

THE XTH INTERNATIONAL FAIR OF INNOVATION AND CREATIVE EDUCATION FOR YOUTH (ICE-USV)

**STEFAN CEL MARE UNIVERSITY OF SUCEAVA,
25 - 27 MAY 2026**

Responding to the objectives provided in the Europe Strategy and in the National Strategy for Tertiary Education, the Stefan cel Mare University of Suceava has assumed the role of „catalyst of creativity and innovation in Romanian society” becoming in recent years national leader both in regarding the number of patent applications as well as the number of patents obtained, according to the rankings made by the State Office of Inventions and Trademarks for the university environment. These results have been achieved through the education and massive involvement of PhD students, master students and even from the undergraduate cycle in the field of invention and scientific creativity.

Scientific Committee of the event :

- Professor Mihai DIMIAN – Chairman of the scientific committee
- Professor Valentin POPA
- Professor Adrian GRAUR
- Professor Radu MUNTEANU
- Professor Valeriu DULGHERU
- Professor Radu-Dumitru PENTIUC
- Professor Mihail Aurel ȚÎȚU
- Professor Ilie MUSCĂ
- Professor Sorin Gheorghe PAVEL
- Professor Marian POBORONIUC
- Professor Marinel TEMNEANU
- Professor Mircea OROIAN
- Professor Narcisa MEDERLE
- Professor Augustin SEMENESCU
- Associate professor Aurora-Adina COLOMEISCHI
- Associate professor Daniela IRIMIA
- Professor Andrei Victor SANDU
- Associate professor Andrei CHICIUC
- Associate professor Ovidiu NEMEȘ
- Professor Ilie NUCĂ
- Professor Silviu Mihai PETRIȘOR
- Associate professor Mihai RAȚĂ
- Associate professor Constatin UNGUREANU
- Dr. Adriana SAVIN
- Lecturer Corneliu BIRTOK-BĂNEASĂ

The organizing committee:

- Professor Mihai DIMIAN – Chairman of the organizing committee:
- Professor Dan Laurențiu MILICI
- Professor Mihail Aurel ȚÎȚU
- Associate professor Constantin UNGUREANU
- Lecturer Mihaela PAVĂL
- Eng. Oana Vasilica GROSU
- Assistant Ciprian BEJENAR
- Eng. Ionuț CÎMPAN
- Eng. Gabriel-Raul STOLER
- Eng. Radu-Ștefan MINESCU

Editor: Lecturer. Mihaela PAVĂL

Program

Day 1, 25.05.2026

- 08:00 – 16:00 Preparation of stands by organizers
- 16:00 – 19:00 Arrangement of stands by participants
- 19:00 International Jury meeting

Day 2, 26.05.2026

- 08:30 Breakfast (Stefan cel Mare University Restaurant)
- 09:30 Participant registration. Arrangement of stands by exhibitors (Venue location: Atrium [Building E](#))
- 10:00 BIS 2026 Opening Ceremony
- 11:00 – 11.30 International Jury meeting
- 11.30 – 13.30 Evaluation of inventions/ projects by the international jury. Panel discussions and presentations by exhibitors. Media interviews with official delegates.
- 13:30 Lunch break (Stefan cel Mare University [Restaurant](#))
- 14:30 10-InSTED – 10 minutes about Innovation in Science, Technology, Engineering and Design (Aula, Building E)
- 14:30 Evaluation of inventions/ projects by the international jury. Panel discussions and presentations by exhibitors.
- 16:00 – 17:00 International Jury meeting
- 18:00 Official Dinner

Day 3, 27.05.2026

- 10:00 Breakfast (Stefan cel Mare University Restaurant)
- 11:00 BIS 2026 Award Ceremony (Auditorium “Joseph Schmidt”)
- 13:00 – 15:00 Visit to the Seat Fortress of Suceava
- 15:00 Closing the event. Bus transfer for all international delegations to Iasi for participation in Euroinvent 2026

REGULATION

This regulation establishes the methodology for the progress and the awarding of the International Fair of Invention and Creative Education for Youth, ICE-USV, eight edition, organized by the “Ștefan cel Mare”, University of Suceava.

Article 1. Purpose

The project is dedicated both to promoting and encouraging student inventions and scientific creation and also for disseminating successful examples regarding creative education, raising awareness in society of the importance and the contribution brought by young researchers in technological development.

The exhibition event aims to increase the interest of the young generation for innovation in all fields of knowledge, establishing bridges between young people with common concerns, highlighting the elements of innovation and inventiveness that has as young researchers (students, master students, doctoral students, doctors and researchers with a maximum age of 35).

Article 2. Thematic categories

Works from all fields of applied sciences and engineering are accepted, which can represent solutions or technical achievements in a field of knowledge and which present novelty and progress towards the known stage, but do not affect the moral, the right to life or the security of any kind of persons. The International Fair of Innovation and Creative Education for Youth has two main sections:

1. Patented inventions/innovations, patent applications;
2. High school project, students and PhD student projects.

Article 3. Registration in the competition

Each work must be registered using the Registration form of the inventions/projects at ICE – USV 2025 at least 15 days before the start of the event (according to the calendar) at the mentioned addresses.

The registration form must contain the purpose, the procedure/ method underlying the work, information regarding the accomplishment of the work, conclusions, other elements that are representative for the work and which highlight the innovative activity of the authors.

Article 4. Acceptance of works

The files of the works proposed and registered according to the calendar at the address above mentioned are automatically accepted at the event. Then they are

analysed by the Scientific Committee of the event regarding the creative, deontological, scientific, technological and engineering level.

Article 5. The manifestation

The event will begin with an opening festivity where the organizers and the jury will be presented.

The organizers will provide sufficient time in the program for arranging the stands before judging the works.

The evaluation of the works will consist in presenting the work by the authors and clarifying some aspects at the request of the members of the jury. The time required for the judging will be according to the complexity of the work, the way it was presented by the authors and the clarification of all aspects related to the judging grid.

The event will end with an award ceremony in which the main conclusions of the jury and the organizers of the event will be score.

The event will include a session of workshops and presentations on creative education and the role of creative thinking in the context of sustainable development.

The program will also include social, cultural and sports activities designed to strengthen the links between the participants and allow the generation of an environment conducive to the exchange of ideas and information.

The presentation of the research results within the exhibition, depending on the capacity of the exhibition location, is logistically and financially supported by the organizing institution with the help of the partners and sponsors of the event.

Organizers do not provide funds for moving teams or transporting exhibits.

Article 6. Presentation of the works during the event

The work may be presented as a poster (mandatory) and exhibited (recommended).

The maximum poster size is 80 x 120 cm. The posters will be visible, will strictly refer to the project and will be displayed vertically.

Maximum size of the exhibit (model, layout): depth 50 cm (front to back), width 80 cm (from one side to the other), height 180 cm (bottom to top). The exhibit may contain calculation techniques included in the model or for the presentation of graphic elements related to the project (photos, films, graphics, simulations, modeling, etc.). Files and notation regarding the tests or determinations made in the experiments can be attached to the model.

Article 7. Elements of ethics and deontology

Scientific fraud and immoral behavior are not accepted at any level of the event. This includes: plagiarizing, using or presenting other people's ideas as their own projects.

The projects that prove fraud will be removed from the competition and the intention will be popularized in the educational and scientific environment.

Article 8. Mandatory requirements

Participants must accept the following rules:

- All projects must respect the ethical elements presented above.
- The introduction of pathogens, toxic chemicals or any dangerous substances in the exhibition area is forbidden.
- The exhibits must comply with the exposure and safety requirements set out in this Regulation.
- It is the responsibility of each participant to check the requirements and restrictions of the competition.
- It is required to respect the calendar, the program of the event as well as the conditions of registration.

Article 9. Judging

The approval of the participation in the competition will be made on the basis of the *Registration Form* and will be made by the scientific committee of the event.

The jury will be made up of personalities with concerns in the field of invention and innovation at national level, university professors, representatives of companies, organizers and sponsors, science journalists.

The judging will be done through individual discussions of the jury members with the author of the project, the study of the registration form and the exhibits.

The jury criteria will take into account:

- The actual activity of the young participant in the presented project;
- Respecting scientific and / or mathematical rigour;
- The importance and relevance of the project in the field;
- The level of deepening of the theme;
- The novelty level of the presented project;
- Design and activity of the young participant in order to achieve the project objectives.

In the discussions between the jury and the participants will be followed:

- Creativity,
- The scientific approach, the complexity of the study approach that led to the completion of the theme,
- The usefulness of the proposed solution,
- Clarity of project presentation (visual and oral).

The hierarchy of works established by the jury is considered final and no contestations, discussions or completions regarding the judging procedure are accepted.

Article 10. Warnings

It is not allowed to use on the presented stand:

- Living organisms;
- Living or fluid tissue elements of the human or animal body (blood, urine, etc.);
- Dangerous or highly odorous chemical materials;
- Hazardous substances or devices (poison, drugs, weapons, ammunition, sharp devices, with the risk of breakage, flammable substances, unprotected lasers, generators and sources of ionizing radiation, ultraviolet or infrared, open flame);
- Devices at risk in operation for the competitor or for the public (eg damaged batteries, voltage sources or capacitors with dangerous voltage and with uninsulated terminals, etc.)
- Prizes, medals previously obtained by the competitor, bank cards, flags, company logos or institutions (except the represented institution), contracts and / or approvals (graphic or written) unless they are fully included in the project;
- Photographs or visual representations describing animals in surgical techniques, dissections, necropsies or other laboratory procedures, minors (except when the parents' agreement exists).

TABLE OF CONTENTS

MACHINE FOR DISCONTINUOUS PRODUCTION OF YARN COMPOSED OF WOOL FIBERS AND YARNS OF DIFFERENT MATERIALS.....	13
HYMICRO - INTEGRATED MICROSYSTEM FOR BIOHYDROGEN PRODUCTION.....	13
HYMICRO - INTEGRATED MICROSYSTEM FOR BIOHYDROGEN PRODUCTION	14
MOVE.AI - PERSONALIZED MOVEMENT ANALYSIS AND CORRECTION USING ARTIFICIAL INTELLIGENCE.....	15
MULTI-FUNCTIONAL MOVABLE ROOF.....	18
PNEUMATIC MOBILE ROBOT FOR CLIMBING VERTICAL SURFACES.....	16
SUN POSITION TRACKING SYSTEM.....	17
EXTENDED RELEASE FORMULATION FOR PARENTERAL USE AIMED AT ALLEVIATING PAIN IN ARTHRITIS PATIENTS.....	17
MATANX.....	18
IOT ACCESS CONTROL SYSTEM.....	18
PYUP-ORDER.....	19
MY HAPPY COLORING BOOK — OFFLINE AI COLORING PAGE GENERATOR.....	20
HIKING ENVIRONMENTAL MONITORING SYSTEM (ESP32 + BLYNK).....	20
INNOVATIVE WORKING MATERIALS FOR SECONDARY VOCATIONAL SCHOOL STUDENTS: INTRODUCTION TO ELECTRONICS AND MICROCONTROLLERS	21
BEYOND THE HORIZON: INNOVATIVE AIRCRAFT DESIGN AND MANUAL ENGINEERING.....	22
CARIE THE MARINE PATROLLER - A SOLAR-POWERED, AUTONOMOUS MARINE TRACKER.....	23
CONCEPTUAL DESIGN OF THE CITY SQUARE, CITY PARK, AND MEMORIAL.....	23
KID PLEARN (KID PLAY & LEARN).....	25
FLEXWEAR STAND.....	26
INNOVATIVE INDUCTION COOKER.....	26
MAGNETIC DRIVEN BALL.....	27
POTATO VARIETY – EVENT	27
POTATO VARIETY – IMPULS	28
CLIMATE-ADAPTIVE STRATEGIES FOR SUSTAINABLE MANAGEMENT OF POTATO LATE BLIGHT AND YIELD STABILITY	29
SPICY DARK BEER - AN INNOVATIVE BEER ENRICHED WITH CHILI EXTRACT FOR ENHANCED SENSORY AND FUNCTIONAL PROPERTIES.....	32
VALUE-ADDED BEER ENRICHED WITH EGGPLANT (SOLANUM MELONGENA L.) PEEL.....	32
PROSTHETIC SYSTEM FOR DETECTING AND COMPENSATING HUMAN LOWER LEG LENGTH DISCREPANCY.....	33
A NEW GENERATION OF METALLIC BIOMATERIALS AS HEALTH SOLUTION FOR A SUSTAINABLE LIFE.....	34
PROCEDURE FOR OBTAINING PRECAST ELEMENTS BASED ON GEOPOLYMER COMPOSITES WITH WASTE WOOD ADDITION.....	35

ARCHITECTS OF INNOVATION: EMPOWERING GLOBAL CREATIVITY.....	36
GEARBOX FOR ELECTRIC CAR.....	37
AUTOMOTIVE TUNING - IMPLICATIONS FOR VEHICLE DYNAMICS AND ROAD SAFETY.....	38
DESIGN AND STRUCTURAL INTEGRITY ANALYSIS OF FRONT AXLE FLOATING CALIPERS.....	38
TECHNOLOGICAL EVOLUTION OF 1.9 TDI POWER UNITS (VAG GROUP).....	38
TARGETED SYNTHESIS AND STUDY OF THE BIOLOGICAL ACTIVITY OF TERPENE COMPOUNDS WITH HETEROCYCLIC STRUCTURAL UNITS.....	39
NEW COPPER(II) COMPOUNDS AS INHIBITORS OF CANCER CELLS PROLIFERATION.....	40
FOLKAI TECHNOLOGY: AUTOMATED ORTHOGRAPHIC ALIGNMENT AND LEXICAL EXPANSION OF BESSARABIAN FOLKLORE DICTIONARIES.....	41
MECHANICAL DEVICE FOR THE CONTROLLED EXTRACTION OF BEARINGS EMBEDDED IN THE MOTOR HOUSING.....	42
SMART SENSOR FOR GLASS DETECTION.....	43
ADAPTIVE TRACK SYSTEM WITH VARIABLE CONFIGURATION FOR DIFFERENT TYPES OF TERRAIN.....	44
ROBOTIC DEVICE FOR SAFETY TRANSPORT UNTIL SCHOOL.....	46
TRANSPORT STRESS INDEX-BASED SMART MONITORING TAG FOR ADAPTIVE INCOMING INSPECTION.....	47
SINGLE CYLINDER MODULAR ENGINE.....	48
ADAPTIVE ROBOTIC GRIPPER WITH SILICONE CONTACT SURFACES.....	49
INTELLIGENT MECHANICAL-HYDRAULIC ADAPTIVE SUSPENSION SYSTEM.....	51
ENHANCING MACHINING PROCESSES USING BLACK PHOSPHORUS NANOPARTICLES.....	52
MEDICAL ROD FOR FRACTURE STABILIZATION AND MONITORING USING ULTRASOUND.....	53
MOBILE INTELLIGENT SYSTEM FOR RAPID REDESIGN AND MANUFACTURING OF INDUSTRIAL MECHANICAL COMPONENTS	55
SMART TORQUE WRENCH WITH AUTOMATED AI-BASED TIGHTENING SYSTEM	57
HEARTBEAT MONITORING DEVICE	59
DEVELOPMENT OF A HYBRID 3D DYNAMIC SCANNING SYSTEM FOR GAIT AND POSTURE ANALYSIS.....	60
ELECTROMAGNETIC SENSOR FOR DETECTING RIM OVALIZATION.....	61
ADVANCED MECHANICAL DEPLOYABLE LADDER STRUCTURE.....	62
DYNAMIC OMNI-TERRAIN MORPHING SYSTEM WITH PROGRAMMABLE STRUCTURAL RIGIDITY	63
MILLING TOOL HOLDER WITH INTEGRATED MECHANICAL WEAR INDICATOR.....	64
MOBILE STRETCHER WITH AUTOMATIC MECHANICAL BRAKING SYSTEM FOR INCLINED SURFACES.....	65
INTELLIGENT MODULAR PAVEMENT, USED FOR GENERATING ELECTRICAL ENERGY AND PURIFYING AIR.....	66
PROCEDURE FOR OBTAINING A COMPOSITE COATING WITH INCREASED DURABILITY ON A METAL SURFACE.....	67
COMPOSITE COATING MATERIAL WITH ANTI-CORROSION AND ANTI-SCRATCH PROPERTIES	67

ORTHOPEDIC DEVICE FOR CORRECTING TALIPES CALCANEUS AND TALIPES CALCANEVALGUS DEFECT	68
DIGITAL TRANSFORMATION OF OCCUPATIONAL SAFETY AND HEALTH PROCESSES IN THE ROAD TRANSPORT INDUSTRY: AN INTEGRATED WORKFORCE SAFETY, TRAINING, COMPLIANCE, AND VEHICLE MONITORING DIGITAL PLATFORM.....	69
OCCUPATIONAL HEALTH AND SAFETY STUDY FOR THE WORK ENVIRONMENT OF AN EQUIPMENT DISTRIBUTION OPERATOR.....	69
INNOVATIVE FLOTATION INSTALLATION WITH HYBRID ECOLOGICAL NANOMATERIALS, USED IN WASTEWATER TREATMENT.....	70
ADVANCING WASTEWATER TREATMENT SYSTEMS: HEAVY METALS REMOVAL USING BRASSICA JUNCEA SEEDLINGS.....	71
HYBRID WATER DECONTAMINATION PROCESS BY ADSORPTION AND PHOTOCATALYSIS USING BIO-BASED COMPOSITE MATERIALS.....	71
ECO-FRIENDLY COMPOSITION BASED ON EXTRACTS OF CALENDULA OFFICINALIS L., CONTAINING PHYTOSYNTHESIZED SILVER OR ZINC OXIDE NANOPARTICLES, WITH ANTIMICROBIAL PROPERTIES, BIOSTIMULANT EFFECT FOR CALENDULA OFFICINALIS L. CROPS, AND HERBICIDAL ACTIVITY, AND METHOD FOR OBTAINING IT.....	72
CEMENT-BASED MORTAR WITH ANTIMICROBIAL PROPERTIES AND METHOD FOR OBTAINING IT.....	73
ACETONE GRAVIMETRIC SENSOR.....	74
OXIFLUORONANOCARBONIC SENSITIVE LAYERS FOR THE RESISTIVE DETECTION OF ACETONE.....	75
ACETONE RESISTIVE SENSOR.....	76
NUMERICAL SIMULATION AND EXPERIMENTAL VALIDATION OF CRITICAL ZONES IN SPECIMEN TESTING USING THE ARCAN DEVICE.....	77
A NOVEL INTEGRATED APPROACH TO EDGE THOMSON SCATTERING DIAGNOSTICS: FEA-VALIDATED DESIGN FOR FUSION HARSH ENVIRONMENTS.....	80
ADAPTIVE VUV SPECTROMETER ARCHITECTURE FOR IMPROVED ALIGNMENT AND DIAGNOSTIC COVERAGE IN FUSION DEVICES: STRUCTURAL INTEGRITY UNDER FUSION-RELEVANT LOADS VALIDATED BY FEA.....	82
PROCESS FOR OBTAINING COMPACTION MASSES WITH REINFORCEMENT BASED ON HYDRAULIC BINDER.....	84
PROCESS FOR OBTAINING HEAT-INSULATING CONCRETE BASED ON HEAVY ASH OF POWER PLANT	85
OPTIMIZATION OF THE CNC PLASMA CUTTING PROCESS FOR COST REDUCTION AND IMPROVEMENT OF PERFORMANCE AND QUALITY.....	87
OPTIMIZATION OF TECHNOLOGICAL PROCESSING BY CUTTING THROUGH USING THE GPS WALTER APPLICATION: ANALYSIS AND IMPLEMENTATION IN THE CONTEXT OF MECHANICAL PROCESSING.....	88
TERRAFLYER- HYBRID VEHICLE SERVING HUMANITY	90
TYRE-TO-HYDROGEN: A MODULAR HYBRID SOLUTION FOR CLEAN ENERGY FROM WASTE.....	93
AIRFLOW ENERGY RECOVERY SYSTEM: HELICAL TURBINE SOLUTION FOR SMART HVAC APPLICATIONS.....	95
COMPOSITE PLATES FROM TETRA PAK PACKAGING WASTES.....	97
METHOD FOR COMPARATIVE EVALUATION OF TECHNOLOGICAL DEVELOPMENT BASED ON THE NUMBER OF REGISTERED PATENTS.....	99
COMPOSITE MATERIALS FROM PLANT FIBRES AND MUSHROOM FARMING WASTE	100
NATURAL FIBER-BASED ECO-MATERIALS.....	101
MATERIAL CU PROPRIETĂȚI FONOABSORBANTE DIN LÂNĂ DE OAI E CU SPUMĂ POLIURETANICĂ ȘI PROCEDEUL DE OBȚINERE AL ACESTUIA.....	102

GEOMETRIE DE TIP FRACTAL IN PIESELE FABRICATE PRIN SLM.....	105
ROQA AI — A DUAL-AGENT AI PLATFORM FOR ENTERPRISE RPA QUALITY ASSURANCE AND OPERATIONS	107
ELI — AN AI COWORKER FOR COLLABORATIVE INTELLIGENCE IN HEALTHCARE REVENUE CYCLE MANAGEMENT.....	107
COST-EFFICIENT METHODS FOR PHYTOTOXICITY TESTING. A CASE STUDY.....	108
COMPARATIVE TESTING METHODS FOR SOME FRUIT TEA ASSORTMENTS. A CASE STUDY ON FIVE FRUIT TEAS	110
COST-EFFICIENT TECHNIQUES FOR VEGETAL (PSYLLIUM, CHIA AND FLAXSEED) HYDROGELS ASSESSMENTS. A CASE STUDY.....	111
METHOD FOR NUTRITION OF BROILER CHICKENS.....	113
FEEDING METHOD FOR BROILER CHICKEN.....	113
FEEDING PROCESS FOR BROILER CHICKEN.....	114
LOW-CALORIE AND HYPOGLYCEMIC YOGURT AND PROCESS FOR OBTAINING IT...	115
SYSTEM FOR SLEEP QUALITY ENHANCEMENT.....	115
SYSTEM FOR AIRING AND VENTILATION.....	116
THERMOSTATIC VALVE.....	116
AUTOMATIC CONTROL SYSTEM OF FLUID FLUX.....	117
REVITAGLOVE.....	117
HEXAPOD.....	118
BIO SPARK.....	118
MINI SUMO.....	119
DRONE INDOOR.....	120
LINE FOLLOWER.....	120
BRACHIOARTIST - BRANCHIOGRAF INTELIGENT CU INTERACȚIUNE ȘI CONTROL MULTIMODAL.....	121
AVION RC.....	122
VOLTERA — INTELLIGENT VEHICLE TELEMETRY PLATFORM.....	123

EXHIBITED PAPERS

MACHINE FOR DISCONTINUOUS PRODUCTION OF YARN COMPOSED OF WOOL FIBERS AND YARNS OF DIFFERENT MATERIALS

Zeljko KNEZIC, Dubravko ROGALE, Zeljko PENAVA, Snjezana FIRST
ROGALE, Ivan KNEZIC

University of Zagreb, Faculty of Textile Technology, Municipality of Majur

In the process of hand-weaving floor coverings, various thicker materials can be used for the weft. In order to be able to use sheep wool from our region and threads made from recycled materials, a machine was designed that produces complex coarser threads suitable for hand weaving in a discontinuous process.

At least two previously prepared threads (or narrow ribbons of recycled material) are laid out in parallel on a 2-meter-long table, and wool fibers or a skein obtained by a carding machine are placed next to them. All threads are fixed to the spindle at one end. After the spindle has been rotated a certain number of revolutions, the desired twists are created on the new thread. The spindle axis is then placed perpendicular to the axis of the created thread, which is wound onto the spindle, and a new amount of material is pulled onto the table to continue the process, which is repeated as desired (or needed). The spindle has an electric motor drive controlled by a counter and a speed regulator.

HYMICRO - INTEGRATED MICROSYSTEM FOR BIOHYDROGEN PRODUCTION

Bruno ZELIC, Anita SALIC, Ana JURINJAK TUSEK, Davor VALINGER,
Zrinka KARACIC, Renata VICEVIC, Nera BEBEK

University of Zagreb Faculty of Chemical Engineering and Technology

This innovation relates to the development of an integrated microsystem for biohydrogen production using enzymatic or microbial biocatalytic processes. The

system enables hydrogen production from renewable biomass sources in microreactors, which provide high mass and heat transfer efficiency, precise control of reaction conditions, and increased productivity. The developed microsystem integrates biocatalysts, microreactors, and process control components, enabling efficient, safe, and scalable hydrogen production. This innovation supports the development of decentralized and modular hydrogen production systems based on renewable resources. The technology has strong potential for applications in energy production, industrial biotechnology, and renewable energy systems, contributing to sustainable energy transition and circular bioeconomy.

Compared to conventional hydrogen production methods, the innovation provides the following improvements:

- Increased production efficiency,
- Reduced energy consumption,
- Enhanced process safety,
- Reduced system size,
- Continuous system operation,
- Possibility of decentralized production,
- Integration of biocatalysis and microreactor technology.

Microreactor systems enable precise process control and higher efficiency compared to conventional reactors.

HYMICRO - INTEGRATED MICROSYSTEM FOR BIOHYDROGEN PRODUCTION

Zvonimir VIDUKA

Altpro d.o.o.

Automatic train protection system RAS90 is an INDUSI PZB90 based ATP system. It is designed in order to increase the safety of railway traffic. RAS90 system consists of central device RAS90, locomotive balise, track balises and signalling and operating elements located in the locomotive cabin.

Functionality: The main function of the system is to initiate automatic braking if the driver doesn't comply with safety regulations. RAS90 is continuously monitoring the speed of the train and does not allow overspeeding at any point during the run. RAS90 can be additionally upgraded with various other functions like dead

man's system, train driver registration, event recording, speed monitoring, wheel lubrication and similar.

Safety: Track and locomotive balises are certified in TUV Rheinland according to EN norms 50121-3, 50121-4, and 50125-3. RAS90 is developed and certified according to EN 50155, EN 50121-3 and EN61373.

Maintenance: Although RAS90 is a microprocessor based high tech system, maintenance procedures are made to be as user friendly as possible. Diagnostic application was developed for the ease of fault diagnosis and system check. Additionally, peripheral units have their own test devices – speedometer is tested by SB18 testing unit and locomotive balise is tested by LMI18.

Connectivity: Connection to other systems on the vehicle is enabled by isolated CAN bus. Connection to the central diagnostic system (CENDIS) is realised through xG router or Wi-Fi.

Analytics: REC90 is a module developed specifically for event recording and it can be used with PC application IRAS viewer. All diagnostic data can be archived in ALTPRO central diagnostic system CENDIS.

System benefits: Track and locomotive balises encased in robust (fire, water, vibration resistant) casings; Equipment compatible with other INDUSI track balise producer; Decentralized architecture; Minimum cable infrastructure - CAN BUS connectivity; Configurable parametrizing of peripheral units; Low life cycle costs; Low initial investment; High level of customization possibilities; Project management (turn key solution)

MOVE.AI - PERSONALIZED MOVEMENT ANALYSIS AND CORRECTION USING ARTIFICIAL INTELLIGENCE

Tomislav BRONZIN, Darko KATOVIC

Citus d.o.o.

MOVE = Motion Observation and Validation Engine

move.AI is an innovative solution that uses artificial intelligence to analyze the user's movements during exercise or sports activities, recognizes movement patterns and automatically detects irregularities in movements. The system uses computer vision and deep learning algorithms to evaluate biomechanical correctness and provides personalized feedback in real time. Each movement is monitored and analyzed as a series of consecutive individual poses in order to be analyzed in detail

and corrected if necessary. The solution is compliant with personal data protection requirements (GDPR, etc.), and enables the implementation of a non-invasive method of monitoring and comparing movements. The move.AI solution is applicable in various industries and scenarios, e.g. recreation, sports preparation, physiotherapy, home exercise and education. The target groups are individuals and specialized sports, health and rehabilitation institutions.

MULTI-FUNCTIONAL MOVABLE ROOF

Ivan BENCETIC

Technical School Zagreb

The multi-functional movable roof is primarily designed for protection when drying laundry outdoors. The roof can also have the same function for covering parked bicycles in cities. The roof is activated by a liquid sensor and it is also activated when it senses too much moisture in the air, the roof is moved by a DC motor. It consists of: Support columns, side supports, guide rods, roof fabric and other electronic components.

PNEUMATIC MOBILE ROBOT FOR CLIMBING VERTICAL SURFACES

Marko BAKOTIC

University of Zagreb Faculty of Mechanical Engineering and Naval Architecture

The innovation represents a mobile robot with pneumatic drive that has the ability to move on vertical flat surfaces using vacuum grippers. It is intended for applications in industry, inspection, maintenance or cleaning of spaces where access for people is difficult or dangerous, for example on glass facades, high walls or inside tanks. Such robots must ensure a firm grip on the wall, carry work tools and equipment and flexible movement while performing specific tasks. The peculiarity of the system lies in the use of pneumatic drive, which makes it environmentally friendly and safe to operate. The robot has a modular design and the control system can be easily adapted depending on the specific application or working conditions. Control is carried out via the Controllino Mini microcontroller, allowing for easy

upgrading and adaptation to new functions. This platform provides a reliable, flexible and multi-use solution for automating demanding operations on vertical smooth surfaces.

