting the data into a Cartesian coordinate system.
To determine the geometric properties of the surface, local regression of the plane along both axes of the surface is performed. The result is an image of the surface of the plane and the cloud of points on the basis of which the surface was built.
The approximated plane allows to reduce the effect of measurement error, as well as to obtain the standard deviation of the cloud of points from it.
After approximating each of the surfaces, we get the opportunity to further measure the difference between distances and angles between the walls, as a result of building a model of the room.

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STAND CONTROL FOR ROCKET MODEL THRUST VECTORING

This thesis deals with the design of a stand model for mounting of model solid fuel rocket engine. It deals with the design of a mechanism that allows for precise control of motor gimball, which allows the thrust vector control of a model rocket. This design consists of the mechanical design using a CAD software, design of the control loop consisting of a microcontroller, sensors and actuators, and also the development of a software background for the chosen microcontroller.

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PREDICTIVE CONTROL DESIGN

This thesis deals with the design and use of predictive control. It describes the mathematical models used in the design of predictive control, then describes the methodology of calculating predicted values and their use in the calculation of action intervention. The MATLAB MPC toolbox environment for predictive control design is also described and used for designing of the model predictive controller. Finally, is evaluated the usability of the predictive control.

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KN Industrial Data Science

AUTONOMOUS WAREHOUSE PROJECT WITH JETRACER

The presentation will cover the scope of the Digital Twin project currently ongoing in Industrial Data Science scientific society. It'll cover the overall idea of implementing digital twins in the industry, and what can be gained from such an implementation as well. In particular the presentation will focus on the implementation of a digital twin for an autonomous warehouse in detail. The presentation will also cover what consists of a 'digital twin' as well as specific use-cases of said technology. On the basis of presented facts and ideas the main aims and goals of Digital Twin project will be shown, as well as a summary of the progress made in the project so far.

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COVIDGUARD - INTELIGENT BIOMETRIC PLATFORM FOR RECOGNITION OF POTENTIAL COVID - 19 INFECTIONS

The CovidGuard biometric platform is an intelligent building guardian. The main part of the platform is a humanoid robot with a movable base, arm and head. In pandemic times, the main task of the project is to use the platform to identify people who represent a potential epidemic risk, either by not adhering to current sanitary guidelines or showing symptoms of coronavirus infection. Measuring devices for basic biometric parameters include a thermal imaging camera, which measures the body temperature of people entering the room or building, and a pulse oximeter, which measures the values of blood saturation and pulse. The CovidGuard platform also uses two HD cameras to acquire images transmitted to a neural algorithm that recognises when a protective mask is worn correctly. It will be possible for users to interact with the humanoid robot through voice commands recorded using a microphone and, after analysis, to receive feedback from the device's speakers. In post-pandemic times, the platform can be used to promote the university or to support and inform guests and employees of AGH.

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NEURAL ALGORITHM FOR OPTIMIZING A MULTIDIMENSIONAL OBJECT CONTROLLER

Optimal control of multivariable systems is a complex dynamic process. It is virtually impossible to achieve optimal control of nonlinear systems through the traditional LQR multivariable object controller. The control of nonlinear multidimensional systems is a very serious problem. The suggested solution is based on the application of the Reinforcement Learning artificial neural network method in the control of a conveyor system with five degrees of freedom. The algorithm has been adapted to the analysis of tabular data. As a result of applying a new structure of control of a multidimensional object, better control quality was obtained than in the commonly known LQR regulators with linearization at the operating point. Also the resource control indices have improved significantly. The neural control architecture ensures that control quality is maintained over the full range of nonlinearities. The results that were obtained when comparing the neural controller with the classical LQR form a wide range of applications in technical systems. The effectiveness of the proposed control system was demonstrated in simulation studies.

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REAL-TIME UHD STEREOVISION USING THE SEMI-GLOBAL MATCHING ALGORITHM

This paper describes the architecture and implementation in a Field Programmable Gate Array (FPGA) of a stereovision module for a 4K (UHD - Ultra-High Definition) video stream. The solution uses the Semi-Global Matching (SGM) algorithm, which is considered one of the best methods for determining depth (disparity) maps in real-time. This paper presents the challenges of the high data rate necessary to process a high-resolution real-time video stream and discusses the 4ppc (4 pixels per clock) vector format. A full stereovision system consisting of image acquisition from two 4K cameras, rectification, and depth (disparity) map estimation based on the SGM algorithm is described. The system has been implemented and run on a Xilinx VC707 evaluation board with a Virtex-7 family FPGA device to generate disparity maps of a 4K (3840 × 2160 pixels) @30Hz HDMI stream with 32 disparity levels.

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TRAFFIC SIGN DETECTION AND RECOGNITION USING EVENT CAMERA IMAGE RECONSTRUCTION

An event camera is a new type of vision sensor based on the working pirinciple of the human eye. It is characterized by high dynamic range, high temporal resolution and low power consumption. Compared to traditional video cameras, they work better in unfavorable lighting conditions, enable the registration of fast movement and have low latency.
In the presentation, the principle of the event camera, a comparison to a traditional camera and an example of its use for traffic sign detection will be described. In this work, a video processing pipeline consisting of two neural networks is designed: FireNet and YOLOv4. The first network enabled the reconstruction of data obtained from the event camera to gray-level frames. The YOLOv4 network, on the other hand, allowed the detection and recognition of traffic signs in the reconstructed images. It was trained on the GTSDB (The German Traffic Sign Detection Benchmark) images obtained with a standard camera. The system for the metrics mAP@0.5IoU and mAP@0.75IoU achieved a value of 87.03% and 64.17%, respectively.

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EMBEDDED ENVIRONMENT PERCEPTION AND CONTROL SYSTEMS IN AUTONOMOUS VEHICLES

Environment perception and control systems in autonomous cars and driver assistance systems allow to determine the orientation of the vehicle in the space in which it is located and to indicate the route on which it can move. In addition, they enable the detection of surrounding pedestrians, obstacles, road signs or traffic lights, thus facilitating a quick reaction to various events on the road. During the presentation, works on the implementation of perception and control systems on NVIDIA Jetson Xavier NX embedded eGPU and SoC FPGA Kria KV260 System-on-Module platforms will be presented. The algorithm's task is to control a vehicle with Mecanum wheels on a miniature city model. Using a vision system and a depth sensor (LiDAR), the robot segments the roadway and detects pedestrians, traffic lights, obstacles and road markings, autonomously moving around the city model and responding to various events. The implementation uses both classical algorithms (such as the Canny algorithm or the Hough transform) and deep neural networks (U-Net, Mask R-CNN). The use of a network for simultaneous segmentation and detection has also been considered. Moreover, the performance of both computing platforms was compared.

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CREATION OF THE PROTOTYPE OF THE UNMANNED AERIAL VEHICLE FOR BLOOD DELIVERY

The main aim of this project was to create a UAV prototype dedicated to fast and secure blood delivery. The drone is prepared to take autonomous flights. To ensure the safe transport of at least 1 unit of blood, a storage component was designed and manufactured to meet the requirements of blood transportation. The storage component was produced in the lamination process. The structure was reinforced with carbon fiber and epoxy resin. To connect the storage component with the UAV, the mounting brackets were designed and printed on a 3d-printer. Additionally, an Android mobile application has been developed to ensure an easy and safe delivery process. The application continuously monitors the temperature readings and allows the user to enter and archive the data such as: transport time, type of the transported blood, flight and blood identification number, temperature. Data is automatically exported to Excel spreadsheets after completed delivery. To test the correctness of working, a physical simulation of the blood storage in the storage component was also carried out to check the temperature drop rate over time.

The presentation will also include the conclusions drawn during the implementation of the project and the analysis of the effectiveness of the solution, as well as the possibilities of further development of the project.

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CONTROL OF A WIND TURBINE WITH A VARIABLE DIFFUSER GEOMETRY IN THE FORM OF A MODULAR MODULE

The entry of our presentation shows a design concept for a wind turbine with a variable diffuser geometry and also motivation for starting the project. Its functionality is discussed as well as means from fields of mechanics, materials science and automatics which are necessary in project design.
An essential part of the demonstration is a detailed description of the problem of automating the turbine operation and a drawer cabinet realised in the form of an original modular system. The division of functionality between the individual driver modules is outlined so does the operation of each system: generators control, safety, couplings control, flywheel control, directing to the wind, power supply and data visualisation. The implementation of serial communication with the use of the MODBUS protocol is described taking into account addressing of each system, sending orders and data.
The presentation also discusses the implementation potential of the solution as well as justification for measures taken in the context of security and problem-solving during design. Particular attention was paid to the benefits and assumptions achieved.

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USING REINFORCEMENT LEARNING TO CONTROL AN UNMANNED AERIAL VEHICLE IN A DYNAMICALLY CHANGING ENVIRONMENT

Reinforcement Learning techniques are a rapidly growing branch of machine learning. This is due to their wide range of potential applications. In particular, they are used in the problem of Unmanned Aerial Vehicle (UAV) control. This paper presents an example of such an application. It uses reinforcement learning techniques to simultaneously generate and execute quadrotor trajectories in the Flightmare simulation environment. In this way, the task of safely flying the vehicle without collision through an area with obstacles in the form of spheres of different diameters was realised. They have a twofold character: static (they always appear in the same location) and dynamic (they change their position). The Proximal Policy Optimisation (PPO) algorithm with a deep neural network agent policy was used to perform this task. After learning it using images from the aforementioned simulator, an agent capable of collision-free flights was obtained. All the work done fits in with the principles of the DogdeDrone Challenge competition organised as part of the ICRA 2022 conference.

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AUTONOMOUS RACING DRONE

Autonomous systems are more and more often replacing humans for specific tasks, including drone control. Unmanned Aerial Vehicles (UAVs) can be used for operations such as monitoring the environment, inspecting objects or delivering packages. Autonomous drone racing is also a specific application and it presents significant engineering and scientific challenges. The work presented here included building an autonomous drone that is equipped with an NVIDIA Jetson Nano computing platform and a camera. This allows the implementation of control algorithms directly on board of the drone. The task of the vehicle is to fly through a path determined by square gates. At the current stage, the navigation is based on special ArUco markers attached to the gates, however, work is in progress on the use of a detector based on neural networks to detect the corners of the gate. Control of the drone is currently implemented using a state machine and proportional controller, but it is planned to also use other control methods, including reinforcement learning.

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INFLUENCE OF GEOMETRIC INACCURACIES ON THE HYDRODYNAMIC PROPERTIES OF THE EPPLER 908 PROFILE BASED ON CFD TESTS

The work concerns the examination of the influence of geometric inaccuracies on the hydrodynamic properties of the Eppler 908 profile. Using the software for CFD testing, it will be investigated how the potential shifts of the profile points affect its performance characteristics. The study will be performed using ANSYS Fluent software, based on 2D simulations. The resources of the Prometheus computing cluster will be used for the work. Geometric inaccuracies will be given as shifts of points in the Y vector by a random number from a given range of values (normal distribution). It is supposed to imitate the inaccuracy of the execution of hydrofoils.

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THE PROCESS OF MODELING THE BLADE GEOMETRY FOR A WIND TURBINE BASED ON THE OPERATION OF THREE GENERATORS

The subject of the thesis is the modeling process of blades for a wind turbine with a rotor surface area of 2 m2. The work begins with the introduction of basic concepts, design assumptions and a general concept related to the modeling of wind turbine operating parameters. Then the functionality of the free QBlade software for testing wind turbines is presented. This program allows for the appropriate selection of the shape of the blade geometry to the given operating conditions, based on the BEM (Blade Element Momentum Theory) theory. The process of machining obtained as a result of modeling of geometry in Autodesk Fusion 360 is presented in sequence. The process of its simplification is also shown in order to properly perform FEM simulation in Ansys Static Structural aimed at showing the weakest points of geometry during given critical working conditions. The simulation result shows the blade stress map and shows which elements are most susceptible to deformation. The task of this simulation is to properly select the thickness of the carbon fiber layers so that the strength of the blade is at the appropriate level.

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BIO-POLYOLS AS AN ALTERNATIVE TO THE PETROCHEMICAL RAW MATERIALS IN THE PRODUCTION OF PUR FOAMS

Rigid polyurethane (PUR) foams are a group of polymeric materials that are produced by the reaction of isocyanates and polyols as compounds containing hydroxyl groups. Currently, the petrochemical polyols are used in the PUR production, which are non-renewable raw materials. An alternative for them are environmentally friendly bio-polyols, which are made of vegetable oils.
In the experimental studies, sunflower oil was used to produce the bio-polyol. Due to the fact that the "crude" oil does not have hydroxyl groups in its chemical structure, it had to be appropriately modified. The hydroxyl groups are necessary for the reaction with the isocyanate. The unsaturated fatty acids were subjected to oxidation reactions, followed by the opening of epoxidized rings. The obtained bio-polyol was mixed with the petrochemical polyol in a ratio of 3:7. Then the isocyanate was added. As a result of the conducted process, PUR foam was obtained.

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THE EFFECT OF POROSITY OF MIXED IONIC-ELECTRONIC CONDUCTORS ON THE DETERMINATION OF TRANSPORT COEFFICIENTS D AND K

In the theoretical part, the basic laws and principles describing diffusion processes will be derived and discussed together with the coefficients. Diffusion profiles for different geometries and dimensions will be presented and different types of diffusion will be considered: two-step kinetics, flush time and diffusion in spherical powders. The main subject of the paper is the influence of material porosity on the processes. The methods of determining the parameters describing this phenomenon, e.g., measurement of mass relaxation by thermogravimetric method will be discussed. The results of computer calculations performed in the MATLAB package will be made available together with their detailed analysis.

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PROPERTIES STUDIES OF NEW MIXED IONIC-ELECTRONIC CATHODE MATERIALS FOR SOFC

The aim of the presentation is to show the results of research on new MIEC-type cathode materials for Solid Oxide Fuel Cells. Mixed ionic-electronic conductors (MIEC) are materials at the forefront of research related to energy storage and conversion technologies. The work presents the development of 6 perovskite oxide materials in the La1-xSrxNi1-yCuyO3-δ system. The crystal structure of the obtained compounds was characterized by means of XRD, and the high-temperature properties of the compounds were examined by means of HT-XRD and dilatometry studies. The chemical stability of the materials was assessed in the presence of three different electrolytes (GDC-10, LSGM and YSZ) indicating good stability and compatibility of proposed cathode materials with electrolytes. Oxygen non-stoichiometry of materials was determined using iodometric titration, while the change of non-stoichiometry as a function of temperature was determined using the thermogravimetric analysis. The morphology of the considered powders were characterized by SEM studies. The cathode material with the best desired was selected and investigated using the impedance spectroscopy study to measure the polarization resistance. The anode-supported SOFC with selected cathode material shows promising electrochemical performance.

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APPLICATION OF ADSORBENTS OBTAINED FROM BIOMASS RAW MATERIALS

This paper presents issues related to the preparation of carbon adsorption materials with significantly developed specific surface area from waste organic materials of biomass origin. In recent years, there has been a growing interest in the use of waste from the wood and food industries to produce activated carbons. Such application of biomass wastes is a good example of practical implementation of a circular economy, combining many sectors, i.e. agro-food, fuel and energy as well as chemical. Adsorption processes are one of the most popular methods for effective removal of pollutants from both gases and liquids and are used in many industrial processes and everyday life, especially in environmental protection.

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ANALYSIS OF GENERATED POWER IN AEOLIA WINDTECH D2CF 200 WIND TURBINE DEPENDING ON SETTING TOWARDS WIND DIRECTION

During the conference presentation an analysis of generated power by Aeolia Windtech D2CF 200 wind turbine depending on its setting toward wind direction will be presented. Calculations have been made by the simulation program TRNSYS allowing for putting in exact power characteristics wind turbine model mentioned before. Comparison will be based on generated electric power based on different angles of rotor axis setting- full 360 degrees and four cases of main world directions. There will be mentioned advantages resulting from the solution of controlling the direction of the rotor axis. During the conference will be presented the solution used in the new wind turbine model being developed currently in the SKN Eko-Energia student group.

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Studenckie Koło Naukowe

REPRESENTATION OF A SOLID OXIDE FUEL CELL ANODE MICROSTRUCTURE USING PERSISTENCE DIAGRAMS

The Solid Oxide Fuel Cell is an energy conversion device characterized by high efficiency. One of the methods of describing SOFC electrode material is the quantitative analysis, where the following values are determined: volume fraction of the phases, average grain size, phase continuity, tortuosity factor and the effective length of the three-phase boundary. Complete microstructure analysis requires the use of computationally complex algorithms. The subject of the presentation is an alternative method of anode material description relying on a topological data analysis tool. Based on Scanning Electron Microscopy Data, persistence diagrams were created, showing changes in the topology of the examined microstructures. Homology analysis was performed for samples taken from the stack of cells after long-term operation and compared with the results obtained brand new anode. The changes due to material degradation shown in the PDs were compared to the quantitative analysis data. On the basis of the results, it was found justified to perform the inverse analysis.

