Technology for Humans

Kaunas University of Technology
Research overview 2022-2024

2025

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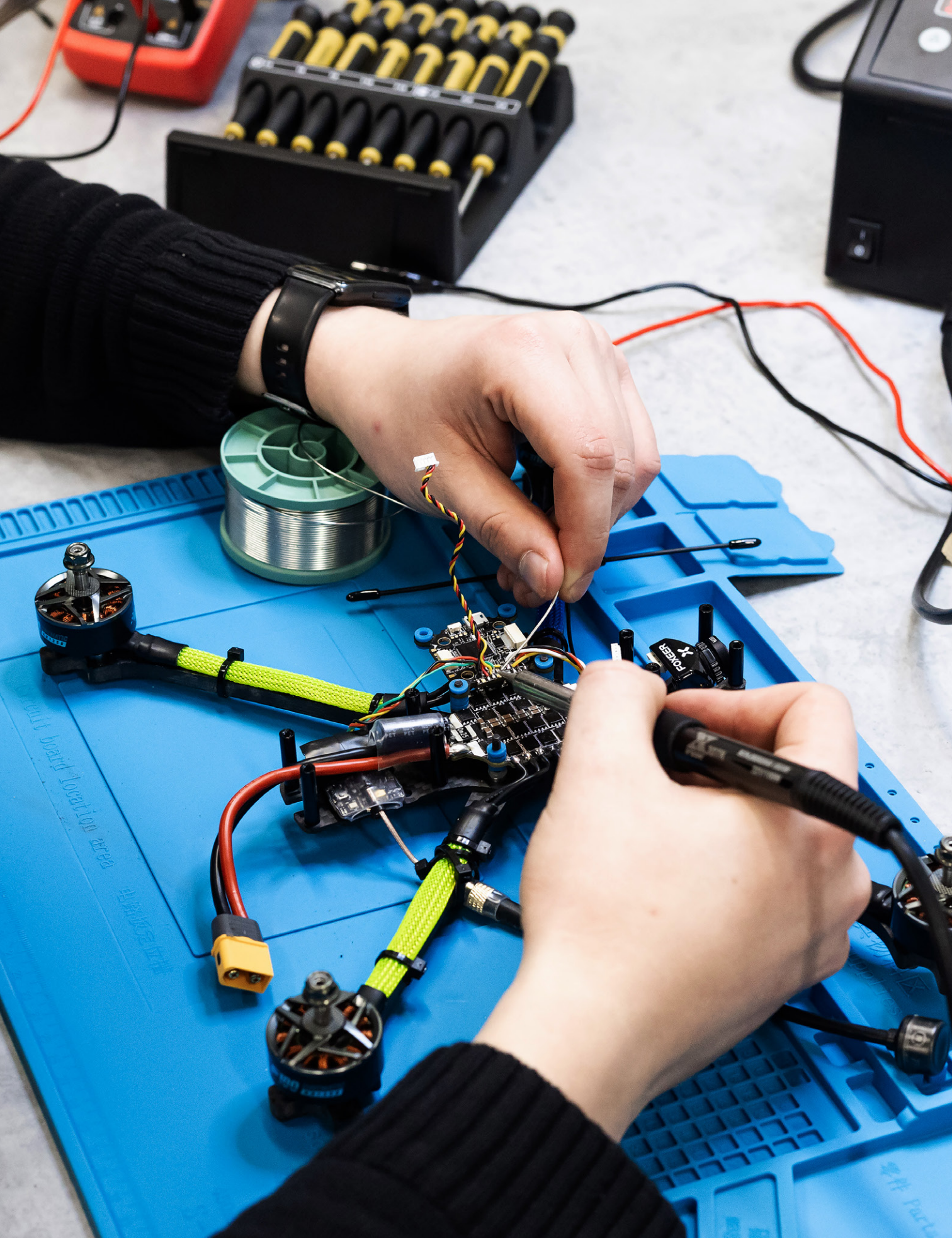

About KTU

Kaunas University of Technology is a renowned institution of higher education in Lithuania where scientific knowledge is transformed into practical solutions, and ideas evolve into technologies that make a difference. Researchers here take a forward-looking approach, creating knowledge-based changes and working closely with industry and society. Innovation at KTU is driven by curiosity, expertise, and a strong commitment to one's field. Each solution begins with a focus on people's well-being and ultimately serves their needs.

KTU research priorities

Information and communications technologies, an inclusive and creative society

Health technologies, biotechnologies and safe food

New production processes, materials and energy efficiency


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F4
F8
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Key Figures