SUN POSITION TRACKING SYSTEM

Youwei ZHANG

University of Zagreb Faculty of Mechanical Engineering and Naval Architecture

A system has been designed that adjusts its angle using four servo motors, pulling chains attached to the four corners of the base on which the solar panel is located. The solar panel is attached to the top of the panel, and four sensors are placed next to it that measure the intensity of light. The sensors send information to the Arduino microcontroller, which is located on the bottom panel. Based on this information, the Arduino controls the servo motors using a complex algorithm that allows simultaneous control of all motors. In this way, the height is adjusted to all four corners of the panel. This tilts the solar panel to the optimal position for maximum use of solar energy, thereby increasing the efficiency of the system. In addition, the system uses springs and hinges that ensure the stability and flexibility of the structure, which allows for better stability and adjustment of the position of the solar panel.

EXTENDED RELEASE FORMULATION FOR PARENTERAL USE AIMED AT ALLEVIATING PAIN IN ARTHRITIS PATIENTS

Ivana SOLJIC JERBIC, Fabio FARAGUNA, Marjana DURRIGL, Leo MANDIC,
Leon MIHIC, Rafael ANELIC, Monika MIHALJEVIC, Petra PONGRAC, Josko
BARBARIC, Karlo BLAZEVIC

*University of Zagreb Faculty of Chemical Engineering and Technology; PLIVA
d.d. Research institute*

The developed formulation consists of a biocompatible and biodegradable polymer system, a biocompatible solvent, and a non-steroidal anti-inflammatory drug (NSAID). The formulation is intended for local application, such as to the knee, where a polymer hydrogel forms and ensures the drug is released according to a

given therapeutic profile over a longer period of time. This method of administration ensures the drug is available locally at the source of pain. It avoids the gastrointestinal tract, where chronic conditions can result from long-term oral administration. It reduces the frequency of administration and increases drug usability, allowing for lower drug consumption.

MATANX

Igor KOLOVRAT

E.V.A. BLUE d.o.o.

A digital-analog business platform with an electric modular vehicle with a hemp body, a device for detecting and analyzing air quality at a micro location with AI software for data and analytics, and 4m2 HD displays with software for advertising, messages, real-time display of air quality conditions with maps of critical locations, etc. are integrated into the vehicle... The vehicle is not intended for sale, but we are building a fleet for selected European cities where, through our business activities in cooperation with the local community, we will help boost the local economy and sustainable way of living. Given that we have three income streams in mind, the main emphasis is on fair and sustainable business. The vehicle is modular and intended for last mile delivery and sale and for tourism in the off road version.

IOT ACCESS CONTROL SYSTEM

Jakov MARKOVIC

Faust Vrancic Technical School of Mechanical Engineering

This project is a fully functional IoT-based access control system built using an Arduino UNO R4 WiFi microcontroller. The system is designed to provide secure entry using two-factor authentication — first by scanning an RFID card and then entering a PIN code on a keypad. Only when both the card and the PIN are correct does the system activate an electric lock. I also designed the physical housing in

Autodesk Inventor, so the system is not only electronically functional but also mechanically well-planned.

This system is ideal for securing places where controlled access is important. It can be used in:

- Banks – to secure vault rooms, employee entrances .
- Schools and Universities – for classrooms, laboratories, teacher offices.
- Offices and Companies – to control access to sensitive areas, meeting rooms, storage.
- Homes and Apartments – for front doors, garages, private workshops.

I plan to enhance the current system so that the door lock automatically unlocks when the temperature measured by the DHT11 sensor exceeds 30°C. This feature can provide emergency access in case of overheating or fire, improving safety. The system would continue to operate the usual two-factor authentication (RFID + PIN) under normal conditions, while giving priority to automatic unlocking when high temperature is detected.

PYUP-ORDER

David KOS

Technical School for Computer Science and Networking

This invention presents PyUp-Order, a web-based digital ordering system designed to simplify the process of ordering in restaurants and similar service environments. The application is built with FastAPI on the backend, a lightweight SQLite database, and a static frontend composed of HTML, CSS, and JavaScript pages. The system allows restaurant owners to create stores, manage menu items, customise the appearance of the menu, generate QR-based access for customers, and receive orders in real time.

Customers can scan a QR code, browse the menu on their mobile phone, submit an order without installing an application, and optionally use a guest flow. The project also introduces user registration, e-mail verification, token-based authentication, image uploads for store branding and products, and a simple deployment guide for a Raspberry Pi server.

The goal of this invention is to document the problem the project solves, explain the technical architecture, analyse the main code modules, evaluate strengths and weaknesses, and present realistic directions for future development.

PyUp-Order is a successful example of a practical school software project that combines a clear business problem, understandable architecture, and realistic implementation choices. It addresses the need for faster, contactless ordering in restaurants while remaining simple enough to deploy and explain in an educational context. The project demonstrates knowledge of Python backend development, SQLAlchemy data modelling, static frontend design, authentication, media handling, and lightweight server deployment.

MY HAPPY COLORING BOOK — OFFLINE AI COLORING PAGE GENERATOR

Marko MARICEVIC, Tibor SKALA, Lara MARICEVIC, Paula SRDANOVIC

University of Zagreb Faculty of Graphic Arts

My Happy Coloring Book is a unique AI application that generates completely original, high quality coloring pages in just a few seconds - entirely offline, without any internet connection. This ensures maximum privacy and safety for children, which is a key advantage over existing online solutions. Powered by local GPU acceleration and advanced line art generation models, the system produces clean, professional illustrations without common AI errors.

The application is extremely easy to use: by selecting a category such as animals, robots, or vehicles, the user instantly receives a brand new coloring page ready for A4 printing with a single click.

The modular AI architecture enables fast integration of new styles and educational content (letters, numbers, tasks), as well as personalized illustrations. This innovative approach encourages creativity, reduces costs, and supports sustainability by printing only the illustrations users truly want - making it ideal for schools, libraries, kindergartens, and home use.

HIKING ENVIRONMENTAL MONITORING SYSTEM (ESP32 + BLYNK)

Danijel ESKERICIC

This system is a portable solution designed for hikers and outdoor enthusiasts, aimed at continuous monitoring of key environmental parameters during

movement in mountainous areas. The device is based on the ESP32 microcontroller, which enables wireless communication via WiFi, using the hiker's smartphone as an access point (hotspot).

The primary purpose of the system is to provide timely information about environmental changes that may impact safety, such as sudden drops in atmospheric pressure indicating possible weather deterioration. The system continuously collects data on altitude, air temperature, relative humidity, and atmospheric pressure, transmitting it in real time to the Blynk application installed on the user's smartphone. This allows the hiker to maintain full awareness of current conditions and make informed decisions during the activity.

The system can be used in various outdoor scenarios, including hiking, mountaineering, and long expeditions. It can also serve educational purposes or be integrated into environmental monitoring and safety systems.

The user can upgrade the project with a rechargeable lit-ion battery and a buzzer or speaker so that, in the event of a change in the measured values, he can receive a signal via the speaker. Also, a sign of a change in measured values can be a notification on a mobile phone (message, call and e-mail), which is created in the Dashboard.

INNOVATIVE WORKING MATERIALS FOR SECONDARY VOCATIONAL SCHOOL STUDENTS: INTRODUCTION TO ELECTRONICS AND MICROCONTROLLERS

Danijel ESKERICIC

The teaching materials Introduction to Electronics (Figure 1) and Microcontrollers (Figure 2) are designed as modern educational tools for students of secondary vocational schools. Their purpose is to provide basic and advanced knowledge in electronics and microcontroller programming through a practical, problem-based and project-oriented approach to learning. The materials were approved by the competent institution for the supervision of teaching in secondary vocational education, and were issued in 2021 and 2022, since when they have been used daily.

These materials on the market of the Republic of Croatia are almost unique in the Croatian language and are aligned with the learning outcomes of teaching subjects and modern educational trends that emphasize active student participation, critical thinking and the application of knowledge in the real world.

These materials introduce:

- Learning based on Arduino UNO and ESP32 microcontrollers and basic electronics elements

- Real-world project development
- High school student-led innovation
- Integration of digital and technical skills
- Independent design and execution of projects
- Cohesion with 3D technologies

Importance:

- Prepare students for the labor market
- Develop practical skills
- Encourage innovation
- Modernize vocational education

The teaching materials Introduction to Electronics and Microcontrollers represent a modern, innovative, and effective approach to vocational education. They enable students to develop essential future skills and prepare them for active participation in a technologically advanced society.

BEYOND THE HORIZON: INNOVATIVE AIRCRAFT DESIGN AND MANUAL ENGINEERING

Sebastian ROTEA

"Schillerschule" Dettingen an der Erms, 8C Class, Germany

This project explores the manual design and assembly of an advanced flight model, utilizing ultra-lightweight polymers to optimize the weight-to-lift ratio. Through experimental modeling techniques, the work demonstrates how manual construction precision and wing geometry directly influence aerodynamic stability during flight. This initiative transforms a passion for modular design into a practical aeronautical engineering solution. Components of the plane: the plane body, 2 long wings, 2 short wings, 2 screws. How to make it: from a sheet of compact foam, the shape of the plane body is cut out, this after it has been previously drawn. The 2 long wings are trapezoidal and rounded at the top, they will be cut wide enough to keep the air under them for the plane to float. The other 2 small wings are positioned at the back side of the plane, at the tail, higher than the other 2 wings, they help maintain the straight trajectory of the plane. The wings are attached with hot glue.

The 2 screws are positioned in front of the plane, on one side and the other, to give weight to the front part, to cut the air and to keep the plane in a straight line and to prevent it from turning over.

CARIE THE MARINE PATROLLER - A SOLAR-POWERED, AUTONOMOUS MARINE TRACKER

Cristina Gabrielle R. CACHO, Maridette Drannel M. BAYLON, Kyoshiro B.
MATA, Jin Kyle B. VENTURA

St. Patrick School of Quezon City, Philippines

The ocean is one of the most prominent sources of transport, trade, food, and energy, but fast growth in human activities has caused massive stress in the marine ecosystems, resulting in overexploitation of biodiversity. In order to face up to this challenge, the Solar Powered Submarine Championing Advocacies to Reinvent the Seas (SPS - CARES), named Carie, offers a sustainable solution to several oceanic issues. Carie uses LEGO Spike Prime parts to portray how she will detect and respond to marine pollution, coral degradation, and even discover endangered and new species.

Carie the Patroller is a multi-purpose submarine that aims to help the ocean bounce-back by reducing its stressors through advanced technology. Carie is equipped with LEGO Spike Prime color sensors that help show how she can adapt and respond to her environment with actual Artificial Intelligence.

CONCEPTUAL DESIGN OF THE CITY SQUARE, CITY PARK, AND MEMORIAL

Ena GATARIC, Dejan DAKIC, Damjana CVIJANOVIC, Lana STANKOVIC,
Ana Marija OROZ, Emilija NAJDEK, Janko TRIVUNOVIC, Tea TODOROVIC,
Helena VUJASINOVIC, Ana TEPIC, Darko RISTIC, Bojana VUCIC, Milica
MARIE, Teodora GAJIC, Tijana GAJIC, Isidora PREDIC

*JU Gradevinska skola Banja Luka, Savez inovatora Republike Srpske, Republic of
Srpska - Bosnia and Herzegovina*

The main goal of the proposed conceptual design of the city square, memorial, and city park is the creation of a harmoniously designed public space that

connects the functions of rest, gathering, and commemoration. The spatial solution integrates the city park as a natural zone, the square as a central urban point, and the memorial as a symbol of collective memory. These three segments are shaped to functionally and visually form a unified whole, that is, a unique and recognizable public space that does not currently exist in the city.

The guiding idea was the promotion and preservation of local identity through natural resources: the Vrbanja River, the drop of water, the bee, and the honeycomb. The river is a key source of life, supports agriculture and ecosystems, and represents the foundation of the community's life and therefore must be preserved.

The very name of the town "Čelinac" is associated with the word "bee," as this area has historically been known for beekeeping. For this reason, the square is designed as a set of hexagonal cells regularly arranged next to one another, symbolically representing family, stability, and togetherness. The fountains are stylized as a drop of water, while the motifs of bees and honeycombs are present in all segments of the project.

In designing the ambience, the space was conceived to be accessible to all user groups, both younger and older generations, as a meeting place of the past and the future.

The urban concept is based on spatial, visual, and functional connectivity. The memorial zone, square, and park are arranged along a single compositional axis that enables unobstructed movement of users and a natural transition between zones, with clear orientation in the north-south direction. A unified palette of materials, lines, and landscape elements ensures visual unity, while each zone retains its own function but is also capable of supporting joint events, cultural programs, and everyday activities.

The area is treated as a pedestrian zone, where the existing roadway along the western part of the site, a section of Prve čelinačke lake brigade Street, is transformed into a pedestrian street with the possibility of occasional vehicle access for delivery purposes, in order to create a calm oasis without traffic noise. Parking is planned in the southwestern part of the site.

The riverside promenade is connected to a network of pedestrian paths that lead through and around all zones, forming a continuous spatial unit, while a bicycle path is planned alongside them, clearly separated by materialization and color.

The memorial, as the most sensitive element of the composition, is designed with the symbolism of the eagle's wing clearly arranged in the sign of faith, emphasized by contemporary lighting and enriched with an audio experience. All elements of the project — benches, stands, pavilion, and seating areas — are

designed in a modern manner, using natural materials and in accordance with the principles of energy efficiency.

KID PLEARN (KID PLAY & LEARN)

Chiratchaya HEMRUNGROJN, Thipok TUNGSIRIPAT, Siranat TOVIKKAI,
Nathasiri TOVIKKAI

*Chulalongkorn University Demonstration Secondary School and King's College
International School Bangkok, Thailand*

Kid Plearn is an innovative game for the new generation kids. It derived from traditional Thai folk children play combined with the neuropsychological science, the key aspects of the Stroop Test and the Digit Symbol Substitution Test. Kid Plearn consists of two games.

The first game was designed to stimulate cognitive flexibility, processing speed and selective attention of the player by forcing the brain to override an automatic habit “reading the word, to instead name and the ink of color”. The purpose of the game is to evaluate cognitive function, attention and the ability to resist distraction.

The second game was designed for the players to remember the symbol corresponding to digits in order to measure and stimulate processing speed, attention, working memory and promote group playing.

To reduce children's issues on addiction to smart phone and online games is the main goal of this innovation because it caused several health problems, i.e. Pseudo attention deficit (ADHD), mental effect on violence, lack of EQ and social skill. Kid Plearn promotes various cognitive skills such as attention, memories, problem solving and social skill.

Not only for Children, Kid Plearn can be adapted as a brain training exercise to enhance mental agility and help to prevent attention span loss from declining of cognition in elderly with fun activities.

FLEXWEAR STAND

Poli HSU

Hsinchu International Academy, Taiwan

FlexWear Stand is a wearable mobile holder designed for hands-free convenience in daily life. With adjustable shoulder straps and an extendable pole, it securely supports your phone at eye level, allowing users to watch videos, video call, or navigate without holding the device. The lightweight pocket design makes it easy to carry and perfect for commuting, traveling, or multitasking. FlexWear Stand solves the problem of limited hand use bringing freedom, comfort, and safety to your mobile experience.

INNOVATIVE INDUCTION COOKER

Yang CHIEH-JU, Lin HSIN-HENG, Lin PIN-CHUN, Lee YU-TING, Hsu CHING-TUNG, Weng TZU-YU, Chung YI-FEI, Hsu TZU-CHENG

National Taipei University of Business, National Chung Senior High School, Hsing Lung Primary School, Dong Sing Junior High School, Fu Long Primary School, Taiwan

Hot pot cookware is easily overheated, energy-intensive, and inconvenient move. We hope to improve its design to enhance safety and convenience while reducing power and costs.

The pot heats efficiently even with a short distance from the heat source. It uses a double-layer design: a stainless-steel inner layer for heat conduction and an aluminum outer layer to reduce heat transfer. A heat pipe with water speeds up heating—100× more efficient than copper. The silicone foam outer layer provides insulation and safety.

The pot features an efficient heat transfer design that accelerates cooking and reduces energy consumption on induction stoves. Its sides are made of non-heat-conductive materials to allow safe and convenient handling.

MAGNETIC DRIVEN BALL

Lin TZU-QI, Chung YI-FEI, Chung YI-KAI, Liu YU-XUAN, Liu JUN-QI, Liu JUN-LIN, Liu YI-SHUO, Liu YI-ZHEN, Tsai PO-HENG, Huang CHING-YEN

Kuai Ji Junior High School, Dong Sing Junior High School, Chung Yuan Elementary School, Shin-Jie Elementary School, Lilin Elementary School, New Taipei City, Taoyuan Elementary School, Qing Xi Elementary School, Taiwan

This educational tool employs magnetic force to lift marble balls to a higher position. By harnessing this innovative mechanism, it creates an engaging experience for students, who can observe the effects of magnetism in action. As the marble balls reach the top, the principle of potential energy is transformed into kinetic energy. This transformation propels the marbles to roll down from the back of the platform, providing an exciting visual demonstration of fundamental physics concepts. Ultimately, the marbles drop into designated slots, adding an element of fun and mystery to the process. This captivating interaction not only enhances the learning experience but also stimulates students' motivation and curiosity for scientific exploration.

POTATO VARIETY – EVENT

Dumitru BODEA, Ioan Cătălin ENEA, Cezar Virgil HATNEAN

Agricultural Research and Development Station Suceava

The potato variety EVENT was developed at Agricultural Research and Development Station Suceava through sexual hybridization followed by repeated clonal selection. The variety was officially registered in 2023 and patented in 2024 under Patent No. 00747. EVENT is recommended for cultivation in areas favorable to potato production and can also be grown in other regions under irrigation conditions.

EVENT is characterized by oval tubers with yellow skin, medium-depth eyes, and light-yellow flesh. The plants have a semi-erect growth habit with 6–8 medium-height stems and a high flowering frequency. From a physiological perspective, the variety belongs to the semi-early maturity group and shows valuable resistance traits. It is resistant to potato wart disease (*Synchytrium endobioticum*),

resistant to Potato virus Y and Potato leaf roll virus (PLRV), and moderately resistant to late blight (*Phytophthora infestans*) on both foliage and tubers, as well as to Potato viruses X, S, and M.

The variety demonstrates high production potential, achieving average yields of 33–38 t/ha, which are 7–13% higher than the zoned control varieties under the same cultivation conditions. Its biological yield potential reaches 60–65 t/ha. EVENT belongs to culinary quality class B and is mainly intended for autumn and winter consumption. The starch content ranges between 16–17%, making it suitable for both fresh consumption and processing purposes.

Economic evaluations carried out in seven locations with different environmental conditions showed an average yield increase of approximately 10% compared to the local control varieties under identical technological conditions. Its high productivity, together with the efficient utilization of fertilizers and irrigation water, contributes to profitable cultivation and increased economic efficiency for growers.

The EVENT potato variety is intended for agricultural companies, farmers associations, and private growers from potato-producing regions interested in cultivating productive and disease-resistant potato varieties adapted to sustainable agricultural systems.

POTATO VARIETY – IMPULS

Dumitru BODEA, Ioan Cătălin ENEA, Cezar Virgil HATNEAN

Agricultural Research and Development Station Suceava

The potato variety IMPULS was developed at Agricultural Research and Development Station Suceava through hybridization followed by repeated clonal selection. The variety was officially registered in 2023 and patented in 2024 under Patent No. 00746. IMPULS is recommended for cultivation in regions favorable to potato production and can also be successfully cultivated in other areas under irrigation conditions.

IMPULS is distinguished by its attractive red-skinned tubers with a regular long-oval shape, fine skin texture, medium-depth eyes, and light-yellow flesh. The plants form medium-sized bushes composed of 5–7 semi-erect stems well covered with foliage. Each plant produces approximately 12–15 tubers per nest. The variety has low flowering intensity, with pink-anthocyanin colored flowers.

From a physiological point of view, IMPULS belongs to the semi-early maturity group. The variety is resistant to potato wart disease (*Synchytrium endobioticum*), tolerant to late blight (*Phytophthora infestans*), and moderately resistant to viral diseases affecting potato crops.

The variety has a high production capacity, achieving average yields of 35–40 t/ha, exceeding the zoned control varieties by 7–18% under similar cultivation conditions. IMPULS responds very well to fertilizer application and irrigation, with a biological production potential of 65–70 t/ha. In terms of quality, the variety belongs to culinary class A–B and is intended mainly for autumn and winter consumption. The starch content ranges between 14–15%.

Economic evaluations conducted in seven different locations demonstrated an average yield increase of 12.5% compared to the local control varieties under identical technological conditions. In the Rădăuți area, the variety achieved a production of 40.2 t/ha compared to 26.6 t/ha obtained by the control variety, representing an increase of 51%. Its high productivity, tolerance to viral diseases and late blight, together with its efficient utilization of fertilizers and irrigation water, make IMPULS a profitable and economically efficient variety for potato growers.

The IMPULS potato variety is intended for agricultural companies, farmers' associations, and private growers from potato-producing areas seeking productive, adaptable, and disease-tolerant potato varieties suitable for sustainable agricultural systems.

CLIMATE-ADAPTIVE STRATEGIES FOR SUSTAINABLE MANAGEMENT OF POTATO LATE BLIGHT AND YIELD STABILITY

Nichita NEGRUSERI, Ioan Cătălin ENEA, Danela MURARIU, Andreea-Mihaela FLOREA, Eugen ULEA

Agricultural Research and Development Station Suceava

The project focuses on the evaluation of potato late blight dynamics, caused by *Phytophthora infestans*, and its impact on the productive performance of *Solanum tuberosum* under the pedoclimatic conditions of northeastern Romania.

The research was carried out during the 2022–2024 growing seasons and aimed to identify the relationships between climatic factors, potato genotype, phytosanitary treatment schemes, disease severity and tuber yield.

Potato late blight remains one of the most destructive diseases affecting potato crops, causing significant yield losses and reducing tuber quality. In the context of climate variability, the development of efficient, flexible and sustainable disease management strategies is essential. This research addresses this need by integrating field monitoring, epidemiological indicators, yield assessment and statistical analyses in order to support sustainable potato production.

The study analyzed the influence of climatic factors such as temperature, rainfall and relative humidity on the occurrence and progression of late blight. The results showed that disease severity was not determined only by the total amount of rainfall, but rather by the interaction between temperature, humidity and the temporal distribution of favorable infection conditions.

Among the three experimental years, 2024 recorded the highest disease pressure, reflected by the highest AUDPC value, while 2022 showed the lowest disease severity.

Disease development was monitored under field conditions using epidemiological indicators such as attack frequency, attack intensity and attack degree. The Area Under Disease Progress Curve (AUDPC) was used as an integrated indicator to quantify disease progression throughout the vegetation period. The disease progress curve showed a typical sigmoidal pattern, with an initial latency phase followed by a rapid increase in disease severity during the flowering and tuber development stages.

The research also evaluated the response of different potato genotypes to late blight infection and to several phytosanitary treatment schemes. The results highlighted the importance of genotype in disease management. Some genotypes showed better tolerance and a more stable productive response, while others were more sensitive and recorded higher AUDPC values.

The interaction between genotype and treatment was significant, indicating that the efficiency of phytosanitary measures depends strongly on the biological characteristics of each variety and on the environmental conditions of each year.

Tuber yield was influenced by genotype, treatment scheme and climatic conditions. In all experimental years, the untreated control variants recorded the lowest yields, while preventive and combined treatment schemes generally led to higher productivity.

The relationship between disease severity and yield varied depending on the year. In 2024, when disease pressure was higher, a clearer negative relationship was observed between AUDPC and tuber production, showing that severe infection can reduce yield and affect production stability.

The study also analyzed tuber yield structure by size fractions. Medium and large tubers represented the largest share of total production, while small tubers contributed less to overall yield. Increased disease severity was associated with a higher proportion of small tubers and a reduction in large tuber fractions, indicating that late blight affects not only yield quantity, but also the commercial quality of production.

Statistical analyses, including ANOVA, correlation analysis and principal component analysis, confirmed the complex interactions between year, genotype and treatment scheme.

The results demonstrated that sustainable disease management cannot rely on a single factor, but must integrate genotype selection, rational use of phytosanitary treatments, climatic monitoring and adapted crop technologies.

The innovative character of this project consists in the integrated approach used to evaluate potato late blight management under local climatic conditions. By combining epidemiological monitoring, yield performance, genotype response and treatment efficiency, the research provides a practical framework for developing climate-adaptive and sustainable strategies for potato disease control.

The results support the adoption of integrated disease management strategies based on the use of adapted and tolerant genotypes, careful monitoring of climatic conditions, and rational application of phytosanitary treatments. This approach can contribute to reducing unnecessary chemical inputs, improving yield stability, maintaining tuber quality and increasing the resilience of potato production systems.

The potential beneficiaries of this research include agricultural research institutions, potato growers, farmers' associations, agricultural companies and extension services. The practical recommendations resulting from the study may be applied in potato-growing regions where late blight represents a major phytosanitary risk, especially under variable climatic conditions.

Overall, the project contributes to sustainable agriculture by promoting an integrated, flexible and locally adapted strategy for managing potato late blight and ensuring stable, high-quality potato production.

SPICY DARK BEER - AN INNOVATIVE BEER ENRICHED WITH CHILI EXTRACT FOR ENHANCED SENSORY AND FUNCTIONAL PROPERTIES

Georgiana HORINCAR, Ioana Gabriela POPA (SAVIN), Iuliana APRODU

Dunărea de Jos University of Galati

The invention presents an innovative formulation of dark beer produced from natural ingredients and enriched with Kashmiri chili extract. The incorporation of Kashmiri chili significantly enhances the sensory properties of the beer, improving its taste, aroma, and color, while also increasing the functional value of the final product.

The proposed approach involves the production of a value-added dark beer through the addition of Kashmiri chili (*Capsicum annum* L.) extract, a natural source rich in biologically active compounds. These compounds contribute notable functional benefits, particularly due to their antioxidant, coloring, and flavor-enhancing properties.

The resulting product is characterized by a dark brown appearance with subtle reddish reflections, a pleasant sweet-fruity taste, and a well-balanced aromatic profile, including notes of fruit, coffee, light smokiness, and a mild spicy aftertaste.

This innovation represents a novel strategy for expanding the range of specialty beers, offering both improved functional properties and increased commercial potential.

VALUE-ADDED BEER ENRICHED WITH EGGPLANT (SOLANUM MELONGENA L.) PEEL

Georgiana HORINCAR, Iuliana APRODU

Dunărea de Jos University of Galati

This work proposes an innovative technological approach for obtaining a value-added beer enriched with eggplant (*Solanum melongena* L.) peel extract, a by-product rich in bioactive compounds. The process integrates the extract into the final stage of fermentation, ensuring the preservation and efficient incorporation of anthocyanins, flavonoids, and phenolic compounds.

The resulting product exhibits significantly enhanced antioxidant activity and improved biological value, while maintaining key sensory attributes such as aroma, taste, and clarity. In addition, the extract imparts a distinctive reddish hue, increasing the product's visual appeal and market differentiation.

The proposed solution demonstrates the potential of eggplant peel extract as a functional ingredient in brewing, offering both nutritional and technological benefits without compromising product quality. At the same time, the invention contributes to the sustainable valorization of agro-industrial by-products, aligning with circular economy principles. By responding to the increasing consumer demand for clean-label, functional beverages with health-promoting properties, this innovation opens new opportunities for the development of differentiated beer products with added value.

PROSTHETIC SYSTEM FOR DETECTING AND COMPENSATING HUMAN LOWER LEG LENGTH DISCREPANCY

Dimitrie-Cristian FODOR, Neculai-Eugen SEGHEDEIN, Vasile-Ion MANTA,
Otilia ZVORIȘTEANU, Dragoș-Florin CHITARIU, Ștefan-Daniel ACHIREI

Gheorghe Asachi Technical University of Iasi

A prosthesis is a medical device intended to replace a missing limb or part of a limb, but this substitution of a missing biological limb cannot be achieved in any way. The artificial limb must meet several aspects related to form, functionality, control and design. All these characteristics define the user in society.

On the market of prosthetic medical devices, there is no prosthesis that meets absolutely all these requirements, in particular a functional characteristic related to the automatic alignment of the artificial limb in relation to the biologically healthy contralateral limb. Therefore, a new type of prosthesis has been proposed, which has an active function, automatic length alignment, without the need for the presence of a specialist doctor, after an initial calibration on the user's body. The prosthesis consists of an extendable module positioned between the prosthetic socket and the artificial leg (which can be conventional or bionic) and a mobile application installed on the phone. The application (developed software) is based on computer vision and detects, based on images taken from the patient, whether the limbs (intact and amputated) are of the same size. If the lengths of the limbs are equal, then no

correction is necessary; however, if the digital system detects an anomaly in the symmetry of the body, the application wirelessly controls the extendable prosthetic module, which can be activated until the length of the prosthesis is equal to that of the contralateral limb. Verification of the maintenance of body symmetry is performed in a loop, and the smartphone running the application can be held by a companion, placed on a tripod or on an improvised support at the patient's home.