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INNOVATIVE WIND TURBINE PROJECT AS A SOLUTION TO THE INSTABILITY OF RENEWABLE ENERGY

Wind's potential as a renewable energy source is significant. However, wind turbines have one problem - they can only work within strict wind velocity parameters, which notably decreases their energy efficiency and profitability. Author presents an innovative solution to this problem - a wind turbine using a system with various performance characteristics generators. This turbine makes it possible to generate energy for a wider range of wind velocity. Author focuses on the instability of renewable energy and describes the specificity of Polish conditions for wind energy development. With financial indicators (such as LCOE, PP) and technical parameters, the paper compares Eko-Energia's project with traditional wind turbines. The analysis proves the described wind turbine to be profitable for conditions in Poland. Increased range of operative wind velocity the turbine can use directly increases yearly energy efficiency. In order to improve the implementation potential, there is a need to optimize investment costs.

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DESIGN OPTIMIZATION OF THE WIND TURBINE

Together with SKN Eko-Energia, we have built "Windy", a wind turbine with a diffuser with a variable diameter, designed to increase the efficiency of the power generation by managing airflow stream. Looking for possibilities to improve the design, I decided to write an engineering thesis in which I checked whether the 3-blade rotor used in the vast majority of new HAWT wind turbines is always the best solution (and not, for example, 4 or 5-blade). In order to study this issue, I designed new, universal versions of the blades for three rotor configurations, which I tested in the aero tunnel at the Faculty of Mechanical Engineering and Robotics AGH. During the presentation, I will present the results of the research and answer the following questions: Why will the new turbines in the Baltic Sea be (most likely) 3-bladed, why "rocket science" in student research clubs slows down progress, and why it is all good for us.

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THE USE OF POLYURETHANE WASTE FOR THE PRODUCTION OF NEW THERMAL INSULATION MATERIALS

In this project, waste polyurethane composites were used to produce new thermal insulation materials. The used PUR materials were made with 10% addition of fly ash from coal combustion. The new materials for the production of which used PUR composites were used were rigid polyurethane foams with the addition of 2.5%, 5% and 7.5% of waste. An appropriate mass of waste was ground and added to the polyol and mixed thoroughly. In the next step, the isocyanate was added and the mixing process was carried out at 1200 rpm using a mechanical stirrer. The final stage was pouring the mixture into appropriately prepared molds. The paper presents the manufacturing technology of new PUR materials and proposes analyses to be applied to new materials in order to test their functional properties. The analyzes will include the study of thermal conductivity, density, brittleness, water absorption, mechanical strength, flammability and thermal stability.

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INVESTIGATION OF HEAT TRANSFER IN LOW-TEMPERATURE CONTACT PROCESSES WITH THE PRESENCE OF MEDIATING SUBSTANCES

The main goal of the project is to investigate heat transfer in low-temperature contact processes with the presence of mediating substances. The research was divided into two main phases. In the first stage of the project implementation, substances with a high thermal conductivity coefficient were selected. In the second series of measurements, substances with a low thermal conductivity coefficient were used. A series of measurements of temperature changes for different values of pressures applied to the samples in contact was made, allowing to determine the effect of the presence of mediating substances between the surfaces remaining in contact on the dynamics of heat exchange between these surfaces. The final effect of this series of measurements was the selection of the substance that most improves heat transfer and the best improves the insulation.

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SYNTHESIS AND CHARACTERIZATION OF THE NOVEL HIGH ENTROPY PEROVSKITES IN THE CONTEXT OF SOFCS APPLICATIONS

High entropy oxides are an innovative group of multicomponent functional materials, which has been under development since 2015. Their increasing popularity results from a number of unique properties, potentially enabling their use in energy conversion technologies. In the presented study, the synthesis and characterization of La 1-x Srx(Co/Fe/Ga/Cu/Mg/Mn/Ni)O_3 high entropy perovskites were carried out, with the emphasis on the possibility of using these materials as air electrodes for technology Solid-oxide fuel cells (SOFC). Based on analysis of structural, thermomechanical, and electrical properties, as well as functional properties such as high-temperature and chemical stability, the La(Co,Cu,Fe,Mn,Ni)O_3 composition was selected for further studies, including characterization of electrochemical properties, in particular cathodic polarization resistance. Obtained results indicate a significant potential of the high entropy approach in the context of SOFC technology, allowing obtaining a unique combination of excellent functional properties, chemical stability, and excellent electrochemical performance in the cell.

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EVALUATION OF BIOGAS POTENTIAL AND SELECTED BIOCHEMICAL PROPERTIES OF PRODUCTION WASTE FROM TINECIA BREWERY

In this study, the biogas potential and selected biochemical properties of waste from beer production at the Tinecia brewery were determined. For this purpose, a sample of brewery waste (thresh) was taken and a technical and elemental analysis was carried out, and the proportion of total dry matter and organic dry matter was determined. In addition, an enzymatic hydrolysis of the material studied was carried out in order to carry out a quantitative analysis of the starches present in it. The sample was also subjected to UV-VIS spectroscopy for quantitative analysis of phenolic acids such as ferulic acid, p-coumaric acid, caffeic acid, gallic acid and synapinic acid. On the basis of the obtained physicochemical data, calculations were made to obtain both the theoretical yield of biogas and biomethane per unit mass of waste and the annual production potential of the above-mentioned fuels, as well as to describe the potential applications of this substance.

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MICROPLASTIC CONTENT IN STABILIZED SEWAGE SLUDGE

Mass production of plastics dates back to the mid-20th century. From that moment on, a growing tendency in their production has been noticed, which, as it turns out, may lead to a global catastrophe. Microplastics, i.e. microfragments of plastics, are already part of every ecosystem, and even the human body. An element of modern ecological thinking is the Circular Economy. However, in case of re-use of samples contaminated with microplactics, there is a risk of their re-emission to the environment. In the study, it was decided to analyze the samples of sewage sludge from Przedsiębiorstwo Wodociągów i Kanalizacji Żory in terms of quantity and quality. The samples were separated and then identified using an FTIR microscope. Larger fractions were analyzed using the ATR FTIR overlay. Research has shown a significant amount of plastics of various sizes, shapes, and colors. The investigated sediments may be an important source of microplastic contamination in ecosystems due to their use in the production of fertilizers.

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GREENING OF THE DISTRICT HEATING SYSTEMS

The paper analyzes the technical and economic effects of converting conventional district heating systems in six towns in Poland, producing 8.5 PJ of heat annually, into efficient district heating systems. The main analytical tool used in this study was the IEA-TIMES model. Two scenarios were considered for the period 2025–2050. The first, STAT, assumed freezing of economic and technical parameters in the period under consideration at the level of 2025 values. In the second scenario, DYN, gas prices and CO2 emission allowance prices changed in the years. A "perfect foresight" optimization was carried out with the main objective to minimize the costs of district heat generation. The operation of district heating systems was analyzed at daily resolution. The results show that reaching a 20% share of heat production by solar thermal would demand extra construction of seasonal heat storage facilities with a total capacity of 197 TJ.

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PROJECT MANAGEMENT IN A LARGE CONSTRUCTION TEAM

The paper will present the method of carrying out design and construction works in our Scientific Club. I will present the course of action in which our projects are created and how they are run and implemented. The way of keeping files will be explained, which significantly improves the organization and reduces the chaos of creating executive documentation. I will also present the process of creating an exemplary element of our project on the example of an emergency brake. I will explain how we create and develop our projects. I will also present the difference in which I manage individual sections on the example of managing a team of designers and a team of electronics. At the end of the presentation, I will summarize my activities that I have implemented as a coordinator of design and construction works in a research club.

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DEVELOPMENT AND IMPLEMENTATION OF ROOM ACCESS CONTROL SYSTEM WITH USAGE OF BIOMETRIC SECURITY AND RADIO-FREQUENCY IDENTIFICATION SYSTEM

The paper presents the development and implementation of room access control system using biometric security and radio-frequency identification system. Commercially existing devices of this type have been reviewed and briefly characterized. The most important components needed to build an electronic device were also described. A circuit diagram was designed, and a prototype was made on its basis. The algorithm of the device operation was presented using block diagrams and the communication scheme with the database in which the authorization history will be stored. Using CAD software, the case for an electronic device was developed. The prototype was made in 3D printing technology. The Arduino programming platform and libraries were used to control the device, allowing for communication and component control. Significant fragments of functions implemented in the Arduino IDE development environment have been described. A several of functional tests were carried out, which confirmed the intended operation of the prototype.

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DEVELOPMENT AND IMPLEMENTATION OF THE EFFICIENT COMPUTATIONAL DOMAIN SEARCH ALGORITHMS IN THE RANDOM CELLULAR AUTOMATA METHOD

The main goal of the work is development of new mechanism for fast point space search, for use in simulations using the random cellular automata method. The grain growth simulation was chosen as a benchmark method. Furthermore, developed mechanisms can be used to simulate various phenomena occurring during modeling of microstructure evolution. The work extends the functionalities presented in the engineering thesis. In addition to optimizing the sequential part of the code, a multi-threaded approach was taken into account, using OpenMP library. In order to verify and properly analyze each algorithm a number of simulations, benchmarks and hardware counter measurements were performed. The collected data allowed to explain the emerging difficulties with the scaling of individual algorithms and the proposed parallel variants.

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DEVELOPMENT AND IMPLEMENTATION OF A SCRIPT DIELESS DRAWING MODEL GENERATION

The main subject of the engineer diploma thesis is development and implementation of a script for dieless drawing model generation using ABAQUS software.
In the introduction, both traditional die drawing and dieless drawing processes were described and they were compared to each other. After that, the main goal and specific goals of the thesis were presented. Later, the main requirements which should be met by the script were specified and then the implementation of these requirements was discussed.
After the code and structure of the script had been described, validation process of developed FEM solution was presented. It consisted of two parts. Part one was comparison of results calculated using the script with literature data. Part two was an execution of dieless drawing process in laboratory and subsequent simulation of that process using prepared script. The laboratory test required developing a temperature control system for the furnace used during the test and determination of thermal characteristic of the furnace. A short review of hardware used in this system was presented in the thesis. Additionally software used to command the temperature control system was described.
At the end, the results were discussed and summarized. On top of that, possibilities of further development of the project were presented.

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Koło Naukowe
MechaBajt

DESIGN OF A SINGLE-SIDED BICYCLE FORK USING THE FINITE ELEMENT METHOD

The invention of the bicycle took place more than 200 years ago. Taking into account the technological progress that took place between the nineteenth and twentieth centuries, it can be thought that this structure has already been developed to a final level, but manufacturers do not stop proposing innovative solutions.

Currently, the finite element method (FEM) plays an important role in the design of bicycle forks. It allows one to improve the design process and test new solutions without the need to build expensive prototypes. In this study, it was used to design a fully functional, rigid, single-sided bicycle fork. The main requirement of such an element is to ensure the safety of its user. Therefore, it was subjected to a series of tests described in the ISO 4210-6 standard in the form of simulations on a mathematical model using FEM. This allowed to detect errors in assumptions and analytical calculations at an early stage of design. In the long term, it allowed for the introduction and testing of new design solutions, both for rigid and suspension forks.

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Koło Naukowe
MechaBajt

THE EMOTION RECOGNITION SYSTEM BASED ON THE FACE IMAGE

The aim of the study was to design, implement and carry out verification tests of an emotion recognition system based on a face image. It works on the basis of a trained neural network as a classifying element and an embedded system, which obtains face images for further processing and analysis.
The first stage of the work was the acquisition of images of people's faces showing the main micro-expressions that define the experienced emotions. The data obtained at this stage allowed the system to be trained and verified.
In order to solve the problem, three selected structures of neural networks were analyzed: feedforward neural network, convolutional neural network and convolutional neural network with its supporting recursive neural network. The methods of image processing and analysis allowed for the identification of features and data coding. The solutions have been implemented and tested in the MATLAB environment.
The last stage of the work was the implementation and validation of an embedded system based on the developed algorithms, which allowed for the classification of emotions on the basis of images obtained from a video camera.

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KN Telephoners

TELECLIMB – A SYSTEM OF APPLICATIONS CREATED TO AUTOMATE THE PROCESS OF JUDGING CLIMBING COMPETITIONS

The aim of the project is to build a system used for judging climbing competitions. Its main focus is automation of delivering and processing data. The project is designed to be a valuable asset in the market/an answer to the demand of the market – currently, there does not exist a system which operates in the described manner.
As far as physical layer is concerned, it is composed of a computer and a few mobile devices. Connection between all the components in the basic scenario should be provided through a local wireless network.
The system will consist of:
- a web application (JavaScript, ReactJS), used by the main referee – his job is to manage the entire event. Its capabilities include: competition configuration, importing the list of competitors, conducting/managing rounds, exporting scores, etc.,
- a mobile application (JavaScript, ReactNative) will be utilised by the problem referees. Each referee will receive a prepared list of competitors, starts of which he will be marking. The results are going to be automatically sent to backend,
- backend (Java, Spring) puts up REST API. It shall possess the entire logic of how the system acts, in accordance with the rules of the Polish Alpinism Association. The data will be saved and downloaded from a built-in file database. Additionaly it will create logs copies, necessary to retrieve lost information on the starts, should any malfunction occur.

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Koło Naukowe
MB
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DESIGN OF SOLAR PANELS STRUCTURE WITH APPLICATION OF FINITE ELEMENT METHOD

The paper concerns the design of supporting structures for photovoltaic installations. A number of phenomena that have a significant impact on the load and efficiency of installations, such as: the influence of the Sun, wind, the influence of terrain and weather conditions have been characterized. Basic information on the finite element method has been presented. The key criteria for the selection of individual components of a photovoltaic installation has been described. A frame constructed of self-designed sections has been presented and its features were compared with competing solutions. The main sources of loads acting on the structure have been characterized, their significance has been determined and the methods of determining their value have been described. Then, the results of a series of analyzes carried out in the Ansys Workbench program have been visualized. The distribution of stresses and displacements in the model has been reported, their maximum values have been determined and the compliance of the structure with its requirements has been confirmed. Subsequently, potential further development directions for the project were identified.

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Koło Naukowe
MechaBajt

MODELLING AND ANALYSIS OF AUTOMOTIVE CONTROL MODULES ILLUMINATION USING ANSYS SPEOS SOFTWARE

Lecture will cover analysis of backlighting of the symbol in the passenger window lifter module from Mercedes-Benz Class C, by performing light simulation in Ansys Speos software. The issue of nonimaging optics, ray-tracing method and most important characteristics of icons and symbols backlighting, as well as Snell's law and TIR (total internal reflection) phenomenon will be discussed. State of the art in the automotive industry regarding lightguides solutions will be presented and exemplary module for each type of lightguide will be described. Light simulation in Ansys Speos software, consisting of backlighting of the symbol in the passenger window lifter module from Mercedes-Benz Class C, will be explained and simulation results will be then confronted with experimental luminance measurments results. Additionally, possible ways of further development for presented light simulation will be shown, regarding possibility of improving symbol backlighting parameters in analyzed module.

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UNIVERSAL EMBEDDED SYSTEM FOR SMART ELECTRIC MOTORBIKE

Presented Thesis was a part of the E-Moto AGH project. System was made to perform in our 8kW motorbike called Pimpek that was lately modernized. As the name calls it , this system is modular and adopting it to the rest of our constructions is trivial.
Thesis implements universal embedded system for smart electric bike. The whole project is divided into 3 big parts: Embedded made for communication with buttons located on handlebar, sensors located inside the vehicle and the the rest of electronic system in motorbike. This project implements CAN-bus communication which is very popular among Automotive industry also used by the rest of motorcycle systems. The main part of this thesis is a virtual dashboard, it contains backend system used for communication with CAN-bus and sending processed data using socket server and frontend system using socket communication to get values of parameters. Virtual dashboard presents data using QML based projects containing animated parts and implemented driving modes.