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research institutes

9

faculties

> 7,600

students

> 330

PhD students

> 370

ongoing projects yearly

> 350

R&D contracts yearly

Key Figures

2

integrated science, study and business centres – valleys

~ 1,000

academic staff

21

doctoral (PhD) programm

> 900

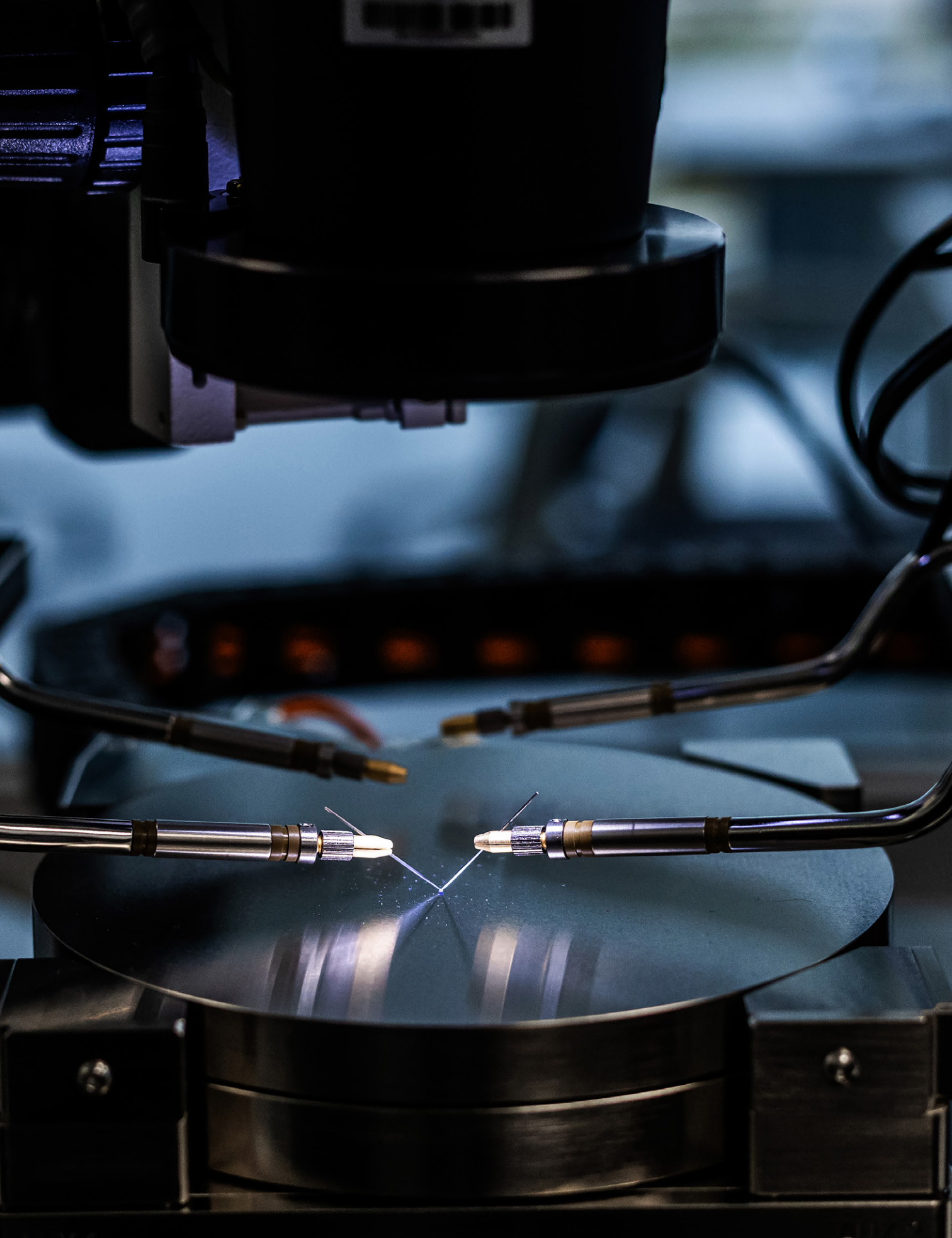
scientific articles yearly

> 8

patents (USTO, JPO, EPO) yearly

> 40

license/IP transfer agreements yearly



Information and communications technologies, an inclusive and creative society

1 chapter

AI-driven real-time digitalisation roadmaps for upgrading small and medium manufacturing enterprises

DESCRIPTION

Digitalroadmaps.eu is a digital platform that facilitates digitisation benchmarking for manufacturing companies. After completing a questionnaire, companies receive a personalised benchmarking report, which includes a digitalisation roadmap. The platform automates expert-based digitalisation audits, offering fast, free, and accessible business-to-business benchmarking. It supports companies in planning and executing digital transformation strategies, helping them stay competitive in the evolving digital landscape. This efficient and user-friendly approach empowers businesses to make informed decisions and drive their digital journey forward.

RELEVANCE

Small and medium-sized manufacturing companies often lack digitisation benchmarking information, making digital transformation planning challenging. The digitalroadmaps.eu platform addresses this issue by providing digitisation benchmarking and transformation planning tools. Using a fast, free model, the platform automates expert-based digitisation readiness assessments and planning processes. Additionally, machine learning algorithms recommend the fastest digital technology adoption sequence and the most effective use cases for digitalisation, helping businesses streamline their transformation efforts and accelerate their adoption of the right technologies.

NOVELTY

The digitalisation assessment is based on a proprietary model that evaluates digital technology-enabled capabilities and management competencies for digital transformation. The platform offers a digitalisation roadmap using a phased approach, reflecting common practices in organisations. Additionally, AI algorithms are employed to generate the roadmap and identify the most effective digitalisation use cases. This approach ensures a tailored and efficient strategy for organisations to navigate their digital transformation journey, maximising the impact of digital technologies and improving overall operational efficiency.