Thus, by maintaining the symmetry of the body of the prosthetic user, certain conditions that may occur in the presence of a discrepancy in the length of the lower limbs are avoided: spinal deformities, prosthetic replacement of joints that have deteriorated due to a change in the center of gravity.

A NEW GENERATION OF METALLIC BIOMATERIALS AS HEALTH SOLUTION FOR A SUSTAINABLE LIFE

VIZUREANU Petrică , BĂLȚATU Mădălina Simona, SANDU Andrei Victor,
ACHITEI Dragoș Cristian, PERJU Manuela Cristina, Corina Ioana MOGA,
BURDUHOS-NERGIS Dumitru Doru

Romanian Inventors Forum / Gheorghe Asachi Technical University of Iasi

A new generation of metallic biomaterials as health solution for a sustainable life“ aims to obtain a new alloys system containing Titanium, Molibdenum, Niobium and Tin (Ti-Mo-Nb-Sn), with characteristics suitable for medical applications. The new generation of biomaterials will overcome the limitations of the titanium, cobalt and stainless-steel alloys as: high elasticity model and low corrosion resistance and biocompatibility. Hence, to achieve long-term stability and rapid osseointegration in orthopedic implants, surface modification of the implant surface is required. In this sense, the new titanium-based alloys will undergo specific heat treatments to obtain alloys with good mechanical properties intended for orthopedic applications.

PROCEDURE FOR OBTAINING PRECAST ELEMENTS BASED ON GEOPOLYMER COMPOSITES WITH WASTE WOOD ADDITION

Dumitru Doru BURDUHOS-NERGIS, Petrica VIZUREANU, Andrei Victor SANDU

Romanian Inventors Forum / Gheorghe Asachi Technical University of Iasi

The procedure described in this invention outlines a technology for producing innovative geopolymer composites suitable for civil engineering applications. These composites comprise an oxide matrix made from fly ash and slag, which is reinforced with particles of timber waste. The process for creating these environmentally friendly geopolymer composites involves mixing two components: one solid and one liquid. The solid component consists of 55-65% class F fly ash, 35-45% ground granulated blast furnace slag, and an additional 10% timber waste. The liquid component is a solution of sodium silicate (Na_2SiO_3) and sodium hydroxide (NaOH) in a mass ratio ranging from 1.2 to 1.3. The mass ratio of the liquid component to the solid component should be between 0.4 and 0.5, and the concentration of the NaOH solution is 8M. The wood chips range from 10 to 30 mm in size, resulting from milling old furniture. Therefore, this eco-friendly manufacturing technology enables the reuse of three types of waste materials (fly ash, slag and timber) in order to develop innovative products.

PROMOTING LONG-TERM ACTION AND SUSTAINABLE TECHNIQUES FOR INHIBITING CONTAMINATION WITH PLASTIC IN FRESHWATER ECOSYSTEM FROM CROSSBORDER AREA RO-RM (PLASTICWISE)

Aurora MATEI, Elena ZUBCOV, Andrei Victor SANDU, Ioana Corina MOGA, Ioana PRUTEANU, Ioan Gabriel SANDU

Romanian Inventors Forum / Gheorghe Asachi Technical University of Iasi

The project addresses the growing environmental threat of plastic pollution in the Prut River basin by combining scientific research with public awareness actions across Romania and the Republic of Moldova. The project also promotes citizen engagement and educational outreach, fostering a culture of environmental responsibility and sustainable waste management practices.

Through collaborative field and laboratory investigations, the initiative will assess the extent of microplastic contamination in fish, water, and sediments, while also studying associated microorganisms. The project seeks to bridge existing data gaps in freshwater ecosystem monitoring.

ARCHITECTS OF INNOVATION: EMPOWERING GLOBAL CREATIVITY

Corneliu BIRTOK BANEASA, Erika KOLLMANN

INVENTCOR Academy Deva, Romania

- **Networking:** Direct connection between young inventors, academia and INVENTCOR Academy, under the aegis of the Association CORNELIUGROUP research-innovation, is an elite hub dedicated to young visionaries. We offer not only education, but a complete ecosystem of mentoring, prototyping and international representation.

PILLARS:

- **EXPERIENCE:** Over 18 years in the field of inventions and innovation.
- **ACHIEVEMENTS:** Over 3000 international awards obtained on 3 continents.
- **MISSION:** Transforming the creative potential of students into viable awarded technical solutions.

INVENTCOR Academy focuses on tangible results:

- **Personalized Mentoring:** Step-by-step guidance from concept to functional prototype.
- **Intellectual Property:** Support in understanding the patenting process & protecting ideas.
- **Global Exposure:** Access to the most prestigious invention salons in the world.
investors.

GEARBOX FOR ELECTRIC CAR

Romeo CĂTĂLINOIU, Sorin AUREL RAȚIU, Imre ZSOLT MIKLOS

Coramex by Service Automobile SA, Politehnica University of Timisoara, Faculty of Engineering Hunedoara, Romania

The invention is an application of Patent RO134406 dated 30.03.2023 and refers to a gearbox intended to ensure the transmission of electrically powered automobiles with the aim of reducing energy consumption and increasing energy autonomy. The gearbox is characterized by the fact that it continuously varies the value of the transmission ratio, by varying the revolutions of the two electric motors, which can work individually or in tandem. The gearbox is a mechanical reducer characterized by the fact that it provides assistance when pedaling through an electric motor, assistance that can be achieved in three modes: low, medium and high, self-adaptive depending on the value of the load torque that must be overcome.

AUTOMOTIVE TUNING - IMPLICATIONS FOR VEHICLE DYNAMICS AND ROAD SAFETY

Denisa Valentina GROSU

Politehnica University of Timisoara, Faculty of Engineering Hunedoara, INVENTCOR Academy Deva, Romania

This study examines the progressive evolution of automotive tuning and establishes a foundational framework for future scientific research concerning vehicle dynamics and traffic safety. A critical analysis is performed on the correlation between non-compliant aftermarket modifications and the degradation of operational safety standards. Central to this investigation is the assessment of the most prevalent unauthorized modifications that pose significant risks to public road safety, specifically the utilization of oversized wheel and tire assemblies that deviate from the original equipment manufacturer (OEM) specifications. By analyzing the detrimental effects of these alterations on stability, braking performance, and steering geometry, this paper highlights the urgent need for standardized technical oversight. The findings serve as a strategic baseline for subsequent studies aimed at mitigating the risks associated with improper automotive customization in the context of contemporary road traffic stability.

DESIGN AND STRUCTURAL INTEGRITY ANALYSIS OF FRONT AXLE FLOATING CALIPERS

Alexandru-Marius IȘTOC

*Politehnica University of Timisoara, Faculty of Engineering Hunedoara,
INVENTCOR Academy Deva, Romania*

This study provides an exhaustive engineering analysis and design methodology for a front axle floating brake caliper, a critical component for automotive active safety and deceleration performance. The research systematically integrates several development phases, beginning with the definition of the functional role and the extreme operating conditions—characterized by high hydraulic pressures and thermal stress—that the assembly must withstand. Following the initial sizing based on braking torque requirements and kinematic constraints, a rigorous material selection process was conducted to optimize the ratio between structural stiffness and unsprung mass. The technical core of the work involves the analytical calculation of tensile strength in critical sections, followed by the development of a high-fidelity 3D CAD model designed to accommodate real-world packaging and cooling needs. The study concludes with a comprehensive Finite Element Analysis (FEA), where numerical simulations under maximum loading scenarios were used to evaluate von Mises stress distribution and structural deformation. The results validate the design's integrity, ensuring that the caliper maintains an optimal safety factor and reliable performance under peak operational demands, thus providing a robust framework for advanced automotive component development.

TECHNOLOGICAL EVOLUTION OF 1.9 TDI POWER UNITS (VAG GROUP)

Stefan NICOLA

*Politehnica University of Timisoara, Faculty of Engineering Hunedoara,
INVENTCOR Academy Deva, Romania*

This study analyzes the evolutionary trajectory of the 1.9 TDI propulsion units, highlighting the transition from rotary pump injection to Unit Injector Systems (Pumpe-Düse) and the implementation of Variable Nozzle Turbines (VNT).

The research evaluates the optimization of power density, specific fuel consumption reduction, and compliance with progressive emission standards through innovations in electronic management and materials science. This synthetic analysis demonstrates how the balance between thermodynamic efficiency and structural reliability established this architecture as a benchmark in automotive engineering.

TARGETED SYNTHESIS AND STUDY OF THE BIOLOGICAL ACTIVITY OF TERPENE COMPOUNDS WITH HETEROCYCLIC STRUCTURAL UNITS

Lidia LUNGU, Crina VICOL, Vsevolod POGREBNOI, Vladilena GÎRBU,
Alexandr BATANOV, Sergiu COJOCARI

Moldova State University

The main objective of the project was to design and synthesize targeted chiral molecular hybrids containing combined norlabdane, thiosemicarbazide, and 1,3,4-oxadiazole fragments, derived from the natural and readily accessible diterpenoid (-)-sclareol. This compound can be isolated from local and renewable raw materials. The project also aimed to evaluate the antioxidant activity of the synthesized compounds using the DPPH method.

The relevance of the project lies in the use of transformation products of the natural labdane diterpenoid (-)-sclareol for the preparation of molecular hybrids that may exhibit selective biological activity and reduced toxicity due to their natural origin.

For the targeted synthesis of compounds with antioxidant potential, five new hybrid compounds were obtained. The first stage focused on the valorization of waste generated during the production of clary sage (*Salvia sclarea* L.) essential oil, from which (-)-sclareol was isolated in the required quantities. This was followed by a series of transformations involving both classical and unconventional methods, leading to the formation of compounds containing combined norlabdane, thiosemicarbazide, and 1,3,4-oxadiazole skeletons.

To determine the antioxidant activity of the synthesized compounds, the DPPH assay was employed, using the free radical 2,2-diphenyl-1-picrylhydrazyl. The five newly obtained hybrid compounds were tested, together with sclareol as a natural control and ascorbic acid (AA) as the reference antioxidant. The initial concentration of the synthesized compounds was 1 g/L, from which 6–7 successive

dilutions were prepared. The initial absorbance of the DPPH radical was approximately ≈ 0.800 a.u.

Among the synthesized compounds, the derivative containing an –SH fragment exhibited the highest antioxidant activity at the maximum tested concentration (0.75 g/L), achieving approximately 80% inhibition and indicating substantial radical scavenging potential. The IC_{50} value, defined as the concentration required to inhibit 50% of DPPH radicals, was estimated to be approximately 0.23 g/L.

Two compounds showed moderate activity, with a progressive reduction in the colour intensity of the DPPH solution, although less pronounced than that of the most active compound. The parent compound, (-)-sclareol, displayed very low to no activity, with the percentage of DPPH remaining almost constant throughout the tested range.

The obtained results highlight the importance of the structural architecture of the newly synthesized compounds, whose electronic and steric features directly influence their ability to interact with the DPPH radical and, consequently, to exhibit antioxidant activity.

NEW COPPER(II) COMPOUNDS AS INHIBITORS OF CANCER CELLS PROLIFERATION

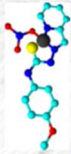
Aurelian GULEA, Victor ȚAPCOV, Olga GARBUZ, Roman RUSNAC, Aliona PÎNTEA

Moldova State University

AIM: The present invention consists in obtaining new coordination compounds that possess properties of inhibiting the proliferation of cancer cells.

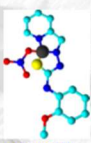
SOLUTION: Synthesis and structural characterization of {N-[(2-methoxyphenyl)-2-(pyridin-2-yl-methylidene)hydrazine-1-carbothioamido]} copper (II) nitrates (compound I) and {N-[(4-methoxyphenyl)-2-(pyridin-2-yl-methylidene)hydrazine-1-carbothioamido]} copper(II) (compound II) as proliferation inhibitors of a cell lines: BxPC-3 – pancreatic cancer, RD – human muscle rhabdomyosarcoma, HeLa – cervical cancer, HL-60 – human myeloid leukemia, LNCaP – human prostate carcinoma cancer, MCF-7 – breast carcinoma cancer, HepG-2 – human liver hepatocellular carcinoma cancer, K-562 – human bone marrow chronic myeloid leukemia cell line.

The IC_{50} (μM) values of anticancer activity of compounds I and II



The IC_{50} (μM) values of anticancer activity of compounds I and II

Compound	Cell lines							
	BxPc-3	RD	HeLa	HL-60	LNCaP	MCF-7	HepG-2	K-562
Cisplatin	0,5	0,15	0,1	0,08	0,8	0,3	0,2	0,3
I	0,1	0,1	0,8	0,03	0,8	0,1	0,4	0,5
II	0,1	1,2	1,1	0,03	0,3	0,6	0,6	0,03



*Average results of three experiments, SEM $\leq$ $\pm$ 3%.

ADVANTAGES: The invention consists of the establishment of anticancer activity of compounds I and II, which exceeds the cisplatin activity by 17-2.7 times and exceeds the analogous characteristics of the structural analogue by 30-1.1 times.

FOLKAI TECHNOLOGY: AUTOMATED ORTHOGRAPHIC ALIGNMENT AND LEXICAL EXPANSION OF BESSARABIAN FOLKLORE DICTIONARIES

Olesea CAFTANATOV, Mircea PETIC, Svetlana COJOCARU, Ludmila MALAHOV, Dmitrii VANGHELII

*Vladimir Andrunachievici Institute of Mathematics and Computer Science,
Moldova State University*

The FolkAI project aims to preserve and promote intangible cultural heritage through the digitization and automated analysis of Bessarabian folklore texts from the 19th–20th centuries. Folklore represents a fundamental component of cultural identity and collective memory, and its digitization enables the integration of these resources into linguistic research, digital education, and the promotion of cultural heritage.

Within the project, 8 folklore books were scanned, totaling over 2,500 pages and approximately 500,000 words, in collaboration with libraries and with the support of the infrastructure of the “Vladimir Andrunachievici” Institute of Mathematics and Computer Science, Moldova State University. The processing of the texts was carried out using the HeDy platform, specialized in the optical character recognition of historical Romanian texts. Existing OCR models, trained on hundreds of thousands of examples, enable the digitization of texts written in

historical scripts; however, the specificity of the folklore vocabulary requires additional corrections and adaptations.

Young researchers involved in the project contributed to the analysis and validation of OCR results, as well as to the identification of vocabulary specific to Bessarabian folklore. The digitized texts are segmented at the word level, and the resulting forms are compared with standard dictionaries (DEX, DOOM). Words that do not appear in these resources are extracted for further analysis, as they may represent regionalisms, archaisms, historical orthographic variants, or OCR errors.

For linguistic analysis, several lemmatization and morpho-syntactic annotation tools were tested, including Stanza, TTL (UDpipe), and RACAI tools. Experimental results show that the performance of these instruments depends on the script of the text, and the existing models are not optimized for historical Cyrillic corpora. Following automated and manual analysis, a set of around 4000 words not found in dictionaries was obtained, which can be manually validated and integrated into specialized dictionaries.

The outcome of the research is the development of a FolkAI technology for automated orthographic alignment and lexical expansion of folklore dictionaries, integrated into the HeDy platform. This approach improves the accuracy of text digitization and creates digital linguistic resources useful for research, education, and the valorization of cultural heritage.

MECHANICAL DEVICE FOR THE CONTROLLED EXTRACTION OF BEARINGS EMBEDDED IN THE MOTOR HOUSING

Aurel Mihail TITU, Daniel BALC, Emanuel BALC, Stefan TITU

"Lucian Blaga" University of Sibiu

The invention refers to a mechanical assembly designed as a compact extraction device intended for removing bearings embedded in motor housings. The assembly is configured to operate in such a way as to allow the extraction of the bearing without damaging the housing or any adjacent components.

The device is engineered to apply controlled, evenly distributed forces that act directly on the outer ring of the bearing, ensuring secure fixation of the bearing within the extractor. The mechanical movements and actions applied are precise, progressive, and repeatable, providing a constant force necessary for extracting the bearing from its seat, even in situations where tolerances are very tight or corrosion is present.

The forces generated by the assembly are calibrated to prevent deformation of the engine housing and to eliminate the need for additional impacts or heating. Its use significantly reduces the risk of material cracking as well as the time required for maintenance operations.

The primary purpose of this invention is to facilitate efficient engine maintenance by enabling the safe extraction of bearings with minimal operator effort and high precision, regardless of the housing profile or the degree of bearing wear.

The device ensures a uniform distribution of forces on the bearing and allows controlled, repeatable, and progressive movements, eliminating the need for mechanical shocks or component heating. Through this approach, the risk of cracking, deformation, or damage to the motor housing is significantly reduced. Operationally, the time required to extract the bearing decreases considerably, and the compact design provides superior maneuverability, enabling use even in housings with complex geometry or limited space, while requiring minimal effort from the operator.

Tests conducted on motor housings with integrated bearings have demonstrated a reduction of up to 60% in total extraction time compared to traditional methods, while causing no damage to the housing in any of the tested scenarios. Performance remained consistent even under challenging conditions, such as moderate corrosion, seized bearings, or tolerances below 0.05 mm. Analysis of the results shows that the device enables safe bearing extraction while providing significantly greater control over the process. In addition, eliminating hammer impacts and heating substantially reduces the risk of microcrack formation, thereby contributing to an extended service life of the motor housing.

SMART SENSOR FOR GLASS DETECTION

Emanuel BALC, Aurel Mihail TITU, Daniel BALC, Stefan TITU

"Lucian Blaga" University of Sibiu

The invention relates to an autonomous sensory device, configured as a compact module, designed for identifying materials based on the physical properties specific to glass. The device is intended to determine, in real time, whether the analyzed material is glass, without requiring direct contact or invasive procedures.

The sensory assembly uses a measurement principle based on ultrasound, measuring the response time of the sound reflected from the piece under analysis, in order to differentiate glass from plastic, composite, or metallic materials.

The system is designed to operate autonomously, performing discrete measurements depending on the application. Its operation is stable, repeatable, and calibrated so that it is not influenced by moderate variations in temperature or lighting. The compact form allows integration of the sensor into industrial lines, portable devices, or automatic sorting systems.

The purpose of this invention is to enable fast and reliable detection of glass materials in industrial, recycling, automated inspection, or safety applications. The use of this sensor reduces material classification errors, optimizes processing workflows, and improves the reliability of systems that require accurate identification of glass.

The device enables rapid and accurate identification of glass without direct contact, reducing the risk of material damage.

Its autonomous and stable operation increases industrial process efficiency and minimizes the need for human intervention.

Its easy integration into production lines or automated systems supports advanced automation and reduces classification errors.

The device introduces a non-contact method of identifying glass, eliminating the risk of damaging fragile components during inspection.

By using ultrasonic response time analysis, the system provides a reliable way to distinguish glass from plastics, metals, and composite materials. Its autonomous operation reduces dependency on human supervision, contributing to higher process stability and repeatability.

The compact module design allows integration into various environments, from industrial production lines to portable field equipment.

ADAPTIVE TRACK SYSTEM WITH VARIABLE CONFIGURATION FOR DIFFERENT TYPES OF TERRAIN

Daniel BALC, Aurel Mihail TITU, Emanuel BALC, Stefan TITU

"Lucian Blaga" University of Sibiu

The invention relates to an adaptive track assembly designed for autonomous or user-operated ground vehicles, intended to enable efficient

movement across terrains with varying properties. The device is engineered to adjust in real time the configuration, stiffness, and shape of the track's contact elements, thereby optimizing traction, stability, and energy consumption regardless of the surface type.

The track assembly consists of a series of interconnected flexible modules equipped with internal mechanisms that control the tension and position of each segment. These mechanisms can be electrically actuated, allowing for modifications to ground pressure distribution, adjustments to the contour of the exterior shape, and adaptation to obstacles, uneven surfaces, or slippery terrain. Sensors integrated into the track structure continuously monitor grip, vibrations, and local deformations, transmitting data to the central processor.

The control unit processes this information and coordinates the necessary adjustments so that the track maintains optimal ground contact, minimizes traction loss, and ensures smooth movement. The system enables the vehicle to efficiently adapt to sand, gravel, mud, snow, hard surfaces, or rough terrain without manual intervention and without changing any physical components.

The adaptive track assembly offers the major advantage of superior mobility on terrains with variable properties, thanks to its ability to adjust its stiffness, shape, and ground pressure distribution in real time. By using interconnected flexible modules and internally electric-actuated mechanisms, the track continuously maintains optimal contact with the running surface, reducing traction losses and improving vehicle stability even in challenging conditions such as sand, mud, or snow.

The adaptive track assembly involves numerous technical aspects, such as the efficient integration of flexible modules and the internal tension-control mechanisms required for the continuous adjustment of shape and rigidity depending on the terrain. The sensor system must monitor traction, vibrations, and local deformations in real time, enabling the central unit to make rapid and precise decisions. It is also essential to analyze how the control algorithms manage ground-pressure distribution to optimize traction and stability in extreme conditions such as sand, mud, or ice. The durability of the flexible components, wear resistance, and the impact of environmental factors are also important elements, along with the energy consumption of the electric drive system. Additionally, it is worth discussing the possibilities of automatic calibration, compatibility with different platforms for ground vehicles, and industrial, military, or utility applications, which can highlight the versatility and competitive advantages of this technology.

ROBOTIC DEVICE FOR SAFETY TRANSPORT UNTIL SCHOOL

Daniel BALC, Aurel Mihail TITU, Emanuel BALC, Stefan TITU

"Lucian Blaga" University of Sibiu

The invention relates to an autonomous robot designed specifically for school environments, conceived as a compact mobile module that fully replaces the traditional backpack. The robot is engineered to safely transport textbooks, notebooks, sports equipment, and other personal items belonging to the student, moving automatically in close proximity to them without requiring physical effort or manual operation.

The device uses a set of optical sensors, ultrasound, lidar, and 3D cameras to identify and track the student, maintaining a safe and optimal distance during movement. Internal processing algorithms calculate safe routes, avoid obstacles, and ensure stable trajectories in crowded environments such as during recess or class transitions. For social safety, the robot includes an AI based anti bullying system capable of detecting potentially aggressive situations such as hostile following, abnormal proximity, raised voices, or threatening gestures. In such cases, the robot can alert the student, send a notification to teachers, or record the incident anonymously in accordance with school policies.

The storage compartment is stabilized with internal damping systems that protect the student's belongings from shocks, vibrations, or rough handling.

The robot carries the full weight of textbooks and equipment, eliminating strain on the student's back and preventing posture problems associated with carrying heavy loads.

The internal AI can detect tense situations, aggressive behaviors, or unauthorized proximity, offering students an additional level of protection and enabling quick intervention from school staff.

The adaptive mechanical system allows the robot to climb and descend stairs, overcoming the limitations of standard robots and ensuring access to all floors within the school.

The robot eliminates the need for carrying a backpack, making it easier for students to move between classrooms located on different floors. It is ideal for schools with multiple buildings or large campuses, where students must cover long distances or frequently climb stairs. At the same time, the IA-based system can act

as a proactive safety tool, being integrated into the school's policies for preventing aggressive behavior.

TRANSPORT STRESS INDEX–BASED SMART MONITORING TAG FOR ADAPTIVE INCOMING INSPECTION

Claudiu-Alexandru COVACI, Aurel Mihail TITU

"Lucian Blaga" University of Sibiu

The invention refers to a compact smart monitoring system designed to record and evaluate transport and handling conditions of goods at container level, with the purpose of supporting adaptive incoming inspection in automotive manufacturing environments. The system is implemented as a reusable electronic module attached externally to standard logistics containers, such as KLTs, enabling continuous monitoring without interfering with the transported components or packaging integrity. The proposed device integrates multiple sensing capabilities, including motion and shock detection through an inertial measurement unit, as well as environmental monitoring of temperature and humidity. These parameters are continuously recorded throughout the transport and storage phases, capturing both peak values and cumulative exposure over time. The data is stored locally and can be retrieved at goods receipt through wireless communication, ensuring rapid access to transport condition history without requiring complex infrastructure. A key element of the invention is the introduction of a Transport Stress Index (TSI), defined as a composite metric that quantifies the overall exposure of the transported goods to potentially harmful conditions. The index is calculated using a rule-based model that combines peak shock events, frequency of mechanical impacts, and cumulative duration of temperature and humidity excursions beyond predefined critical-to-quality limits. The TSI enables a structured and objective evaluation of transport-induced risks, transforming raw sensor data into actionable information.

Based on the calculated TSI, the system supports a dynamic decision-making process for incoming inspection. Instead of relying solely on static sampling plans or historical supplier performance, the inspection strategy is adapted in real time according to the actual transport conditions experienced by each container. Depending on the index value, the system recommends standard inspection, extended inspection with increased sampling, or quarantine and containment actions

in case of critical exposure. Additionally, predefined threshold conditions act as hard-stop criteria, triggering immediate intervention regardless of the overall index value. The invention addresses a significant limitation in current supply chain quality management, where transport conditions are not directly integrated into inspection decision processes. Existing solutions, such as standalone shock indicators or temperature loggers, provide limited and often non-integrated information, lacking direct applicability in quality control workflows. By combining condition monitoring with a structured risk evaluation model, the proposed system establishes a direct link between logistics exposure and quality assurance actions. The implementation of this system enables improved traceability of transport conditions at container level, supports evidence-based communication between suppliers and customers, and reduces the likelihood of undetected transport-induced defects entering the production process. Furthermore, it contributes to optimizing inspection resources by focusing efforts on high-risk situations, thereby improving efficiency and reducing unnecessary inspection costs. Experimental simulations and controlled test scenarios demonstrate that the use of the Transport Stress Index allows effective differentiation between low-risk and high-risk transport conditions. The results indicate that the system can significantly enhance the robustness of incoming inspection processes by enabling early identification of potentially compromised shipments. In addition, the structured data collected by the device can support continuous improvement activities, including root cause analysis and supplier performance evaluation. The compact design, ease of integration, and modular architecture of the device ensure its applicability across a wide range of logistics and manufacturing environments. The invention represents a practical approach to bridging the gap between transport condition monitoring and quality decision-making, contributing to the development of more resilient and data-driven automotive supply chains.

SINGLE CYLINDER MODULAR ENGINE

Adrian BARSAN, Darius Alexandru COSTEIU

"Lucian Blaga" University of Sibiu

This invention allows for an engine that can be as large or as small as desired, by assembling individual modules next to each other. For example, a 3-cylinder engine can be converted into a 4-cylinder engine by rotating the crankshaft

to the required angle and coupling it with additional single-cylinder modules, effectively combining multiple modular units into one engine.

The engine is air-cooled and carburetor-fed, with a chain-driven camshaft and an oil pump. Each module can operate independently or as part of an assembly, being connected to others using durable bolts.

The crankshaft is slightly extended and designed as a conical spline shaft with multiple teeth. It uses a conical coupling mechanism that, when pressed together with other crankshafts, self-centers and minimizes or eliminates radial play.

The concept of a modular engine lies in its versatility. Its use can range from small applications such as lawnmowers or generators, which require a single-cylinder engine, to automobiles that may need 3 to 6 cylinders. The engine can be disassembled, and its modules reused for temporary purposes. For example, a car engine could be taken apart in an emergency, with each module repurposed for use in a generator, water pump, cultivator, or motorcycle. Due to its versatility and ease of assembly and disassembly, the engine can be used in a wide range of applications, including generators, water pumps, cultivators, mopeds, motorcycles, go-karts, ATVs, UTVs, buggies, automobiles, DIY projects, and racing or sports cars. It can also serve as a teaching aid. Because the engine is modular, if one cylinder fails or is severely damaged, it can be removed from the assembly. The remaining modules can be reconfigured at appropriate angles to allow the engine to continue running smoothly with one fewer cylinder. For example, a 4-cylinder engine could be reduced to a 3-cylinder engine in an emergency. Although performance may decrease, the vehicle would remain operational, unlike a conventional engine which might be completely disabled under similar conditions. This invention aims to provide the ability to customize the engine's power output based on specific needs and applications.

ADAPTIVE ROBOTIC GRIPPER WITH SILICONE CONTACT SURFACES

Constantin Roberto DOARA, Petru Daniel CIORAN, Alexandru George MAMULARU

"Lucian Blaga" University of Sibiu

The designed robotic arm is an advanced mechanical system engineered for precision handling and adaptability, featuring three slim, articulated arms that end in specialized silicone gripping heads. Each gripping head is designed with a slightly

rectangular shape and fine, step-like micro-textures on one side, enhancing friction and improving control during object manipulation. The silicone material, available in blue or black, provides a soft yet secure contact surface, allowing the system to handle delicate, irregular, or sensitive objects without causing damage.

The arm is powered by high-precision servo motors or electric actuators, enabling smooth, controlled, and repeatable movements. Its lightweight yet durable structure supports efficient operation in various environments, from industrial settings to research laboratories. The three-point gripping configuration ensures balanced force distribution, increasing stability and reducing the risk of slippage. Additionally, the modular design allows for easy customization, maintenance, and integration into automated systems, making this robotic arm a versatile and reliable solution for modern applications.