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KN AGH Solar Plane

PROJECT OF THE FLIGHT CONTROLLER AND SIMULATOR

The presentation describes the most important elements of construction and testing controller for unmanned aerial vehicles. The presentation consists of two main parts: overview of controller's operating principle and testing environment.
In the first part there is a controller description. Firstly input data received by the controller such as: gps, imu and user input will be discussed. Then we will discuss output data like: aileron and rudder settings or proper engine power. Next we will present different operating modes and differences between them. Lastly we will discuss methods of controlling the unmanned aircraft in the event of a crisis situation, such as loss of connection with the control apparatus, or fail-save.
In the second part we will present architecture of flight simulator. We will discuss reasons for creating such simulator. The main reason will be to test the controller in safe conditions. This will allow not to expose people at risk of incorrect operation of the controller.

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DESIGN AND IMPLEMENTATION OF A PLATFORM DEDICATED TO REMOTE ROBOT CONTROL

The goal of the project was to create a tool enabling users to remotely monitor and control different types of devices. The implemented system is based on cooperation across each modules of the project, that is, the website, server application and device control applications.
The main assumption during the whole implementation process, including database design and features, was the flexibility of each element of the application, so that the software could provide freedom to the user in managing any device. The project has been tested and used to control, among others, a robotic arm using a microcontroller application adapted to this purpose.
The whole project includes:
• A server application using the ASP .Net Core tool, which is the connection point between each element of the project,
• Client application implemented in Flutter framework, which is a user interface,
• An application based on the ESP32 WiFi microcontroller that is used to control a robotic arm, which is an example of a manageable device.

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DEVELOPMENT AND IMPLEMENTATION OF THE USER INTERFACE AND SERVER FOR THE SOFT BASTION PORTAL, SUPPORTING THE PROCESS OF REMOTE LEARNING BASE ON GAMIFICATION

The mission of the project is to answer the following questions: Why are you learning? Why are you teaching? And consequently how to teach most effectively? The project involves the creation of an e-Learning platform which would support the process of learning programming with the help of gamification.

The goal of the platform is to modernize the way of learning programming by implementing a non-standard teaching model, using gamification mechanisms which will allow to keep the student's and master's commitment and motivation at a constant, high level throughout the entire learning process.

The main feature of innovation of the proposed solution is the implementation of a gamification model adapted to the needs of learning programming, giving a new quality to the classes conducted by implementing a plot that will be followed by course participants.

The designed system will provide the teacher with the ability to manage the course plot, create new tasks, track the progress of students in real time, modernize the process of writing colloquiums, giving students the ability to program in the editor provided by the portal, compile the code, display the results and perform unit tests of the implementation.

The project is supported by Design Thinking.

Research supervisor of the paper:
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KN Promote.Me

ORGANIZATIONAL LEARNING BASED ON SCRUM TEAMS

In recent years, the dominant approach in the IT industry has become an agile approach to both project and enterprise management. In order to increase their flexibility, companies related to the production of IT products have declared and adopted actions according to the Scrum methodology.
A survey carried out on the representatives of the population of companies and IT teams allows for the indication of the actual activities of companies in the Scrum methodology. The questions posed concern both the implementation of the assumptions of this methodology and the implementation of activities and characteristics of the learning organization. This allows for the analysis of the correlation of these two factors. The questions were selected specifically for the IT industry in order to simplify the assumptions of management theory for line employees of IT companies.

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Section VI. Material Engineering

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HYDROGEL MATERIALS AS 3RD GENERATION DRESSINGS

Hydrogel transdermal systems are the most modern generation of dressing materials which differ significantly from traditional dressings applied to patients. They provide a good environment for wound healing, have a direct effect on the healing process, have a protective function, form a barrier for bacteria, do not adhere to the wound making dressing changes painless for the patient. Moreover, they do not move and reduce the frequency of dressing changes. In addition, they do not cause allergic reactions or toxic effects. Hydrogel dressing applied on a wound shortens its healing process twice as much as traditionally applied dressings. This effect is due to maintaining appropriate humidity, in the presence of which the healing process is accelerated. Hydrogel dressings are the third generation of dressing materials and due to their unique properties they are most applicable in the treatment of post-operative wounds, burns, bedsores and ulcer wounds. Hydrogel dressings enable the treatment of patients in a comprehensive manner definitely more than traditional dressing materials. The scientific objective of the ongoing research is the synthesis of hydrogel dressings, as transdermal systems containing antibiotics, which could effectively combat the condition of diabetic foot.

This work was prepared within the framework of the SMART-MAT Functional Materials Research Group and the FutureLab PK project conducted at the Faculty of Materials Science and Physics, Krakow University of Technology.

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INVESTIGATION OF THE EFFECT OF SPS SINTERING TIME ON SELECTED PROPERTIES OF ALUMIX431 – B4C COMPOSITES

Powder metallurgy is a very efficient and innovative technology for the production of sintered products with high mechanical properties. It is an economically and environmentally competitive production process compared to casting. Advanced sintering techniques such as Spark Plasma Sintering used to produce the samples for this study is a more efficient process compared to traditional sintering methods due to faster heating and shorter sintering time, among others. The purpose of this study was to determine the effect of sintering time in the SPS process on selected properties of Alumix431 - B4C composites. Different composite sintering times (3,15 and 10 minutes) were used. The tests carried out included: microstructure tests, density measurements, hardness test by Vickers method and bending strength tests. The obtained results clearly showed that the composite sintered in 10 minutes has better properties. Its microstructure consists of grains of similar size, and the strengthening phase is located mostly on the grain boundaries. The hardness of the composite was 127 HV1, flexural strength was 618 MPa and density was 2.81 g/cm3.

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TECHNOLOGY OF MAKING FORGED CARBON FIBRE PARTS USING COMPRESSION MOLDING

The paper covers the method of making forged carbon fibre parts using compression moulding introduced 9.12.2021 on YouTube chanel EasyComposites Ltd. The paper presents process of 3d modeling three generations of compression moulds. The paper describes pross and cones of the process, mistakes that were made during prototyping and solutions that were implemented in next generations of moulds. The paper covers process of making the parts themselves, ways to make them stronger and comparison between different release agents.

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ASSESSMENT OF THE THE LEVEL OF THE OPERATING DESTRUCTION OF MATERIALS WORKING IN THE ENERGY SECTOR

The purpose of the study is to assess the effects of long-term exploitation of materials operating in industrial conditions. The tested material is subject to such phenomena as abrasive wear, oxidation, fatigue and creep. The analysis covers structural changes caused by high-temperature corrosion, the properties of materials and the scale formed on the outer and inner surfaces. The destruction of the material under the influence of the prevailing working conditions was assessed. On the prepared samples, using the SEM scanning electron microscope, an assessment of the material structure was performed, providing information on the condition of the surfaces on which the scale had formed and the morphology of the grain structure at the surface and inside the material. The grain structure was analyzed in terms of damage, the thickness of the created scale layer was assessed, as well as the size of the loss resulting from long-term use of the material. The use of EDS analysis provided information on the chemical composition of the scale and the detailed distribution of elements. Hardness measurements were performed in order to assess the influence of surface degradation on the properties on the material cross-section. The final results of the research allowed to determine the effects of degradation on the structure of the material, the hardness measurement using the Vickers method showed that the surface damage of the material leads to deterioration of the mechanical properties not only on the surface itself, but also affects the entire cross-section of the material.

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TESTING CARBON FIBER COMPOSITES

In this paper, I will describe the tests of carbon fiber samples. The tests that I have carried out give data on the strength of a given material for tensile and three-point compression. The paper contains a theoretical introduction to the creation of samples concerning the laminating technology and the material which is carbon fiber. The method of conducting the research was described in the paper. The tests were carried out at AGH on a testing machine. The tests were carried out according to the standards. Carbon fibers are a very light material and very durable. You can use them to create various things of various structures. Carbon will displace other construction materials, such as aluminum, because it is lighter, and in many cases, thanks to weight reduction, we can achieve much better performance. Carbon fiber can be used, for example, in the production of wind blades.

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ANALYSIS OF SELECTED COMPOSITE MATERIALS AND ANTI-ADHESIVE AGENTS

The presentation will compare the most important composite materials. In the first part, we will analyze the preparation time and cross-linking of epoxy resins in combination with various hardeners. Based on the results, we will be able to determine which combination is best for your application. In the next part, we will focus on the comparison of release agents, i.e. polyvinyl alcohol, frecote and wax. We will carry out the comparative test in few variants intended for the best surface preparation for the gelcoat layer. We will perform tests on both flat forms made of tempered glass and on complex surfaces made of resin-hardened MDF boards. We will check how the complexity of forming surfaces affects the application of anti-adhesive agents. Then we will analyze the method of stiffening the gelcoat forms by comparing the application of different types of glass fibers. In addition, we will focus on comparing the method of fixing composite materials by pressure and using the vacuum method. In the vacuum method, we will check the suitability and necessity of elements, including delaminating fabric, suction mat, perforated foil. We will show the difference of the surfaces made. The conducted research will allow us to find the right solutions for our projects in the student reaserch group Eko-Energia.

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EXAMINATION OF THE DEGREE OF RESIN INFILTRATION IN MOLDS MADE OF MEDIUM-DENSITY FIBERBOARD (MDF)

The goal of the AGH Solar Boat Team project is to build racing solar boats. The boat's structure includes many elements with non-standard shapes, such as hydrofoils and struts, which, when the sufficient speed is reached, allow the hull to raise above the water surface. These elements are manufactured in our workshop from carbon fiber and epoxy resin. To obtain the desired geometries, a special form is needed in order to press down laminated fibers properly and provide a good surface finish of the product after completing the lamination. The most convenient material for making the mold is MDF board, due to its availability and ease of machining. However, it is not hard and absorbs liquids well, so the mold needs to be secured before the lamination. This is done by covering the milled surface with resin - its role is to harden the outer layer of the board, which allows to obtain the desired smoothness, prevent absorption of the resin intended for lamination and protect the mold from moisture. A frequent problem is insufficient resin absorption by the MDF, which manifests itself during further processing of the mold and results in a surface unsuitable for further work. The subject of this paper is to compare the degree of resin infiltration in MDF board depending on the method and circumstances of applying the resin to the mold surface.

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FIBROUS CARBON SUBSTRATES WITH AN ACTIVE SURFACE TO FILL CARTILAGE TISSUE DAMAGE SIMULATING THE PROCESS OF ITS REGENERATION

The topic of our project is an attempt to use fibrous carbon substrates with an active surface as a filling of cartilage tissue damage, simulating the process of its regeneration. Low-modulus carbon fibers are used in medicine due to their high biocompatibility and safe degradation products removed by the organism. The chitosan used in the project, due to the presence of numerous amide groups and brittle glycosidic bonds in the chain, allows the production of biomimetic microstructurally and chemically carbon substrates by applying the hydrogel in the form of chitosan to their surfaces. Such activation of the fiber surface should lead to better stimulation of the regeneration process of damaged cartilage. The research was carried out in four stages: (1) microscopic characteristics of the carbon substrate before and after chitosan modification (optical microscope and scanning electron microscope), (2) structural characteristics of the fiber surface (FTIR-DRIFT tests), (3) physicochemical characteristics of the fibers and the influence of the degree of cross-linking chitosan on surface wettability, (4) biological studies with MG-63 osteoblast-like cells. As a result of the research, the material and modification method was selected which is best suited for filling cartilage defects, fulfilling its role as a scaffold and initiator of the auto-repair process.

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STRESS AND STRAIN FEM ANALISYS OF BIOMIMETIC COMPOSITE INSPIRED BY CRUSTACEAN CARAPACE

For the project „Stress and strain FEM analysis of biomimetic composite inspired by crustacean carapace" Finite Element Method simulations in ANSYS Workbench were conducted. The simulated tests were specific, normalized mechanical tests for composite laminates, with composite being made of carbon fiber and epoxy resin. Composite was biomimetically designed to mimic crust of Odontodactylus Scyllarus, otherwise called Mantis Shrimp. Simulations were created in order to analyze the behavior of plies in laminate while under working load.

To explore the properties of this composite, virtual models of several samples were made, which differed by the orientation of layers and the boundary conditions. Results of those tests were stress and strain distribution diagrams for all of the simulated models. Simulation outcomes were analyzed and precisely described, which results in understanding composite's and all the layers reaction to tensile test.

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QUALITATIVE ANALYSIS OF MICROPLASTICS IN RAMAN MICROSPECTROCOPY

One of the biggest environmental risks of recent decades is pollution by plastic, which has been decomposed for hundreds of years due to its durability. Decomposable plastics in the range of micro- and nanometres are present in both, the terrestrial and aquatic environments, so there is a high probability of certain amounts entering the human body. The detection and identification of these materials can be crucial for the diagnosis of many disease units, requiring the development and improvement of analytical methods.

One of the basic methods used for the analysis of micro- and nanoplastics is Raman microspectroscopy. It exploits the phenomenon of inflexible scattering of light quanta. It allows the identification of the polymer composition of microplastics with an extremely accurate resolution of less than one micrometer.

In this paper, the results of microplastic studies are analyzed with the help of Raman microspectroscopy. The collected samples are plastics for everyday use.
The frequencies obtained were subjected to a qualitative analysis, in particular to determine the composition of the samples studied and to collect a database of reference spectra.

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Section VII. Metal Engineering

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TEXTURE ANALYSIS OF FINE-GRAINED MAGNESIUM DURING PLASTIC DEFORMATION AT ROOM TEMPERATURE

One of the ways to improve formability of magnesium is refinement of its structure, which in turn can trigger an activation of alternative deformation mechanisms. In this work, an attempt has been made to determine the dominant deformation mechanisms of fine-grained magnesium during tension and compression deformation at room temperature. As extruded materials and samples after plastic deformation were examined by XRD techniques. The results show that independently of the grain size initial Mg samples develop strong basal texture. Tension and compression deformation trigger further texture evolution depended on dominant deformation mechanism operating during plastic flow. Detailed texture evolution for Mg samples with the average grain size of 5 µm and 0.8 µm deformed under tension and compression was performed via EBSD techniques. It was found that under compression deformation of Mg samples with the grain size below 1 µm, twinning dominates during plastic deformation, although the twinning activity is strongly suppressed at the early stage of deformation in comparison to coarse-grained specimens.

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COMPARATIVE STUDIES OF RECYCLING METHOD, MICROSTRUCTURE, AND MECHANICAL PROPERTIES OF ALLOYS RECOVERED FROM HARD DRIVES

Nowadays, recycling is an important element of environmental protection. In the era of increasing development of electronics and IT departments, more and more amounts of worn-out or obsolete waste are generated. One of the types of such electro-waste is definitely HDD hard drives, which are slowly becoming obsolete and are replaced by more modern solutions, such as SSDs. Considering that since the 1970s, sales of drives have been steadily increasing, and in 2010 reached the level of 675 million copies sold, in the following years sales began to decline, in favor of newer solutions. In 2020, sales of HDDs reached only 260 million units, and over 330 million SSDs were sold. It can therefore be concluded that part of the HDD memory has been replaced with the more modern one and the old drives have become electronic waste, the elements of which are subject to the recycling process. However, due to the difficulty of disassembling the drive's components, it is difficult to find information on the re-use of its components in the literature, and recycling of HDD memory is difficult to implement on a large, industrial scale.
The work focuses on the comparison of the two best-known metal alloy recycling methods - the melting method and the plastic consolidation method. The main elements of HDD memory, i.e. data carriers, colloquially known as hard disk platters, were investigated. The most common plates are made of 5XXX series aluminum alloy and covered with a thin magnetic layer made of nickel. The research involved removing data carriers from approximately 30 HDD hard drives and fragmenting them. The next step was to divide the plates into three groups, one part of which was melted, the other part was subjected to plastic consolidation, and the third group was chipped and also consolidated. Then, in the process of co-extrusion, bars were pressed from each material, which were tested for chemical composition, microstructure, hardness by Vickers method, and uniaxial tensile test, and then the obtained results were compared.

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INFLUENCE OF MNO_2 ADDITION ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF THE AL-MNO_2 COMPOSITE

The aim of the research was to produce an aluminum matrix composite with different MnO_2 content (Al-3MnO_2, Al-6MnO_2) using the plastic consolidation method. The mixture of Al and MnO2 powders was prepared using a TURBULA mixer and then compacted into compacts with a diameter of 38m and a height of 10mm. The charge consisting of 6 compacts was squeezed at 375 °C into a rod with a diameter of 8 mm. Observation of the microstructure (SEM) was carried out and the mechanical properties were determined (hardness measurement by the Vickers method, static tensile test). The legitimacy of using MnO_2 as the reinforcement of the Al matrix composite was determined.