MORE INFORMATION

Computers & Industrial Engineering, 2024, DOI: 10.1016/j.cie.2024.110473

Technology Management, 2023, DOI: 10.1108/JMTM-01-2023-0031

Journal of Manufacturing Technology Management, 2022, DOI: 10.1108/JMTM-12-2021-0505

CONTACT PERSON

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An ultrasonic non-destructive testing system for detection and quantification of early-stage subsurface creep damage in the thermal power generation industry / CreepUT

DESCRIPTION

The objective of the CreepUT project is to develop an advanced ultrasonic measurement system designed specifically for the inspection of existing pipelines in the power generation industry. This system will be capable of detecting subsurface damage caused by creep, a critical issue affecting the structural integrity of pipelines. By implementing this technology, the project aims to enhance the ability to detect creep-related damage at its early stages, providing a valuable tool for preventative maintenance and ensuring the safety and efficiency of power generation infrastructure

RELEVANCE

Creep is defined as the time-dependent, thermally assisted deformation of a component that is operating under stress. It is frequently a pivotal element in the engineering of components utilised in the power generation sector, particularly in fossil fuel and nuclear facilities. Additionally, it plays a crucial role in the evaluation of their remaining operational lifespan. Pressurised components, including boiler tubing, headers and steam piping in fossil-fuelled power plants, operate at temperatures of 538°C up to 570°C. This causes creep damage to appear throughout the pipelines' operational lifetime.

NOVELTY

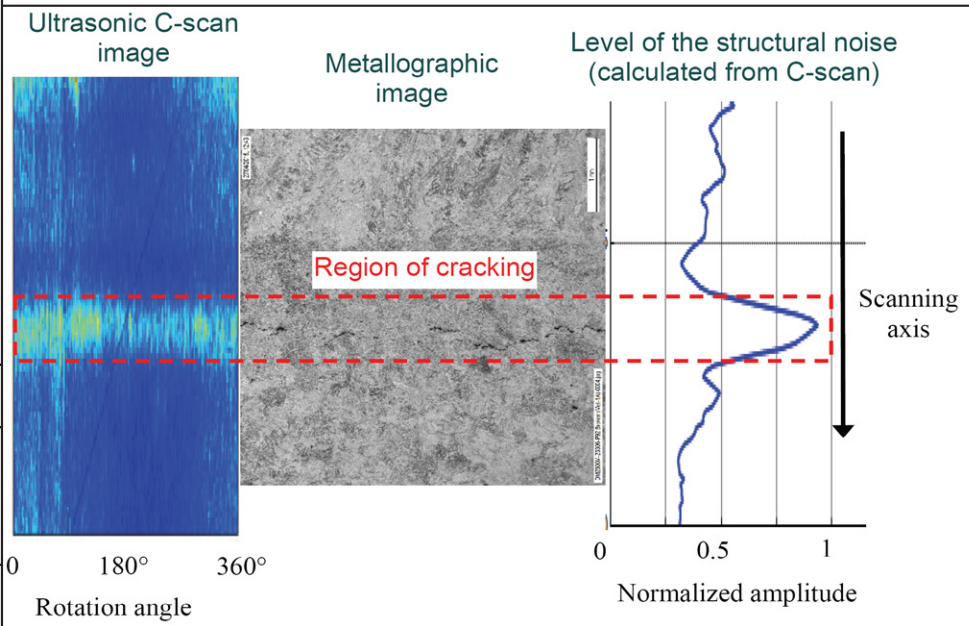
A special high-frequency and low-noise ultrasonic measurement system has been developed for the generation, reception, amplification and digitisation of ultrasonic wave signals. The laboratory testing and validation of the developed system was conducted using authentic X20CrMoV121 and P91 samples with welds. The on-site experiments were conducted in a power plant. A sophisticated post-processing algorithm and software for the detection of internal regions of pipe walls affected by creep damage were developed.

MORE INFORMATION

International Journal of Pressure Vessels and Piping, 2022,
DOI: 10.1016/j. ijpvp.2022.104613

PARTNERS

INETEC (Croatia), TWI (United Kingdom), Public Power Corporation S.A. (Greece)



CONTACT PERSON

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Cybersecurity missions

DESCRIPTION	RELEVANCE	NOVELTY
Our research focuses on the visual analysis of heterogeneous data related to cybersecurity threats. This encompasses a range of areas, including network monitoring, intrusion detection systems, and the investigation of security threats to critical infrastructure. The primary challenge is to effectively support analysts in creating knowledge from large volumes of security records. The overarching requirement for situational awareness, which is essential in many security applications to support knowledge building, implies a strong need for visualization support to engage the analyst in complex data analysis tasks.	The challenges in developing interactive cybersecurity data analysis and visualisation (s) systems stem from the data's multidimensional and dynamic nature. Interactive visualisation models will enable faster, more effective cybersecurity assessments and foster new insights for threat analysis. Fog computing, an emerging paradigm, extends cloud computing to network edge devices. This architectural concept supports various evolving applications, including the Internet of Things (IoT), 5G wireless systems, and embedded AI. By bridging cloud and edge, fog computing enhances data processing efficiency and responsiveness in decentralised environments.	Cybersecurity and power consumption are key challenges in fog computing, requiring innovative solutions for safety and efficiency. These can be addressed by developing secure, low-resource cryptographic algorithms and protocols, along with advanced service orchestration methods to optimize resource use. From a sustainable development perspective, research in information security and energy-efficient systems is crucial. These efforts enhance system performance and contribute to environmentally friendly technologies, supporting the broader goal of sustainable and secure computing infrastructure.