The advantages include high versatility due to the three silicone gripping heads that can handle fragile or irregular objects. A secure grip is ensured by silicone without applying excessive force, protecting sensitive surfaces, and pressure distribution across three contact points improves the stability of the handled object. The system is energy efficient and can be programmed for repetitive or complex tasks. Moreover, the risk of product damage is significantly reduced compared to traditional rigid grippers. The design also allows easy maintenance and quick replacement of worn components.

The field of applications of the robotic arm spans the food industry, where it can handle delicate products such as fruits, pastries, or fragile packaging. The silicone heads allow gripping without crushing or damaging the items, while the material is easy to clean and compatible with hygiene standards. Automating this process reduces human error and increases production line efficiency. In the medical field, the arm can handle sensitive instruments or biological samples, where gentle gripping is essential to avoid contamination or damage. It can also be integrated into automated laboratory systems for testing and analysis, with its precision and high level of control making it ideal for environments where safety and accuracy are critical. In warehouses, the robotic arm can manage a wide range of products, from rigid boxes to fragile items. The flexible gripping heads adapt to different shapes, reducing the need for multiple gripping systems, which optimizes space and costs. Additionally, automating sorting and packaging processes increases operational speed and reduces the risk of product damage.

INTELLIGENT MECHANICAL-HYDRAULIC ADAPTIVE SUSPENSION SYSTEM

Constantin Roberto DOARA, Petru Daniel CIORAN, Alexandru George MAMULARU

"Lucian Blaga" University of Sibiu

This product is an adaptive suspension system designed to automatically adjust its stiffness and damping depending on road conditions, while avoiding complex electronics. Instead of using sensors and control units, the system relies mainly on mechanical and hydraulic components to react naturally to vibrations.

The suspension uses a hydraulic shock absorber with multiple chambers filled with oil and pressurized gas. Inside the damper, a specially designed mechanical valve controls the flow of hydraulic fluid. The key element is an inertial mechanism (a small moving mass combined with a spring) that reacts to the intensity of vibrations.

When the vehicle travels on relatively smooth roads, the valve stays more open, allowing the oil to flow easily and making the suspension softer for better comfort. When the suspension experiences strong impacts, such as large bumps or rough terrain, the inertial mass moves and partially restricts the fluid flow. This increases the damping force, making the suspension temporarily stiffer and improving stability.

A major advantage of this system is that it adapts in real time without needing electronics, which keeps the design simpler, cheaper, and more reliable. Because of this, the suspension could be useful for low-cost cars, ATVs, bicycles, electric scooters, or agricultural vehicles where durability and affordability are important.

The advantages are lower cost as no expensive electronics are required, high reliability since fewer electronic components means fewer possible failures, automatic adaptation because the suspension adjusts itself based on road vibrations, better comfort as softer response on smooth roads reduces vibrations, and easy maintenance since simple mechanical design makes repairs easier.

The field of applications of this adaptive mechanical-hydraulic suspension system includes various types of vehicles where comfort, stability, and low cost are important. It is suitable for low-cost passenger cars, ATVs, bicycles, electric scooters, and agricultural or off-road machinery. Because it does not rely on complex electronics, it is especially useful in environments where durability, simplicity, and easy maintenance are required.

ENHANCING MACHINING PROCESSES USING BLACK PHOSPHORUS NANOPARTICLES

Dumitru BUSILA, Roberto CISMAS, Alisia ENACHE, Iuliana FIRTONEA

"Lucian Blaga" University of Sibiu

The purpose of this research is to outline the benefits of using Black Phosphorus nanoparticles, herein referred to as BP nanoparticles, in cutting processes. The enhancement consists of a cutting fluid composition comprising a base fluid and BP nanocapsules dispersed therein which can be used in machining processes. BP is a two-dimensional single crystal layered material being an allotrope of phosphorus whose structure consists of atomic chains stacked together through weak van der Waals forces making exfoliation feasible. The main properties of BP are mechanical flexibility, good surface adherence, rolling effect, tribofilm formation, mending effect, polishing effect and heat transfer capacity, dissipating high temperatures in the less active areas of the process. Moreover, BP is the most chemically stable allotropic form of phosphorus. BP is encapsulated in polyamide (Nylon 6) capsules exhibiting a high melting point required for thermal activation during semi-finishing operations for stainless steel and refractory steel. Polyamide is obtained by interfacial polymerisation in an emulsion by reacting diamines with acid chlorides in order to form stable microcapsule coatings. The nanocapsules are to be used strictly with group 3 oil-in-water emulsions, group 4 activated emulsions and group 5 mineral oils. The nanocapsules allow gradual release of active agents (BP) only at elevated temperatures of 200-250°C, generated during machining. Once the critical temperature is reached, nanocapsules dissolve in the cutting fluid thereby permitting BP to reduce friction between the detached chip and rake face of the tool and between the undetached chip and tool edge by forming an atomic nanosheet called phosphorene. Not only do BP nanoparticles create a tribofilm, but they also ameliorate tool wear and energy loss. Based on the aforementioned considerations, black phosphorus encapsulated in polyamide nanocapsules in cutting fluid exhibits distinctive properties that substantially enhance tribological performance in machining processes. The advantages are: favorable tribological conditions which aid evacuation of detached chip, improved surface quality by means of a continuous nanometric layer, reduced roughness, prevention of scratching and work hardening during machining, reduced energy loss, improved heat transfer, prevention of build-up edge formation, creating a thin lubricating film, mitigated vibrations, protection of the surfaces to be machined and protection of the tool through a physical and

chemical anticorrosive and antioxidant barrier, chip and debris removal effect, preventing adhesion of microchips and metallic dust on cutting tool. BP nanocapsules are intended for machining operations involving stainless steel and refractory steel, materials characterised by low thermal conductivity, a high coefficient of friction and a pronounced tendency for chip adhesion to the cutting edge of the tool. Given the circumstances, the tool–chip contact zone heats rapidly, which may lead to work hardening, build-up edge formation and accelerated tool wear. In this regard, the use of nanocapsules can alleviate the process stability and can protect the machined surface. The field of application is particularly relevant in semifinishing operations such as precision turning, grinding, and boring, wherein surface quality and roughness are critical parameters. BP nanocapsules dispersed in oil–water emulsions (Group 3) or activated emulsions (Group 4) form a thin tribofilm that reduces friction and prevents chip adhesion. Furthermore, the high thermal conductivity of BP facilitates local heat dissipation, complementing the role of high-flow coolant, which transports heat away from the contact zone.

MEDICAL ROD FOR FRACTURE STABILIZATION AND MONITORING USING ULTRASOUND

Dumitru BUSILA, Roberto CISMAS, Alisia ENACHE, Iuliana FIRTONEA

"Lucian Blaga" University of Sibiu

Intramedullary rod is an orthopedic implant designed to stabilize long bones fractures. The rod is inserted into the medullary canal of the bone to keep bone fragments aligned during healing process. The invention consists of a rod incorporated with sensors and ultrasonic transducers integrated at both ends of the implant. The system enables the transmission and reception of ultrasonic waves through the bone in order to supervise the fracture consolidation process. The operating principle is based on integrating an ultrasound generator at one of the rod and an ultrasound receiver at the other end. The generator produces ultrasonic signals that passes through the fractured bone and the implant material. The receiver detects these signals and measures the time of flight of ultrasound waves between transmitter and receiver. Time of flight is an essential information which reflects mechanical and structural properties of the affected area in the bone. As the bone heals and mineralizes, the way ultrasound propagates through the bone tissue is changing. Thus, measuring variations of this parameter in time, the system can

provide an objective assessment of the current state of bone healing process, thereby identifying potential complications (e.g. delayed fracture consolidation) and can aid clinical decision-making while avoiding frequent radiation exposure. The first step is ultrasound emission which consists of an ultrasonic transducer integrated at the distal end of the intramedullary rod converts the electrical signal into ultrasonic waves. These waves represent high-frequency mechanical vibrations capable of propagating through biological tissues and bone structure. In the second step, wave propagation through bone takes place: the ultrasonic waves propagate through the bone and across the fracture site. The propagation velocity and transmission characteristics depend on bone density and microstructural properties, as ultrasonic waves travel differently through intact bone, fractured bone, and bone undergoing the healing process. Next, at the opposite end of the rod, an ultrasonic receiver detects the waves transmitted through the bone. The receiver converts the mechanical vibrations back into electrical signals for further processing and analysis. Then, the time of flight is calculated via the electronic system that measures the time required for the ultrasonic wave to travel from the emitter to the receiver. This parameter correlates with bone status and the degree of callus formation during fracture healing. Lastly, the acquired data is analyzed to evaluate the progress of the healing process. There is a series of advantages that will be taken into consideration. First advantage is the absence of ionizing radiation because ultrasound does not employ ionizing radiation unlike conventional radiography or computed tomography (CT). Consequently, it can be used repeatedly without exposing the patient to radiation-related risks, making it suitable for frequent monitoring and safe for vulnerable populations such as pediatric patients and pregnant women. Secondly, the ultrasonography is non-invasive and safe. It is a non-invasive diagnostic modality that does not require traumatic procedures or invasive instrumentation. The examination is generally well tolerated, comfortable for the patient, and can be repeated multiple times without known adverse biological effects. Next advantage is the accessible and rapid ultrasound. Devices are typically more compact and cost-effective than magnetic resonance imaging (MRI) or CT systems. This facilitates broader clinical accessibility, allowing their use in hospitals, outpatient clinics, and even resource-limited or rural healthcare settings. Moreover, the assessment is in real-time, ultrasonography provides real-time imaging and quantitative data regarding bone structure and fracture healing progress. This immediate feedback enables clinicians to make prompt clinical decisions without waiting for delayed image processing or interpretation. Next advantage consists of the continuous monitoring unlike radiographic examinations which are usually performed at relatively long intervals (e.g., every 6–8 weeks), ultrasound can monitor fracture

healing from very early stages. It is capable of detecting early callus formation within the first two weeks after injury, allowing earlier and more detailed assessment of the healing process. Lastly, early detection of complications can be crucial for patients. Ultrasound may reveal early alterations in soft tissue and developing bone callus earlier than conventional radiography. This facilitates the early identification of complications such as delayed union or insufficient callus formation. This invention can be applied in: orthopedics and traumatology, management and stabilization of long-bone fractures, including those involving the femur, tibia, and humerus, monitoring of bone healing because ultrasonography can identify early callus formation and assess the progression of fracture consolidation during the healing process. Not only can it be used in sports medicine for evaluation of skeletal recovery in athletes following fractures or bone-related traumatic injuries, but also in physical and rehabilitation medicine for monitoring the progress of bone healing throughout treatment and during the rehabilitation phase. Moreover, the intramedullary rod could be used in modern orthopedic surgery in development of smart orthopedic implants capable of real-time monitoring of bone status and fracture healing and in biomedical research for investigations focused on bone regeneration and the development of advanced technologies for monitoring fracture healing.

MOBILE INTELLIGENT SYSTEM FOR RAPID REDESIGN AND MANUFACTURING OF INDUSTRIAL MECHANICAL COMPONENTS

Andrada Maria IANC , Tudor Andrei SUMULENCIU, Marius Ioan MURESAN,
Robert Adrian CIUCIU, Paul Gheorghe ISTRATE

"Lucian Blaga" University of Sibiu

The invention consists of a mobile intelligent system designed for the rapid redesign and on-site manufacturing of critical mechanical components used in industrial production systems. Its purpose is to reduce production downtime caused by sudden failures of essential parts such as gears, bushings, shafts, or structural connectors. Unlike conventional maintenance methods that rely on external suppliers and long delivery times, the system enables immediate digital reconstruction and fabrication of replacement components directly at the industrial site. The system includes a compact mobile manufacturing unit equipped with high-resolution 3D scanning technology, AI-assisted design software, and a modular fabrication module

capable of producing metallic parts through additive manufacturing or powder metallurgy processes. When a component fails, the damaged part is scanned to capture its geometry and structural characteristics. The data is then processed by an intelligent design module that reconstructs the digital model, corrects wear or deformation, and optimizes the geometry based on operational stresses and material properties. The manufacturing module produces high-precision replacement components using controlled metal powder deposition and sintering technologies. The system automatically selects suitable materials according to mechanical loads, thermal conditions, friction, and fatigue requirements. An integrated quality-verification subsystem checks dimensional accuracy and structural integrity before the component is approved for installation. By integrating scanning, automated digital redesign, and rapid on-site fabrication into a single mobile platform, the system significantly reduces industrial downtime, improves maintenance efficiency, and increases operational reliability across sectors such as manufacturing, energy production, heavy machinery, and automated production lines. The proposed system is a mobile integrated platform that combines high-resolution scanning, AI-assisted digital reconstruction, and advanced metal additive manufacturing to enable rapid on-site reproduction of failed mechanical components, significantly reducing industrial downtime and eliminating dependence on external spare-part supply chains. The process begins with precise scanning of the damaged part, followed by AI-based analysis that reconstructs and, when necessary, optimizes the digital model, which is then directly manufactured on site using high-precision metal powder technologies to produce fully functional replacement components. This solution offers high flexibility and can be deployed across multiple sectors, including automotive, aerospace, manufacturing, energy, construction, heavy machinery, maritime engineering, and remote or offshore installations where spare parts are difficult to obtain. By enabling fast, localized production, the system ensures operational continuity while also reducing maintenance costs, material waste, and transportation needs. In addition, it supports sustainability and efficiency through the creation of a digital library of reconstructed components for future reuse and replication.

SMART TORQUE WRENCH WITH AUTOMATED AI-BASED TIGHTENING SYSTEM

Marius Ioan MUREȘAN, Robert Adrian CIUCIU, Tudor Andrei SUMULENCIU,
Paul Gheorghe ISTRATE, Andrada Maria IANC

"Lucian Blaga" University of Sibiu

The invention consists of a high-precision manual torque wrench integrated with an AI-assisted control system designed to eliminate human error in mechanical assemblies. Unlike standard tools, this smart system allows the operator to perform the tightening manually while the device acts as an intelligent supervisor. The device utilizes an advanced energy-efficient microcontroller architecture to ensure long-term operational autonomy in demanding industrial environments, featuring a dual-layer protection circuit for electronic stability.

The system features a Material Resistance Sensor that analyzes the initial feedback during the first degrees of rotation through a high-frequency sampling rate of the torque curve. Using an AI-assisted microcontroller and an internal database, the wrench identifies the fastener type and the material's properties to determine the optimal tightening torque automatically. Furthermore, the algorithm compensates for thermal expansion variables, surface friction coefficients, and micro-imperfections in the thread geometry that often compromise standard torque measurements in non-ideal conditions.

The core innovation is the Automated Tightening Control: the operator applies force manually, but once the calculated optimal value is reached, the microcontroller triggers an instantaneous mechanical lock via a high-response electromagnetic actuator. This physical override prevents any further rotation, ensuring the fastener is never over-tightened, regardless of the operator's continued effort or lack of attention. This hybrid approach combines the ergonomic flexibility of a manual tool with the absolute precision of digital automation, creating a new standard for manual fastening reliability and structural longevity.

The main advantages of this system are the following: active over-tightening prevention through an automatic mechanical lock that physically prevents the operator from exceeding the torque limit, acting as a foolproof safety barrier; intelligent material detection that eliminates the need for manual torque lookup by identifying material resistance in real-time, thus reducing the risk of using outdated or incorrect technical sheets; elimination of human error by removing the risk of incorrect manual settings or overshooting the target value caused by physical fatigue

or lack of focus; haptic and visual feedback through vibration and an OLED display confirming the tightening value in Nm when the process is complete, ensuring high precision even in noisy environments; high portability and durability, offering the precision of a laboratory instrument in a rugged manual format suitable for field use, remote construction sites, or emergency repairs; data traceability through the logging of every tightening operation for industrial quality audits; extended fastener lifespan by applying the exact required tension, thus preventing material fatigue and permanent deformation of high-cost components; reduced training time through an intuitive interface that allows even less experienced technicians to perform complex assemblies with expert-level precision, lowering operational costs; and eco-friendly maintenance by minimizing the need for replacement parts, preventing thread stripping and joint failure, and contributing to more sustainable industrial practices.

The main fields of application include: the automotive industry, critical for assembling safety-sensitive components such as braking systems, engine cylinder heads, and suspension links where precise torque is vital for passenger safety; aerospace maintenance, ensuring structural integrity in aircraft components where over-tightening can lead to catastrophic fatigue cracks and failure under pressure; industrial assembly lines, used as a semi-automated solution in environments requiring human dexterity and zero-defect quality standards for mass production; high-end electronics and carbon composites, particularly suited for fragile materials such as carbon fiber or aluminum alloys that can be easily damaged by manual error; infrastructure and energy, for the maintenance of wind turbines, telecommunication towers, and solar panel arrays where reliability and portability are essential; medical equipment assembly, facilitating the precise calibration of robotic surgical arms and diagnostic hardware where mechanical tolerances are measured in microns; and maritime engineering, ideal for ship engine maintenance in high-vibration environments where fasteners must be secured against specific resonant frequencies to prevent loosening.

HEARTBEAT MONITORING DEVICE

Paul-Gheorghe ISTRATE , Marius – Ioan MUREȘAN , Robert – Adrian CIUCIU,
Tudor-Andrei SUMULENCIU, Andrada-Maria IANC

"Lucian Blaga" University of Sibiu

The Heartbeat Monitoring Device is a sophisticated, non-invasive cardiac safety system integrated directly into a vehicle's steering wheel. Designed to enhance road safety, it utilizes state-of-the-art sensors and complex algorithms to monitor the driver's heart rate and detect potential cardiovascular risks, such as a myocardial infarction, in real time.

The system functions through sensors subtly placed at the "9 and 3" or "10 and 2" positions, where drivers naturally rest their hands. These sensors, which may be optical, pressure-based, or conductive depending on the hardware generation, maintain constant contact with the driver to ensure accurate data collection without interfering with the driving experience. The device communicates the driver's health status through an intuitive, color-coded visual system located on the steering wheel display. A Green light indicates that all cardiac parameters are normal, allowing the driver to focus on the road. A Yellow light serves as a cautionary signal, appearing when slight deviations in heart rate or blood pressure are detected, suggesting the driver should relax or take a break. In the event of a Red alert, which signifies a critical cardiac event or a detected heart attack, the system triggers a flashing warning, a loud audible alarm, and the message "EMERGENCY STOP! MAJOR RISK!".

Simultaneously, the vehicle activates automated controlled stop procedures. The primary advantages of this technology are its capacity for accident prevention and early warning. By identifying medical emergencies before the driver becomes incapacitated, the system can autonomously stop the vehicle to prevent collisions. Furthermore, it provides the driver with a discreet way to monitor heart health during daily commutes, offering a vital window of time to seek medical assistance or pull over safely.

DEVELOPMENT OF A HYBRID 3D DYNAMIC SCANNING SYSTEM FOR GAIT AND POSTURE ANALYSIS

Robert Adrian CIUCIU, Marius Ioan MURESAN, Paul Gheorghe ISTRATE,
Tudor Andrei SUMULENCIU, Andrada Maria IANC

"Lucian Blaga" University of Sibiu

The Hybrid 3D Dynamic Scanning System represents a sophisticated biomechanical diagnostic platform designed to capture a "4D Digital Twin" by merging a high-precision motorized treadmill with a continuously rotating annular gantry. Unlike traditional static imaging modalities like CT or MRI that require patients to remain motionless, this system is explicitly designed to capture volumetric surface geometry and kinematic behavior during functional movement. It utilizes a multimodal sensor fusion of LIDAR for sub-millimeter geometric accuracy and high-speed stereophotogrammetry for rich surface textures and RGB color mapping. By employing an annular scan geometry, the device achieves continuous 360-degree topographical mapping, which effectively eliminates the optical shadows and occlusions that typically plague fixed-camera setups where swinging limbs often obscure key anatomical markers. The core acquisition mechanism relies on phase-shifted fringe projection, a technique analogous to those described in patent CN112571426A, where mathematically precise sinusoidal patterns are projected onto the subject. These distorted patterns are captured by high-speed cameras and translated into dense Cartesian 3D spatial coordinates using mathematical phase-unwrapping algorithms. To ensure clinical validity, the system accounts for complex helical acquisition paths and employs absolute microsecond time-stamping within a unified middleware framework like the Robot Operating System (ROS) to eliminate motion artifacts and "ghosting" in the point cloud. Furthermore, the software utilizes advanced machine learning for an automated Anatomical Landmark Marking System, identifying bony structures such as the lateral malleolus or acromion process through voxel density analysis without the need for physical markers. The data processing pipeline also rigorously compensates for Soft Tissue Artifacts (STA)—the deformation of skin and fascia over bone—by applying rigid joint motion constraints to calculate the most mathematically probable trajectory of the underlying skeletal structure. The primary advantage of this hybrid system is its ability to provide objective precision, replacing the subjective human error and poor repeatability associated with manual marker placement or "eyeballing" joint angles. Because the platform is non-invasive and

markerless, it captures the patient's natural and uninhibited gait, ensuring that the resulting data is a true reflection of real-world biomechanics. The rotating gantry provides a unique technological whitespace by maintaining a continuous line of sight, solving the critical issue of swing-foot occlusion where one limb obscures the other during movement. Applications include dynamic measurement of pelvic tilt and knee flexion to predict spinal disorders and osteoarthritis, fall prevention in geriatrics by quantifying foot clearance, elite sports science for optimizing stride patterns, ergonomic workstation design, and identification of biomechanical stressors. Results are presented through an intuitive Tri-stage Color-Coded Interface—Green, Yellow, and Red—providing clinicians with an instantaneous visual triage of pathological deviations.

ELECTROMAGNETIC SENSOR FOR DETECTING RIM OVALIZATION

Tudor Andrei SUMULENCIU, Andrada Maria IANC, Marius Ioan MURESAN,
Robert Adrian CIUCIU, Paul Gheorghe ISTRATE

"Lucian Blaga" University of Sibiu

The invention relates to the field of vehicle running system diagnostics and proposes a device capable of detecting rim ovalization or deformation by analyzing variations in an electromagnetic field. The system uses an electromagnetic sensor mounted near the rim, which generates a stable electromagnetic field. During wheel rotation, the metal rim interacts with this field. If the rim has a correct circular shape, the distance between the sensor and the rim surface remains constant, and the electromagnetic signal shows minimal variations. If the rim is deformed, the distance from the sensor varies periodically, producing detectable changes in the electromagnetic signal. These variations are analyzed by an electronic processing unit that identifies deviations from reference values. To avoid false alarms caused by potholes or road irregularities, the algorithm analyzes the periodicity of the deviations. Real rim deformations generate repetitive signals with each wheel rotation, while vibrations caused by road surfaces occur randomly and are filtered out. The system also includes a customizable calibration function that allows new reference values to be recorded when different rims are installed. Calibration can be performed automatically during driving or through the vehicle's electronic system or a mobile application. By using electromagnetic detection, filtering external vibrations, and adaptive calibration, the invention enables real-time identification of

rim deformations, contributing to improved vehicle safety. The system provides multiple advantages, including improved vehicle safety through early detection of rim deformation, preventing stability issues and loss of control. It ensures real-time fault detection by continuously monitoring rim condition and alerting the driver when irregularities occur. Early identification of defects reduces tire wear and stress on suspension components, leading to lower maintenance costs. The sensor operates automatically during driving, offering continuous supervision without driver intervention. Its adaptive calibration enables compatibility with various rim types, while easy integration with vehicle electronics allows data transmission to onboard systems or mobile applications. Additionally, the system detects early wheel imbalance, improving driving comfort by reducing vibrations and noise, and supports predictive maintenance by enabling timely interventions. The system can be applied in automotive safety and diagnostic systems, vehicle service centers, and fleet management to prevent operational failures. It is also suitable for electric and autonomous vehicles and smart monitoring applications. Beyond the automotive field, it can be used in the railway industry, industrial machinery, and robotics to monitor rotating components and detect wear, deformation, or imbalance.

ADVANCED MECHANICAL DEPLOYABLE LADDER STRUCTURE

Sebastian Mihai GIUGIU, Bianca Cassiana GRADINARU

"Lucian Blaga" University of Sibiu

The Automatic Extendable Ladder System is an innovative mechanical structure designed to provide a compact, portable, and efficient solution for reaching elevated areas. The system is based on a scissor-like (pantograph) mechanism that allows the ladder to expand and retract smoothly while maintaining stability and strength.

When in its compact form, the ladder occupies minimal space, making it easy to transport and store. Upon activation, a mechanical actuation system such as a manual crank, spring-assisted mechanism, or motor enables the structure to extend vertically or at an inclined angle. The design ensures synchronized movement of all segments, resulting in a uniform and controlled deployment.

The ladder is constructed from lightweight yet durable materials such as aluminum or reinforced steel, ensuring both portability and load-bearing capacity.

Safety features may include locking joints, anti-slip steps, and stabilizing supports to prevent accidental collapse during use.

Advantages : space-saving design with high portability, rapid and efficient deployment, purely mechanical operation (optional, no electronics required), adaptability for various applications, easy transportation and storage in compact spaces.

Applications: construction sites for quick access to elevated work areas, firefighting and emergency rescue operations where rapid deployment is critical, military or disaster-relief operations requiring lightweight, deployable structures, lightweight construction with strong load-bearing capacity.

DYNAMIC OMNI-TERRAIN MORPHING SYSTEM WITH PROGRAMMABLE STRUCTURAL RIGIDITY

Darius GORDITA, Catălin GRUMAZESCU

"Lucian Blaga" University of Sibiu

The Omni-Terrain Morphing Wheel represents a paradigm shift in mechanical engineering by integrating a non-pneumatic auxetic lattice with a central iris-driven actuation system, allowing the wheel to physically alter its diameter and tread geometry in response to varying topographic conditions. This mechanism replaces traditional air-filled tires with a tensegrity-based internal framework and magnetorheological damping, enabling the wheel to transition seamlessly from a rigid, low- friction circular profile for high-speed pavement travel to a compliant, high-traction lugged configuration for navigating extreme obstacles. By achieving programmable structural rigidity through real-time feedback loops, this innovation eliminates the risk of mechanical failure due to punctures while providing an unprecedented level of energy efficiency and adaptive stability for autonomous exploration and heavy-duty industrial vehicles

MILLING TOOL HOLDER WITH INTEGRATED MECHANICAL WEAR INDICATOR

Bianca Cassiana GRADINARU, Catalin GRUMAZESCU

"Lucian Blaga" University of Sibiu

The invention consists of a mechanical diagnostic system designed for industrial CNC machining, created with the purpose of reducing the negative economic effects and the technical risks associated with cutting tool wear during prolonged automated processes. Based on its facilities, the system allows the real-time monitoring of tool degradation, eliminating the uncertainty of manual inspections and preventing current damage to both the workpiece and the machine spindle due to tool failure or excessive axial stress.

The diagnostic system consists, as shown in the technical assembly, of an ergonomic housing unit integrated into the tool holder with a layout for clear observation, additionally equipped with an internal signaling sub-assembly featuring a tri-stage color-coded cylinder (Green, Yellow, Red) that serves as the visual interface; a mechanical transmission assembly with a specialized lever designed to translate the axial pressure exerted by the tool into vertical movement; a high-precision compression spring calibrated to provide resistance and ensure the automatic return of the indicator to its resting position; a protection system including an industrial-grade sealing O-ring created to shield the internal mechanism from coolants and metallic debris; a secure fixation assembly composed of a locking washer to maintain the structural integrity of the components during high-speed rotation.

The system functions by converting the physical force exerted on the cutting tool into a direct visual signal. When the tool is in an optimal state, the indicator remains in the Green zone. As wear progresses and the axial pressure increases, the transmission assembly lowers the colored cylinder against the spring, moving the indicator into the Yellow (Warning) or Red (Critical) zones.

This is the active and intended phase of action which allows the operator to perform a voluntary interruption of the machining process at the optimal time. After the worn tool is replaced, the internal spring brings the indicator back to the upper resting position, effectively resetting the system for a new working sequence. This mechanical feedback loop compensates for the lack of expensive electronic sensors, providing a highly reliable and maintenance-free solution for predictive diagnostics.

MOBILE STRETCHER WITH AUTOMATIC MECHANICAL BRAKING SYSTEM FOR INCLINED SURFACES

Catalin GRUMAZESCU, Bianca Cassiana GRADINARU

"Lucian Blaga" University of Sibiu

The invention consists of a medical stretcher equipped with an integrated mechanical system designed for automatic braking, created with the purpose of reducing the negative health effects and the stressful effects of uncontrolled acceleration during transport on ramps. Based on its facilities, the system allows at certain times the automatic interruption of gravitational movement when a critical inclination is detected, by controlled interposing of certain short time sequences in which the motion is subjected to braking effects. These sequences physically and by means of stabilization compensate the cumulative effects of gravitational acceleration that could otherwise lead to spinal damage or accidents during prolonged or steep descents. According to the invention, the stretcher consists as shown in figure 1 and figure 2 of an ergonomic assembly 1 with a layout for transporting a person seated or lying down, which is additionally equipped with a sub-assembly 3 for independent gravitational detection. The system features an assembly 4 with folding levers to engage the braking action on the wheels 5, a control panel for operating the working sequences, and an electronic module 5 created around a micro-controller to create the automatic and programmable working sequences of the braking phase. Furthermore, the assembly includes a safety sub-assembly 2 with belts to stabilize the torso of the human body 7, ensuring that the patient remains securely partially suspended or fixed during the active phase of action. This is the active and intended phase of action which uses gravitational force to ensure the safety of the human body 7 by preventing the stretcher from sliding or accelerating on the ramp 6. After the period allocated for the stabilization and safe passage of the incline, the braking assembly is brought back to the resting position by electric or mechanical command, as in figure 1, being lifted or released to allow the human body to be transported in a normal in a normal position under its lower back as in any standard movement on flat surfaces.