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DETERMINATION OF THE OPTIMAL MELTING CONDITIONS FOR ALUMINUM BOTTLE CAPS

The aim of this study was to determine the most optimal method of remelting aluminum caps. The scope of work included a series of tests and calculations for recycling trials with and without firing as well as for trials without and with the use of salt. It also contains information on the construction of the metal cap, obtaining aluminum from ore, sources of aluminum for recycling and devices for its melting. The obtained results show that flaming of the caps and use of about 15% by mass of salt gives the most optimal results from the point of view of metal recovery.

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DETERMINATION OF DIMENSIONAL DEVIATIONS OF ROUND PIPES 50X2 MM EXTRUDED FROM EN AW-7021 ALLOY ON A 7-INCH 2500 T PRESS WITH THE USE OF THE GOM ATOS PHOTOGRAMMETRIC SYSTEM

The purpose of the engineering work was to determine the dimensional deviations for aluminum pipes made of the EN AW-7021 alloy. The tubes were extruded in various temperature and speed conditions by using two different dies. Research included the preparation of the samples and scanning them with the use of GOM's ATOS photogrammetric equipment, 3D models of scanned samples at GOM Inspect and measurement on models. The paper also contains information on extrusion process, analyzed material and its alloys. On the basis of the measurements made, the summary tables of the results and the graph for each of the analyzed ones were carried out. The results show that in order to achieve proper product, a higher billet temperature (500°C) and a low extrusion speed (1 mm/s) must be applied. The design of the tool (porthole die) is also important.

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TESTING THE PROPERTIES OF COMPOSITE MATERIALS BASED ON BACTERIAL NANOCELLULOSE

The aim of the work was to learn about the properties of new materials created on the basis of a combination of biological material with various metallic additives. The principle of producing these materials is based on the bacteria and yeast cultures known as SCOBY (symbiotic culture of bacteria and yeast). They use the sucrose present in the medium to produce a layer of nanocellulose on the surface of the liquid, which becomes thicker with time. The rate of growth and the structure of the growing layer depend on many factors; temperature, nutrient solution composition, type of bacterial culture, liquid mixing. These materials can be modified with various additives, such as metallic particles, or deposited on reinforcement meshes. Medicine may be a potential recipient of such material. Impregnation with specific substances would make it possible to create oxygen-permeable dressings and accelerate wound healing.

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INVESTIGATION OF THE EFFECT OF SPS SINTERING TIME ON SELECTED PROPERTIES OF ALUMIX431 – B4C COMPOSITES

Powder metallurgy is a very efficient and innovative technology for the production of sintered products characterized by high mechanical properties.

SPS sintering is a relatively new and developing manufacturing process. This study describes the process parameters and the equipment used. The purpose of this study was to determine the effect of Spark Plasma Sintering (SPS) process sintering time on selected properties of Alumix431 - B4C composites. Different composite sintering times (3,15 and 10 minutes) were used. In the following work, density measurement, Vickers hardness and flexural strength tests were carried out and the microstructure of the composite was observed.

The results showed that the composite sintered for longer time has better properties. Its microstructure is made up of similar grain sizes, and the reinforcing phase is located mostly on the boundaries. The hardness of the composite was 127 HV1, the flexural strength was 618 MPa and the density was 2.81 g/cm3.

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FROM SPACEX TO NUCLEAR POWER PLANTS, THE USE OF 304L AND 904L LASER-WELDED STEELS

Laser welding is a welding process that uses a heat source such as laser radiation with high energy concentration. It is one of the most rapidly developing welding methods. Due to the properties of the resulting joints, it is often used in the industrial sector, as the laser beam is focused in a concentrated area resulting in a narrow and precise weld, with a reduced heat affected zone. Austenitic stainless steels have become a cost-effective and stable material for long-term applications in many industrial sectors, including the automotive, energy and aerospace industries. Their potential, more specifically 304L steel, was recognized by Elon Musk, who chose austenitic stainless steel as the hull material for the latest rocket made by SpaceX. Steel 904L is successfully used as a material for chemical installations in nuclear power plants.
The subject of this paper is a study of a dissimilar welded joint made of 304L and 904L steel using the 521 method, a solid-state laser welding method using a 3000W Ng:YAG laser source. The research included the determination of the microstructure on the cross-section of the joint using a light microscope, performing a static tensile test and analyzing the fractures after the completed test using a scanning electron microscope. Additionally, hardness of the welded joint and native materials was measured.

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IS IT POSSIBLE TO ENHANCE BEAUTY BY AN EXPLOSION?

The paper describes the construction, the advantages and the use of the container made of three-layer plated material intended for the cosmetics industry, namely for the manufacture of the container intended for melting wax. Information was also provided on the benefits of such inductively heated storage systems. It is explained that the use of induction heating coils is a more environmentally friendly solution than other methods of heating such tanks (due to the use of electricity that can come from renewable, environmentally friendly sources), and it describes the role of the copper used in this material, which ensures an even temperature distribution during the heating process. In the work, the choice of trimetal steel 410s – pure Cu – 316l for the construction of the tank is also discussed and justified. The paper also describes the explosive coating technology used to produce the three-layer material used in the construction of mentioned tank. The resulting three-layer sheet was subjected to ultrasonic tests and the strength parameters and plasticity were determined in a static tensile test. In addition, microstructural investigations were carried out with a light microscope and a scanning electron microscope.

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METALLIC MATERIALS WELDING USING ADDITIVE METHODS

The presentation deals with the complex issue of welding of metallic materials. In additive processes, the material is applied in layers to obtain a finished product. In the WAAM arc welding process (Wire Arc Additive Manufacturing), the metal parts are assembled layer by layer with an electrode wire under protective gases. Considering conventional material production methods, there are many similarities that are discussed in the presentation. These methods connect unlimited planning freedom and the production of complex component shapes in a short time at low cost. The material used in tests is alloy 316L. It is used in many industries, e.g., for welding when high corrosion resistance is required. Incremental technologies in the 21st century are widespreaded, and new methods and materials are constantly being researched to optimally depict metallic products. The microstructures of the samples obtained with different methods were analyzed, a sintering and debending experiment was performed and the results were compared with traditional methods.

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THERMAL CYCLE SIMULATION OF 2205 STEEL WELD JOINT AND MICROSTRUCTURE ANALYSIS

The development of the energy facility has put influence on the use of new steel grades that are resistant to atmospheric corrosion and the transported medium, and at the same time have good mechanical properties. The scale of the structures in the energy sector determines the use of materials characterized by good weldability. Among the group of corrosion-resistant steels, there are steels with a two-phase structure (duplex), which combine the benefits of the presence of ferrite and austenite. However, due to the large amount of alloying elements, carbides and intermetallic phases will appear in the structure. For this reason, duplex steels, under the influence of thermal processes, may degrade their functional properties. The study simulated thermal processes occurring during conventional welding methods, by performing annealing for various parameters. Analysis and comparison of the microstructure of the annealed and welded material were carried out. Their selected mechanical properties were measured.

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COMPARISON OF STRUCTURE AND MECHANICAL PROPERTIES OF NICKEL SUPERALLOY INCONEL 718 WELDED JOINTS USING TUNGSTEN ELECTRODE

The object of this study was to analyze the structure and mechanical properties of welded joints of nickel superalloy, welding was carried out orbital with the use of tungsten electrode. Inconel 718 tubes with a diameter of 6.35 mm, wall thickness of 0.7 mm and length of 200 mm were used in the study. Welding was carried out around the entire circumference of the joined tubes using the TIG method without the use of filler material.

The tests were conducted on single-, double- and triple-welded joints, where all joints were butt joints with a single-sided butt joint with full penetration. The scope of investigations included visual testing (VT) to determine the quality of the joint, macroscopic and microscopic examinations (using light and electron microscopy) to reveal the structure, Vickers hardness measurements and a static uniaxial tensile test to determine the mechanical properties of the joint. In addition, fractographic studies were performed for joints previously subjected to tensile testing.

The tests performed for butt joints showed that they are characterized by the correct geometry and shape. Microscopic examinations revealed a structure characteristic of welded joints of nickel superalloy Inconel 718. In the case of all joints, precipitates were observed, which in the area of the base material had a massive, globular morphology, while in the case of the weld area they occurred in the form of lamellar precipitates located in interdendritic areas. Hardness measurements indicate similar values in the weld, HAZ and the base material. The static tensile test shows that the strength and elongation of the tested samples are at the expected level.

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MICROSTRUCTURE AND PROPERTIES OF DUPLEX RESISTANCE WELDED JOINTS

The purpose of the thesis is to investigate the influence of resistance welding parameters on the properties and microstructure of Duplex steel joints. The thesis contains the theory of stainless steels and welding. The research part is based on the interpretation of microstructures photos of made of joints, using light and electron microscopy, and microhardness tests.

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HOW MANY PEOPLE CAN ROMEO AND JULIET MAKE A HOUSEWARMING PARTY FOR ON THEIR BALCONY TODAY?

Every woman would surely like to go out on her flowered balcony and look out for her Romeo, unfortunately this is difficult in some buildings. In the old buildings there are simple solutions in the form of suspended balconies. Such suspension is possible thanks to anchors, which support the entire weight of the balcony. However, equally important is the welding of the sections, of which such a balcony is made.
For the construction of the balconies S235 steel was used, which was MIG welded in accordance with the in accordance with the developed technological instruction of welding. From the welded joints, the following were cut. From the welded joints, test specimens were cut for testing, on which hardness measurements were taken, and microstructural.
The samples were cut out of such welded joints for testing, on which hardness measurements were made, and microstructural tests were carried out using a light microscope and a scanning electron microscope.
electron microscope. On the basis of the tests and calculations Romeo and Juliet drew their conclusions.

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INNOVATIVE SYSTEM OF GENERATORS IN WIND TURBINE EKO-ENERGIA

Explanation of the idea, and project visualization of the innovative system of generators in wind turbine consisting of three generators clutching to the rotor's schaft depending on the wind speed . The main goal of the project is optymalization the work of the turbine and maximization generated power. Prezentation of the mechanical subsystems that is bearings system, clutching, torque transmission.

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WIND TURBINE NACELLE DESIGN

The paper will present the process of designing a compact wind turbine nacelle constructed in the Eko-Energia Science Club. The presentation will begin with recognizing the problem that take place in the turbine drive and we will define the operating conditions of the mechanism. I will present the thought process that accompanied the creation of this assembly. I will analyze the various stages of designing this system. I will show the various stages and solutions that this project went through. I will support the selection of components with MES simulations. I will devote the second part of the presentation to the gondola fairing, which was made by us ourselves. I will explain the process of making its fiberglass parts. Finally, I'll go over the turbine blade mounting hub. The entire presentation will include high-class visuals and animations presenting the project. The fairing made by us will also be presented.

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DART UNMANNED COMBAT VEHICLE

The autonomous combat vehicle DART is intended to fulfill the role of direct infantry support. Its main task is to accompany soldiers and provide them with fire support and cover, as well as additional information about the battlefield thanks to a number of sensors and cameras. To fulfill its task the vehicle must be able to operate in difficult terrain and weather and be resistant to enemy small arms fire. Such objectives forced the students to develop an innovative approach to the construction and propulsion system of the combat vehicle. The DART combat vehicle does not resemble any of the vehicles currently used in the army. The use of electric drive with eight independent engines allows to create a vehicle with low heat and radar signature, which at the same time allows high modularity of the vehicle and adapting it to a specific mission.

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INTELLIGENT MONITORING SYSTEM FOR ROLLER BEARING DAMAGE DETECTION

Mechanical vibrations are a common phenomenon occurring all around us. Unfortunately their influence can often be destructive. Industrial machines and their parts are particularly exposed to the harmful effects of vibrations. Bearings are one of these parts. Their proper testing is crucial for safe machine operation. Traditional methods use expert knowledge, but methods based on the use of artificial intelligence are developing more and more dynamically. This paper presents the results of research on a platform that uses vibration data and convolutional neural networks for ball bearing fault detection. The paper proposes two models the first one based on image processing and the second one which is based on one dimensional data vector processing. These models were trained on data collected directly during machine operation. The device allows to assign the state of a bearing to one of three: healthy, damaged outer race, damaged inner race. The platform enables measurement, data visualization and damage detection. The models perform classification on the basis of data from a signal recorded by an accelerometer.

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KN Eko-Energia

ROTARY SYSTEM OF WIND TURBINE RELATIVE TO THE WIND DIRECTION

During the presentation there will be shown the analysis and calculation process of external forces acting on the turbine diffuser during its operation and related moments, for example, the force resulting from the action of wind pressure on the side surface of the diffuser, which led to the concept of a wind turbine rotating bearing. Based on the above process, the designed 3D model will be shown, which was supported by strength simulations using the finite element method in Fusion360. There will also be presented an estimated cost of the designed rotary system and a comparison with standard solutions. During the presentation, technological processes that will enable the production of the presented project will also be proposed. Additionally, a short analysis of the frequency of speed and direction changes in Poland will be included, which will explain the reason why the issue was considered in the previously presented manner.

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MODERNIZATION OF AN ELECTRIC OFF-ROAD E-MOTO AGH MOTORCYCLE WITH THE NOMINAL POWER OF 30KW

The paper deals with the modernization of an electric motorcycle which has a nominal power of 30kW and was built by students as part of the E-Moto AGH project. The aim of the modification is to obtain the possibly lightest and manoeuvrable design that competes with mass-produced combustion motorcycles. The work includes a description of a comprehensive modification of the load-bearing structure as well as a modification of the battery pack. The protective and visual elements in the form of motorcycle fairings have also been redesigned. The paper presents the advantages of changing the structure to a self-supporting one and the use of an integrated drive transmission system. The problem of combining a modern look with functionality and ergonomics was raised through the design of the motorcycle's external covers. The final part of the paper is to present the challenges posed by the new structure. The aim of the work is to make recipients aware that electric motorcycles have the driving parameters comparable to combustion ones, but they are free from disadvantages such as exhaust emissions and noise generation, and at the same time provide adrenaline and a positive driving experience.

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PRACTICAL RECONSTRUCTION OF AN ANCIENT NEUROBALISTIC SIEGE MACHINE

After many years of accumulating knowledge and experience in carpentry, joinery, ironwork and history, I undertook the reconstruction of a neurobalistic (i.e. using energy stored in twisted rope bundles) siege machine, specifically a Roman Ballista. Despite having already built five working trebuchets and one Onager (commonly called a catapult), this project was challenging because there is little detailed technical information about these machines. I mainly used Robert Jurga's book on siege machines in my work. I found many descriptions and even technical drawings, but there were many things I had to add basing on my experience, or deliberately rebuild. I carefully chose the materials and the way of processing and joining, trying to preserve the historical character and the safety of use at the same time. This project is certainly not the last, as only the Ballista built in practice shed much light on the actual operation of another, very similar machine: Scorpio. And I have a feeling that following the leads I have caught so far I may soon succeed in making the world's first reconstruction of Scorpio, that will finally fully reflect it's potential.

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KN Maszyn i Napędów Elektrycznych Promotor

OPTIMIZATION OF THE NEW TRANSVERSE FLUX MACHINE DESIGN

The paper presents the new design of the Transverse Fulx Machine (TFM) and the early effects of its optimization. The new approach to the design of the TFM machine significantly simplifies its design, but its main disadvantage is still a large cogging torque. The optimization activities presented in the retefet are aimed at developing a machine design with the best ratio of the main torque to the cogging torque.

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PROJECT, CONSTRUCTION AND BENEFITS OF HYDROFOILS IN A ZERO-EMISSION SOLAR RACING BOAT

The artice presents the process of designing and building hydrofoils for a racing solar boat. Modern software and materials were used in the construction process. Thanks to the use of numerical fluid mechanics and the finite element method, their shape was optimized. This allowed for the selection of the best shape for specific applications, in this case racing. Modern materials, such as carbon fiber, guarantee high strength and low weight of the wing. Thanks to CAD systems, it was possible to precisely design the entire element, and the CAM software helped to make the mold for wings on a CNC milling machine and then perfect the finished elements. Light and durable composite materials give the boat an advantage and provide better performance than would be the case with steel or aluminum. The combination of modern technologies and materials allows for crossing the existing barriers, and the hydrofoils themselves are a very future-oriented aspect that may change the water transport industry in the near future.

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COMPARISON OF TECHNOLOGIES USED TO BUILD A DECK FOR A SOLAR BOAT

AGH Solar Boat Team is a student project which builds zero-emission solar boats that use 100% renewable solar energy. One of the most important structural components of our boat is the deck. Together with the hull, it forms a monocoque structure which allows for considerable rigidity of the entire structure of the boat. Solar panels are also installed on board, which provide energy to our boat. The deck is made of a sandwich composite with two carbon fiber covers and a PMI foam core. When developing the technology of its creation, we encountered several problems, such as poor adhesiveness of the cover to the core, or low resistance to mechanical damage. Therefore, a series of tests was carried out using an alternative method, i.e. pre-impregnated carbon fiber fabrics. This time an aramid Honeycomb spacer was used as the core. The paper presents the advantages and disadvantages between the given technologies.