MORE INFORMATION

IEEE Access, 2024,
DOI: 10.1109/ACCESS.2024.3452003

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Dataverse repository of the Lithuanian Data Archive for Social Sciences and Humanities (LiDA)

DESCRIPTION

The Lithuanian Data Archive for Social Sciences and Humanities (LiDA) is a virtual digital infrastructure for the acquisition, long-term preservation and dissemination of data and research resources within the field of Social Sciences and Humanities (SSH). It provides access to over 600 data and research resources. All data and research resources are documented in both Lithuanian and English following international standards. Access to the resources is provided via the Dataverse repository. LiDA curates a variety of data and resources and maintains collections of SSH data submitted by Lithuanian academic and research institutions, as well as by governmental agencies.

RELEVANCE

LiDA is the leading national open-access virtual infrastructure for SSH, advancing the open science and open data movement. It employs Dataverse repository software (dataverse.org) to provide access to empirical SSH data from Lithuania, ensuring compliance with FAIR (findable, accessible, interoperable, reusable) principles. The software supports automatic metadata harvesting through various protocols, making data and resources discoverable on platforms like LVB (www.lvb.lt), Google Dataset Search, and OpenAIRE. By adhering to international standards, LiDA enhances the visibility, accessibility, and reuse of Lithuanian research data worldwide.

NOVELTY

The Dataverse repository software used at LiDA is an open-source, actively developed platform that offers flexibility for creating new solutions. Seed funding supported developing a prototype to display rich metadata from the Dataverse Repository on the Ex Libris Primo Library Discovery Service. The software enables innovative data curation solutions, including controlled vocabularies, versioning, provenance management, data previewing, and online analysis. These features enhance the accessibility, usability, and management of curated research data, improving discovery and advancing social science research.

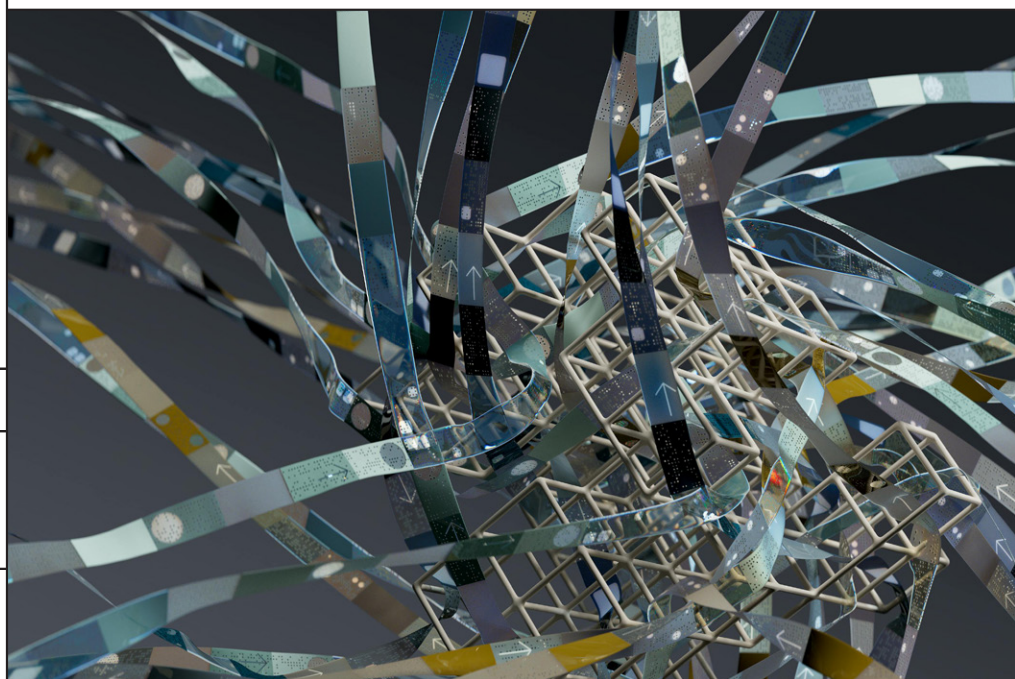
MORE INFORMATION

About LiDA: data.ktu.edu/EN/data-archive

Dataverse repository: lida.dataverse.lt

PARTNERS

Consortium of European Social Science Data Archives (CESSDA ERIC)
(Main Office: Norway)



CONTACT PERSON

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Developing a model for analysing battery lifetime and reliability data, and technology for intelligent battery health diagnosis and prognosis

DESCRIPTION

The objective of this project is to develop a data science based model for battery lifetime and reliability, as well as a technology for intelligent diagnosis and prognosis of battery status. The project is focused on developing a product (prototype) that will provide an automated information technology system for battery performance monitoring. The project includes the following activities: research of literature, data, methods, and determination of their suitability (1), development and validation of diagnostic and prognostic technology (2), research, application testing, and development of prognostic technology (3).

RELEVANCE

Battery ageing models are available, yet significant gaps persist between theoretical advancements and practical applications. By leveraging data from Battery Management Systems (BMS), improved tools could enhance the estimation of key battery parameters such as State of Charge (SOC), State of Health (SOH), and optimized charging cycles. This research focuses on developing an AI-based tool designed to monitor battery ageing and assess failure risk. Utilising deep learning, the tool aims to enhance SOH classification and failure risk estimation, offering real-time prediction and risk analysis specifically tailored for lithium-ion (Li-ion) batteries.