INTELLIGENT MODULAR PAVEMENT, USED FOR GENERATING ELECTRICAL ENERGY AND PURIFYING AIR

Darius Alexandru COSTEIU, Adrian BARSAN

"Lucian Blaga" University of Sibiu

The invention would mean a intelligent, modular pavement method that would be able to produce electrical energy from many sources from the urban area. The pavement would transform mechanical energy into electrical energy from using piezoelectric elements integrated in these pavement tiles internal structure. When a person would step on these tiles, the surface would bend for a small amplitude, resulting in a mechanical deformation. This deformation would then produce electrical energy that is then collected in the system. In the same time, the surface would get electrical energy from sun rays through the solar panel from the surface, which transforms solar radiation into electrical energy, that is also collected into the system. The invention transforms an urban infrastructure into an active sustainable and intelligent energy producing system. Each module would be 400x400mm with a height of 60mm. The modules could be easily installed on large surfaces in urban zones. The structure of the module consists of an superior layer that is both durable and anti-slip that allows the protection needed for inside components, while keeping pedestrian safety. Under the first layer, there are the solar panels that catch solar energy to transform into electrical energy. An intermediary layer is added, that includes piezoelectric elements, responsible for generating electrical energy when stepped on by pedestrians. A fourth layer includes the solar panel material that will contribute to purify the air. The last layer includes the durable structure and the way to connect the modules. The modules are connected one to another by a magnetic system. On each side of the tiles, there are protected neodymium magnets that allow for an accurate and correct alignment of the tiles. Inside of this system, there are copper electrical contacts which allow transfer of energy between tiles. The energy produced by each tile is then transmitted automatically towards an central storing unit. This system allows the installation to be quick, easy, easy to maintain and easy to replace in case of a broken module. Advantages: use of existing urban areas for energy production, energy production from two sources, mechanical energy and solar energy, easy to install modular system, simple maintenance and quick replacement of modules, contribution to reducing air pollution. Applications: urban pedestrian areas, university campuses, parks and tourist areas, public transport stations, commercial areas.

PROCEDURE FOR OBTAINING A COMPOSITE COATING WITH INCREASED DURABILITY ON A METAL SURFACE

Vili PASARE, Dan Florin NITOI, Augustin SEMENESCU, Mihnea Cosmin COSTOIU, Oana Roxana CHIVU, Dragos-Florin MARCU, Radu Claudiu FIERASCU, Irina FIERASCU, Raluca SOMOGHI

National University of Science and Technology POLITEHNICA Bucharest

The invention relates to a process for producing composite coatings with increased durability of metal surfaces and in particular of brake cylinder surfaces to be used in PTI stations. According to the invention, the process consists of the successive deposition of layers of composite material on the metal surface of a brake roller, supported and rotated by means of bearings (16) assembled in a metal housing (15) which, in its turn, is mounted on a support plate (17) and, after the deposition of one or more layers of composite material consisting of resin with hardener (7) and quartz sand with filler (8) in an epoxy resin : hardener : filler : water mixing ratio of 1.6...2,2 : 1 : 3...8 : 1...5, where the filler is made of quartz sand heated to 80°C for 2 hours, with a particle size < 0.15 mm and the anti-corrosive components zinc oxide with a particle size < 100 µm and magnetite with a particle size < 500 µm in a ratio of 2.5...6 : 1 : 1.5...3, the composite coating is subjected to an ultrasonic field with vibration frequencies within the range of 20...80 KHz and with amplitudes in the range of nanometres, which enables the intermolecular cohesion between the resin, the sand granules and the metal substrate, the ultrasonic field coming into contact with the roller (1) for a period of time determined by requirements of activation of the processes of diffusion, emulsion formation, dissolution and polymerization.

COMPOSITE COATING MATERIAL WITH ANTI-CORROSION AND ANTI-SCRATCH PROPERTIES

Radu Claudiu FIERĂSCU, Vili PASARE, Augustin SEMENESCU, Mihnea Cosmin COSTOIU, Dan Florin NITOI, Oana-Roxana CHIVU, Dragoş Florin MARCU, Irina FIERĂSCU, Raluca SOMOGHI

National University of Science and Technology POLITEHNICA Bucharest

The invention relates to a composite coating material, which simultaneously exhibits high cohesion and a high degree of resistance to scratch, dedicated to carbon steel support materials, while also providing anti-corrosion

protection. According to the invention, the composite material consists of bi-component epoxy resin based on a commercially available water and a functional filler component, the composite being made by mixing four elements epoxy resin : hardener : filler : water in the following ratios 1.6... 2.2 : 1 : 3...8 : 1...5, where the filler is made of quartz sand heated to 80°C for 2 hours, with a particle size < 0.15 mm, and the anti-corrosive components, zinc oxide with a particle size of < 100 µ m and magnetite with a particle size < 500 µ m, in a ratio of 2.5...6 : 1 : 1.5...3.

ORTHOPEDIC DEVICE FOR CORRECTING TALIPES CALCANEUS AND TALIPES CALCANEOVALGUS DEFECT

Mihnea Cosmin COSTOIU, Augustin SEMENESCU, Cristian Vasile DOICIN, Mihaela Elena ULMEANU, Florin Catalin CIRSTOIU, Ioana Cristina DOICIN, Ileana Mariana MATES

National University of Science and Technology POLITEHNICA Bucharest

The invention relates to an orthopedic device for the correction of a foot malposition expressed by the defects named talipes calcaneus and talipes calcaneovalgus, particular variants of Talus valgus, and to a process for manufacturing the same. The claimed device consists of a fixed subassembly (1), mounted on the calf of the foot, which is assembled by means of a cylindrical joint with a movable subassembly (2), mounted on the defective foot, and which allows the correction of defects of talus valgus type by actuating a rosette-like member (39) which drives a worm (3) - worm wheel (4) gear, assembled, by means of countersunk screws (6 and 7), with a graduated cap (5) provided with an angular scale (51), incrementally graded by 10° and which allows controlling the angular displacement necessary for the correction of the defect, the fixed subassembly (1), the movable subassembly (2) and the graduated cap (5) being custom-manufactured by technologies such as selective laser sintering of composite and metal powders, by using anatomical data taken from DICOM images, which are then converted into STL and GCODE files and sent to a 3D printing equipment to be manufactured.

DIGITAL TRANSFORMATION OF OCCUPATIONAL SAFETY AND HEALTH PROCESSES IN THE ROAD TRANSPORT INDUSTRY: AN INTEGRATED WORKFORCE SAFETY, TRAINING, COMPLIANCE, AND VEHICLE MONITORING DIGITAL PLATFORM

Oana Roxana CHIVU, Andrei Ștefan IACOB, Mihnea COSTOIU, Alina TRIFU, Roland MORARU, Marilena GHEORGHE, Claudia BORDA

National University of Science and Technology POLITEHNICA Bucharest

The study presents the implementations and validations of the SSM online platform in three road transport companies with different sizes and profiles (small, medium, large), using all four levels of the Kirkpatrick model and an Interrupted Time Series (ITS) design to quantify changes before and after implementation. The study also contains the application of FRAM (Functional Resonance Analysis Method), one of the most effective modern techniques for analyzing complex socio-technical systems, to demonstrate the vulnerabilities of the traditional OSH training process in road transport.

OCCUPATIONAL HEALTH AND SAFETY STUDY FOR THE WORK ENVIRONMENT OF AN EQUIPMENT DISTRIBUTION OPERATOR

Oana Roxana CHIVU, Augustin SEMENESCU, Andrei Ștefan IACOB, Claudia BORDA, Mădălina Giulia BOBOCEA, Marilena GHEORGHE, Dan Florin NIȚOI

National University of Science and Technology POLITEHNICA Bucharest

The study presents the occupational risks within SC AC BONT TOOLS SRL, a company specialized in the distribution of industrial equipment. The main hazards associated with the activity are identified, such as handling heavy equipment, ergonomic risks, exposure to chemicals and transport safety. Solutions are proposed for the findings, creating work safety, highlighting the importance of periodic training, equipment modernization and optimization.

INNOVATIVE FLOTATION INSTALLATION WITH HYBRID ECOLOGICAL NANOMATERIALS, USED IN WASTEWATER TREATMENT

Cristina Ileana COVALIU-MIERLA¹, Ioana Corina MOGA², Gigel PARASCHIV¹, Sorin Ștefan BIRIȘ¹

¹National University of Science and Technology POLITEHNICA Bucharest, Romania

²DFR Systems SRL Bucharest, Romania

The project focuses on developing an innovative solution for the treatment of industrial wastewater containing high levels of fats and colloidal substances. This approach is based on a flotation process enhanced by environmentally friendly magnetic nanomaterials. The technology is being advanced to a pilot scale with a treatment capacity of approximately 50 m³/day.

The process relies on dissolved air flotation combined with fine-bubble diffusion, while hybrid magnetic nanomaterials play a key role in improving wastewater treatment performance. These materials contribute to foam stabilization, enhance pollutant retaining in foam, and reduce the risk of secondary contamination. An important advantage is their ability to be magnetically recovered and reused, which increases both process efficiency and sustainability.

The proposed technology demonstrates very high treatment efficiency, achieving pollutant removal rates between 96% and 100%. At the same time, it reduces environmental impact and supports the development of patentable innovations. Compared to conventional wastewater treatment methods, this solution offers superior technical performance, improved economic viability, and enhanced environmental sustainability.

ADVANCING WASTEWATER TREATMENT SYSTEMS: HEAVY METALS REMOVAL USING BRASSICA JUNCIA SEEDLINGS

Alexandru BECHERU, Cristina Ileana COVALIU-MIERLA, Gigel PARASCHIV

¹National University of Science and Technology POLITEHNICA Bucharest, Romania

Industrial wastewaters containing heavy metals such as lead, nickel, and hexavalent chromium represent a significant threat to aquatic ecosystems and human

health. Although phytoremediation is widely regarded as an environmentally friendly alternative to conventional treatment methods, its practical application is often constrained by the long time required for plants to reach maturity. *Brassica juncea* is among the most extensively studied hyperaccumulator species for heavy metals; however, its performance at the seedling stage, particularly in high-density hydroponic systems similar to microgreens cultivation, remains insufficiently investigated.

This study addresses this gap by evaluating the blastofiltration capacity of *Brassica juncea* seedlings for the removal of Pb^{2+} , Ni^{2+} , and Cr^{6+} from synthetic wastewater. Seeds are germinated for seven days in distilled water, after which the seedlings are exposed to individual metal solutions at a concentration of 1 mg/L. Residual metal concentrations are measured using photometric methods, and removal efficiencies are subsequently determined.

The objective of this research is to assess whether the well-documented hyperaccumulating properties of *Brassica juncea* at maturity are already expressed during the early seedling stage.

HYBRID WATER DECONTAMINATION PROCESS BY ADSORPTION AND PHOTOCATALYSIS USING BIO-BASED COMPOSITE MATERIALS

Radu Claudiu FIERASCU, Irina FIERASCU, Toma FISTOS, Anda Maria BAROI,
Roxana Ioana MATEI, Irina Elena CHICAN, Valentin RADITOIU

*National Institute for Research & Development in Chemistry and Petrochemistry –
ICECHIM Bucharest*

The invention relates to a hybrid water decontamination process based on integrated adsorption and photocatalysis mechanisms, using bio-based composite materials, intended for the simultaneous removal of organic compounds and heavy metals from natural, groundwater, and industrial waters. The process is carried out by treating the contaminated water in a reactor equipped with an irradiation system, in the presence of a composite material based on hydroxyapatite, natural polysaccharides, mineral materials, and metal oxides. Through the synergistic interaction between adsorption and photocatalysis, an increase in the degradation efficiency of organic pollutants and an effective removal of heavy metals are achieved, without the use of additional chemical reagents and with the possibility of at least partial in situ regeneration of the material. The process enables operation

under conditions close to real-life environments and exhibits high long-term stability, being applicable for the treatment of waters with complex composition.

**ECO-FRIENDLY COMPOSITION BASED ON EXTRACTS OF
CALENDULA OFFICINALIS L., CONTAINING PHYTOSYNTHESIZED
SILVER OR ZINC OXIDE NANOPARTICLES, WITH ANTIMICROBIAL
PROPERTIES, BIOSTIMULANT EFFECT FOR CALENDULA
OFFICINALIS L. CROPS, AND HERBICIDAL ACTIVITY, AND METHOD
FOR OBTAINING IT**

Radu Claudiu FIERASCU, Irina FIERASCU, Toma FISTOȘ, Anda-Maria
BAROI, Roxana-Ioana MATEI, Ioana Silvia HOSU, Irina Elena CHICAN,
Cristina Emanuela ENAȘCUȚA, Daniela IONESCU, Justinian-Andrei
TOMESCU, Cristina-Mihaela LUNTRARU, Alexandra ENE-MANEA

*National Institute for Research & Development in Chemistry and Petrochemistry –
ICECHIM Bucharest*

The present invention relates to an eco-friendly composition based on plant extracts obtained from *Calendula officinalis* L. waste, containing phytosynthesized silver nanoparticles or zinc oxide nanoparticles, with antimicrobial properties, a biostimulant effect for *Calendula officinalis* L. crops, and selective herbicidal activity, as well as to the method for obtaining the same. The plant extract is obtained through hydroalcoholic extraction of the aerial parts of the plant and is used for the reduction of metal ions derived from silver or zinc salts, leading to the formation of nanoparticles stabilized by the bioactive compounds present in the extract.

The resulting composition exhibits antimicrobial activity against the strains *Bacillus subtilis* and *Bacillus cereus*, antifungal activity against the strain *Aspergillus niger*, and an inhibitory effect on bacterial biofilm formation. It also demonstrates a biostimulant effect on the germination of *Calendula officinalis* L. seeds and selective herbicidal activity against the species *Trifolium pratense* L. and *Lolium perenne* L.

The invention provides an eco-friendly, efficient, and cost-effective solution for crop protection and the development of sustainable agriculture.

CEMENT-BASED MORTAR WITH ANTIMICROBIAL PROPERTIES AND METHOD FOR OBTAINING IT

Irina FIERASCU, Radu Claudiu FIERASCU, Toma FISTOȘ, Anda-Maria BAROI, Roxana-Ioana MATEI, Ioana Silvia HOSU, Irina Elena CHICAN, Adriana MOANȚA, Ionela PETRE, Carmen MUNTEANU

*National Institute for Research & Development in Chemistry and Petrochemistry –
ICECHIM Bucharest*

The present invention relates to a cement-based mortar with antimicrobial properties and to the method for obtaining the same, having potential applications in the field of conservation and restoration of cultural heritage, among others. The cement mortar is enriched with silver nanoparticles phytosynthesized using *Salvia officinalis* extracts (the antimicrobial component), obtained through conventional hydroalcoholic extraction at temperature.

The mortar according to the invention consists of Portland cement type CEM I, river sand (fraction < 2 mm), and a liquid phase composed of water, of which 10–30% of the total volume is replaced with hydroalcoholic *Salvia officinalis* extract containing silver nanoparticles (AgNPs). The cement/sand ratio is 1:3, and the binder/liquid ratio is 0.5. The mortar has a density of at least 1.80 g/cm^3 and a compressive mechanical strength after 28 days of at least 35.50 MPa, while exhibiting antimicrobial effects against Gram-positive and Gram-negative bacteria.

The preparation method involves producing the antimicrobial component and incorporating it into the cement-based composition during the mortar preparation stage.

ACETONE GRAVIMETRIC SENSOR

Bogdan-Cătălin ȘERBAN, Octavian BUIU, Maria Roxana MARINESCU, Marius BUMBAC, Cristina NICOLESCU

*National Institute for Research and Development in Microtechnologies - IMT
Bucharest*

Acetone sensors are used in various applications, such as industrial safety and environmental monitoring, including the detection of leaks or excessive emissions and air quality monitoring, disease diagnosis, particularly in the diagnosis

and management of diabetes, since acetone is a key biomarker of this metabolic disorder, as well as in research and development activities. Acetone sensors can also be used to monitor fat burning during dieting and physical exercise. Regardless of the type of sensor used for the detection and monitoring of acetone vapor concentration, the sensitive film appears to play a crucial role in improving the performance of the proposed sensor.

The technical problem addressed by the present invention consists of obtaining new sensitive layers for monitoring acetone vapor concentration. The sensitive films described in this invention are used in the design of a surface acoustic wave (SAW) sensor.

A surface acoustic wave device is typically composed of a piezoelectric substrate, a pair of interdigital transducers, and a film sensitive to the gas being analyzed. The electrical signal applied to one of the transducers generates a surface acoustic wave that propagates toward the other transducer, where it is converted into an electrical signal.

These sensors use new nanocomposite films consisting of oxidized carbon nanohorn - oxCNH / oxidized onion-like nanocarbon materials -oxCNO / carboxymethyl cellulose.

The claimed sensor is of the dual “delay line” type, fabricated on a quartz piezoelectric substrate. The sensor features a double delay line to compensate for thermal drift. Thus, one delay line is coated with the film sensitive to variations in acetone vapor concentration, while the second delay line consists of the piezoelectric substrate without a sensitive layer.

To obtain a signal due exclusively to the chemical interaction of acetone molecules with the ternary nanocomposite matrix, the signal associated with the delay line without the sensitive film can be subtracted from the signal of the delay line coated with the sensitive layer (differential scheme). The sensitive films are deposited onto the quartz piezoelectric substrate by the drop-casting method.

OXIFLUORONANOCARBONIC SENSITIVE LAYERS FOR THE RESISTIVE DETECTION OF ACETONE

Bogdan-Cătălin ȘERBAN, Octavian BUIU, Maria Roxana MARINESCU, Marius
BUMBAC, Cristina NICOLESCU

*National Institute for Research and Development in Microtechnologies - IMT
Bucharest*

Acetone sensors are used in a wide range of applications, such as industrial safety and control (detecting leaks in pipelines, chemical plants, and other industrial environments), environmental monitoring (tracking acetone concentration as a pollutant), breath analysis as a non-invasive diagnostic tool (of major importance, since acetone can serve as a biomarker for diabetes and other metabolic disorders), and research and development. These sensors are especially useful even for monitoring acetone at very low concentrations, in parts per billion (ppb).

The main types of acetone sensors include electrochemical sensors, capacitive sensors, chemiresistive sensors, gravimetric sensors, and optical sensors.

The technical problem addressed by the present invention consists in obtaining new resistive sensors for monitoring the concentration of acetone vapors.

The sensitive layers described in this invention, which can be used to obtain resistive acetone vapor sensors, are nanocomposite matrices of the type oxyfluorinated carbon nano-onion materials (generically denoted ox-CNOs-F) / fluorinated reduced graphene oxide (generically denoted rGO-F).

The synthesis of ox-CNOs-F is carried out by treating carbon nano-onion materials in F₂-N₂ and Ar-O₂ plasma. The synthesis of rGO-F is carried out by treating reduced graphene oxide in F₂-N₂ plasma. From the standpoint of the detection principle, the resistance of the sensitive layer varies with the concentration of acetone vapors.

The functionalization of carbon nano-onion nanomaterials in F₂-N₂ and Ar-O₂ plasmas has the advantage that, by varying the plasma type, exposure time, and power, it can ensure an optimal C:F:O atomic ratio, thereby providing suitable sensitivity.

The sensor substrate is made of Si/SiO₂ and measures 5 mm, while the electrodes are made of either the same material (gold, chromium) or different materials.

The electrode width is approximately 200 microns, with a separation of 6 mm between them. Acetone vapor monitoring capability is investigated by applying

a constant current between the two electrodes and measuring the voltage at different values of the acetone concentration to which the sensitive layer, consisting of the ox-CNOs-F/rGO-F nanocomposite matrix, is exposed.

ACETONE RESISTIVE SENSOR

Bogdan-Cătălin ȘERBAN, Octavian BUIU, Maria Roxana MARINESCU, Marius BUMBAC, Cristina NICOLESCU

*National Institute for Research and Development in Microtechnologies - IMT
Bucharest*

Acetone sensors are used in industry (for detecting leaks in pipelines and chemical plants), in environmental monitoring (for determining acetone concentrations as pollutants), and in research and development. It is worth mentioning that acetone sensors are also used in breath analysis for the possible non-invasive diagnosis of diabetes, as acetone may serve as a biomarker for this metabolic disorder.

The main types of acetone sensors include capacitive, electrochemical, surface acoustic wave, chemiresistive, and optical.

The sensitive layers described in this invention, which can be used to obtain resistive acetone vapor sensors, are nanocomposite matrices of the oxidized carbon nanohorn type (generically denoted CNHox)/fluorinated graphene oxide (generically denoted FGO). The acetone vapor monitoring capability is investigated by applying a constant current between the two electrodes and measuring the voltage at different acetone concentration values to which the sensitive layer of oxidized carbon nanohorns/fluorinated graphene oxide is exposed.

CNHox is synthesized by treating pristine carbon nanohorns in an Ar–O₂ plasma. FGO is synthesized by reacting graphene oxide with HF at a temperature of 180°C. The functionalization of carbon nanohorns in Ar–O₂ plasma has the advantage that, by changing the plasma type, exposure time, and power, it can ensure an optimal atomic C:O ratio, thereby providing appropriate sensitivity. From the detection principle point of view, the resistance of the nanocarbon film increases with increasing acetone vapor concentration. The sensor substrate is made of Kapton or PET, while the electrodes are made either of the same material (gold, chromium) or of different materials. They may be linear or have an interdigitated configuration.

NUMERICAL SIMULATION AND EXPERIMENTAL VALIDATION OF CRITICAL ZONES IN SPECIMEN TESTING USING THE ARCAN DEVICE

Ionuț MITITELU, Silviu Gabriel DOBRESCU, Cătălin Andrei ȚUGUI

National Institute of R&D for Technical Physics, Iasi

Fiber reinforced composite materials have seen remarkable progress in recent decades. This is mainly due to their excellent strength-to-weight ratio and the possibility to tailor their mechanical properties according to specific application needs Figure 1. A key characteristic of composite materials is their anisotropic behavior, which is strongly influenced by fiber orientation, matrix properties, and the quality of the fiber-matrix interface. In this context, combining experimental tests with numerical simulations is essential for a better understanding of their mechanical behavior.

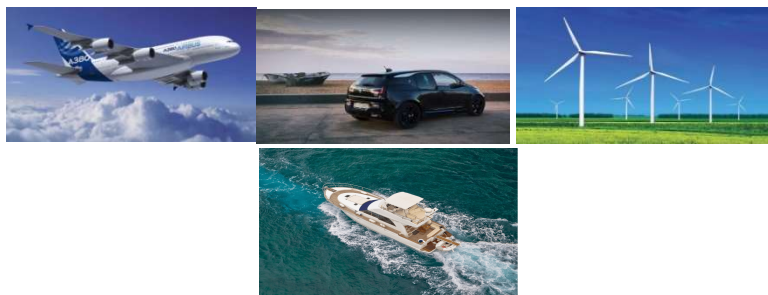


Figure 1. Application of composite materials

FEA allows the evaluation of stress distributions and the identification of critical zones, while substantially reducing the number of costly experimental tests and facilitating the optimization of design parameters. Using ANSYS simulations, the geometry of the Arcan specimen was optimized by adjusting the gripping hole configuration and introducing metallic tabs in the region located within the fixture's loading disks. This modification was implemented to reduce hole ovalization and material crushing at the hole level. For the simulations, a fixed support was applied to the left side of the specimen (Figure 2), according to the configuration used for the specimens tested in the laboratory.

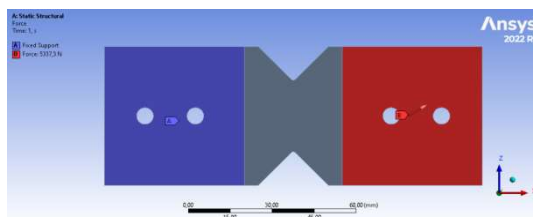


Figure 2. Location of support A, force application in region B

The maximum force applied to the specimen, 5337 N, was distributed along the X and Z directions, corresponding to the loading angle: 30°, 45° and 60°. Figure 3 illustrates the von Mises equivalent stress field obtained from the finite element analysis of a CFRP specimen subjected to static loading at a 30° angle. Maximum stresses are concentrated in the central region of the specimen, confirming the role of stress concentrators in crack initiation and propagation.

Figure 4 illustrates the specimen tested experimentally in the laboratory, highlighting the crack initiation zones at the notch tip, in agreement with the FEA results.

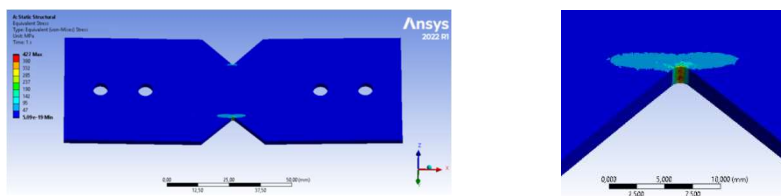


Figure 3. Von Mises stresses at 30°

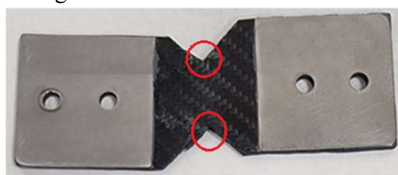


Figure 4. Experimental test at 30°

Figure 5 presents the stress distribution at a 45° orientation. The specimen subjected to static loading at this angle exhibits maximum stresses concentrated in the central region and around the stress concentrators. This indicates the primary zones of crack initiation, leading to fiber delamination and progressive fracture toward the center of the specimen, up to the intersection with the other stress concentrator. Compared to the laboratory tests in figure 6, failure occurs between the two notches with identical zones of crack initiation and propagation.

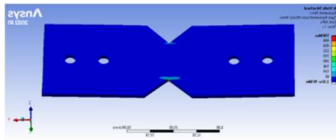


Figure 5. Von Mises stresses at 45°

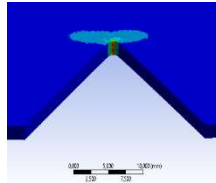


Figure 6. Experimental test at 45°

In the figure 7, the von Mises equivalent stress field obtained from the finite element analysis of the CFRP specimen subjected to static tensile loading at a 60° angle is shown, maintaining a similar pattern to the simulations at 30° and 45° . This reveals two critical stress zones that lead to crack initiation and propagation toward the center of the specimen.

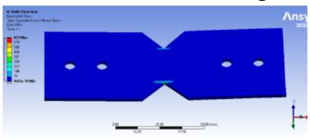


Figure 7. Von Mises stresses at 60°

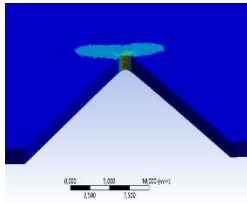


Figure 8. Experimental test at 60°

The results, accurately indicate the regions where stress accumulation becomes critical, and the experimental tests in figure 8 showed similar behavior at the same angles, confirming the consistency between the numerical and experimental results. The finite element analyses at 30° , 45° , and 60° loading angles consistently show that the maximum stresses are concentrated in the central region of the CFRP specimen. The overall stress distribution pattern remains similar across all loading angles, highlighting the primary zones of crack initiation and propagation. These results confirm the effectiveness of finite element analysis in accurately predicting stress concentrations and identifying critical regions susceptible to failure, as validated by experimental data obtained in the laboratory.

Acknowledged: This work was carried out through the Nucleus program within the PNCDI 2022-2027, carried out with the support of MCID project no. PN 23 11 01 02.

A NOVEL INTEGRATED APPROACH TO EDGE THOMSON SCATTERING DIAGNOSTICS: FEA-VALIDATED DESIGN FOR FUSION HARSH ENVIRONMENTS

Sorin SOARE (Supervisor), Alexandru OLTEANU, Laura-Maria FUMUREANU, Mihai-Victor ZERBES

National Research And Development Institute For Cryogenic And Isotopic Technologies (ICSI), Râmnicu Vâlcea

1. FIELD OF INNOVATION

Precise optical alignment in fusion diagnostics is not a static problem, but a dynamic one. In real operation, alignment is continuously affected by thermal loads, structural deviations, and restricted access conditions.

This work presents an integrated Edge Thomson Scattering diagnostic subsystem designed to improve optical alignment precision and stability in fusion-relevant environments.

Nuclear fusion is widely regarded as one of the most promising solutions for future clean energy production, with the potential to deliver high power output, low CO₂ emissions, and virtually unlimited fuel resources. Fusion systems operate under extreme conditions, including plasma temperatures of approximately 150 million °C, ultra-high vacuum levels (10^{-6} – 10^{-8} mbar), and electromagnetic fields approximately 5 Tesla. Under these conditions, even small misalignments directly impact measurement accuracy.