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COMPARATIVE ANALYSIS OF BOAT HULL TECHNOLOGIES ON THE EXAMPLE OF THE AUTONOMOUS BOAT ROBUR

Comparative analysis of boat hull manufacturing technologies on the example of the autonomous boat Robur
The AGH Solar Boat Team project deals with building racing solar boats and autonomous boats. Our first autonomous boat Robur is designed to explore water reservoirs in terms of bottom shape and water quality. In order to prolong the battery life and increase the boat's acceleration and top speed without interfering with the engine power, we focused on reducing the boat's weight. After analysing the boat's existing hull construction, which was manufactured by wet lamination of carbon fibres, together with a core of perforated PVC foam. An alternative method of making the hull using pre-impregnated carbon fabrics and a Honeycomb aramid spacer core was considered. The paper presents both methods and indicates their advantages and disadvantages, when manufacturing a boat hull.

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EFFECT OF OXYGEN CONTENT ON THE CRITICAL DIAMETER IN THE ZR52.5CU17.9NI14.6AL10TI5 GLASS-FORMING ALLOY

Vitreloy 105 alloys were prepared by the suction casting method in the form of rods of various diameters. As reference samples, cylinders with a low oxygen content were casted. The samples had an increased oxygen content compared to the reference ones, which was obtained using zirconium sponge as a substrate in the alloying process. The critical diameter of the alloys with high and low oxygen content was determined as 4 and 6 mm, respectively. Observation of the microstructure of samples with a higher oxygen content made it possible to determine whether crystallites appeared in the material. Zr3Al2 crystallites were found to be present in all samples with a diameter greater than the critical one. The amount of crystallites was greater the closer to the core of the rod. The characteristic temperatures for the alloys with high oxygen content were determined, and selected parameters of glass-forming ability were calculated.

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ANALYSIS OF THE RELATIONS BETWEEN SELECTED MECHANICAL PROPERTIES AND THE VALUES OF BARKHAUSEN MAGNETIC NOISES

The topic of the work is the analysis of the relations between selected mechanical properties and the values of Barkhausen magnetic noises. The tests were carried out for an element used in the aviation industry, specifically for the sport plane undercarriage leg. For its production, spring steel with the designation 51SiCr7(+ A) was used. Apart from the above-mentioned part of the sport plane construction, documentation of its heat treatment, chemical composition, data related to plastic processing and manufacturing drawings were available.
The element was not used before. The research activities in the work included the simulation of stresses using the finite element method, measurement of Leeb hardness, measurement of Barkhausen magnetic noise, static tensile test and microstructure analysis. Stress simulation and hardness measurement were performed on the undercarriage leg supplied by the manufacturer, while the remaining tests were carried out on samples taken using the waterjet method. For comparative purposes, Barkhausen magnetic noises measurements were performed on the part both before and after the cut. The obtained results are presented in the form of tables and graphs. Numerous relationships between them were also observed, which was the main objective of the work.

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SHAPE MEMORY ALLOYS AS POTENTIAL DRIVE SOURCES

The paper presents a brief history of the development of various types of propulsion used throughout human history. Based on this overview, the possibility of using smart materials, such as shape memory alloys, as a potential source for a new type of drive was proposed. For this purpose, the most important characteristics of selected shape memory alloys, the principle of their functioning and their current applications were presented.
A working model of a walking robot, which uses wires made of a shape memory alloy for moving, has been presented and discussed as a proof of the possibility of using such alloys as a drive system. Possible directions for the development of the demonstrated design to increase its mobility efficiency are also presented.

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WHY THE HEART HAS BROKE: BRIEF LOVE STORY OF CAPTAIN BORCHARDT

February 19 - March 5, 2022 for the 100th anniversary of the Faculty of Metals Engineering and Industrial Computer Science of AGH there was a cruise on the sailing ship of Kapitan Borchardt. During this voyage heart of the bell broke.
To examine cause of destruction samples were taken from the broken heart. Fractographic and metallographic tests were made using light microscope and scanning electron microscope. The tests have shown fatigue destruction with participation of corrosion.

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ELECTROPLATING OF COPPER COATINGS ON ELEMENTS MADE WITH ADDITIVE METHODS OF PLA MATERIALS FOR ELECTRONIC APPLICATIONS

The aim of this study is to develop a technology for applying copper coatings to components made with additive methods from polymer materials, for applications in electronics. The use of the above technology may allow the creation of conductive materials made on simple FDM printers. In theory, it will also be possible to manufacture 3D printed conductive circuits.

The studies were carried out on samples made of PLA and PLA with an admixture of CNTs. Various primers were used, including graphite paste, silver paint, and a PVD-applied sublayer.

In order to analyze the properties of the samples, their microstructure was examined using an optical and scanning microscopes, as well as tests of adhesion and layer thickness.

Correlations between the parameters of the copper plating process and the microstructure and properties were determined.

Process parameters were developed to obtain coatings with good adhesion and satisfactory conductivity.

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EFFECT OF THE ADDITIVE MANUFACTURING PROCESS ON THE MICROSTRUCTURE AND PROPERTIES OF MARTENSITIC STEEL 15-5PH

The technique of addictive manufacturing is one of the most rapidly developing techniques of producing elements, allowing to obtain almost any shape of an object, designed in a digital form. This form of recording allows the device to immediately implement the project into production. Additive techniques are widely used in the production of polymeric materials, however, they have also gained recognition in the case of metallic materials. This is due to the reduction of time required for machining, which is necessary to give the manufactured component the designed shape. In addition, 3D printing allows the production of components with complex geometries that would otherwise require a combination of several more conventional manufacturing methods.
Producing components from metal powder, involves transferring energy to them in the form of heat to create a metallic bond between the powder particles. Powdered 15-5PH steel was used to produce the printed components. This steel is characterised by a martensitic structure reinforced by copper separations. The additive manufactured specimens were subjected to mechanical property tests and, at the point of rupture, to fractographic tests, in addition to microstructural tests using light microscopy and scanning electron microscopy.

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MICROSTRUCTURAL ANALYSIS AND SELECTION OF HEAT TREATMENT PARAMETERS FOR SELECTED SPECIAL ALLOY STEELS

This thesis is a preliminary stage of the research project carried out by the Science Club Era Inżyniera as part of the AGH Rector's Grant. The aim is to analyze and select heat treatment parameters for selected alloy steels, including structural, tool and corrosion-resistant.
The great advantage of iron-based alloys is the possibility of significantly increasing their strength properties by changing the chemical composition and, above all, applying the appropriate heat treatment.
Selection of the above-mentioned heat treatment parameters for each of the iron-based alloys can give the tested steel high mechanical and functional properties, and thus shorten the time of selecting the above-mentioned properties and the time of proper heat treatment.
The study analyzes the influence of austenitizing temperature on the hardness of structural steel and cast steel for hot work. The research also concerned the measurement of austenite grain. The following research methods were used in the work: microstructure tests, dilatometric tests, hardness measurements using the Vikers method. When measuring samples from the tested steels, an appropriate loading force will be applied depending on the stage of testing and the type of tested material. Dilatometric tests will be performed using the L78R.I.T.A. from the German company LINSEIS, where the critical temperatures for the tested alloy steels will be determined. The different variants of heat treatment will be performed in a Carbolite RHF16 / 19 laboratory furnace.

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MATERIAL SOLUTIONS APPLIED IN TOLRECON CONVEYOR - "TANDEM OF THE LUNAR REGOLITH CONVEYORS"

As a result of a joint effort by SpaceTeam AGH members, we have reached the final phase of the “Over the Dusty Moon Challenge” organised by Colorado School of Mines in the USA. The goal of the first phase of the project was to create a complete documentation describing the concept of a conveyor made for transporting the lunar regolith under real space conditions. This requirement led to a number of design problems that we had to face, especially aspects such as: lightweight construction, innovative solutions, ease of assembly on the lunar surface and the transport capacity of our conveyor had to be evaluated. In this project, I was responsible for deciding whether to use the right materials for a potential future design, so as they meet all competitive requirements. In my presentation I am going to present the search process for suitable material solutions for our conveyor, explain the main advantages and disadvantages of the individual solutions and present the current progress made in the final phase of the competition.

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INFLUENCE OF MO AND CR ALLOYS ON THE KINETICS OF PHASE TRANSFORMATIONS OF STEEL FOR THERMAL IMPROVEMENT IN CONTINUOUS COOLING

A large group of structural steels are alloyed steels for thermal improvement, which face high requirements regarding the Re/Rm ratio and impact strength. These are medium-carbon alloys with the following alloy additions: Cr, Ni, Mn, Si, Mo and V. Their heat treatment consists in quenching (850°C ÷ 950°C) in water or in oil and high tempering (540°C ÷ 680°C), as a result of which the tested alloys are characterized by a microstructure composed of alloy ferrite and fine carbides (highly-tempered martensite).
In this work, the analysis of kinetics of phase transformation of undercooled austenite of two hypoeutectoid steels, which differed in the presence of Mo and Cr in their chemical composition, was undertaken. The remaining background of the alloying elements of the investigated steels was similar and the carbon content was approx. 0.4%.
The following research methods were used in the work: metallographic and dilatometric examinations as well as hardness measurements. Metallographic examinations were carried out on a Axiovert 200 MAT light microscope. Sections were etched with a 3% HNO3 solution in C2H5OH. Dilatometric tests were performed using L78 R.I.T.A dilatometer. Using dilatometer the changes of elongation (Δl) of the samples with dimensions φ 3x10mm as a function of temperature (T) were registered. Obtained heating curves were used to precisely determine the critical temperatures for the tested steels, while the differentiation of obtained cooling curves allowed to precisely define the temperatures of the beginning and the end of particular transition to draw CCT diagrams.
Finally, three CCT diagrams were developed that were supported by microstructural analysis and hardness measurements. It has been shown that the addition of manganese to the hypoeutectoid steel definitely increases hardenability. This is evidenced by the slightly increased time to the beginning of the bainitic transformation and the shift of diffusion transformations to the right on the CCT diagram.

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MICROSTRUCTURE AND PROPERTIES OF FRICTION STIR PROCESSED ALSI9MG ALLOY

Cast aluminium alloys are characterised by good castability and low shrinkage, which makes them suitable for use in complex parts such as engine pistons. However, the tendency to segregate and the high porosity of such alloys remains a major problem. This project addresses an AlSi9Mg alloy modified via friction stir processing to reduce porosity and homogenise the structure as a consequence of intensive plastic deformation.

The aim of the project was to characterise the microstructure and properties of AlSi9Mg alloy after friction stir processing. Microstructural studies were carried out using a light microscope and scanning electron microscope equipped with an EDS detector for chemical composition analysis. Electron backscaterred diffraction (EBSD) measurements were also performed. A dendritic and porous structure was observed in base material and a significantly fragmented structure without porosity was found
in the FSP zone. The optical profilometer test confirmed the effectiveness of the FSP method in reducing porosity and the cavitation test showed better resistance of the modified alloy. The hardness of the material measured along a line parallel to the surface underwent slight step changes.

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MORPHOLOGY AND PROPERIETIS OF THINK TI6AL4V PLD COATING. IMPACT OF PLD SPUTTERING ON MORPHOLOGY OF TI6AL4V TARGET

Titanium alloy Ti6Al4V is widely known for its properieties, such as: biocompatibility, corrosion resistance, repassivation ability, good strenght/weigt ratio and high elasticity. Penetration of organism by small amounts of this alloy usally doesnt cause allergic reaction or inflammatory state. Thanks to those properieties it is widely used in produtcion of bone and dental implants. It could also be used as a material to produce a barrier coating, protecting from corrosion impact implants, artificial organs and dentures. Thin Ti6Al4V made by Pulsed Laser Deposition method might be used for separating poliurethane construction of artificial heart from agressive enviroment of human body. During presentation results of of scratch test, morphology examination and EDS will be discussed. Morpohology of target after process will also be presented.

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SCANNING ELECTRON MICROSCOPY IMAGING METHODS FOR POLYMER MATERIALS

Scanning Electron Microscopy enables the analysis of the topography of both organic and inorganic materials using an electron beam. The basic condition for the correct performance of the above-mentioned analysis is that the tested material must conduct the current at least on the surface. This thesis describes three methods that allow to visualize the topography of polymeric materials with low or no current conductivity using a scanning electron microscope. The topographic analysis was performed on a polymethyl methacrylate (PMMA) sample.

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COMPARATIVE ANALYSIS OF PROPERTIES OF COCRWMO PROSTHETIC ALLOY OBTAINED BY 3D PRINTING ADDITIVE METHOD

The aim of this study was to analyse the properties of a Co-Cr-W-Mo alloy before and after a heat treatment (annealing). The samples were fabricated using the selective laser powder sintering (DMLS) method. The investigations in this study used, among others, were light microscopy (LM), which was used for microstructural analysis, and scanning electron microscopy (SEM), which was used to analyse the powder after production sifting and target powder, the surface of both solid samples, and the microstructure of both samples. EDS analysis of the powder sample after production sifting and the solid samples before and after the annealing treatment was also performed. The corrosion resistance of both samples was tested and their hardnesses were measured. The study shows that heat treatment significantly affects the microstructure, hardness and corrosion resistance. The microstructure obtained is characterised by high hardness, while the annealing treatment increases the roughness of the sample, which slightly worsens its corrosion resistance.

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ANALYSIS OF THE CHEMICAL COMPOSITION OF METALLIC- DIAMOND TOOLS PRODUCED IN INDUSTRIAL CONDITIONS

Metallic-diamond composites are tool sinters used for cutting and grinding concrete, asphalt and natural stone. The essential element in the construction of this type of tool is the matrix material, which should have good retention properties, have a high capacity to hold diamond particles and wear out such a speed as to allow the worn out diamond crystals to fall out, revealing new ones, which ensures self-sharpening of the tool. Technological progress in the production of metal-diamond tools is manifested by the desire to design tools with better functional properties and reducing the costs of their production.
The work focuses on the presentation of the production process and materials used as a matrix in metallic-diamond tools, as well as microscopic observations and chemical composition analysis of working elements for wire and circular saws, using a scanning electron microscope with an EDS system.

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THE INFLUENCE OF THE SINTERING ATMOSPHERE ON THE PROCESS OF REMOVING BINDER FROM SINTER BASED ON NEXT 400 AND COBALITE CNF POWDERS

Powder metallurgy technology is used for the production of metal-diamond tools, especially working elements of tools. The properties of the materials produced by the powder metallurgy method depend on the chemical composition of the mixture, the type of powder, and the parameters of the consolidation process.
A binder is added to reduce the friction reduction between the powder particles and between the compact and the die surfaces are added to the powder blend prior to compacting and then removed during sintering. Binders are a type of adhesive that connects loose materials into a homogeneous mass, increases the strength of the molded part and prevents dusting and self-segregation of the powder.
Thethesis describes the influence of the sintering atmosphere on the process of removing binder from sinters based on Next 400 and Cobalite CNF powders. Two types of binders and two sintering atmospheres (nitrogen and hydrogen) were used. The obtained sinters were tested for density, hardness and microstructural tests.

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3D PRINTING TECHNOLOGY - THE PROBLEM OF SHAPE AND LAYERING

The problem of the formation of a non-smooth surface of 3D prints and the influence of shape on the strength properties were investigated. The finished samples were painted with two substances with nail polish and modeling paint, and their roughness and tensile strength were tested. The study of the influence of shape on compressive strength was aimed at minimizing the material used for production.

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TESTING OF CHANGES IN STRENGTH PROPERTIES OF 3D PRINTS MADE FROM PLA AFTER HAVING THEM UNDERGONE THERMAL TREATMENT

This study aimed to analyze and test changes in strength properties of 3D prints made from PLA after having them undergone thermal treatment. With the emergence of the fourth industrial revolution, 3D printing as a technology plays a bigger role in our lives with every passing day. First chapter of this study is introductory and deals with the examination of the printer and technology used in my thesis. Chapter two focuses on conducted experiments, with the description of the post processing process used in thermal treatment, the norms and specimens and final results of the tests. Conclusions are drawn in chapter three, in which it can be seen that thermal treatment has positive impact only on specimens with the infill percentage equal to 100%, and it has negative impact on specimens with lower infill. The main aim of my thesis has been reached.