NOVELTY

New research findings, building on prior phases, enable key advancements in battery modelling and prediction. The novel integration of physical and data-driven models allows SOC-OCV and other battery assessments to be calculated on server-based platforms for BMS use. Our purely data-driven approach linked to the equivalent circuit model (ECM) offers more precise, battery-specific predictions. This innovation mainly uses internal BMS parameters like current and voltage, significantly improving prediction accuracy and enhancing overall prognostic technology for practical battery applications.

MORE INFORMATION

Machine and deep learning methods applications in ageing modelling and reliability assessment of lithium-ion batteries, S-ST-23-61, 2023-2024

Estimation of state-space model parameters by combining particle filtration and MCMC methods, S-ST-24-115, 2024-2025

CONTACT PERSON

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Development of a forecasting tool for market analysis of dairy prices

DESCRIPTION

In this project, we apply backpropagation to the application of mathematical models of predicted indicators to machine learning over time for recurrent neural networks. To enhance the research into price stability, the tool has been integrated with the Lambert function method for the purpose of conducting research into price stability. A set of functions has been compiled into a library, and a user interface tool has been developed for the forecasting model. This interface enables users to modify system parameters and observe the resulting outputs, providing a flexible and interactive platform for analysis.

RELEVANCE

The ability to forecast future market prices and assess their stability makes this tool an invaluable resource for informed decision-making across various economic sectors. By providing accurate predictions and insights into market trends, it helps businesses and policymakers make more strategic choices. Currently, a project focusing on market price analysis in the meat sector is underway, with similar initiatives planned for other agricultural industries. These projects aim to deepen our understanding of market dynamics, offering valuable data to enhance economic planning and support more sustainable practices within the agricultural sector.

NOVELTY

Updated Lambert's functions were applied to assess the stability of predicted indicators, improving model accuracy. Machine learning variables were derived from time series data using advanced techniques for consistency and precision. The mirror reflection principle of the predictive indicator ensured alignment with the model's framework, providing reliable results. This approach enables robust predictions, enhancing decision-making. By reinforcing data integrity and predictive reliability, the method supports accurate forecasting and adaptability to dynamic conditions, improving analytical performance over time.

MORE INFORMATION

Creation of a Forecast Tool for Market Analysis of Dairy Sector Prices, 01.2.1-MITA-T-851-06, 2021-2022

CONTACT PERSON

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Development of a mechanism for broad and regular horizon scanning, monitoring and assessment of the most recent technological developments in synthetic biology

DESCRIPTION

Synthetic biology is a new technological field that fuses life sciences and digital technologies. Various applications of synthetic biology are being explored as solutions for global sustainability challenges, while also creating new biosafety risks. As co-chair of the Ad Hoc Technical Expert Group on Synthetic Biology (AHTEG) to the United Nations Convention on Biological Diversity, in 2023-2024 Dr. Florian Rabitz has coordinated the successful development of an international prototype mechanism for horizon scanning, monitoring and assessment of novel technological developments in synthetic biology.

RELEVANCE

The early identification of novel technological opportunities and challenges is critical for developing effective governance solutions for global sustainability. A mechanism for horizon scanning, monitoring and assessment of new biotechnologies is crucial for informing international policy decisions under the Convention on Biological Diversity, one of the world's largest Multilateral Environmental Agreements and a key forum for the regulation of biotechnology. The mechanism developed by Dr Florian Rabitz and the other AHTEG members was discussed at the 2024 United Nations Biodiversity Conference.

NOVELTY

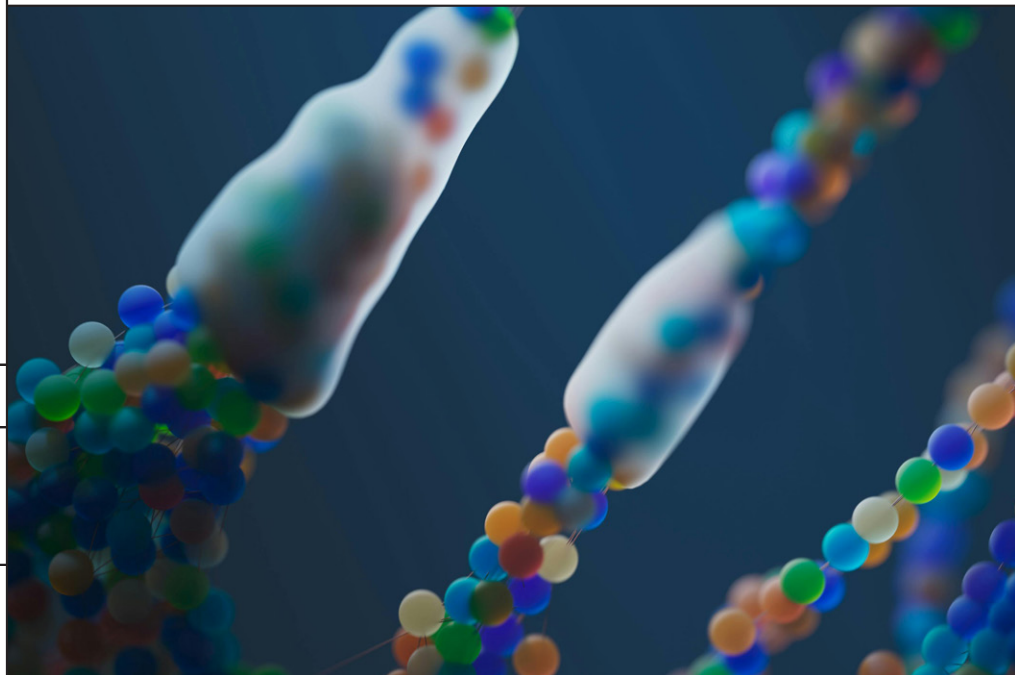
Horizon scanning, monitoring, and assessment mechanisms are innovative tools in global governance. The prototype developed under the Convention on Biological Diversity is the first permanent tool to inform international decisions on regulating synthetic biology. A test run in 2023-2024 identified and assessed emerging technologies, such as self-spreading vaccines for wildlife and the application of AI and large language models to digital genetic sequence data. This mechanism provides a vital foundation for proactive, informed decision-making in response to rapidly advancing scientific developments.