The plasma edge region is particularly demanding due to strong gradients and thermal effects, while most old systems remain fixed or only minimally adjustable.

2. ORIGINAL APPROACH

The proposed system introduces a configurable diagnostic architecture focused on precise and continuous control of optical alignment.

Unlike old systems, the design integrates a high-precision positioning mechanism with 15 degrees of freedom (DOF), mounted on a mobile structure. This enables continuous compensation of assembly tolerances, structural deviations, and thermally induced displacements.

A key aspect is the integration of alignment, protection, and stability into a single system. Optical components are protected through a dedicated shutter, while active cooling reduces thermally induced deformation that would otherwise affect alignment.

Material selection follows fusion-specific constraints, using vacuum-compatible solutions such as austenitic stainless steel (SS316), with appropriate magnetic behavior, and sealing elements based on materials such as Viton, ensuring reliable operation in ultra-high vacuum conditions.

3. ANALYSIS AND VALIDATION

The system was validated using Finite Element Analysis (FEA), focusing on mechanical behavior (including multi-axis accelerations) and thermal effects under representative fusion-relevant conditions.

Results indicate a safety factor of approximately 1.5, with deformation remaining within limits required for high-precision optical alignment. Structural elements were optimized within the 10–16 mm range to ensure sufficient rigidity while respecting integration constraints.

The design is developed with real manufacturing and implementation in mind, and a physical prototype of the optical support (Port Plug subsystem) has been realized, demonstrating practical feasibility and integration potential in large-scale fusion tokamak systems.

4. INNOVATION AND IMPACT

The main contribution is a 15-degree-of-freedom alignment system that transforms optical alignment from a fixed condition into an actively controllable parameter.

This approach enables stable operation in large tokamak configurations, where maintaining alignment under thermal and mechanical perturbations is essential. By integrating positioning, optical protection, and thermal stabilization into a single system, the proposed solution improves reliability in demanding environments.

The work goes beyond a purely conceptual study, being supported by physical prototyping and representing a design prepared for real implementation, contributing to the development of next-generation diagnostic systems for fusion applications such as ITER and future commercial fusion reactors.

ADAPTIVE VUV SPECTROMETER ARCHITECTURE FOR IMPROVED ALIGNMENT AND DIAGNOSTIC COVERAGE IN FUSION DEVICES: STRUCTURAL INTEGRITY UNDER FUSION-RELEVANT LOADS VALIDATED BY FEA

Sorin SOARE (Supervisor), Alexandru OLTEANU, Laura-Maria FUMUREANU, Mihai-Victor ZERBES

National Research And Development Institute For Cryogenic And Isotopic Technologies (ICSI), Râmnicu Vâlcea

1. FIELD OF INNOVATION

This work addresses the development of a Vacuum Ultraviolet (VUV) spectrometer dedicated to plasma diagnostics in tokamak fusion devices. In fusion devices, the accuracy of VUV plasma diagnostics is strongly limited by fixed optical alignment and restricted diagnostic access. Plasma spectroscopy in the VUV range (10–125 nm) enables the detection of radiation emitted by plasma impurities, where most emission lines occur at high electron temperatures. It allows the identification of intrinsic and extrinsic impurities and the estimation of their concentration and spatial distribution without perturbing the plasma.

However, existing systems typically rely on fixed line-of-sight configurations, which limit diagnostic flexibility, alignment precision, and access to critical regions such as the divertor. In fusion environments characterized by ultra-high vacuum conditions, strong electromagnetic fields, and high thermal loads, even small misalignments can significantly affect measurement accuracy.

2. ORIGINAL APPROACH

The proposed system introduces a modular optical architecture based on a tandem mirror configuration, combining primary and secondary mirrors to extend the field of view and enable indirect observation of the divertor region.

This tandem mirror arrangement enables efficient optical relay across geometrically constrained environments, significantly improving diagnostic coverage while maintaining high optical precision.

The system integrates a high-precision alignment mechanism with laser-guided positioning and up to 22 degrees of freedom (DOF), enabling fine adjustment of optical components and compensation for structural deviations and thermal effects.

Compared to existing VUV spectrometer systems, which rely on fixed lines of sight and limited adjustability, the proposed design enables controlled alignment through:

- precision mechanical positioning;
- laser-assisted alignment;
- multi-degree-of-freedom adjustment (up to 22 DOF).

Materials such as SS316 and Zerodur ensure compatibility with ultra-high vacuum conditions and high thermal stability, while an integrated shutter mechanism protects optical components and preserves long-term performance.

3. ANALYSIS AND VALIDATION

The system was evaluated using Finite Element Analysis (FEA), focusing on structural, thermal, and seismic behavior under representative operating conditions.

Thermal-structural analysis indicates a maximum stress of approximately 6 MPa and a deflection of about 1.5 mm, mainly in the lower region due to thermal contraction. Under seismic loading, the system reaches approximately 71 MPa and around 3 mm deflection under multi-axis acceleration.

These results confirm that the structure remains within acceptable limits for high-precision optical alignment.

Key components, including the port plug structure and the protective shutter mechanism, have been physically realized and are currently under functional testing, supporting the transition from conceptual design to practical implementation.

4. INNOVATION AND IMPACT

The main contribution of this work is the transformation of optical alignment into an actively controllable parameter within a VUV spectrometer designed for harsh fusion environments.

The system enables:

- extended diagnostic coverage of the divertor region;
- high-precision alignment control (22 DOF) under thermal and mechanical perturbations;
- improved durability through integrated optical protection;

By combining advanced optical design, precise alignment control, numerical validation, and experimental validation, the system represents a robust and practical solution for next-generation fusion diagnostics.

The proposed solution supports advanced plasma diagnostics, including applications relevant to ITER and future next-generation fusion reactors.

PROCESS FOR OBTAINING COMPACTION MASSES WITH REINFORCEMENT BASED ON HYDRAULIC BINDER

Georgeta Luminița POPESCU, Mădălina Mirabela MARICA, Traian Alexandru ABAGIU, Georgeta PREDEANU, Cristinel RACOCEANU, Mihai CRUCERU, Cristinel POPESCU, Bogdan Marian DIACONU, Florin Cristian CIOFU, Ramona CAZALBAȘU, Lucica ANGHELESCU

University „Constantin Brâncusi„ of Târgu Jiu

The invention refers to a process for obtaining quick-hardening masses, based on hydraulic binder, used in the execution of reinforced form, leveling or filling layers, in construction works. The process according to the invention capitalizes on the specificity of the oxidic and mineralogical chemical composition of the secondary steel treatment slag, in that, after grinding to an appropriate fineness for a rest of a maximum of 10% on the sieve with the meshes of 0.09mm, is used as a hydraulic binder in the composition of the compacting masses. The process according to the invention uses industrial waste with a relatively low degree of recovery as granular aggregates, to obtain the compaction masses with rapid hydraulic hardening: steel making slag in an electric furnace and ash of power plant.



NOVELTY / BENEFITS

- Reducing the amount of waste material that requires storage.
- Reducing the impact of the energy and metallurgical industries on the environment.
- Recovery and recycling of industrial waste from: the energy industry (ash collected at the base of the hearth) and from the metallurgical industry (electric furnaces, secondary treatment of slag); these are unique applications in Europe and even worldwide.

- Capitalizing on the hydraulic binder potential of slag resulting from secondary treatment, potential given by the presence of free calcium oxide and calcium silicates.
- Economy and long-term protection of natural resources: (1) 60-80% natural aggregates – sand, crushed stone, resulting from replacement with ash and slag and (2) lime and cement, resulting from replacement with metallurgical slag (secondary treatment).
- Energy saving compared to the conventional process.
- Obtaining a product with low cost but with high added value.
- Reduction of the carbon footprint associated with the production flow of rapid setting compaction compounds and reduction of energy consumption due to the economy of natural resources.

AREAS OF APPLICATION

- Leveling layers, filling, construction preparation works (roads, pedestrian walkways, ground preparation for foundations, etc.).
- The process can be applied in construction without changing the current technology.
- The interest for economic agents of the invention lies in the favorable economic effects resulting from its application.

PROCESS FOR OBTAINING HEAT-INSULATING CONCRETE BASED ON HEAVY ASH OF POWER PLANT

Georgeta Luminița POPESCU, Mădălina Mirabela MARICA, Traian Alexandru ABAGIU, Georgeta PREDEANU, Cristinel RACOCEANU, Mihai CRUCERU, Cristinel POPESCU, Bogdan Marian DIACONU, Florin Cristian CIOFU, Ramona CAZALBAȘU, Lucica ANGHELESCU

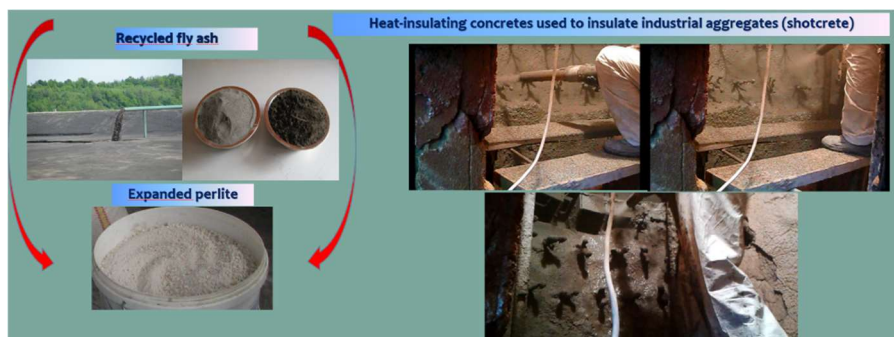
University „Constantin Brâncuși,, of Târgu Jiu

DESCRIPTION

The invention refers to a process for the manufacture of heat-insulating concrete, with the use of hearth ash resulting from the burning of coal in thermoelectric power plants as a light granular aggregate.

It is known that for the manufacture of heat-insulating concrete with maximum usage temperatures of up to (1000-1100)°C, light aggregates are currently used, such as calcined diatomite and granulated blast furnace slag, raw materials that are currently in short supply in Romania. The technical problem that the invention

solves consists in obtaining concrete with thermal power plant ash, through a cheap, economical and easy to apply process in production. The process of obtaining heat-insulating concretes, based on thermal power plant fly ash and cement, assumes that in the composition of these concretes, ash represents (25-80)%, either as a single granular aggregate or in combination with other types of heat-resistant, lightweight granular aggregates, usual, such as, for example, expanded perlite. Heat-insulating concretes based on thermal power plant ash, obtained according to the invention patent, can be put into operation by known technical processes, of casting-vibration or shotcrete.



NOVELTY / BENEFITS

- Reducing the amount of waste material for which storage is required;
- Reducing the impact of the energy industry on the environment;
- Recovery and recycling of industrial waste from the energy industry (fly ash) currently produced or stored in closed historic repositories;
- Capitalizing on the aluminosilicate potential of ash from the hearth base
- Economy and long-term protection of natural resources: fly ash replaces between 70 and 100 % of lightweight natural aggregates (expanded perlite, calcined diatomaceous earth, expanded vermiculite) and/or synthetic aggregates (lightweight burnt bricks) depending on the type of concrete manufactured
- Energy saving compared to the conventional process
- Obtaining a product with low cost but with high added value
- Reduction of the carbon footprint associated with the production flow of heat-insulating concrete used for the thermal insulation of industrial aggregates, as well as the indirect reduction, by reducing energy consumption associated with the exploitation of natural resources

AREAS OF APPLICATION

- Thermal insulation of industrial aggregates (up to a maximum temperature of 1000 °C) in various industries (energy, metallurgy, machine building, chemical, petrochemical, etc.)
- The process can be applied in practice through conventional techniques: casting-vibration, shotcrete, without the need to modify the technological process and aggregates

The interest for economic agents of the invention lies in the favorable economic effects resulting from its application.

OPTIMIZATION OF THE CNC PLASMA CUTTING PROCESS FOR COST REDUCTION AND IMPROVEMENT OF PERFORMANCE AND QUALITY

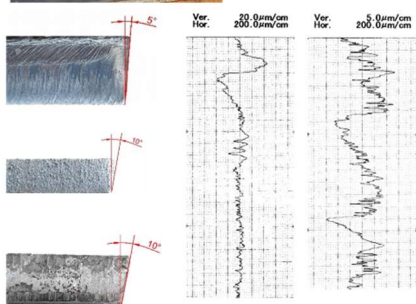
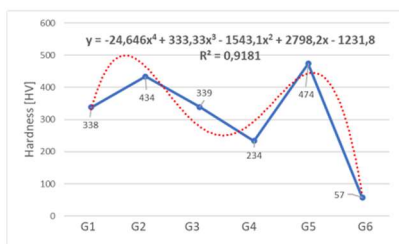
Alin STANCIOIU, Ștefan Sorinel GHIMIȘI, Constanța RADULESCU, Nicoleta-Maria MIHUȚ, Aurora Cătălina IANAȘI, Alin NIOAȚA, Elena Loredana STANCIOIU

University „Constantin Brâncusi„ of Târgu Jiu

Description

The paper analyzes the optimization of the CNC plasma cutting process to reduce costs, improve performance, and enhance the quality of machined parts. This technology enables fast and precise cuts on conductive materials such as steel and aluminum, but its efficiency depends on process parameters and proper equipment configuration. The selection and adjustment of cutting current, arc voltage, and gas type influence the thickness, speed, and quality of the cut. The distance between the nozzle and the material also plays a crucial role, determining the precision and final appearance of the piece. The plasma cutting process requires careful configuration and calibration of the CNC equipment, with each component directly impacting overall performance. Monitoring the wear of consumables such as nozzles and electrodes helps maintain cutting quality and extend the equipment's lifespan. Implementing advanced technologies for automatic parameter adjustment aids in process optimization and reduces material waste. Cost reduction is achievable by adjusting cutting speed and current, using alternative gases, and adopting more energy-efficient solutions. These measures not only lower operational expenses but

also contribute to reducing environmental impact. Continuous equipment monitoring through predictive maintenance systems allows for defect prevention and minimizes downtime. Optimizing the CNC plasma cutting process is essential for achieving high-quality products, reducing costs, and increasing sustainability. By precisely adjusting parameters and utilizing modern equipment, an efficient, cost-effective, and environmentally friendly process can be ensured, meeting the demands of the modern industry.



OPTIMIZATION OF TECHNOLOGICAL PROCESSING BY CUTTING THROUGH USING THE GPS WALTER APPLICATION: ANALYSIS AND IMPLEMENTATION IN THE CONTEXT OF MECHANICAL PROCESSING

Constanța RADULESCU, Ștefan Sorinel GHIMIȘI, Alin STANCIOIU, Nicoleta-Maria MIHUȚ, Aurora Cătălina IANAȘI, Alin NIOAȚA, Elena Loredana STANCIOIU

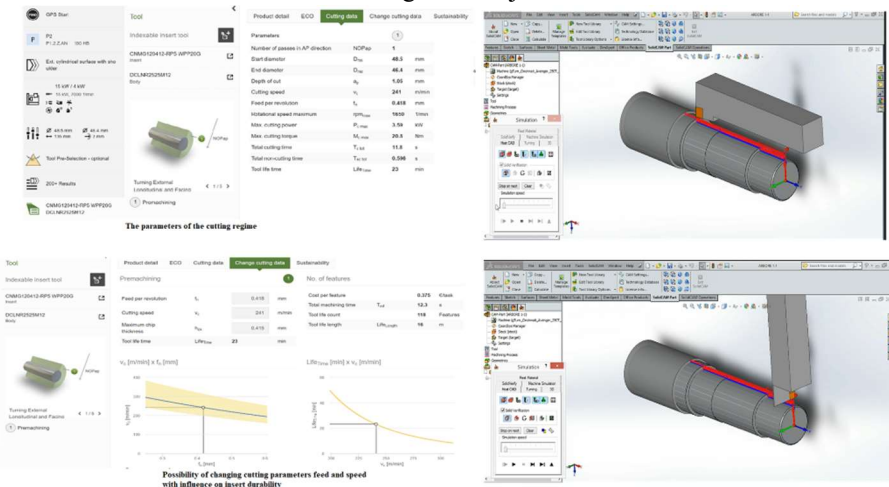
University „Constantin Brâncuși,, of Târgu Jiu

The general objective of the research project was to analyze and implement the Walter GPS application in machining processes, in order to increase their

efficiency and productivity. The project aimed to identify and apply the most efficient technological solutions for optimizing work parameters, such as: cutting speed, feed and depth of cut, reducing production time and tool wear. It also aimed to improve the quality of machined parts and reduce operating costs. As a case study of the use of the Walter GPS platform, in order to determine the cutting regimes, a "distribution shaft" type part was chosen for the mass production variant, the operations: roughing turning and finishing turning.

As a case study of the use of the Walter GPS platform, in order to determine the cutting modes, a "distribution shaft" type part was chosen for the mass production variant, the operations: roughing turning and finishing turning. The values obtained regarding the cutting modes were compared with the values obtained through the classical determination of the cutting modes (analytical method). Also, the part was drawn in SOLIDWORK, and then in SOLIDCAM the part processing simulation and the cutting tool trajectory tracking were performed, for a single variant.

In conclusion, the optimization of the machining process encompasses a wide range of aspects aimed not only at increasing productivity and reducing costs, but also at increasing the quality of the markets, safety, sustainability and durability of the machining process. The use of advanced technologies (e.g. simulation software, real-time monitoring, and applications for optimizing machining regimes) includes a crucial element in achieving these objectives.



TERRAFLYER– HYBRID VEHICLE SERVING HUMANITY

Emmyly Pavel

„Nicolae Bălcescu” Land Forces Academy Sibiu

Abstract: TerraFlyer (fig. 1) is a hybrid autonomous platform designed to operate across ground and aerial environments. It integrates terrestrial mobility and VTOL flight within a single modular architecture, enabling adaptability in complex terrains. Built using additive manufacturing and controlled by a Pixhawk 4 system, the platform combines dual propulsion for efficient multi-domain operation. With a thrust-to-weight ratio of 1.43, it achieves stable vertical lift while maintaining high ground efficiency.

The project demonstrates a low-cost, scalable solution for logistics, monitoring, and emergency applications.

1. Introduction

Conventional autonomous systems are limited to a single operational domain, creating a trade-off between endurance and accessibility.



Fig. 1

TerraFlyer introduces a hybrid mobility approach, aligned with recent developments in VTOL and multi-domain systems discussed in the literature [4], allowing efficient ground operation with the capability of vertical flight when required. This unified system extends operational flexibility in complex environments.

2. Technical Description

The platform is based on a modular multi-layer architecture integrating mechanical, electronic, and control subsystems. The structure is manufactured using 3D printing (PETG-CF, ABS), ensuring strength and rapid prototyping.

The propulsion system includes two T-Motor MN701S motors for ground traction and four T-Motor MN4014 motors for VTOL lift, based on manufacturer specifications [2], coordinated by a centralized Pixhawk 4 controller running PX4 firmware.

Real-time sensor fusion (GPS, IMU, barometer) and adaptive PID control enable stable navigation and seamless transition between modes, following approaches commonly used in hybrid VTOL systems [3].

3. Innovation

The TerraFlyer project introduces a novel hybrid autonomous system that integrates ground mobility and VTOL flight within a single unified platform.

The core innovation lies in the integration of dual propulsion systems within a centralized control architecture, enabling seamless transition between terrestrial and aerial modes without external intervention. This transition is achieved through a real-time reconfigurable control logic, managed by the Pixhawk 4 system, which dynamically adapts control parameters during operation.

A second key innovation is the multi-layer modular architecture, which structurally separates propulsion, control, and electronic subsystems. This design enhances system reliability, simplifies maintenance, and allows rapid reconfiguration depending on mission requirements.

Furthermore, the use of additive manufacturing (3D printing), widely explored in modern robotic system design [3], enables low-cost production, fast prototyping, and scalable deployment, reducing the total system cost to under €1,000.

Together, these elements define TerraFlyer as a novel engineering architecture for multi-domain autonomous mobility, extending beyond the limitations of conventional UAV and UGV systems.

4. System Architecture Overview

The TerraFlyer platform is an integrated mechatronic system combining mechanical, electronic, and control subsystems.

It uses two T-Motor MN701S motors for ground traction and four T-Motor MN4014 motors for VTOL lift, coordinated by a centralized Pixhawk 4 controller running PX4 firmware [1].

Real-time sensor fusion (GPS, IMU, barometer) ensures stability, while adaptive PID control enables automatic transition between ground and aerial modes [3].

The modular 3D-printed structure provides efficient weight distribution, structural resilience, and easy maintenance.

5. System Architecture, Performance and Validation

TerraFlyer integrates ground mobility and VTOL flight within a unified modular architecture designed for multi-domain operation. The system uses dual propulsion, combining MN701S motors for ground traction and MN4014 motors for vertical lift, all coordinated by a Pixhawk 4 controller with real-time sensor fusion and adaptive PID control.

Performance analysis confirms system feasibility, achieving a thrust-to-weight ratio of 1.43, which ensures stable VTOL operation. The platform maintains approximately 110 minutes of ground autonomy and around 26 minutes of aerial operation, validating its efficiency and capability in complex multi-terrain environments [3].

6. Conclusions and Future Development

TerraFlyer introduces a scalable hybrid mobility concept combining ground and aerial capabilities in a single system.

Future work includes integration of LiDAR, computer vision, and AI-based control for fully autonomous operation in complex environments.

9. References

- [1] PX4 Autopilot Team (2024). PX4 Autopilot User Guide – Pixhawk 4 Documentation, In *Open Source Flight Control Project*. Disponibil online: <https://docs.px4.io>
- [2] T-Motor (2023). MN4014 & MN701-S Series Motor Specifications, In *T-Motor Technical Data Sheet*.
- [3] L. Zhang & X. Chen (2023). Design and Dynamic Modeling of a Hybrid VTOL Drone for Civil Applications, In *Journal of Intelligent & Robotic Systems*, Springer, vol. 108, no. 3, pp. 455–470.
- [4] NASA Aeronautics Research Mission Directorate (ARMD) (2022). Urban Air Mobility and eVTOL Concept Studies, In *NASA Technical Reports*.

TYRE-TO-HYDROGEN: A MODULAR HYBRID SOLUTION FOR CLEAN ENERGY FROM WASTE

Laura Maria FUMUREANU, Elena-Andreea BUCĂ, Ada-Rahela BARAC,
Alexandru OLTEANU, Claudiu ISARIE, Mihai-Victor ZERBES,
Mihaela ROTARU, Liliana Georgeta POPESCU, Marinela INȚĂ, Sorin SOARE

*The Creation and Invention Club within Student Culture Center of Sibiu/ Lucian
Blaga University of Sibiu /National Research And Development Institute For
Cryogenic And Isotopic Technologies (ICSI), Râmnicu Vâlcea*

The present solution introduces a breakthrough modular hybrid system for converting end-of-life tyres (ELTs) into high-purity green hydrogen, redefining waste as a strategic energy resource. Positioned at the intersection of circular economy and clean energy innovation, the solution directly addresses two critical global challenges: the continuous accumulation of tyre waste and the urgent need for low-carbon energy carriers. Globally, over 25 million tons of tyre waste are generated annually, with a significant portion still subjected to inefficient disposal methods such as landfilling or incineration. These conventional approaches are associated with high greenhouse gas emissions, loss of material value and limited contribution to advanced circular economy models. In contrast, the proposed solution enables the recovery of the intrinsic chemical value of ELTs, transforming them into a high-value energy vector—hydrogen. The system integrates thermochemical conversion, catalytic upgrading and advanced gas separation technologies into a single, intelligent and scalable platform. The process begins with controlled pyrolysis (400–700°C) and gasification (>800°C) in an oxygen-free environment, where complex hydrocarbon structures are decomposed into synthesis gas (syngas), consisting mainly of hydrogen, carbon monoxide, carbon dioxide and light hydrocarbons, alongside liquid fractions and solid residues. To maximize hydrogen production, the syngas is subjected to catalytic upgrading processes, including the water-gas shift reaction, which converts carbon monoxide and steam into additional hydrogen. The system employs optimized reactors and transition metal-based catalysts (e.g., Ni, Fe), ensuring high conversion efficiency, process stability and adaptability to variable feedstock composition. Hydrogen separation and purification are achieved through advanced technologies such as pressure swing adsorption (PSA), membrane separation or cryogenic processes, enabling hydrogen purities exceeding 99.9%, suitable for demanding industrial and energy applications. In parallel, secondary products are efficiently valorised: recovered carbon black (rCB) can be reintegrated into material manufacturing, while liquid fractions can be

used as fuels or chemical feedstock, contributing to overall process efficiency and economic viability. A key differentiator of the solution lies in its integrated, closed-loop architecture, designed to minimize emissions while maximizing resource utilization. Compared to conventional tyre waste management methods, the system has the potential to significantly reduce CO₂ emissions and environmental impact, while generating a valuable clean energy output. Preliminary modelling indicates strong performance potential in terms of conversion yield, energy efficiency and emission reduction, positioning the technology as a competitive alternative to both traditional waste treatment and fossil-based hydrogen production. The system is inherently modular and scalable, enabling flexible deployment from laboratory-scale demonstrators to industrial installations. It can be implemented in proximity to waste collection centers, industrial hubs or energy platforms, supporting decentralized hydrogen production. Furthermore, the integration with renewable energy sources for auxiliary processes enhances sustainability and aligns the solution with green hydrogen production standards. Digitalization plays a central role in system performance, with real-time monitoring and intelligent control of key parameters such as temperature, pressure and gas composition. This ensures process optimization, operational safety and compatibility with Industry 4.0 and smart energy systems. From a technological maturity perspective, the solution is currently positioned at an early development stage (TRL 2–3), with ongoing work focused on thermodynamic modelling, process optimization and definition of key performance indicators (KPIs), including hydrogen yield, purity, energy efficiency and emission reduction. The next development phases include prototype construction, experimental validation and techno-economic and life cycle assessment (LCA). The application potential of the solution is significant, with hydrogen being a key enabler in sectors such as industry (steel, chemicals), transport (fuel cell mobility) and energy systems (storage and grid balancing). By transforming a problematic waste stream into a high-value clean energy carrier, the solution creates both environmental and economic benefits. Aligned with the European Green Deal, hydrogen strategies and global decarbonization targets, this solution represents a scalable, sustainable and economically promising pathway towards a circular and hydrogen-based economy.

In essence, this solution goes beyond waste treatment—it establishes a new paradigm in which waste becomes a resource, emissions become opportunities for reduction, and energy is produced in a cleaner, smarter and more sustainable way.

AIRFLOW ENERGY RECOVERY SYSTEM: HELICAL TURBINE SOLUTION FOR SMART HVAC APPLICATIONS

Elena-Andreea BUCĂ, Ada-Rahela BARAC, Laura Maria FUMUREANU,
Alexandru OLTEANU, Mihai-Victor ZERBES, Liliana Georgeta POPESCU,
Marinela INȚĂ, Sorin SOARE

*Lucian Blaga University of Sibiu /National Research And Development Institute
For Cryogenic And Isotopic Technologies (ICSI), Râmnicu Vâlcea/The Creation
and Invention Club within Student Culture Center of Sibiu*

The present solution introduces an innovative system for recovering energy from exhaust airflows generated by HVAC (Heating, Ventilation and Air Conditioning) systems through the integration of advanced helical turbine technology. Unlike conventional wind energy systems that rely on natural and unpredictable wind conditions, this approach utilizes “manufactured wind” — a controlled, continuous and predictable airflow source available in modern buildings.

HVAC systems operate continuously in residential, commercial and industrial environments, generating a constant flow of exhaust air that is typically wasted. This solution transforms that overlooked energy stream into a valuable source of micro-generation, contributing to increased energy efficiency and reduced operational costs in buildings.

At the core of the system is a helical vertical-axis turbine (VAWT), specifically designed to operate efficiently at low and variable airflow velocities. Compared to traditional turbine geometries, the helical configuration provides stable torque, reduced vibration and low-noise operation, making it highly suitable for integration within HVAC ducts. The aerodynamic design enables efficient capture of both lift and drag forces, ensuring consistent rotational motion even under fluctuating airflow conditions.

The system operates through a streamlined four-stage process. First, the airflow generated by the HVAC system is captured by positioning the turbine within the exhaust duct. Second, the helical blades convert kinetic energy from the airflow into mechanical rotation, which drives a permanent magnet generator to produce electricity. Third, the generated electrical energy is conditioned using power electronics, including rectifiers and converters, enabling efficient storage in hybrid energy systems such as batteries and supercapacitors. Finally, the system is optimized using aerodynamic enhancement elements such as diffusers and guide vanes, which accelerate airflow and mitigate backpressure effects.

A critical innovation of this solution lies in its ability to minimize aerodynamic losses and prevent negative impacts on HVAC system performance. Backpressure, a common issue in duct-integrated energy recovery systems, is addressed through optimized flow management strategies validated by Computational Fluid Dynamics (CFD) simulations. These optimizations ensure that energy recovery is achieved without compromising ventilation efficiency or increasing energy consumption of the primary HVAC system.