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MANUFACTURE AND TESTING OF EASILY SINTERED WARP POWDERS IN METALLIC-DIAMOND TOOLS

The work presents the possibility of fabrication of inexpensive iron-base powders intended to form the matrix in sintered diamond-impregnated tool components. In this study, a finely dispersed, pre-alloyed steel powder, containing over 94 wt.% Fe, has been designed and fabricated by means of a proprietary process developed at AGH-UST. It has been shown that the experimental powder can be consolidated to a closed porosity condition (>95% TD) by pressure-less sintering. The as-consolidated material is characterised by an excellent combination of hardness and mechanical strength.

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INFLUENCE OF THE HIGH-FREQUENCY WELDING POWER ON THE MORPHOLOGY OF THE WELD AREA

The paper presents the results of metallographic analysis (light and scanning microscope) of the weld area of high-frequency welded sections for welding power of 95, 98, 102 and 104 kW. Analysis of the weld lines in individual specimens showed presence of low-carbon ferrite in the weld line and carbon-rich areas of increased hardness down to the parent material. The hardness distribution in the weld area depends on the welding power; the correct distribution (the highest hardness in the vicinity of the weld line) was obtained for the highest welding power values. Geometric measurements of the weld zone were also made. The paper describes the technology of HF welding and discusses the main factors influencing the quality of the weld.

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INVESTIGATIVE METALLURGY - PREMATURE PITTING CORROSION OF A STAINLESS STEEL CHIMNEY INSTALLATION SECTION

The paper presents the results of metallographic analysis (light microscopy and SEM+EDS) of an area of intense pitting corrosion of a component (90 degree elbow) of a chimney installation made of austenitic stainless steel. Apart from revealing in the structure areas of strong plastic deformation formed during forming of the elbow, no possible defects of metallurgical origin were found, which could affect the formation of corrosion pits. The probable cause of premature corrosion of the installation was the combustion of sulfated solid fuel and errors in the design of the installation.

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THE ISSUE OF BRIQUETTING WASTE MATERIALS

The aim of the presented research is to describe the problem of briquetting many materials as a way to minimize losses incurred in various different industrial sectors and to avoid the harmful effects of many substances and heavy metals on the environment. The paper presents the advantages and parameters of introducing the agglomeration process of various types of waste. Waste materials are compacted to a form that can be reused or sold at a profit to the producer of the generated waste, which results in the absence of problematic landfills and benefits for important industries such as metallurgy, energy, mining and construction. Possible directions of briquetting development in the world, which puts more and more emphasis on ecology and effective management of waste materials were presented. The results of research on the structure and parameters of briquettes made of different waste materials are described.

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DESIGN OF THE CASTING TECHNOLOGY OF AN OBJECT FROM A POPULAR SERIES OF COMPUTER GAMES

Artistic casting is a broadly defined field, thanks to which modern culture develops. Nowadays, many young people are spending more and more time in virtual reality. With the help of modern techniques, many artefacts created in games can be recreated in real life. In this study, an attempt was made to recreate a medallion from the popular Witcher game series (more precisely, from The Witcher 3 Wild Game). The aforementioned element was designed using 3D modeling software. Then, the technology was designed, appropriate simulations were carried out, and finally a real cast of the Witcher Cat Guild medallion made of silicon bronze 331 was created and the results of the simulations were compared with the created artistic cast.

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DEVELOPMENT OF THE NEW TECHNOLOGY FOR THE PRODUCTION OF CLIMBING HOLDS

The aim of the project is to develop a technology for making climbing holds using 3D printing and compare it to resin casting technology. In addition, testing them in terms of compliance with the PN-EN 12572 standard (roughness and strength test) and assessing the profitability of the proposed technologies.
Expected effects of the project:
a. Development of new technologies for the production of climbing holds using 3D printing and cast resin.
b. Selection of the best materials; creating your own composites for resin castings, printing the skeleton of a climbing grip.
c. Making our own climbing holds; designing a ready-made set of climbing holds.
d. Comparison of different manufacturing methods and their compliance with the standard; analysis of the cost and time of production of the finished set of holds.
e. Obtaining results that will be used for further development of the project.

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ANALYSIS OF CASTING TECHNOLOGIES ANALYSIS OF SELECTED TECHNOLOGIES OF CASTING PARTS USED IN THE AUTOMOTIVE INDUSTRY WITH THE USE OF SIMULATION TOOLSLECTED PART USED IN THE AUTOMOTIVE WITH THE USE OF SIMULATION TOOLS

The presented work concerns the use of the CAD tools and computer simulations at the design stage of the manufacturing process of part used in the automotive industry, in the gravity casting technology. The selected element used in cars will be made of nodular cast iron. The work covers the preparation of a three-dimensional model of the selected part on the basis of a technical drawing. Based on the size and volume of the 3D model, the elements of the gating system and the filling time were calculated. The MAGMASoft simulation program was used to analyze the processes of pouring the mold cavity as well as solidification and cooling of the casting. A series of simulations were performed for various proposed casting technologies for the selected part. In order to increase production yield and minimize amount of casting defects, the optimization module available in this program was used. As a result of the presented research, a technology was obtained that can be used to make the casting. In order to implement the selected technology for production, a printer working in the FDM technology was used to create the casting model.

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NUMERICAL ANALYSIS OF THE CYLINDER HEAD CASTING

The application of numerical simulations in the foundry allows to predict and analyze pouring and solidification processes of the casting, as well as to locate potential defects in the cast. The publication describes the research on the use of CAD and CAE tools in order to properly design the process of producing an aluminum cylinder head in the gravity die casting technology. Empirical formulas used in the foundry were used to calculate elements of the gating and feeding systems, as well as the pouring time. In order to optimize the head manufacturing process, several simulations were carried out with the use of the MAGMASOFT5 program, allowing the technology to be refined so that the casting was of the best quality. AlSi6Cu4 alloy was used, whose thermophysical parameters were available in the standard database of the program.
As a result of the research, the proper method of supplying the metal into the cavity of the metal mold was determined. The result of using appropriate risers was also examined.
Application properly selected risers and chills allowed to eliminate casting defects. The obtained test results allow for the proper selection of the casting technology and implement the above automotive element for the production.

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MELTING AND CASTING FECO ALLOY IN AN INDUCTION VACUUM MELTING FURNACE FOR ULTRASONIC ATOMIZATION

The work attempts to smelt an alloy based on iron, cobalt and nickel intended for operation at higher temperatures. The melting was carried out in a laboratory vacuum induction melting furnace. The tapping was made into specially designed molds, which make it possible to obtain the alloy in the form of bars, which are the feed material for the ultrasonic atomization process. The charge materials were selected to ensure the obtaining of the alloy with the desired chemical composition, as well as the thermodynamic conditions of the process and the melting time affecting the quality of the obtained alloy.
The capabilities of the laboratory vacuum induction melting furnace allow to produce new or modify the existing iron alloys combined with the stabilization of the chemical composition within narrow limits.

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EFFECT OF L-PBF AND L-DED PROCESS ON THE MICROSTRUCTURE OF INCONEL 625 ALLOY

Today, additive manufacturing technologies are one of the fastest developing methods of materials production. Methods using a laser beam, such as powder-bed fusion (L-PBF) and direct energy deposition (L-DED), are commonly used for the production of metal elements. In both methods, focused laser beams are used, but they differ in the feeding material system and the size of the molt pools during the process.
In both methods, the microstructure depends on the type of material, the rate of solidification and the temperature gradient during the process. The study investigated the influence of both methods on the microstructure of the Inconel 625 alloy using light microscopy and scanning electron microscopy.
The microstructure of Inconel 625 after L-PBF and L-DED was characterized by the formation of a cellular dendritic substructure with different sizes of cells and grains. In both methods, numerous precipitation of the carbide and Laves phases were observed. In the case of L-DED, the microstructure consisted of larger size of cells and precipitates.. The differences in microstructure were a results of a lower temperature gradient and a higher volume of molten metal pools during the solidification in L-DED than in L-PBF.

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CHARACTERIZATION OF 316L STEEL POWDERS FOR 3D PRINTING OBTAINED BY DIFFERENT METHODS

Spherical metal powders with the particle size 20 – 100 µm are used in the Laser-assisted Powder Bed Fusion (L-PBF) to 3D printing metal parts. These powders should be characterized by low porosity and spherical shape, allowing for optimal filling of the bed and the obtaining low porosity in the printed material.
Spherical metal powders are most often obtained in various atomization processes. On an industrial scale, gas atomization is most often used to produce a powder with a size distribution of up to several hundred µm, which can later be used as a feed material for 3D printing. However, gas atomized powder usually has many defects, such as satellites and gas porosity. On a laboratory scale, the ultrasonic atomization method can be used to produce a powder with high sphericality and low porosity.
In this work, the morphology of 316L steel powders obtained in the gas and ultrasonic atomization process was investigated using a scanning electron microscope (SEM). Both types of powders were found to be suitable for use in L-PBF. However, ultrasonically atomized powders were characterized by much greater sphericity, fewer defects, and a more uniform size distribution and consequently better fluidity

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RECYCLING OF METAL CHIPS BY DENSIFICATION AND PLASTIC PROCESSING

The objective of this research is to develop a technology for recycling metal shavings generated during machining operations by densification and subsequent plastic processing. The scope of the research includes the development of densification parameters and then designing the deformation process to minimize the porosity of the product. The project considers the use of different types of materials including aluminum alloys, copper alloys and steels. The variety of processes from which the material is derived will also allow for an assessment of the effect of morphology on porosity, densification and the properties of the obtained materials. In order to control the quality of the obtained products, microstructure tests will be carried out to observe the quality of the connections between the chips and the volume of the present pores. In addition, for each material, press curves will be plotted at different press pressures. Sintering will also be optimized to maximize the environmental performance of the process. The study will verify the applicability of different forming processes, including rolling, extrusion and forging, under various boundary conditions.

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THE USE OF NUMERICAL ANALYSIS IN THE DESIGN OF AN ALUMINUM RIM, TAKING INTO ACCOUNT A STRUCTURE LOAD TESTING

This thesis is a representation of CAx systems as a tool improving engineer's work in designing part's geometry. In thesis has been proved the value of using numerical methods in constructor's work, which eliminates incompatibilities in production process, or during the exploitation. The purpose of this thesis was designing the wheel rim using SolidWorks software. For proper design of safe in use part, there have been used functionalities, which let to design precise geometry of wheel rim based on existing standards and with use of designer's creativity. In addition, for testing mechanical properties of designed geometry, there has been used simulation modulus, which let to model standard tests and real exploitation conditions in virtual space. The results of analysis has been the information of general stress occurring in part during exploitation, that let consider created rim as a safe for using.

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THE TECHNOLOGY OF FORGING MULTIPLE FORGINGS OF THE LEVER FOR THE FUEL SYSTEM

The research on the technology of multiple forging of the lever forgings for the fuel system was divided into two main parts. In the first part, the existing technology in the company was analyzed. Full-volume forgings were examined for defects and the surface of the forging tools. Based on the data provided by the company, the boundary conditions of the simulation were developed, enabling the mapping of industrial conditions and the performance of numerical calculations. Based on the analysis of the results, own boundary conditions and two different tool geometries were developed. Subsequently, the maps of distribution, strain intensity, temperatures, mean stresses in the entire volume of forgings and tool wear as a result of normal pressures and shear stresses were analyzed for tool variants, with the help of which a defect-free product was obtained. The proposed technologies were also compared with those existing in the company.

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THE DEEP DRAWING PROCESS OF MULTILAYERED MATERIALS OBTAINED WITH EXPLOSIVE WELDING

The aim of this work was to analyze the behavior of multilayer material subjected to the stamping process. The first part of the paper is devoted to the literature analysis, which contains information on the method of Severe Plastic Deformation SPD. In the following subsections the subject of explosive welding and stamping technology is explained.
In the research part, an analysis was carried out which focused on the evaluation of the strengthened material subjected to the stamping process and the evaluation of the material overstressing resulting from the stamping process. Six specimens were used to perform the study. Each specimen had a different width, and deformation was performed until the material continuity was broken. The specimens were encapsulated and then ground and polished. Layer thickness measurements were taken at three locations on each sample and the hardness of each layer of the Titanium-Armco-Titanium material was tested.

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DESIGN OF A DROP FORGING PROCESS FOR AN AXISYMMETRIC FORGING WITH A BOTTOM

The purpose of this study was to review the process of forming an axisymmetric forging with a bottom using impression die forging technology. The scope of the work includes getting acquainted with several types of bottoms, which are used during the production of forgings and their influence on the basic parameters of the process. An additional study investigated the effect of the location of the bottom in three heights of the forging. These were the bottoms placed in: the upper, lower and in the middle of the height of the forging. On the basis of the finished part model a drawing of the forging with all necessary allowances was prepared. The next step was to construct the dies needed for the simulation. The dies were prepared on the basis of the drawing of the forging with the allowances. The final stage was to perform 2D numerical simulations. Parameters such as effective strain, mean stresses, flow line and undersurface flow line distribution were studied in the simulation. After all the simulation results were obtained, their analysis was performed. This analysis was aimed at selecting the most optimal variant that affects both the properties of the finished forging and is as optimal and efficient as possible.

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NUMERICAL MODELING OF FORGING OF HEXAGONAL NUT

The subject of this engineering thesis is the design of a closed die forging process for a hexagonal nut. To plan an alternative way of manufacturing the part in order to avoid large material losses during machining. Using numerical simulations, the hot and cold single die forging of the nut was planned.
Based on a drawing of the finished nut, the forging was designed taking into account the machining allowances, forging skews and roundings. Using SolidWorks, die models were created for two operations: forging and punching.
Using QForm software, a simulation of hot and cold forging was created, followed by punching. From the simulation, the mean stress values in the forging were registered and the dimensions of the finished forging were checked. In the case of hot forging, the temperature distribution was also read.
The process of manufacturing the nut using machining is presented and the advantages and disadvantages of the different technologies are compared. It was evaluated when it would be more cost-effective to produce the nut by drop-forging instead of machining.

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ANALYSIS OF THE FORGING PROCESS OF THE CANNON BARREL ON SWAGING MACHINE

The manufacture of barrel weapons, due to its specific working conditions and high requirements, makes it necessary to use swaging machines. Forging on swaging machines allows the cross-section of the material to be altered and the internal surface of through-hole products such as pipes or thick-walled sleeves to be shaped. The deformation caused by a single impact of the anvils is small, which allows the material to be superficially strengthened. The process can allow for high volume production. The barrels allow the projectile to move in a specific direction and direct the energy created by the shot. Thanks to the forging process on swaging machines, barrels can be threaded without the need for machining. This weapon component has to endure significant increases in temperature and pressure over a short period of time. The process was simulated in the FEM-based program Qform. It was possible to construct a model of the swaging machine, anvils and mandrel (models of the individual components were created using SolidWorks), define the charge, operating conditions of the machine and tools, the material, as well as the boundary conditions. A simulation of forging a section of the barrel for 50 blows was carried out. As a result of the simulation, maps of the actual stress distribution, average stress, temperature, strain intensity, tool temperature as well as the desired geometry were obtained. The data were analysed. A satisfactory shape of the forging was obtained by extending the axis of the charge without significant defects and forging.

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RESEARCH ON CYCLIC TWISTING OF FLEXIBLE COPPER CABLE CORES FOR ROBOTICS APPLICATIONS

The subject of the work was to check the mechanical and electrical properties of class 5 conductors, made of Cu ETP grade copper, for torsion. The tests consisted of a static torsion test. During the test on the measuring bridge, the following parameters were checked: relative change in resistance, dynamics of change in resistance in line with the conductor deformation and symmetry of resistance changes and checking whether differences are visible when twisting the wires to the left and right.

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INFLUENCE OF METHOD OF MANUFACTURING ON SELECTED PROPERTIES OF TITANIUM β ALLOY

The aim of the research was to evaluate the influence of the methods of manufacturing on selected properties of titanium β alloy. The Ti-5553 alloy used in the research was obtained by powder metallurgy method, with two technological variants using a mixture of elemental powders. The first one consisted of pressing the powders at room temperature and sintering the obtained moldings, while the second variant involved the hot-pressing process. The materials obtained in these technological paths were subjected to metal forming processes. The hot-pressed material was rolled while the sintered specimen was upset. The tensile test, and microstructural analysis were performed on the deformed materials, and on reference specimens. As a result, it was found that the hot processing allows to obtain a material with satisfactory strength properties and a high relative density.