MORE INFORMATION

Final report of the group: www.cbd.int/doc/c/8cb2/d007/23a9f799f-b31180cb¬353d6e2/sbstta-26-04-en.pdf

PARTNERS

37 experts nominated by governments, civil society organisations, and other organisations: www.cbd.int/synbio/current_activities/ahteg



CONTACT PERSON

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Development of combined physical behavior and artificial intelligence models to determine hydromorphology of rivers by indirect measurements (ArtHydRes)

DESCRIPTION

Hydromorphological features are vital for assessing water quality, tracking river evolution, and predicting ecosystem impacts. While direct measurements are precise, they are costly and limited to small areas. Indirect methods, such as remote sensing, offer large-scale, efficient observations, especially in inaccessible regions. This project integrates hydrology, computer vision, numerical simulation, and optimisation to create an AI-based model using UAV multispectral images. By ensuring that predictions align with physical laws, the model enhances monitoring, detects changes, and enables timely decisions to mitigate environmental impacts effectively.

RELEVANCE

Preserving water quality is crucial amid climate change and water scarcity in Central and Eastern Europe. The EU's Directive 2000/60/EC assesses ecological status using physico-chemical, hydromorphological, and biological elements. Hydromorphological features like as river runoff and riverbed character are key, yet 40% of EU water bodies, including 319 in Lithuania, fail to meet good status. Traditional methods are costly and slow. This project combines multispectral imaging with AI models constrained by physical laws, enabling faster, cost-efficient hydromorphological analysis while addressing environmental and computational challenges.

NOVELTY

The project combines image analysis, computer vision, decision-making models, and physical river flow modelling for lowland rivers with unique physico-geographical attributes. It consists of two stages: in the training stage, a supervised machine learning model is trained on image data and measured hydromorphological features, while in the application stage, the model predicts values. An additional layer ensures consistency with physical laws due to limited data and environmental sensitivity. Integrating a numerical hydrodynamics model into AI emphasizes the interdisciplinary nature of the approach.

MORE INFORMATION

International Journal of Applied Earth Observation and Geoinformation, 2024, DOI: 10.1016/j.jag.2024.104154

PARTNERS

Lithuanian Energy Institute

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Enterprise financial performance data analysis tools platform

DESCRIPTION	RELEVANCE	NOVELTY
The monitoring of a company's financial data involves using normative limits of KPI values, called thresholds. They define the allowable limits or ranges of indicator values that assess the compliance of the activity being performed with the normative (safe and unsafe) state. Thus, financial KPIs describe business processes and allow the status of business processes to be assessed when a specific KPI threshold is known from experience. From our point of view, the analysis of the change of the KPI over time adds a dynamic dimension to determine the nature of the evolution of the KPI, allowing the visualisation of this information for financial management experts.	The thresholds (normative values) of financial KPIs play a vital role in evaluating a company's performance over a financial period. These benchmarks enable the creation of templates (patterns) that software systems use to automate assessments, categorising performance into zones such as safe, risk, or disaster. Equally important are the thresholds for Behavioral Change Indicators (BCIs), which should be defined individually for each KPI. Setting these limits allows for the development of tailored templates, enhancing the system's ability to monitor and respond to changes, thereby supporting more effective decision-making and risk management.	The software system automaticall evaluates BCI values, assesses risks associated with changes in KPI time series, and identifies any anomalies in financial data. Setting acceptable limits (normative values or thresholds) for financial BCIs, tailored to specific KPIs, is a complex challenge that demands expert-driven research and analysis. In our project, the proposed method empowers experts to define these thresholds experimentally using an interactive dashboard. This approach not only enhances precision but also provides flexibility, allowing experts to fine-tune the limits based on real-time insights and evolving business conditions.

MORE INFORMATION

Appl. Sci. 2022, DOI: 10.3390/app12178558

PARTNERS

Intellerts (Lithuania)

CONTACT PERSON

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Environmental management system for wastewater containing pharmaceutical substances

DESCRIPTION

Our research is the first in Lithuania to analyse the flows of diclofenac and macrolide antibiotics at a national level, providing balance models from import to environmental release. Substance Flow Analyses (SFA) were applied to River Basin Management (RBM) and the theoretical load of pharmaceutical substances on wastewater treatment plants, focusing on individual treatment processes. The methodology developed in this study, along with the proposed management system and recommendations, could also be applied in countries similar to Lithuania, offering valuable insights for pharmaceutical substance management.

RELEVANCE

The proposed methodology for investigation can be employed to estimate the residue concentrations of pharmaceutical substances in surface water bodies, providing valuable insights into their presence and potential environmental impact. By accurately assessing these concentrations, the methodology allows for a detailed evaluation of the environmental hazards associated with pharmaceutical residues. This approach can help identify critical areas of concern, guide appropriate regulatory measures, and support the development of strategies aimed at mitigating the effects of pharmaceutical substances on aquatic ecosystems and human health.