The integration of smart management and hybrid energy storage further enhances system performance. Real-time monitoring and control allow dynamic adjustment of operational parameters, ensuring optimal energy recovery under varying conditions. The hybridization of storage systems enables efficient energy utilization, smoothing fluctuations and supporting building-level energy management strategies.

From a performance perspective, the system demonstrates strong potential for improving overall building energy efficiency. By converting waste airflow into usable electrical energy, it contributes to achieving a positive energy balance at the building level. Preliminary analyses and simulations indicate that optimized configurations can significantly enhance energy recovery while maintaining system stability and reliability.

The modular and adaptable design of the solution allows for easy integration into existing HVAC infrastructures, as well as implementation in new building designs. This flexibility makes the system applicable across a wide range of environments, including commercial buildings, industrial facilities, data centers and smart buildings.

In terms of technological maturity, the solution is currently positioned at an early development stage, with ongoing research focused on aerodynamic optimization, system integration and experimental validation. Future development directions include prototype construction, real-world testing and scaling strategies for broader deployment.

The application potential of this solution is substantial, particularly in the context of increasing global demand for energy-efficient and sustainable building technologies. By harnessing an untapped energy source, the system contributes to reducing overall energy consumption, lowering carbon footprint and supporting the transition towards smart and sustainable urban environments.

Aligned with global sustainability goals and energy efficiency strategies, this solution represents a novel and practical approach to distributed energy generation. It not only improves the performance of existing systems but also

introduces a new paradigm in which waste energy streams are transformed into valuable resources.

In essence, this solution redefines the role of HVAC systems—from passive energy consumers to active contributors in energy generation—offering a scalable, efficient and environmentally responsible pathway towards the buildings of the future.

COMPOSITE PLATES FROM TETRA PAK PACKAGING WASTES

Miron Sorin RANCEA, Ovidiu NEMEȘ, Nicoleta Alina HOLHOȘ

Technical University of Cluj-Napoca

Obtaining advanced materials with high performance is a major challenge worldwide, in the context of increasingly stringent requirements imposed by sustainable development, resource efficiency and reduced environmental impact. Current research is focused on identifying new materials and manufacturing technologies that allow improving the functional properties of products, reducing production costs, optimizing energy consumption and limiting the risks associated with pollution.

In this context, the valorization of waste as alternative raw materials for obtaining composite materials in the research direction area of great scientific and applied interest. Multilayer packaging of the Tetra Pak® type, offers their complex structure, made up of thermoplastic polymers, paper and aluminum foil, offers favorable premises for the development of eco-materials with controllable properties, by applying appropriate technologies.

The process of obtaining composite materials included several essential stages, namely the collection and cleaning of the raw material, the initial fragmentation by manual cutting into small pieces, followed by the formation of the materials by hot pressing, under controlled conditions of temperature and pressure. Particular attention was paid to the influence of processing parameters, given their determining role on the structure, homogeneity and final properties of the obtained composite materials.

The process of hot forming of composite materials based on multilayer packaging waste was carried out using a specially designed mold, consisting of two heated mobile plates, arranged in the upper and lower parts, as illustrated in Figure

2. The thermal energy necessary for the plasticization of the thermoplastic components in the multilayer waste structure was provided by an electric heating system integrated in the mold, ensuring the achievement of the forming temperature required by the process.

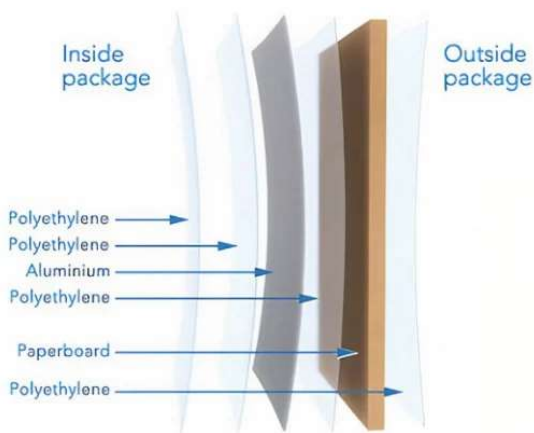


Fig. 1 Tetra-Pak construction



Fig. 2 Composite material plate thermoforming system

To achieve precise thermal control, the mold was equipped with strategically placed temperature sensors, which allowed for continuous monitoring

and maintenance of a uniform temperature distribution across the entire forming surface.

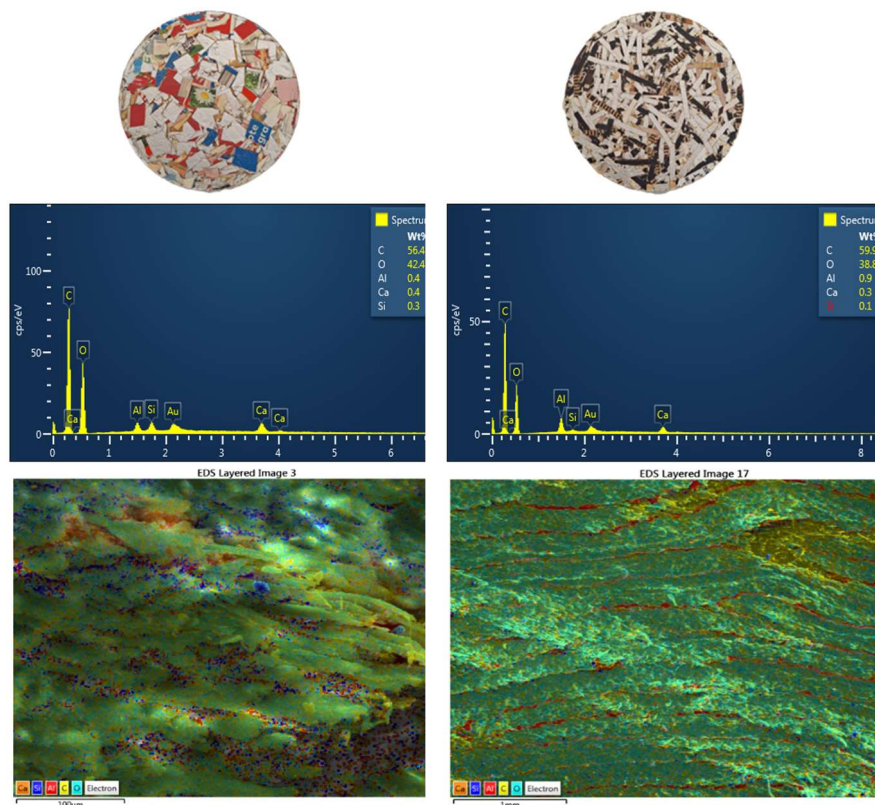


Fig. 3 The plates obtained

METHOD FOR COMPARATIVE EVALUATION OF TECHNOLOGICAL DEVELOPMENT BASED ON THE NUMBER OF REGISTERED PATENTS

Cornel CIUPAN, Mara-Alina CHIFOR, Mihai CIUPAN

Technical University Of Cluj-Napoca

The project investigates the evolution of patent activity in the field of major unconventional manufacturing technologies, such as electrical discharge machining

(EDM), plasma cutting (PC), waterjet and abrasive waterjet cutting (AWJ), laser cutting (LC), and additive manufacturing (AM). The analysis is grounded in the premise that the emergence of new technologies is typically preceded by an increase in patenting activity, followed by a more accelerated growth phase once the technology reaches industrial implementation. This dynamic reflects the intensification of research and development efforts, which is captured through the rising number of patent applications over time.

Methodologically, the study applies to a structured approach based on patent analysis. Initially, the relevant technologies are selected according to their innovation potential and industrial significance. For each technology, corresponding CPC (Cooperative Patent Classification) codes are identified to ensure a standardized and internationally comparable dataset. The analysis period is then defined, spanning from 1971 to 2020 in this case, to capture long-term technological trends and development phases.

The empirical investigation is conducted using Espacenet, a comprehensive patent database provided by the European Patent Office. Data extraction is based on three main criteria: keywords in the title or abstract, relevant international patent classifications, and the registration period. The collected data are structured into time series reflecting the number of patent applications and granted patents, and are further processed into tables, graphs, and comparative analyses.

The interpretation of results reveals distinct evolutionary patterns across the analyzed technologies. In all cases, an initial phase of low patent activity is followed by a significant increase corresponding to technological maturation and industrial adoption. This confirms that patent dynamics can serve as a reliable indicator of technological development stages.

COMPOSITE MATERIALS FROM PLANT FIBRES AND MUSHROOM FARMING WASTE

Nicoleta Alina HOLHOȘ, Ovidiu NEMEȘ

Technical University of Cluj-Napoca

Natural fiber composites (NFCs) are gaining prominence as sustainable alternatives to conventional composite materials, with reduced environmental impact.

By using renewable resources such as hemp fiber and mycelium-based matrices, these composites offer advantages including biodegradability and a low environmental footprint.

Despite their benefits, these materials face several challenges, primarily the tendency of natural fibers to absorb moisture.

To overcome these limitations, various surface treatments are being investigated, including chemical, plasma, and biological methods. These modifications aim to reduce water absorption, thereby improving mechanical properties, thermal insulation, dimensional stability, and wear resistance.

Hemp fiber offer distinct advantages, including high and competitive stiffness, as well as a favorable strength-to-weight ratio.

The specific properties inherent in plant fibers facilitate their use in a wide range of industrial applications. In the automotive industry, they function as components in dashboards and interior panels, as well as fillings.



Figure 1. Composite plate made from hemp fibers and mushroom farming waste.

NATURAL FIBER-BASED ECO-MATERIALS

Oana-Roxana LĂPUȘAN (HANDABUȚ), Ovidiu NEMEȘ, Ana Maria JEFLEA

Technical University of Cluj-Napoca

Natural fiber composites (NFCs) represent a rapidly growing class of materials, valued as environmentally friendly, sustainable, low-cost, and low-density alternatives to traditional synthetic composites. This project comprehensively examines the advancements in NFCs, focusing on crucial aspects: fiber surface treatments, resulting composite properties, and expanding applications. Key advantages of driving research include the biodegradability and renewability of

natural fibers like hemp, wool, flax, jute, and bagasse, enabling their use in automotive, construction, packaging, and insulation sectors. However, significant challenges persist, primarily the inherent hydrophilicity of natural fibers leading to moisture sensitivity, and poor interfacial adhesion with common hydrophobic polymer matrices, which can compromise performance and durability.

The project details various surface modification strategies employed to overcome these limitations, including chemical treatments (e.g., alkali, silane, acetylation), plasma treatments, biological methods, and the incorporation of coupling agents or nanofillers like nanoclays. The impact of these treatments on enhancing fiber-matrix bonding and improving mechanical properties (tensile, compressive, flexural strength, hardness), thermal insulation, and wear resistance is critically assessed. It highlights the distinct contributions of different fibers, such as the high specific stiffness and favorable strength-to-weight ratio of hemp fibers, which make them suitable for structural and semi-structural applications, and the excellent thermal and acoustic insulation, as well as inherent fire retardancy, of sheep wool. In comparison to flax, hemp fibers exhibit comparable specific stiffness, although they may present slightly lower average values and higher variability depending on cultivation conditions, fiber extraction processes, and subsequent treatments. Furthermore, the potential of hybrid systems, combining fibers like hemp and wool to leverage complementary characteristics – such as the high mechanical performance of hemp and the superior insulation and fire resistance of wool – is discussed in detail. Finally, the project outlines current applications and future perspectives, emphasizing the need for continued innovation in treatments, hybrid material design, and long-term durability assessment to facilitate wider adoption of these sustainable composites in more demanding technological fields.

MATERIAL CU PROPRIETĂȚI FONOABSORBANTE DIN LÂNĂ DE OIE CU SPUMĂ POLIURETANICĂ ȘI PROCEDEUL DE OBȚINERE AL ACESTUIA

**SIMONA IOANA BORLEA (MUREȘAN), OVIDIU NEMEȘ, ANCUȚA-ELENA
TIUC, GYORGY DEAK**

Technical University of Cluj-Napoca

Invenția se referă la obținerea unui material cu proprietăți fonoabsorbante, utilizând ca materie primă lână de oaie și spumă poliuretanică

biocomponentă rigidă, destinat utilizării în construcții civile și industriale pentru reducerea nivelului global de zgomot, a transmisiei zgomotului structural, asigurarea unei acustici adecvate spațiilor închise și la un procedeu de obținere al acestuia.

Problema pe care o rezolvă invenția și anume realizarea de materiale multistrat fonoabsorbante constă în recuperarea deșeurilor de lână și încercarea de a elimina metodele clasice de valorificare a deșeurilor și obținerea unui material stratificat cu proprietăți acustice superioare materialelor compozite fonoabsorbante deja existente. Acest fapt fiind un avantaj deoarece se reduc cantitățile de deșeuri, poluarea sonoră se diminuează, se protejează resursele naturale epuizabile și se reduce consumul de energie. Un lucru care trebuie remarcat este faptul că se utilizeze tot mai mult materialele ecologice în diferite domenii, astfel noile materiale ar ajuta la dezvoltarea industriei moderne în această direcție.

Scopul acestei invenții este de a obține un material care să fie ușor și ieftin de fabricat, acordând o atenție deosebită aspectelor ecologice. Fiind destinat utilizării în special pentru clădiri rezidențiale dar și industriale, promovând în același timp un climat interior sănătos motiv pentru care izolația trebuie să fie optimă din punct de vedere al sănătății, să fie difuzibilă și higroscopică.

Pentru a se obține materialul s-a folosit lână de oaie merinos neagră și spumă poliuretanică bicomponentă rigidă. Înainte de experimente, lână brută a fost spălată pentru a îndepărta impuritățile, nisipul și praful, s-a uscat și s-a cardat.

Spuma poliuretanică bicomponentă rigidă utilizată la realizarea materialului multistrat, componentul A care reprezintă un polioli formatat cu densitatea de $1,08 \text{ g/cm}^3$ și vâscozitate la 20°C de 470 mPa s și componentul B care este difenilmetan diizocianat polimeric, unul dintre cei mai utilizați izocianați la obținerea spumelor poliuretane, el are densitatea de $1,24 \text{ g/cm}^3$ și vâscozitate la 20°C de 300 mPa s , raportul masic între componente A:B este de 100:140.

S-au obținute materiale compuse din trei straturi, un strat de lână de oaie procesată anterior prin presare la cald la 80°C și 5 MPa , cu grosimea finală de 2, 4, 6 și 12 mm; un strat de spumă poliuretanică bicomponentă rigidă, cu grosimea de 8...37 mm și un strat de tranziție, cu grosimea de 1...20 mm, rezultat prin migrarea spumei poliuretane în timpul procesului de fabricare a panourilor multistrat în stratul de lână și/sau migrarea lânii în stratul de spumă poliuretanică.

Lână și spuma poliuretanică reprezintă combinația dintre izolarea acustică și absorbția acustică– lână absoarbe sunetul și îl reduce, iar datorită structura rigidă a spumei poliuretane (structură cu pori închiși), aceasta nu lasă sunetul să meargă mai departe determinând izolarea acustică.

Procedeu de obținere a materialului din lână de oaie cu spumă poliuretanică are următoarele etape:

- a. presarea lânii de oaie la cald în matriță închisă, la 80 °C și 5 MPa,
 - b. introducerea într-un recipient de amestecare a componentei A - polioli formatat cu densitatea de 1,08 g/cm³ și vâscozitate la 20 °C de 470 mPa s și a componentei B - difenilmetan diizocianat polimeric.
 - c. amestecarea componentelor A și B la temperatura camerei timp de 10...12 secunde,
 - d. turnarea amestecului în matriță peste stratul de lână și menținerea 24 de ore în matrița închisă pentru finalizarea reacțiilor și realizarea structurii unitare,
 - e. extragerea materialului fonoabsorbant din matrița de formare.
- Prin aplicarea invenției se obțin următoarele avantaje:
- Lărgirea gamei de produse din categoria materialelor multistrat realizate din fibre naturale.
 - Obținerea unui nou material multistrat cu proprietăți fonoabsorbante superioare.
 - Coeficientul de absorbție acustică are valori bune în gama de frecvențe 100 – 3200 Hz în comparație cu spuma poliuretanică rigidă.
 - Valorificarea superioară a deșeurilor rezultate din lână de oaie.
 - Reducerea cantității de deșeuri și în același timp reducerea poluării sonore.
 - Densitatea materialelor este relativ mică.
 - Reducerea consumului de materiale și energie.
 - Producția lor are un impact redus asupra mediului.
 - Reintroducerea în circuit a unor materiale considerate deșeuri.
 - Materialul se obține ușor într-o durată de timp relativ mică.



A



B

Fig. 1. Fazele de procesare A: Faza I – Placa de lână presată la cald; B: Faza II – Structura finală a plăcii

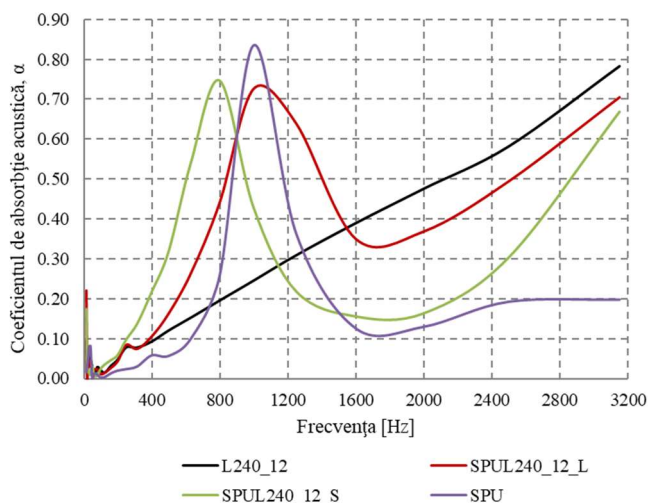


Fig. 2. Variația coeficientul de absorbție acustică în funcție de frecvență.

GEOMETRIE DE TIP FRACTAL IN PIESELE FABRICATE PRIN SLM

Anca Viorica STANCIU-BIRLESCU

Technical University of Cluj-Napoca

Fabricația aditivă a devenit din ce în ce mai utilizată în ultimii ani în domeniul industrial, medical și nu numai, avantajele sale oferind multe oportunități pentru inovații în inginerie. Aceasta tehnologie creează piese (elemente mecanice) prin depunerea de material strat cu strat, și astfel se pot crea geometrii foarte complexe, care cu alte tehnologii convenționale (așchiere, turnare) ar fi foarte greu sau chiar imposibil de realizat, cum ar fi structurile interne, geometrii neobișnuite, combinarea unui ansamblu într-o singură piesă. Structurile interne pot face piesele mai ușoare, dar și mai rezistente și aduc un plus acestei fabricații, dar timpul de fabricație ridicat poate fi un dezavantaj. Costul echipamentelor și al materialelor poate fi ridicat, însă este rentabil pentru piesele cu geometrii deosebite, materialul fiind adăugat doar unde este necesar și nu sunt necesare diferite scule așchietoare. Prin fabricația aditivă se pot crea ușor și piese cu un grad înalt de individualizare, fiind foarte util în domeniul medical. Fabricația aditivă se poate face din multiple materiale, precum plastic, rășini, metal și altele (e.g., materiale compozite). Fiecare

material necesită un procedeu, respectiv o tehnologie diferită prin care se depune material pentru crearea pieselor. Selective Laser Melting este o astfel de tehnologie care folosește pulbere de metal (titan, aluminiu, oțel, nichel, și diferite aliaje) pentru realizarea de piese cu o densitate foarte apropiată de piesele metalice clasice. Prin SLM se pot introduce ușor structuri interne de tip lattice, pentru a face piesele mai ușoare. Componentele de tip „leightweight” sunt tot mai des utilizate în domenii precum aeronautică și automotive. Pentru construirea aeronavelor, folosirea de pulbere de titan, aluminiu și structuri interne la fabricarea pieselor prin SLM a dus la scăderea greutateii și astfel și la reducerea consumului de combustibil.

Natura a oferit în trecut diferite oportunități de inovare în domeniul ingineriei. Una din cele mai întâlnite structuri lattice este cea de fagure, care a fost inspirată din natură. Conceptul de biomimicry este folosit în proiectarea pieselor, acestea preluând diferite modele din natură, pentru a rezolva eficient și a oferi soluții pentru probleme ingineresti. Din aceasta categorie fac parte și structurile de tip fractal, care sunt iterative, recursive, scalate la o scară din ce în ce mai mică și auto similare. Câteva exemple de astfel de structuri sunt fulgul de zăpadă, copacii, frunzele.

Ideea de a folosi fractali în fabricația aditivă nu este nouă. Literatura arată că diferite tipuri de fractali s-au folosit pentru a fabrica epruvete și piese (din metal, dar de multe ori și din materiale plastice, care au condus și la un consum redus de material), dar au fost folosiți și în domeniul construcțiilor pentru structuri de rezistență.

Scopul tematicii de cercetare este de a defini, genera, simula și testa (de la teorie către practică) structuri interne și de suport, care au geometrie de tip fractal. Ideea de a folosi în acest scop fractalii în fabricația prin topire selectivă cu laser este nouă. Folosirea structurilor fractal de tip copac ar putea duce la avantaje precum reducerea contracțiilor la deformările termice și eliminarea mai ușoară a suporturilor de sprijin, care deseori este dificilă și necesită mult timp. Structurile de tip fractal pot să se formeze după forma piesei astfel încât ultimul strat de ramuri să acopere cât mai multă suprafață.

Pentru a introduce structurile de tip copac în construcția pieselor, se va realiza un model matematic pentru generarea structurii de tip copac, în funcție de lungimea ramurilor și unghiul dintre acestea. Apoi, aceste structuri se vor intersecta cu diverse suprafețe ale pieselor, creând suporturi sau structuri interne după caz. Aceste structuri vor fi transferate ca fișiere .STL pentru a putea fi fabricate. Modelul matematic are ca scop generarea automată a fractalilor, ca proiectantul să nu fie nevoit să proiecteze fiecare fractal individual. După generarea structurilor de fractali, acestea se vor introduce în diferite configurații în epruvete și vor fi simulate și

optimizate, urmate apoi de fabricarea lor și determinarea proprietăților prin teste mecanice. În urma rezultatelor obținute se va face și o comparație cu structurile lattice. Diferite structuri de tip fractal vor fi introduse și în aplicații industriale (e.g. portscule). În final, în urma tuturor cercetărilor se va realiza un ghid pentru a oferi posibilitatea de a utiliza diferitele configurații de fractali, din diverse materiale metalice în multiple aplicații și industrii.

ROQA AI — A DUAL-AGENT AI PLATFORM FOR ENTERPRISE RPA QUALITY ASSURANCE AND OPERATIONS

Mihai CERBU, Sorin CHIRITA

SYNC TECHNOLOGIES SRL

The present innovative project introduces ROQA AI — a dual-agent AI platform purpose-built for UiPath Orchestrator environments, combining two complementary intelligent services: ROQA AriA, a conversational AI agent that delivers natural-language access to the entire Orchestrator via Microsoft Teams, Slack, or Web API; and ROQA MonA, an intelligent monitoring solution that establishes data-driven performance baselines, detects anomalies in real time, and takes autonomous remedial action such as restarts and targeted escalations. Both agents operate under read-only OAuth2 scopes with full credential isolation and per-answer data provenance. Together, AriA and MonA transform RPA operations from reactive firefighting into proactive, intelligence-driven management — reducing downtime, standardizing code quality, and unlocking optimization opportunities that were previously hidden across tenants. The platform is self-service: users connect an Orchestrator in minutes and begin receiving value without consulting engagements or project plans.

ELI — AN AI COWORKER FOR COLLABORATIVE INTELLIGENCE IN HEALTHCARE REVENUE CYCLE MANAGEMENT

Mihai CERBU, Peter CAMP, Joyce ZHANG, Amy WOOLDRIDGE

SYNC TECHNOLOGIES SRL

The present innovative work introduces Eli, an AI Coworker developed by CampTek.ai that combines Robotic Process Automation, Machine Learning, and

Generative AI into a single collaborative teammate for Healthcare Revenue Cycle Management (RCM). Eli addresses Prior Authorization, Claim Denials Management, Claims Status, Post-Visit Encounter Adjustments, and HOPD Coding — executing workflows while continuously learning from 835 claims data, payor plan changes, and production outcomes. Rather than a siloed automation, Eli is designed as a true coworker: it unlocks the tribal knowledge of an organization from both people and data, integrates natively with major EHR (Epic, Cerner, MEDITECH, eCW, Siemens) and payor ecosystems, and delivers its intelligence through agentic bots, dashboards, chatbots, or direct API integration. The result is measurable recovery of lost top-line revenue, reduction of clinician and staff burden, and a defensible strategy for providers in an era of increasingly AI-driven payors.

COST-EFFICIENT METHODS FOR PHYTOTOXICITY TESTING. A CASE STUDY.

Andrijana PUJICIC, Ioana-Maria TOPLICEAN*, Cosmina-Alecsia COSMA, Diana ISTRATE, Constantina-Bianca VULPE, Bianca-Vanesa AGACHI, Daniela IACHIMOV-DATCU

West University of Timisoara, Faculty of Chemistry, Biology, Geography

Phytotoxicity testing is largely applied for characterizing the various toxic effects that different chemical substances have on plant species growth, development, overall physiology and biological active compounds accumulation (Alghofaili et al. 2025; Dar et al. 2024; Klátyik et al. 2024). These effects can be seen as symptoms such as delayed germination, necrosis, chlorosis of leaves, reduced root or shoot elongation. In some cases, death of vegetal individuals can be noticed (Hasanussaman et al. 2020, Lewis 1995). Principal causes can be damages produced in meristematic cells, hormonal imbalances, or enzymes inhibitions.

The main aim of this project is to analyze, describe and present various tests that can be applied to numerous vegetal organisms to analyze the phytotoxic effects of different xenobiotic substances. These measurements are cost-efficient and do not need numerous chemical substances as reagents. Also, in terms of time, these tests can be conducted quickly for satisfying results.

The most common and widely used phytotoxicity tests include OECD 208 Seedling Emergence and Seedling Growth Test, which evaluates the effects of xenobiotics on germination process and seedlings growth, OECD 221 Lemna sp.

growth inhibition test, where duckweed species are tested with various concentrations of foreign compounds, in order to observe the effects on growth and development, OECD 227 Vegetative Vigor Test, EPA 850.4100 Seed Germination / Root Elongation Test, EPA 850.4150 Vegetative Vigor or EPA 850.4230 Seedling Emergence. Moreover, other analysis can be made to obtain more data. Regarding gravimetric indices, commonly for vegetative organs, fresh and dry weight can be determined, together with initial water quantity, humidity of the sample or mineral content.

In addition, morphometric analysis can improve this type of investigation. Some common and pretty sensitive morphometric indices include leaves thickness, lengths, widths, but also perimeters and areas, or total root length, primary root length, number of lateral roots, or root/shoot ratio.

Regarding microscopical indices which can be used for phytotoxicity assessments, some of these can offer pretty sensitive responses: cortex thickness, root cylinder diameter or root hairs diameters and lengths. Nonetheless, biochemical evaluation can be done, for example, in order to obtain responses for the effects of oxidative stress. Some enzymes can be determined spectrophotometrically, pretty quick and not with big costs. Here, we can mention catalase or superoxide dismutase.

These types of measurements: phytotoxicity tests, morphometric, gravimetric, but also biochemical approaches permit a comparison of the effects of different xenobiotics on various plant species, reflecting also a cumulative effect, depending on the exposure time; moreover, can be highly sensitive to reduced concentrations of contaminants, being also closely linked to plant health and productivity. Some biochemical markers provide early toxic and sublethal responses, being highly sensitive. Regarding novelty, this assessment can be adjusted for various types of contaminants. For example, some aquatic xenobiotic can be assessed through Lemna growth inhibition test, completed by morphometric and biochemical analysis, in order to obtain a more accurate response.

To sum up, phytotoxicity testing is a necessity nowadays, due to the growing number of chemicals that are developed, utilized and can be found in various environments.

COMPARATIVE TESTING METHODS FOR SOME FRUIT TEA ASSORTMENTS. A CASE STUDY ON FIVE FRUIT TEAS.

Ioana-Maria TOPLICEAN, Dariana-Alexia CRAȘOVAN, Daniela Iachimov-DATCU

West University of Timisoara, Faculty of Chemistry, Biology, Geography

One of the most popular drinks in the world, tea, is valued for its many bioactive ingredients, which have antioxidant and health-promoting properties, in addition to its pleasant aroma (Sharangi, 2009). The antioxidant, immunostimulatory, anti-inflammatory, and metabolic benefits of fruit teas are attributed to their abundance of biologically active substances, including anthocyanins, polyphenols, organic acids, flavonoids, vitamins, minerals, and other components (Tariq et al. 2010; Varga & Pintér, 2012; Šavikin et al. 2014).

The main goal of this project is to develop and optimize a fruit tea evaluation system based on various testing methods. These methods are diverse and provide information on antioxidant capacity, chemical composition, and various gravimetric properties that indicate the quality of the tea. The proposed methods are low-cost and easy to implement. They allow the assessment of various tea characteristics as well as quality, preservation method and efficacy.