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DEVELOPMENT OF TECHNOLOGICAL PARAMETERS OF FORGING AND ROLLING PROCESSES OF MATERIAL CHARACTERIZED BY HIGH ENTROPY INTENDED FOR MILITARY APPLICATIONS

Standard metal alloys are usually based on one chosen element, which constitutes most of the alloy`s chemical composition, other elements are added, in relatively small amounts, to modify the properties of an alloy. In 2004, reports appeared on the possibility of creating a new group of multicomponent alloys containing equilibrium contents of elements with a simple solid solution structure. These alloys, due to their high mixing entropy, were called high-entropy alloys and to this day it is a strongly developed group of materials.
The aim of the project was to develop technological parameters of the metal forming of a high-entropy alloy ingot dedicated to armour of an military vehicle. The chemical composition was selected on the basis of previously performed studies. Then, models and parameters for forging and rolling processes were developed. The material was formed accordingly to the optimized thermomechanical process parameters to obtain a flat bar of the desired dimensions. At the last stage, in cooperation with the AGH Adamantium Scientific Club, a composite with Al2O3 ceramic was prepared and subjected to ballistic tests. The deformed flat bar after ballistic tests was examined by 3D scanning and subjected to EBS Electron backscatter diffraction.

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DETERMINATION OF PROPERTIES AND DEVELOPMENT OF ROLLING TECHNOLOGY FOR SHEET METAL FROM SUPER-LIGHT STEELS WITH IMPROVED STRENGTH AND PLASTICITY PROPERTIES DEDICATED TO THE AUTOMOTIVE INDUSTRY

Metal alloys are mainly based on one selected element, where it constitutes the main element of chemical composition and relatively small contents of other elements changing the alloy properties. At the beginning of the 21st century, theories appeared about the possibility of creating a new group of multicomponent alloys containing equilibrium contents of elements with a simple solid solution structure. These alloys, due to their high entropy of mixing, were called high-entropy alloys.
The main expected outcome of the project was the production of a sheet of high-entropy steel. Based on a literature analysis and a simulation predicting the material properties, the chemical composition of the steel was selected. A full production process was carried out on a laboratory scale (from ingot preparation, through structure homogenisation in the annealing process, to rolling processes and finished product property tests). Sheets of a thickness allowing Erichsen pressability tests were produced. The technological parameters were chosen in such a way that high formability of the plates was achieved.
Due to the high strength and plasticity properties and the reduced weight of the sheets tested (compared to sheets made of standard structural steels), it is assumed that they will be used for the production of car bodies, e.g. in electric cars.

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AGH-IX VIRTUAL AUTOMATIC INTERNET EXCHANGE POINT

Project "AGH-IX Automated Virtual Internet Exchange Point" is addressed to students, employees of AGH, and other users with routable ASN and IPv4, IPv6 resources. The main goal of the project is to create a web-app where users will be able to register their resources in the form of IP addresses and autonomous systems. Our software will automate the process of verifying the correctness of RPKI ROA prefix advertisment, create required tunnels(GRETAP, VXLAN, ZEROTIER) and also setup BGP sessions for users with appropriate filters that guarantee no problems with incorrect prefix advertisment and route leaks. Users will be able to peer with our route server or with themselves.

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ACCESS CONTROL WITH MAIN VERIFICATION SERVER

Paper talks about using database and server application for authentication and validation in access to rooms and labs, divided bay sectors and security levels with use of only one database and server (in the same time easy redundant).

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PROOF-OF-WORK CAPTCHA WITH PASSWORD CRACKING FUNCTIONALITY

Current CAPTCHA implementations are a frustrating, yet necessary part of every online form. Despite that, there are many websites offering tools or services that help solve or completely bypass that mechanism by outsourcing it to another human or by using artificial intelligence. My project is offering an alternative way of fighting unwanted web traffic. Instead of selecting squares containing traffic signs, the user has to donate a small portion of his device's computing power to complete a "cryptographic puzzle". Said computing power is then used to crack password hashes. Additionally, the server responsible for managing and scheduling these puzzles puts in place certain requirements that a potential solution has to meet so as to test a wide range of possible hash values.
Any bad actor willing to bypass the mechanism needs to consider the hardware and electricity expense placing a real-world cost on the attacker.
The system has been designed to be flexible in terms of difficulty of each task. Suspicious or unusual traffic can receive substantially harder puzzles which require much higher computing power to complete, thus successfully deterring spammers.

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CZĘSTUJEM - A FOODSHARING APPLICATION

The purpose of this project is to create a mobile application that will allow its users to share food they will not manage to eat. Designing the presented solution will mean assembling popular social media groups and advertisement portals into one medium that will help prevent food waste. The platform will not allow selling meals – each product will be available for free, what may also support people in crisis. The application will use localization services to operate locally and adjust offers to the user's current location. The chat functionality will also be implemented to allow users to communicate with each other, so they can schedule a time and place to pick up their order. The application will be composed using Flutter, what will grant the access to it on devices with Android or iOS operating system. Due to the chosen platform, the programming language used in the project will be Dart. A database to store information about users or available products, Firebase, will also be used.

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DOMESTIC HOT WATER CONTROLLER

The aim of the project is to reduce the energy and water usage in households. The water circulation pump must run all the time to always have hot tap water. The activated pump increases the comfort of the household members, but unnecessarily consumes electricity (about 50W) and natural gas.
The solution to the problem is to use a driver that will automatically turn on and off the pump. This can happen either at certain times of the day, when the activity of the household is at its peak, or when the person turns on the tap. The controller will constantly monitor the pipe temperature approximately 30 cm behind the stove. When hot water is not used for a long time and the circulation pump is turned off, the temperature behind the stove will drop. When you open any tap in the house, hot water will start to flow and heat the pipe. This sudden change will be detected by the controller, which will turn on the pump for a certain period of time. After waiting a few seconds, you can turn on the tap again and there should be warm water.

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A PLATFORM FOR MONITORING THE RESOURCES OF KVM HYPERVISORS

The aim of the project is to develop a platform that will allow administrators to effectively and easily manage the available resources of servers hosting virtual machines based on the KVM Hypervisor.
The developed application will allow to monitor the resources of servers hosting virtual machines and display basic information about them.
GUI of the application will display historical data in the form of resource usage charts, which will be beneficial primarily for engineers administering servers.
The innovative element of the project will be the development of an algorithm that allows for the optimal selection of a server on which a new instance of a virtual machine can be created that meets specific requirements, to use the resources: CPU, RAM and disk space in the most efficient way on each of the available servers. This algorithm will be implemented in the resource reservation tool, which, after declaring VM requirements, will return the server on which it should be created.
One of the most useful feature implemented in the described tool will be search engine for servers and virtual machines, thanks to which it will be easy to associate a VM instance with a hypervisor.
Compared to the existing tools, such as VManager or Proxmox, the created system will allow the administrator to quickly select a server on which a virtual machine can be created that meets specific requirements. In addition, the database will store historical entries, thanks to which it will be possible to find a list of changes made on particular server. It is also worth mentioning that the platform will be developed with the use of software based on Open Source licenses, thanks to which it will be possible to use it completely for free, also for commercial purposes.
The developed tool will consist of a web interface, database and a REST API, responsible for sharing information about KVM resources stored in the database and saving them. Within the created website, the aforementioned algorithm will be deployed.
There will be also created a Bash script to collect information about the resources of virtual machines and send them to the database. This script will be able to be placed on each of the supervised servers from which it will be regularly executed.

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ML-MPK - UNDERSTANDING MUNCIPAL TRANSPORT IN KRAKÓW WITH MACHINE LEARNING

The project aims to analyze the similarities between line numbers and similarities between the actual routes.
In the line number, the first digit depends on the type: 1 means urban line, 2 - agglomeration, 6 - night urban. However, the relation between numbers and routes is not officially documented by Public Transport Authority (ZTP) in Kraków.

Public transport data can be obtained either manually through web scraping or by asking ZTP directly. Contacting ZTP can also reveal the method of assigning the numbers to lines and data on potential new bus lines. Gathered information (numbers, routes and stops placement) will be transformed into a public transport network graph which will be subject to machine learning methods (Graph Neural Networks - GNN). The base task of the created network will be to predict the line number prediction based on the route.

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REMOTE CONTROL CAR

The main goal of the project is to create a model of remote-controlled car using Bluetooth technology. A ready-made RC car model will be used for construction. The Arduino Uno module with the AVR ATmega 328P microcontroller will be installed on it.
The main drive unit will be two electric motors powered by a 9V battery and two-channel driver L293D motors will be used to control them. Each of the electric motors will operate on one axle, driving axle and steering axle.
Communication with the microcontroller will be provided by the HC-05 bluetooth module operating in the bluetooth 2.0 standard. This will allow to control the car using any bluetooth device (e.g. smartphone) with a dedicated application installed. This solution will ensure communication between the car and the controller over a distance of about 10 meters.
In addition, the car will be equipped with distance sensors located at the front of the model. This will allow to automatically respond to obstacles. If the car approaches the obstacle within a certain distance, it will stop to avoid a collision.

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WEATHER FORECAST STATION

Our project aims to build complete weather forecast station which makes use of temperature and humidity sensors. Based on collected data machine learning model will try to predict the weather for upcoming days. Results will be shown on dedicated web application with user-friendly interface, moreover there is possibility to check the weather using Telegram application with appropriate commands. Furthermore, user can compare the weather from different sources, which are downloaded from open-access services.

The weather station was built using ESP32-WROOM-32 system, which temperature and humidity sensors are linked to. Microcontroller is connected to Wi-Fi network, data are downloaded to Raspberry Pi server and saved to MySQL database. User has access throw graphical interface via web application. The application is written in the following technologies: backend: Django, frontend: React.

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INTERACTIVE CHESSBOARD

The aim of the project is to create an interactive 3D chessboard that will be able to interact with players. The chessboard will have dimensions of approx. 30x30 cm and will be created with the pieces from scratch using 3D printing technology. After connecting the board to the power supply, individual fields will light up depending on the mode selected by the users:

- free play mode - in this mode the fields of the chessboard will be highlighted only in white only in places where pieces are placed
- educational mode – each user during his turn will be able to display possible moves of each piece

The innovation of the project is the ability to distinguish individual pieces on the chessboard by the program. This is ensured by voltage dividers created on each field between the resistors placed in the pieces and the reference resistor located under the chessboard field, and then the voltage readings using 8 analog multiplexers. The ability to display several colors on each field (64 RGB LEDs) will be provided by proprietary system made of 32 SIPO shift registers. All logic will be controlled by one microcontroller from the STM32F4 series.

In the future, the project can be developed using open-software algorithms for predicting user movements so that only one user can play with the computer using this chessboard.

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INTELLIGENT WINDOW BLINDS SYSTEM

This project aims to implement an adaptive system of controlling window blinds. The system will be based on microcontrollers Arduino/ESP8266, photodiodes, and Weather API available on the Internet. Users will be able to define their plan or use an adaptive one using an Android application. The software will communicate with Arduino/ESP8266 modules by the WLAN network. The module will be sending information about light intensity from the photodiode to the mobile application. Based on information from the photodiode and current weather downloaded using the API interface, the application in adaptive mode will apply appropriate window blinds settings at a specified time. The Arduino module will be controlling window blinds using servomechanism. Using buttons, the user will program them once. The mobile application will be written using Java/Kotlin programming language. The innovation of this project is the use of its intensity sensor and the Internet in order to drive installation costs down.

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EDUCATIONAL TOOL FOR PRESENTING ADVANCED ATTACKS ON WI-FI NETWORKS

The project aims to make an exemplary implementation for carrying out advanced Wi-Fi attacks, using unspecialized home-user equipment.

The project will be based on the scientific paper: "Advanced Wi-Fi Attacks Using Commodity Hardware" by M. Vanhoef and F. Piessens. The result of the project will be a modified firmware for Atheros AR7010 and AR9271 devices along with software for controlling user attacks to observe and understand the processes on which they are based.
Attack ideas to be implemented:

- unfair channel usage of stations in the network - disabling the backoff procedure, modification of the CW window, and AIFS / SIFS times, etc.
- jamming - jamming of the radio channel
- MITM

Idea and innovation
Our project aims to show and make students aware of how low-cost it is to perform advanced attacks on Wi-Fi networks. We want as well to explain the mechanisms and the weaknesses exploited by the presented attacks. The results of our work should be a valuable supplement to the available laboratory resources.

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SYSTEM CRM WITH FUCTIONALITY FOR PREDICTING ENERGY PRODUCTION WITH PHOTOVOLTAIC INSTALATION

Project contains creation of CRM web system with basic client relationship management functionalities like email corresponding with clients from the system level, client statuses management, resource management along with orders, handling events reported by clients. The system will also have functionality intended for companies dealing with the installation of photovoltaic installations, which will allow you to send a newsletter to selected customers with information on how much the photovoltaic installation they have will generate energy on a given day. This information will be calculated using machine learning on the basis of data collected from the client, such as the exact address, size, direction (including the angle of inclination) of the installation and data downloaded from the server, i.e. weather information in a given location. The system will be made with a view to its expansion so that adding new functionalities is not time-consuming and that integration with the system is not complicated.

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NA STARYM TRAKCIE – MULTIPLAYER COMPUTER CARD GAME

The goal of the project is to create a multiplayer game available on PC and Android using the Unity game engine and C#.

NST is a turn-based card game in which every player has his own character which she/he develops by increasing abilities (strength, agility, magic power. In each turn, the player draws an opponent with whom he can fight, surrender - which results in the loss of a health point or reroll to another opponent - the player must fight the rolled opponent. The fight is based on a comparison of the player's and the opponent's abilities. If the hero’s abilities are much higher than the opponent’s, it turns into The Monster - a more powerful enemy from a special deck. Each 5th turn the player can go to the city where he can perform special actions.

The game ends when the first player reaches 15 victory points.

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A MOBILE APPLICATION FOR MANAGING HOUSEHOLD CHORES

The submitted project topic is a mobile application, whose task is to enable its users (for example families or roommates), to manage their household duties.

The application will be distinguished by an algorithm suggesting tasks to the user on the basis of previous activities in their "place" and positioning them on the list depending on the collected data. If users take out the garbage every 3 days, the system on the third day, while creating a task, will position this activity higher. Another example could be feeding pets - if for a certain period of time the user does not add tasks related to pets, this option will be set at the very bottom. In addition, the algorithm would be able to generate a template schema of tasks for a given period of time, based on the data collected by the application. This option, would be available after using the app for about two to three weeks to collect relevant data on which the template generation would be based. This is an innovative approach for this type of app as it allows for customization to users. Because the app generates and adapts to our "place" users will not have to laboriously type in each task manually one by one.

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PC STATUS – MONITORING TOOL FOR PROCESSES RUNNING ON PC

The app will show status and progress of various processes running on pc.

The goal of the project is to add new feature to a smartphone by connecting it with pc. By doing so it will gain remote monitoring functionalities. Currently there's software like vnc (allowing viewing and controlling whole pc) but on smartphones' small screens and without a keyboard it is not practical.

The tool will be handy in monitoring long running processes such as: downloading huge file, copying a lot of data and also in monitoring disk, RAM, cpu usage.

The tool will consist of 3 subprograms:
- PC Client – sending statuses to server
  Tech stack: c++, libcurl
  Command line tool, intended for use in scripts, for Linux.
- Android Client – showing statuses.
  Tech stack: java, android studio
  Android app fetching data from server and showing them to the user. Will have login, simple settings & list of statuses screens.
- Server – message "forwarder" from PC Client to Android Client. Will store them as well.
  Tech stack: php, laravel
  Will support multiple users with ability to create new ones by invoking special command line command on the server.

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OWN IMPLEMENTATION OF THE COMMAND&CONTROL SERVER

The C&C server is a tool used by both cybercriminals and individuals performing penetration tests. It is used to operate, manage and attack the victim's system which has been infected with a so-called Agent, which in turn connects to the C&C server. The system allows to manage multiple sessions in case of multiple victims. The server has some basic features:

- Jitter - time that is added randomly or according to some algorithm to packets sent to the server. The reason is to increase difficulty in separating this transmission from, for example, standard http, dns communication.
- Usually, instead of a huge agent, a tiny "dropper" is sent to the victim's computer, which then downloads all the necessary components and loads them into memory. A small program is much easier to hide from an antivirus.
- Improved shell that includes additional features such as Mimikatz support, file transfer, remote screenshot capture, etc.

The innovation introduced in the solution will be the implementation of the original one an algorithm that generates a part of the payload, thanks to which detection by anti-viruses will be more difficulty due to the randomness of the file signature.

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2D PRINTER

The goal of the project is to build 2d printer, which will use a pen to print. We will use a wooden structure as a foundation for elements responsible for drawing: rails, step motors and gears which are necessary to provide the appropriate range of movement for the pen. The rails and racks will be made using a 3d printer. To control the device, we will use Arduino Nano with an extension which provides more pins. Arduino requires a 5V supply voltage, so it will be provided by the computer, but the motors need 12V from an indepedent power supply.