NOVELTY

The main scientific novelty of this study lies in the comprehensive analysis of the flows of substances of very high concern, specifically diclofenac and macrolide antibiotics, on a national scale. This research involves the development of balance models that trace the journey of these substances, from their import into Lithuania to their eventual release into the natural environment. By focusing on these substances' movement and impact, the study provides valuable data that can inform better regulatory practices and environmental management strategies, aiming to mitigate the negative ecological effects of pharmaceutical substances.

MORE INFORMATION

Water. Basel, 2023,
DOI: 10.3390/w15010010

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Image-based feature extraction, using AI & ML for quantification of complex subsurface pore scale structures, to assess the impact of CO2 & H2 storage

DESCRIPTION

This project aims to enhance understanding of pore-scale processes related to CO_2 and hydrogen storage in subsurface reservoirs. The long-term impact of CO_2 and hydrogen retention in Lithuanian reservoir rocks will be assessed using a novel AI and machine learning method. This approach predicts the dynamic properties of subsurface reservoirs from 3D digital volume images obtained through micro-X-ray computed tomography scans. The project will improve knowledge of pore space distribution, fluid flow, geochemical reactions, and geo-mechanical behavior, helping to identify suitable reservoirs for reliable sequestration evaluation.

RELEVANCE

In response to the urgent need to reduce carbon emissions and combat climate change, two key areas have gained significant attention: CO_2 capture and storage in subsurface reservoirs, and hydrogen storage. Following the COP26 summit, there has been growing interest in carbon capture sequestration (CCS) and hydrogen production in the Baltic Sea Region. While Lithuania has established a hydrogen platform and initiated CO_2 injection pilot projects in past, dedicated research in these fields remains limited. Our research seeks to address this gap, contributing to the advancement of these vital technologies for climate action.

NOVELTY

This project advances research on the long-term storage of CO2 and hydrogen in subsurface reservoirs, focusing on pore-scale processes using AI and machine learning to develop 3D digital rock models. It aims to improve predictions of fluid flow, geochemical reactions, and geomechanical behavior, crucial for assessing geological storage feasibility. The project includes uncertainty modelling to address geological heterogeneity and fluid migration risks, employing tools like GANs and CNNs for image analysis and simulation. It also evaluates the risks of CO2 and hydrogen leakage and their potential impact on reservoir integrity.

MORE INFORMATION

International Journal of Greenhouse Gas Control, 2024,
DOI: 10.1016/j.ijggc.2024.104097

Image based feature extraction, using AI & ML for quantification of complex subsurface pore scale structures, toassess the impact of CO2 & H2 storage, S-PD-22-19, 2022-2024

PARTNERS

Indian Institute of Technology IIT Roorkee, Texas A&M University Qatar, Minijos Nafta (Lithuania)

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Multimodal human-computer interactions

DESCRIPTION

Most of our solutions and research is related to extended reality technologies (virtual and augmented reality, haptics), which we apply to disease diagnosis, rehabilitation, training and learning.
We use virtual reality tracking sensors to detect postures, analyse physiological data to detect different mental states in order to evaluate proposed solutions for learning.

RELEVANCE

We focus on enhancing surgical training through immersive technologies such as virtual reality, augmented reality, and haptic devices, allowing students to practice in a safe environment.
Tactile feedback in VR provides a realistic simulation of surgical procedures, helping students develop motor skills and confidence. We use immersive technologies to train caregivers by employing AI to simulate natural patient behaviour, including speech recognition and synthesis, ensuring more lifelike interactions during training.

NOVELTY

Our approach introduces haptic devices into training simulations, enabling the recording of tactile data to develop advanced learning materials. These materials are designed to enhance skill transfer during training, providing students with a more realistic and immersive experience. Additionally, we simulate lifelike interactions with virtual patients using AI-driven assistants, creating dynamic and natural responses to better prepare trainees for real-world scenarios.

MORE INFORMATION

Robotics, 2022,
DOI: 10.3390/robotics11020041

PARTNERS

University of Agder (Norway), University of Siena (Italy), Lithuanian Health Science University, University of Oulu (Finland), Frostbit (Finland)

CONTACT PERSON

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NO-GAP: A virtual achievement analytics tool for middle schools

DESCRIPTION

The NO-GAP virtual achievement analytics tool empowers school leaders to monitor student learning progress, uncover the factors influencing achievement, identify disparities among student subgroups, and make informed decisions to support school improvement. Built on big data technologies and validated through rigorous educational research and advanced statistical methods, the tool automatically processes data across multiple student cohorts. It incorporates retrospective data, offers comparative insights at both municipal and national levels, and provides AI-driven recommendations tailored to each school's unique context.

RELEVANCE

School leaders face growing societal expectations regarding high student achievement. To strategically improve student progress, principals need insight on factors that promote or hinder achievement in their school.
In-depth analysis of school data is time-consuming and resource-intensive. NO-GAP provides instant, data-driven, and actionable insights tailored to each school, significantly reducing the time and resources for analysis. NO-GAP empowers school leaders to act as strategic decision-makers, better equipped to meet the growing societal expectations for educational quality.