First, one of the methods is gravimetric analysis for diverse types of fruit teas. This method allows the determination of the level of humidity, initial water content in the product and the percentage of dry matter. The results of these statistically analyzed indicators provide information related to the degree of drying, microbiological stability, and the quality of the preservation of the teas. An elevated level of dry matter is generally associated with a high density of phytochemicals and bioactive compounds. On the other hand, a too high level of humidity is directly related to an increased risk of alteration and deterioration of quality. In addition to chemical and gravimetric analyses, additional information related to the chemical profile of fruit teas can be provided by instrumental analytical techniques.

Another method is related to the antioxidant properties of these fruit teas, which can be measured using a spectrophotometric method such as the Folin-Ciocalteu test for estimating total polyphenols in tea extracts. This method requires minimal laboratory equipment or reagents and can be performed quickly.

In addition, another method involves the analysis of volatile compounds that provide differences in aroma intensity among tea types. These compounds are evaluated using gas chromatography with mass spectrometry (GC-MS). These

analyses are well-established and widely applied. On the other hand, non-volatile metabolites can be identified and quantified using UPLC-MS/MS.

From an industrial perspective, the proposed approach allows the classification of tea varieties according to stability, technological value and functional properties, which makes it a valuable tool for quality control in the tea and dried vegetable products industry. In addition, the analysis of tea residues or used tea bags offers new perspectives, and this integrated methodology helps to create new approaches for the valorization of plant biomass within the circular bioeconomy. Overall, the proposed method represents a technical and scientific contribution with high potential for industrial transfer, due to its simplicity, relevance, applicability and cost-effectiveness.

COST-EFFICIENT TECHNIQUES FOR VEGETAL (PSYLLIUM, CHIA AND FLAXSEED) HYDROGELS ASSESSMENTS. A CASE STUDY.

Rebeca-Didina IANUȘ, Andra LIONTE, Patricia SIRBU, Bianca-Vanesa AGACHI, Daniela IACHIMOV-DATCU

West University of Timisoara, Faculty of Chemistry, Biology, Geography

Due to the fact that they are biodegradable, biocompatible, and have a low environmental impact, plant hydrogels have become increasingly popular, especially when obtained from renewable plant materials or agro-industrial by-products (Oyen, 2014; Sayed, 2023; Ali et al., 2024). These materials are widely investigated for applications in agriculture, biotechnology, and environmental protection due to their ability to retain large amounts of water and improve soil moisture conditions (Alonso-Cuevas et al., 2025; Sarmah and Karak, 2020; Azahari et al., 2023). Cost-effective techniques that require minimal equipment, low reagent consumption, and short analysis time represent practical alternatives for preliminary investigations and comparative studies.

The main goal of this approach is to provide simple evaluation techniques that can be used for the rapid characterization of plant hydrogels. Without the need for complex equipment, these techniques, which are based on physical measurements and fundamental laboratory techniques, allow the evaluation of hydration capacity, structural composition and functional behavior.

Gravimetric analysis is one of the most important and widely used cost-effective methods. Gravimetric analysis is one of the most important and widely

used cost-effective methods. The hydrogels undergo preparation and purification processes which makes the initial gel weight (W_i) and dry weight (W_f) measurements possible. From these initial measurements, the DMC and GMC values were determined, which led to the quantifying of the efficiency of the hydrogel in water retention. An increased humidity reflects a highly hydrated matrix, characteristic of systems with an abundance of soluble polysaccharides. An increased humidity reflects a highly hydrated matrix, characteristic of systems with an abundance of soluble polysaccharides.

The evaluation of hydrogel performance can be achieved by measuring the swelling capacity, an accessible method that complements traditional gravimetric indices. The equilibrium swelling rate and sorption kinetics are determined by immersing dehydrated samples in water or buffer solutions, followed by monitoring the mass at regular intervals. These parameters are fundamental indicators of the polymer network architecture and water retention potential, vital aspects for the efficiency of hydrogels in agricultural applications.

The structural stability of hydrated systems can be elucidated by analyzing the processes of water retention and desorption during storage. In addition, the determination of the swelling capacity as a function of pH quantifies the response of polysaccharide-based networks to external stress factors, thus defining the degree of interaction and adaptability of the matrix to environmental conditions.

Optical microscopy provides additional information at low cost, allowing the study of residual plant particles, aggregation processes or structural homogeneity.

In conclusion, basic physicochemical analyses are a useful method for the initial evaluation of plant hydrogels. The development of inexpensive and environmentally friendly hydrogel systems is aided by these techniques, which help to identify and optimize plant-based materials for use in biotechnology, sustainable agriculture and environmental management.

METHOD FOR NUTRITION OF BROILER CHICKENS

Larisa CAISÎN, Adriana DABIJA, Vitalii AGAPII, Ludmila BIVOL,
Dumitru MALENCHI, Ionuț AVRĂMIA

Technical University of Moldova, Ștefan cel Mare University of Suceava

Description: The invention relates to the field of poultry farming, in particular to the composition of compound feeds intended for broiler chickens, with the inclusion of brewer's yeast.

A method of feeding broiler chickens, characterized in that brewer's yeast is introduced as a biologically active feed additive into compound feed formulations differentiated according to the growth phases of the birds, namely the starter phase, grower phase, and finisher phase. The brewer's yeast is included at a proportion of 2.0% with the aim of improving nutrient utilization, optimizing growth performance indicators, reducing specific feed consumption, and increasing carcass yield.

The inclusion of brewer's yeast in broiler diets contributes to improved feed conversion efficiency and enhanced productive performance. Hematological parameters showed moderate variations between groups, with all values remaining within physiological limits.

FEEDING METHOD FOR BROILER CHICKEN

Larisa CAISÎN, Dumitru MALENCHI, Ludmila BIVOL, Ana RAILEANU, abd
Aljabar Hassan AL KHATIB JEHAD

Technical University of Moldova, Ștefan cel Mare University of Suceava

The invention relates to poultry farming, in particular to a method of feeding broiler chickens, and can be used in the production of compound feed. A method for feeding broiler chickens, characterized by the inclusion of meal obtained from *Hermetia illucens* larvae at 3.5% in nutritionally balanced compound feed formulated according to the growth phases, as follows:

– Starter phase: corn 36.49%; wheat 20.0%; soybean meal 34.41%; soybean oil 1.40%; limestone 1.70%; vitamin–mineral premix 2.5%; *Hermetia illucens* larval meal 3.5%;

– Grower phase: corn 40.08%; wheat 20.0%; soybean meal 30.66%; soybean oil 2.16%; limestone 1.10%; vitamin–mineral premix 2.5%; *Hermetia illucens* larval meal 3.5%;

– Finisher (Phase I): corn 36.44%; wheat 25.0%; soybean meal 25.0%; sunflower meal 3.68%; soybean oil 3.08%; limestone 0.80%; vitamin–mineral premix 2.5%; *Hermetia illucens* larval meal 3.5%.

FEEDING PROCESS FOR BROILER CHICKEN

Larisa CAISÎN, Adriana DABIJA, Vitalii AGAPII,
Ludmila BIVOL, Dumitru MALENCHI, Ancuța CHETRARIU

Technical University of Moldova, Ștefan cel Mare University of Suceava

The invention relates to poultry farming, in particular to methods of feeding broiler chickens, and can be used in poultry farms to optimize nutrition and valorize alternative feed resources.

The essence of the method consists in using an optimized level of 4.0% dried wine yeast as a feed additive in compound feeds intended for broiler chickens during growth phases (Starter phase: corn – 34.84%; wheat – 20.0%; soybean meal – 34.05%; soybean oil – 2.64%; limestone – 1.97%; vitamin-mineral premix – 2.5%; wine yeast – 4.0%; Grower phase: corn – 38.37%; wheat – 20.0%; soybean meal – 30.31%; soybean oil – 3.42%; limestone – 1.40%; vitamin-mineral premix – 2.5%; wine yeast – 4.0%; Finisher phase (Period I): corn – 34.99%; wheat – 25.0%; soybean meal – 24.74%; sunflower meal – 3.50%; soybean oil – 4.26%; limestone – 1.00%; vitamin-mineral premix – 2.5%; wine yeast – 4.0%), aimed at improving productive performance and economic efficiency, reflected in increased body weight, reduced feed consumption, and improved carcass yield.

The additive contributes to more efficient feed utilization, increased body weight and carcass yield, while maintaining the normal physiological state of the birds and stable hematological and biochemical parameters.

LOW-CALORIE AND HYPOGLYCEMIC YOGURT AND PROCESS FOR OBTAINING IT

Adriana DABIJA, Mihai COVAȘA, Andrei LOBIUC, Camelia Oana IAȚCU,
Sebastian Andrei AVATAMANIȚEI

Ștefan cel Mare University of Suceava

This invention related to a low-calorie and low-glycemic yogurt, designed as a functional food, made exclusively from natural ingredients without food additives. The product contains milk with 1% fat, oat flakes, pea protein isolate, and milk thistle extract. The invention addresses the limitations of some existing fermented dairy products (low nutritional value and low dry matter content) by enriching them with proteins, fibers, and bioactive compounds. The production process involves milk standardization, addition of functional ingredients, pasteurization, inoculation with lactic cultures, and controlled fermentation until the optimal pH is reached, followed by cooling and maturation.

The main advantages of the product are: low fat content and increased protein and dry matter content;

- low glycemic index, useful in the prevention and management of diabetes; high dietary fiber content (β -glucans) with beneficial digestive and metabolic effects; functional properties due to milk thistle extract (antioxidant and hepatoprotective effects); positive effects on intestinal microbiota. In conclusion, the invention proposes a yogurt with improved nutritional value and multiple health benefits, obtained through an adapted technological process.

SYSTEM FOR SLEEP QUALITY ENHANCEMENT

Valentin POPA, Ciprian BEJENAR, Laurențiu-Dan MILICI, Mihai DIMIAN,
Constantin UNGUREANU, Mihaela PAVĂL

Ștefan cel Mare University of Suceava

System for sleep quality enhancement assumes a unitary body composed of an elastic rectangular structure of thermo-sensitive elements that react to the local temperature variation, depending on which it adapts the shape of the rest mattresses between the layers of which it is embedded, that it modifies according to the shape

of each user's body and returns to its original shape after each use, so that it represents an appropriate solution for the role it fulfills.

SYSTEM FOR AIRING AND VENTILATION

Marian BEJENAR, Ciprian BEJENAR, Oana-Vasilica GROSU, Visarion-Cătălin IFRIM, Mihaela PAVĂL, Laurențiu-Dan MILICI, Eugen IAVORSCHI, Daniel-Sebastian SOLOVĂSTRU

Ștefan cel Mare University of Suceava

System for airing and ventilation features a disc/propeller with flaps/blades made partly of an intelligent material of metallic nature, with the property of two-way shape memory, with variable geometry, automatically depending on the temperature of the blocked or circulated air flow, while the constructive shape of the disc/propeller ensures the modification of the incidence angles or the stabilization of the angular momentum.

THERMOSTATIC VALVE

Ciprian BEJENAR, Marian BEJENAR, Vasile-Eusebiu TOADER, Laurențiu-Dan MILICI, Eugen IAVORSCHI, Vlad-Mihai CREȚU

Ștefan cel Mare University of Suceava

Thermostatic valve involves a seamless construction with hydrophobic surfaces, along with a cavity of proper shape, in which there is a mechanism with a single moving part for controlling the flow of liquids or gases, driven both due to the contact with these fluids and/or through power supplying of certain electrical inductors, which ensures a bidirectional transition to one of the two memorized forms of the special actuator, used for the thermos-mechanical unlocking or locking of the flow through the circulation channel.

AUTOMATIC CONTROL SYSTEM OF FLUID FLUX

Vasile-Eusebiu TOADER, Laurențiu-Dan MILICI, Ciprian BEJENAR, Eugen IAVORSCHI, Mihaela PAVĂL

Ștefan cel Mare University of Suceava

Automatic control system of fluid flux assumes an integrated solution within the ventilation grilles frame, that enables the automatic and gradual control of the fluid flux through the shutter flaps with which it is equipped, using temperature-dependent actuation mechanisms, that determine the angular position of each flap, to assure heating or force cooling of the assemblies it can equip.

REVITAGLOVE

Călin CIOBAN, Maria TAMAZLICARI

Ștefan cel Mare University of Suceava

Sistem mecatronic de recuperare a mobilității maini ReVitaGlove este un sistem mecatronic destinat recuperării mobilității mâinii, proiectat pentru asistarea și monitorizarea exercițiilor de reabilitare în cazul pacienților care au suferit accidente, intervenții chirurgicale sau afecțiuni neurologice. Sistemul utilizează senzori flex pentru detectarea mișcărilor fiecărui deget, un modul MPU-9250/6500 pentru monitorizarea orientării mâinii și un microcontroler ESP32 pentru procesarea și transmiterea datelor în timp real. Platforma include și o aplicație 3D interactivă realizată în Unity, prin intermediul căreia pacientul poate efectua exerciții într-un mediu virtual, controlând mișcările personajului prin gesturile mâinii. ReVitaGlove oferă feedback vizual, stocarea progresului între sesiuni și posibilitatea analizării datelor de către medic, contribuind la creșterea motivației pacientului și la eficientizarea procesului de recuperare.

HEXAPOD

Andrei SPĂTĂRESCU, Paul OTCU

Ștefan cel Mare University of Suceava

Proiectul Hexapod prezintă dezvoltarea unei platforme robotice cu 18 grade de libertate, concepută pentru educație, cercetare și testarea algoritmilor de robotică mobilă, având la bază controlul prin cinematică inversă și algoritmi de deplasare. Sistemul utilizează un Raspberry Pi 5, două controllere PCA9685 și 18 servomotoare pentru coordonarea în timp real a mișcărilor fiecărui picior, oferind stabilitate și mobilitate omnidirecțională. Lucrarea are ca scop realizarea și validarea unei platforme modulare capabile să integreze atât componente hardware și software moderne, cât și funcții avansate de simulare și inteligență artificială, prin compatibilitatea cu ROS 2, Gazebo și extensia AI bazată pe modele LLM locale. Prin această abordare, proiectul urmărește crearea unui sistem accesibil pentru studiul roboticii complexe, dezvoltarea algoritmilor de control și experimentarea soluțiilor de navigație, percepție și interacțiune inteligentă în medii reale și simulate.

BIO SPARK

Călin HONCERIU, Mădălin ULIAN, Rareș ONCILEANU, Alexandru STANICA

Ștefan cel Mare University of Suceava

BIO SPARK este un proiect realizat de 4 studenți ai Facultății de Inginerie Mecanică, Autovehicule și Robotică, care urmărește îmbunătățirea modului în care motoarele utilizează combustibilul.

Soluția propusă se bazează pe utilizarea celulelor piezoelectrice pentru a transforma bioetanolul într-o formă mai fină înainte de ardere, cu scopul de a obține o combustie mai eficientă și mai curată.

În cadrul standului, este prezentată funcționarea sistemului, iar echipa a reușit deja să pornească un motor folosind această abordare, validând astfel conceptul la un nivel de bază.

Proiectul reflectă interesul studenților pentru inovație și dezvoltarea unor soluții tehnice cu impact asupra eficienței și mediului.

MINI SUMO

Robert VASILIU, Petru-Arcadie POPOVICI, Alesandro BĂLAN

Ștefan cel Mare University of Suceava

În inima competiției de mini-sumo, un robot compact dar redutabil se pregătește de luptă, guvernat de un microcontroller Arduino Uno care rulează la 16MHz și procesează în timp real fiecare decizie tactică, coordonând simultan toți senzorii și actuatorii într-un ciclu de control care se repetă de sute de ori pe secundă. Creierul său primește informații de la trei senzori de proximitate JS40F montați strategic pe caroserie — unul frontal și doi laterali — care detectează prezența adversarului în raza de acțiune și transmit semnale digitale filtrate printr-un algoritm de histerezis ce elimină falsele detecții cauzate de reflexii parazite sau zgomot electronic. Marginea albă a ringului este supravegheată permanent de o bară de senzori de linie HW-871 montată sub șasiu în partea frontală, care declanșează instantaneu o secvență de evitare ori de câte ori roboțelul se apropie periculos de limita arenei. Forța de propulsie este asigurată de două motoare JSumo de 750 RPM cu reductor, fiecare controlat independent printr-un driver cu punte H L298N, care primește semnale PWM de la Arduino pentru a regla precis turația și direcția — permițând atacuri frontale la putere maximă, viraje în arc pentru urmărirea adversarilor detectați lateral sau rotații pe loc pentru reorientare rapidă în timpul căutării. Roțile sunt echipate cu jante dedicate și cauciucuri cu aderență ridicată, esențiale pentru a transmite eficient forța motoarelor pe suprafața ringului în momentele de împingere maximă. Întregul sistem este alimentat de o baterie LiPo de 3.7V și 500 mAh, aleasă pentru densitatea sa energetică ridicată și capacitatea de a furniza curenți mari în momentele de atac, iar nivelul de încărcare este gestionat de un circuit dedicat HW-107. Tensiunea bateriei este adaptată la nivelurile necesare diferitelor componente prin intermediul a două convertoare de tensiune step-up, care asigură o alimentare stabilă și continuă indiferent de nivelul de descărcare al acumulatorului. Pornirea și oprirea robotului se realizează de la distanță printr-o telecomandă cu infraroșu și un receptor IR dedicat, respectând regulamentul competiției care impune un start întârziat de cinci secunde după primirea comenzii. Când senzorii JS40F frontali confirmă contactul cu inamicul, robotul împinge fără ezitare la putere maximă, iar dacă adversarul rezistă mai mult de două secunde, un algoritm de antiblocare îl face să se desprindă scurt și să reia atacul dintr-un unghi diferit, alternând sistematic sensul de rotație la fiecare manevră. Fără pilot, fără comenzi în timp real, condus exclusiv de logica sa internă scrisă în C++ pe platforma

Arduino IDE, acest mic gladiator de oțel și cod luptă singur, calculat și neobosit, până când adversarul este scos definitiv din ring.

DRONE INDOOR

Răzvan UDUDEC, Călin CIOBAN

Ștefan cel Mare University of Suceava

Sistemul mecatronic de zbor fără pilot reprezintă o dronă quadcopter proiectată și realizată pentru participarea la competiția ZEM 2026, în cadrul probei „Sisteme Mecatronice de Zbor fără Pilot – Indoor”. Drona este destinată utilizării în mediu interior, fiind optimizată pentru manevrabilitate, stabilitate și viteză într-un spațiu restrâns. Sistemul utilizează un controler de zbor SpeedyBee F405 Mini Stack, motoare brushless T-Motor Velox V2207.5 2550KV V2, ESC SpeedyBee 55A BLHeli_32 și elice DAL T5146, alimentate de un acumulator LiPo Gens Ace 4S 5000mAh. Cadrul dronei a fost proiectat și realizat prin imprimare 3D din material PETG, având o diagonală între motoare de 225 mm și o greutate totală de aproximativ 1 kg. Controlul sistemului se realizează prin telecomandă RadioMaster Pocket ELRS, iar configurația software este realizată în Betaflight, utilizând modurile de zbor Angle și Acro. Datorită performanțelor demonstrate în cadrul competiției, proiectul a obținut Locul I la proba „Drone Indoor”, echipa fiind formată din Cioban Călin și Ududec Răzvan.

LINE FOLLOWER

Adrian LUPĂȘTEAN, Adrian MUNTEANU

Ștefan cel Mare University of Suceava

Proiectul reprezintă un robot autonom de tip „line follower”, proiectat și realizat pentru participarea la competiția națională “Zilele Educației Mecatronice” (ZEM) 2026 din Timișoara.

Sistemul este optimizat pentru viteză, accelerație rapidă și precizie pe trasee complexe, având la bază controlul mișcării prin algoritmi de reglare PID.

Arhitectura hardware este coordonată de un microcontroler ESP32-U și integrează micromotoare de curent continuu Pololu N20 cu reductor, o matrice de senzori IR Pololu QTR pentru urmărirea liniei și senzori infraroșu pentru detecția obstacolelor.

Pentru a susține un regim dinamic ridicat, alimentarea este asigurată de două acumulate LiHV BetaFPV (480 mAh, 95C), toată electronica fiind consolidată pe un circuit imprimat (PCB) personalizat, fabricat in-house prin metoda transferului termic și a corodării cuprului cu clorura ferică.

Din punct de vedere mecanic, șasiul a fost proiectat cu o arhitectură modulară și realizat prin imprimare 3D. Acesta integrează o zonă frontală de impact, interschimbabilă, menită să protejeze senzorii IR la viteze mari, în timp ce sprijinul platformei folosește o bilă de transfer liberă ce minimizează frecarea. Datorită eficienței designului integrat și a algoritmilor de control, proiectul a obținut un onorabil loc 4 în cadrul competiției.

BRACHIOARTIST - BRANCHIOGRAF INTELIGENT CU INTERACȚIUNE ȘI CONTROL MULTIMODAL

Konstantinos BARBĂ, Bogdan OSTAFI

Ștefan cel Mare University of Suceava

Descriere : BrachioArtist este un robot desenator- un plotter cu braț articulată- conceput și construit integral de la zero, cu structura mecanică fabricată prin imprimare 3D din material PETG. Proiectul a participat la ZEM 2026, obținând locul 4 din 20 de echipe în cadrul probei “Realizări în Domeniul Mecatronicii”.

Obiectivele sale vizează cercetarea interacțiunii naturale Om-Robot, integrarea inteligenței artificiale generative într-un sistem fizic și crearea unui asistent capabil să comunice atât vocal, cât și prin expresivitate vizuală. Robotul poate desena în trei moduri: dintr-un fișier imagine local, dintr-o imagine generată de AI pe baza unui prompt vocal și dintr-un portret capturat în timp real prin camera web. Indiferent de sursă, contururile sunt vectorizate și convertite în comenzi G-Code, transmise serial unei plăci ESP32 (programat prin Arduino IDE). Un driver PCA9685 coordonează cele 9 servomotoare — 3 pentru brațul articulată și 6 pentru mecanismul ocular animatronic — oferind mișcări naturale și umane. Ochii urmăresc pixul în timpul desenului, sistemul recunoaște zâmbetul utilizatorului și reacționează, iar un display TFT afișează sincronizat forme de undă animate când

robotul vorbește. Recunoașterea facială și detectarea zâmbetului sunt realizate cu OpenCV și MediaPipe, iar inteligența conversațională este alimentată de modelul de limbaj Llama-3 prin platforma Groq, permițând răspunsuri coerente în timp real.

AVION RC

Alexandru ANGHEL

Ștefan cel Mare University of Suceava

Proiectul reprezintă un avion RC realizat ca proiect personal hobby, dezvoltat pentru integrarea practică a noțiunilor de proiectare CAD, construcție ușoară, propulsie electrică și control electronic al zborului.

Aeronava are configurație de tip trainer, fiind proiectată pentru stabilitate, manevrabilitate predictibilă și comportament sigur în timpul testelor de zbor. Aripa utilizează profil aerodinamic Clark Y, cu anvergura de aproximativ 1,20 m și coarda de aproximativ 0,22 m. Structura este realizată modular, cu lonjeron central pentru rigidizare și elemente imprimate 3D pentru fixare, îmbinare și integrarea componentelor.

Sistemul de propulsie este alcătuit dintr-un motor brushless 2217 1100KV, elice 10x5E, ESC de 50 A și acumulator LiPo 3S 2200 mAh. Această configurație oferă suficientă tracțiune pentru decolare, urcare și zbor stabil, păstrând în același timp o masă redusă și o autonomie potrivită pentru testare experimentală.

Din punct de vedere electronic, avionul integrează un controler de zbor Matek F405 Wing V2, receptor RC cu protocol EL și modul GPS. Aceste componente permit stabilizarea automată a aeronavei, monitorizarea parametrilor de zbor și utilizarea unor moduri autonome precum Loiter, Return to Home și AutoLand. Integrarea sistemului de control de zbor transformă modelul într-o platformă experimentală pentru testarea comportamentului în zbor asistat și semi-autonom.

Proiectarea componentelor a fost realizată în mediu CAD, iar structura a fost validată prin montaj, reglaje mecanice și teste reale de zbor. Prin acest proiect au fost urmărite optimizarea masei, rigiditatea structurii, poziționarea corectă a centrului de greutate, răspunsul comenzilor și integrarea sistemelor electronice într-un fuselaj compact. Proiectul demonstrează aplicarea practică a principiilor de mecatronică într-un sistem aeromodelistic funcțional.

VOLTERA — INTELLIGENT VEHICLE TELEMETRY PLATFORM

Iustin Iulian DODIȚĂ

Ștefan cel Mare University of Suceava

The Problem

Roughly 900 million vehicles on European roads today were built before the connected-car era. They generate no data, offer no warnings, and give drivers no insight until something has already broken down. A check engine light is not intelligence — it is a post-mortem.

OEM smart systems cost thousands of euros and are locked to specific models. Aftermarket alternatives are either too basic or too expensive for the average driver or small fleet operator. Yet every vehicle manufactured after 1996 ships with an OBD-II diagnostic port that streams live engine data every second the engine runs. That data goes almost entirely unused. Voltera changes that.

What Voltera Is

Voltera is an end-to-end IoT platform consisting of a custom-engineered hardware adapter and a cross-platform mobile application. It transforms any OBD-II equipped vehicle into a fully connected, intelligent machine — no modifications, no manufacturer subscriptions, and a hardware cost of under \$25 per unit.

The hardware core is an ESP32 microcontroller running a custom firmware stack that interfaces with the vehicle's OBD-II port via the ELM327 protocol, extracting real-time sensor data and transmitting it wirelessly via Wi-Fi to the Voltera mobile app. The application decodes raw telemetry into actionable insights across multiple functional modules.

Core Features

-Real-Time Telemetry Dashboard — Live visualization of speed, RPM, engine temperature, throttle position, and engine load in an at-a-glance interface.

-Driving Score — A dynamic 0–100 score computed from acceleration events, braking patterns, RPM behavior, and speed consistency. Immediate, objective feedback with no ambiguity.

-Eco Score & Fuel Estimation — Real-time fuel consumption in L/100km, with per-trip cost calculated in local currency, giving drivers direct visibility into what their habits actually cost them.

-Smart Trip Analysis & Self-Comparison — Every session is automatically logged. Voltera detects recurring routes and compares performance across sessions: "Yesterday on this route, you used 11% less fuel."

-Speed Heatmap — Trip routes rendered on a map with color-coded overlays: green for calm driving, yellow for moderate variance, red for aggressive or high-speed segments.

-Predictive Fault Detection — Continuous monitoring against each driver's own historical baseline. Deviations trigger proactive alerts before they become actual faults.

-Automatic Crash Detection — The ESP32's onboard accelerometer monitors G-force throughout every trip. On detecting an impact above a defined threshold, Voltera automatically sends the driver's GPS coordinates, timestamp, and vehicle ID to a pre-configured emergency contact — no manual input required.

-Fleet Lite Mode — Live telemetry from multiple vehicles aggregated into a single dashboard, showing real-time status, location, driving scores, and alerts for an entire small fleet simultaneously.

AI Virtual Mechanic

A conversational AI assistant with full awareness of the vehicle's real-time and historical state. Integrated via a large language model (LLM) API, it lets drivers ask questions in plain language and receive context-specific answers:

- ✓ "Why is my engine temperature higher than usual today?"
- ✓ "What does fault code P0301 mean for my driving pattern?"
- ✓ "Is it safe to keep driving?"

Every response is grounded in live telemetry — current RPM, temperatures, active fault codes, recent trip history — making it the equivalent of an experienced automotive engineer available on demand, at zero marginal cost per query.

Driving Style Classifier

A machine learning classification model trained on labeled driving behavior data. It evaluates continuous streams of speed, RPM, acceleration, and braking to assign real-time behavioral profiles:

- ✓ Eco Driver — low RPM, smooth acceleration, early braking anticipation
- ✓ Normal Driver — balanced behavior with occasional variance
- ✓ Aggressive Driver — frequent high-RPM operation, sharp acceleration, late braking

The classifier adapts to driving context (urban vs. highway) and provides per-segment classification across the full route, making feedback specific and actionable.

Anomaly Detection Engine

An unsupervised ML model trained exclusively on each driver's own historical telemetry. Rather than firing on absolute thresholds, it detects relative deviations that are statistically unusual for that specific vehicle and driver. If an engine that consistently runs at 78°C begins trending toward 87°C over several trips — still below any generic alarm threshold — the engine flags the drift and alerts the driver before it becomes a breakdown.

Market Opportunity

The global connected-car aftermarket exceeds \$50 billion USD and grows at double digits annually — yet the vast majority of solutions target new vehicles or require professional installation. Voltera addresses the underserved segment: 900 million legacy vehicles with no access to intelligent telemetry.

Beyond individual consumers, the platform positions directly for three adjacent markets: small fleet management (SMEs, courier services, driving schools), usage-based insurance a(pay-as-you-drive data provision), and eco-driving corporate programs (fleet emissions optimization for ESG compliance). A fleet of 50 vehicles can be fully equipped with Voltera telemetry for less than the annual cost of a single OEM connected-car subscription.

Conclusion

Voltera is not a diagnostic tool, a dashcam, or a GPS tracker. It is a complete vehicular intelligence platform that makes every car smarter, every driver safer, and every fleet operator better informed — through a port that already exists in nearly every car on the road.