Elements necessary to complete the project:
● Arduino nano board with an expansion module
● Three stepper motors responsible for controlling the movement in the OX/OY axis and lifting the pen or pencil
● Elements made with a 3D printer (racks, motor mounts, guide rails)
● 12V stepper motor power supply

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PLANTPY – SUPPORTING CROPS AND PLANTS CULTIVATION

The aim of the project is to develop functional mobile application allowing managing and supporting of plants cultivation processes. The main functionality is monitoring their health status using machine learning for disease recognition using photo comparation to already gathered samples.

The main audience for application are farmers, for whom it will improve crops supervision. Using functionality of drone synchronization, it could work without even leaving home. For non-experienced users – there is also a possibility of using app – just by using their mobile phone camera.

App will be sending photos to the server which will be hosted in cloud – then photos will be analysed by algorithm – which will return proper classification about plant species and health condition (or identified disease).

Additional advantage will be user identification by using log-in system. Each registered user will have possibility of creating own database – periodically monitoring growth of his plants. By registering digital identity, users can be part of community – using prepared forum.

For advanced users with confirmed botanic knowledge there will be prepared module, by which they could participate in model accuracy – classifying photos sent by other users. Categorized photos will be added to the model using „Transfer Learning" technique.

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TERMINAL COMMUNICATION WITH LINUX SYSTEM USING E-INK DISPLAY

The point of this project is to build a device responsible for communication with Raspberry PI terminal in a compact form, housing that will be self-designed and printed in a 3D printer. On the screen, there will be a default TTY1 terminal session displayed. This software will be triggered while the system starts up, to ensure this device can be ready for work as soon as possible. The use of the e-ink display ensures low power consumption combined with a convenient presentation of the displayed data. The display is made of electronic ink - microparticles of white and black colors with different electric charges. The appropriate voltage polarization moves the microparticles up or down, changing the color of the pixel. Energy is only needed when changing the content of the displayed image. It is possible to refresh only a part of the screen to speed up the process. The display resembles a piece of paper and its content is clearly visible in daylight, which is why it is often used in e-book readers. The elements available from the research club were used, listed below:

- E-paper E-ink 9,7” – display with HAT module for Raspberry PI
- Raspberry PI 4 model B WiFi

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DECENTRALIZED VPN WITH 2FA AUTHENTICATION

The project presents decentralized VPN network that is made up of certain number of nodes that are standalone server instances. The goal of this attribute is to get rid of central control unit. Every node has a built-in router that point next destination for packets. Moreover, every node will be configured using yaml files which containes the IPs of internal subnetworks and one IP of the server. The VPN network will not be addressed with the "network economy" issue due to the limited time to complete the project. The communication is based on UDP protocol and symmetric cryptography. The server will be using TUN interface. Two-factor authentication will contains classic login with username and password, but after that the user will be asked for one-time code from his email. All the implementation will be created using mainly Golang programming language and a little of Python and Bash. The whole idea of this project is to create decentralized, lightweight VPN network with recommended and popular two-factor authentication.

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PRACTICE ENVIRONMENT FOR SKILLS AND TOOLS USED IN PENETRATION TESTING - VULNERABLE WEB APPLICATION

The aim of the project is to prepare and develop vulnerable web application, on which one is able to practice skills related to penetration testing, as well as test effectiveness of various tools available on the market. Thanks to the created application, interested security enthusiasts will be able to expand their knowledge through specially prepared didactic materials, better understand technologies and protocols on which web applications are based, and then translate the acquired theoretical knowledge into practice, where they will be able to test vulnerabilities on a "living organism". The application will consist of three modules, each designed to enable training of a selected group of vulnerabilities:

- XSS module - created using NodeJS, Express and Pug and the Bootstrap front-end library. It contains several vulnerabilities from the Cross Site Scripting family, which are common vulnerabilities with serious consequences, such as stealing user session tokens or cookies.

- SQL Injection module - created using the Flask Python framework. Contains vulnerabilities related to injecting SQL queries into the database. Such attacks are potentially very dangerous as they can lead to leaking logins/passwords (or hashes) as well as any other sensitive data stored in databases.

- XXE module - also created with Flask and Python. It contains vulnerabilities from the XML External Entity family, which is a functionality of XML libraries that is intentionally built into every parser. If the developer does not properly secure the parser and enable XML External Entity support, it may lead to many vulnerabilities that could potentially end in unauthorized access to files as well as code execution The prepared application will not cover the most obvious methods of exploiting vulnerabilities, but will focus more on less obvious and less popular ones. Thanks to that it will differ from the applications available on the market and will allow for additional extension of its competences. Anyone interested will be able to use the application, improve their skills and learn new ways of attack. This leads to a broader general knowledge of IT security and a better understanding of the threats that lurk on the Internet.

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SECURITY TOKENS

The aim of the project is to create a program designed to generate tokens in a form of files with an appropriate extension to support the creation of phishing campaigns in companies, and which by their specificity will enable detection and localization of an attacker who broke into the system. The tokens can be for example a link or a file (docx, odt, ods, etc.). Their aim will be to inform about opening of a potentially malicious link or document, which will allow to estimate employees' awareness of such problems in case of phishing campaigns or to detect a current attack on the system along with the approximate location and permissions of the attacker.

The implementation is based on sending HTTP requests via generated tokens to a server controlled by us. When a token is used by a user, relevant information about the user will be sent to us. Each token will be equipped with a unique value based on which it will be identified in our system.

The solution currently existing on the market, which was the inspiration to create this project does not offer a client version, which would allow you to customize it to your needs and use it without intermediary in the process by software manufacturers, which ensures full confidentiality. Additionally, our solution has a wider range of token types.

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WI-FI JAMMER

The project aims to explore the topic of WiFi jamming. Different types of jamming will be studied and described including their positive applications.
The possibility of using an Intel 9650 network card to perform jamming, by modifying the card registers but without success, was investigated.
Using the python library for packet manipulation, Scapy, the possibility of using any network card for jamming by continuously sending RTS frames with the duration field set to the maximum value, was investigated. In this way, the channel is occupied by the virtual carrier sensing.
In addition, a TP-Link TL-WN722N version 1 network card was obtained which enables advanced WiFi attacks including continuous jamming using ModWifi software. This software was made available to us after contacting the author on the condition that it is used for research purposes as it is not publicly available.
The presentation will run the aforementioned jammer and demonstrate its effectiveness using the iperf application.

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INTELLIGENT BLINDS

The aim of the project is to create software for internal window blinds. For preparation, you will need internal window blinds, AMZDelivery microcontroller board, light intensity sensor GY-302 - BH1750, motor controller, stepper motor for raising and lowering roller blinds, which will enable fully automatic operation.

The ability to set the level of light radiation will be made available thanks to the communication of the controller board with the mobile phone via Bluetooth. Default acceptable solar radiation level will be set on the controller board, which can be changed using a mobile phone. The controller board will be programmed using the Arduino IDE platform.

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INSUREIT - INSURANCE CLAIM PREDICTION PROGRAM

The aim of the project is to create a Python program that uses machine learning to predict whether a person will potentially claim the insurance in the future from the insurance company. This information, known in advance, will allow insurance companies to reduce potential costs. Test data available on the Internet was used due to the fact that it would be difficult for a single person to generate the relevant data in the right amount. Used data consist of:

- sex,
- age,
- BMI,
- daily number of steps,
- number of dependents,
- if the person smokes cigarettes,
- how much, on average, a person spends on treatment per year, settled by health insurance,
- in which part of the country the person lives (in the USA),
- whether the person has collected an insurance claim in the past

The innovation of the project is emphasized by the fact that a proprietary model created with the help of the Keras library was used, which made it possible to create your own neural network. This solution is unique, and at the same time allows you to introduce ;deep learning in a simple way.
The program has its own GUI, thanks to which each user is able to clearly enter the required data and check the obtained result from the first moments of using the program.

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BET ADVISOR – BETTING ANALYSIS SUPPORT

The goal of the project is to create an application supporting the process of analyzing potential bookmaker bets, with the possibility of checking the percentage chances of winning a bet and its profitability in terms of the given odds. It will be possible to preview the odds of a given team winning or drawing.

The project will be implemented with the Python programming language. The chances of obtaining realistic and reliable results will be provided by the machine learning used in the project, based on current data. For this purpose, special software will be created in order to obtain real-time data. The software will check the team's formation and will calculate the profitability of the bet based on this data. This is an innovative approach, because usually just before the start of the match the odds remain unchanged.

The program will analyze data from soccer leagues due to the multitude of sources that calculate statistics for this sport. The matches and the odds will be broken down into the four most important leagues - Premier League, La Liga, Serie A and the Bundesliga.

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A PLATFORM FOR MONITORING THE RESOURCES OF KVM HYPERVISORS

The aim of the project is to develop a platform that will allow administrators to effectively and easily manage the available resources of servers hosting virtual machines based on the KVM Hypervisor.
The developed application will allow to monitor the resources of servers hosting virtual machines and display basic information about them.
GUI of the application will display historical data in the form of resource usage charts, which will be beneficial primarily for engineers administering servers.
The innovative element of the project will be the development of an algorithm that allows for the optimal selection of a server on which a new instance of a virtual machine can be created that meets specific requirements, to use the resources: CPU, RAM and disk space in the most efficient way on each of the available servers. This algorithm will be implemented in the resource reservation tool, which, after declaring VM requirements, will return the server on which it should be created.
One of the most useful feature implemented in the described tool will be search engine for servers and virtual machines, thanks to which it will be easy to associate a VM instance with a hypervisor.
Compared to the existing tools, such as VManager or Proxmox, the created system will allow the administrator to quickly select a server on which a virtual machine can be created that meets specific requirements. In addition, the database will store historical entries, thanks to which it will be possible to find a list of changes made on particular server. It is also worth mentioning that the platform will be developed with the use of software based on Open Source licenses, thanks to which it will be possible to use it completely for free, also for commercial purposes.
The developed tool will consist of a web interface, database and a REST API, responsible for sharing information about KVM resources stored in the database and saving them. Within the created website, the aforementioned algorithm will be deployed.
There will be also created a script to collect information about the resources of virtual machines and send them to the database. This script will be able to be placed on each of the supervised servers from which it will be regularly executed.

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SOFTWARE FOR LAN TOPOLOGY VISUALIZATION

The project is designed to help troubleshoot physical LAN connections by using tools to detect the connection status between devices and to provide a graphical representation of the information gathered in the form of a network diagram. This will automate the creation of up-to-date network diagrams. This solution will be useful for both education (e.g., lab connectivity verification) and commercial applications (e.g., network infrastructure update included in official company documentation).
The project involves writing a program that will provide a graphical representation of the network topology. This diagram will show the devices that are in the network and the connections between them. The program will require the creation of a management network through which the controller will be connected to the LAN. This controller will allow access to each device and read network parameters through SSH. The script in the program will be responsible for executing the commands necessary to check the network status and parameters. The driver will remotely launch a series of operations on all the devices in the network, connecting one by one with each device. The responses to the queries will be processed and based on them a database of connections between components will be created. Then, based on the information gathered, the program will generate a diagram showing the current status of the network.

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SMART MOUSETRAP

Our project aims to improve the process of catching vermin (rodents) in households with the use of modern technologies. We are going to build a simple trap that would keep the animal in a cage. Additionally for user's convenience, we are going to create an android application that will send notifications when a rodent is detected and caught. Then the user will take appropriate actions - confirm the detection or mark it as a false alarm. Streaming from the camera and history of events will also be visible in the app. The photo will be processed by a machine learning algorithm that will be trained using transfer learning to recognize smaller pets and rodents. If the photo is classified as a rodent, the application on the phone will send a notification. Otherwise, the trap will be opened, so that the animal that we do not want to catch (such as a cat) would get out. This is an innovative trap approach as there are no solutions available on the market that notify you when an animal is caught, so you need to individually monitor the status of each trap every day.

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GIMBAL – CAMERA STABILIZATION SYSTEM

The project's goal is to create a “gimbal”, a device balancing telephone during taking photos or shooting a movie.
Finally, all vibrations caused by hand quivers or rapid movements might cause the quality deterioration of photos/videos.
The final product will be made with low expenditure while ensuring good quality service.
Implementation
The end device consists of:

- Case and frame
- Device movement sensory system
- Stabilizing system
- Power system

The case and frame in which the electronic device will be placed will be made in 3D printing technology.
The movements sensory system is a 3-axis accelerometer with a gyroscope, its going to react to changes in position with collected data sent to the computational unit.
The stabilizing system consists of 3 servos, receiving instructions from the computational unit, to balance the device in case of unwanted movement operating on all 3-axes.
The computatonal unit is microcontroler. The program uploaded to it contains algorithms taking in the raw data from the accelerometer computing them to the set of instructions controlling the right servos.

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DEVELOPMENT OF THE MICROCNOTROLER WITH WIFI MODULE WHICH ENABLES SENDING KEY SEQUENCES TO THE HOST

The project aims to develop the so-called Malicious USB, a USB device pretending to be HID (Human Interface Device), and then present methods of attack with its use. These devices do not pass any verification in most cases, thus constituting a very vulnerable vector of attack.

We propose a completely new and innovative approach to the subject through its implementation from scratch by ourselves. This will enable an in-depth understanding of the vulnerability of modern operating systems (Windows, Linux distributions, etc.). It can also be used as a presentation of an attack on hosts that are excluded from the network. The Arduino Leonardo board will be used to execute the project, which provides full USB support and will act as HID. The ESP8266 board connected to it will be responsible for WiFi connections. The device will therefore have the ability to operate offline (with a pre programmed string of characters) or online, where the strings will be sent over the network. The device will have:

• two or more buttons, the pressing of which will run a script tailored to a Linux or Windows machine,

• display with information useful for debugging, current operating mode, WiFi connection status, etc.

The project will be helpful in the process of auditing the company's security. Often, when thinking about cybersecurity, the physical security of servers and personal computers is overlooked. Our project will present the risk related to unauthorized physical access to the machine, even for a short time.

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TELECLIMB – A SYSTEM OF APPLICATIONS CREATED TO AUTOMATE THE PROCESS OF JUDGING CLIMBING COMPETITIONS

The aim of the project is to build a system used for judging climbing competitions. Its main focus is automation of delivering and processing data. The project is designed to be a valuable asset in the market/an answer to the demand of the market – currently, there does not exist a system which operates in the described manner.
As far as physical layer is concerned, it is composed of a computer and a few mobile devices. Connection between all the components in the basic scenario should be provided through a local wireless network.
The system will consist of:
- a web application (JavaScript, ReactJS), used by the main referee – his job is to manage the entire event. Its capabilities include: competition configuration, importing the list of competitors, conducting/managing rounds, exporting scores, etc.,
- a mobile application (JavaScript, ReactNative) will be utilised by the problem referees. Each referee will receive a prepared list of competitors, starts of which he will be marking. The results are going to be automatically sent to backend,
- backend (Java, Spring) puts up REST API. It shall possess the entire logic of how the system acts, in accordance with the rules of the Polish Alpinism Association. The data will be saved and downloaded from a built-in file database. Additionaly it will create logs copies, necessary to retrieve lost information on the starts, should any malfunction occur.

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AUTO DJ – THE APP THAT MAKES PLAYLIST INTO "DJ SET"

The app would focus on providing a high-quality mix of tracks, without need of having a dedicated, often expensive, software and specialist skills. Main goal of the app is processing some music tracks into one continuous “DJ set”-track. The used algorithm would focus on measuring the tempo and intensity and detecting “culminative” moments (e.g., choruses) of every track. Basing on collected data the algorithm would arrange them in order, placing most similar ones next to each other. Main functionality of this program would be creating a consistent mix of given tracks, by adjusting smooth transitions between them (for example – track would gradually be muted and adjust its tempo to the one it transitions into. Then, until final transition the second track would start playing with its tempo adjusting to its normal, gradually unmuting to full volume.). Between tracks with high similarity parameter, transitions would be performed not only after the first track ends but also in "culminative” moments, giving a feel of real-time mixing. The algorithm would also focus on skipping the most monotonous parts of tracks or parts not really matching the rest of the mix. The app main focus is to create consistent whole irrespectively of music genres of tracks provided and for that goal it would use similarity matrix.

For implementation I will use Python. Tracks will be classes of attributes (tempo, intensity, “culminative” moments localization) which will be assigned to them after analyses. Basing on those attributes there will be similarity matrix of each track created. Then tracks will be put in order and then by application of patterns transitions will be added.

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