NOVELTY

NO-GAP advances the field of educational analytics by delivering automated achievement-focused insights tailored to each school. By leveraging cohort-based longitudinal data, NO-GAP offers a contextualized and comparative view of school performance over time. The indicators are specifically developed for the tool and validated through rigorous educational research. A distinctive scope and breadth of the data and the quality of the indicators used make NO-GAP a powerful resource for strategic leadership on educational improvement across diverse schools.

MORE INFORMATION

Studies in Educational Evaluation, 2024, DOI: 10.1016/j.stueduc.2024.101398

International Journal of Educational Research, 2023, DOI: 10.1016/j.ijer.2023.102231

Lithuanian Data Archive for SSH (LiDA), 2023, hdl.handle.net/21.12137/5SAURM

Disparities in school achievement from a person and variable-oriented perspective: A prototype of a learning analytics tool NO-GAP, 01.2.2-LMT-K-718-03-0059, 2020-2023

CONTACT PERSON

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Nowcasting of economic activity using real-time big data

DESCRIPTION

Research shows that combining econometric and machine learning techniques with real-time big data improves the accuracy of economic activity predictions under uncertainty, with minimal delay. A comprehensive system of macroeconomic and sectoral modules has been developed, divided into two categories: (1) Economic Activity Modules, covering e-inflation, transport intensity, labor market trends, real estate, electricity markets, media trends, car market analysis, air pollution, and stock market performance; and (2) Economic Activity Forecast Modules, providing real-time forecasting and an economic activity index module for integrated trend analysis.

RELEVANCE

The COVID-19 pandemic has highlighted the critical need for real-time nowcasting of economic activity. However, traditional econometric methods typically rely on historical macroeconomic indicators, which are subject to significant time lags, reducing the accuracy of economic forecasts and the effectiveness of policy interventions. To address this challenge, we developed and tested an interactive online platform designed to improve the accuracy of real-time forecasts of economic activity. The platform serves as a valuable resource for businesses, public institutions, national authorities and households.

NOVELTY

A novel methodology for calculating the economic activity index was developed through the application of the principal component analysis method. Using a modular system, an interactive tool was created that integrates artificial intelligence methods and advanced information technologies. This platform automatically aggregates and visualises economic activity data from various alternative sources, enabling real-time nowcasting of economic changes. By leveraging these technologies, the platform offers enhanced forecasting capabilities, helping users monitor and predict economic shifts with greater accuracy and efficiency.

MORE INFORMATION

Applied Sciences, 2023,
DOI: 10.3390/ app13106119

Economies, 2023,
DOI: 10.3390/economies11050130

Journal of Economic Surveys, 2023,
DOI: 10.1111/joes.12579

Economies, 2023,
DOI: 10.3390/economies11050134

Mathematics, 2022,
DOI: 10.3390/ math10193461

Mathematics, 2022,
DOI: 10.3390/ math10193461

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Simulations and artificial intelligence technologies for engineering education

DESCRIPTION

A scientific inquiry and engineering design cyberinfrastructure is being developed to support citizen science for students. This will be achieved by combining open-source, AI-enabled, and web-based Aladdin CAD software. The developed features will be incorporated to facilitate the modelling and design of architectural styles of cultural significance. The capabilities of AI, including generative design, learning analytics and monitoring dashboards, are to be enhanced in order to meet the needs of the learners. To illustrate, process mining will be employed to extract insights into students' learning processes from the event logs of the software.

RELEVANCE

The Aladdin design and simulation system, when applied in an educational context, allows students to create residential building designs and analyse their energy consumption over different timeframes, such as a day or a year. This hands-on approach helps learners understand energy dynamics in real-world scenarios. The Net Zero Energy Challenge, a citizen science programme, actively involves students in exploring renewable energy sources and implementing energy efficiency strategies. Its primary goal is to minimise a building's energy consumption, fostering awareness and innovation in sustainable design and energy management practices.

NOVELTY

The aim of this citizen science programme, grounded in simulation-based learning, is to inspire participants to design solar power solutions tailored to their own schools. Through the programme, students will apply STEM knowledge and skills gained from the project, fostering creativity and innovation. A key feature is the use of generative AI, which empowers participants to develop novel, efficient designs by exploring a range of possibilities. This hands-on approach not only enhances technical proficiency but also encourages sustainable thinking and real-world problem-solving in renewable energy applications.

MORE INFORMATION

Sustainability, 2023,
DOI: 10.3390/su15086850

PARTNERS

Institute for Future Intelligence (USA), Institute of Renewable Energy of the National Academy of Sciences (Ukraine)

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Unique technologies of ethnographic textile: preservation practices in Western Ukraine and Lithuania

DESCRIPTION

The objective of our research was to gather, analyse, and share knowledge about the restoration and preservation of unique folk textile manufacturing technologies found in Lithuania and Western Ukraine. By employing an interdisciplinary approach, we aimed to explore the historical, cultural, and technical aspects of these traditional crafts. This approach not only highlights the rich heritage of textile production in these regions but also seeks to ensure that this valuable knowledge is preserved and passed on to future generations, fostering appreciation and encouraging its continued practice.

RELEVANCE

The research into traditional textile production techniques in Lithuania and Western Ukraine encompasses a range of disciplines, including technology, ethnography, art history and stylistic analysis. It also involves a comparative approach to examining the universal and distinctive characteristics of the region's textile heritage. The research is particularly pertinent in the current global context, where societies are becoming increasingly cosmopolitan. In this socio-cultural environment, it is important to preserve one's national identity, which leads to a cooperative relationship between the two countries, sharing similar historical circumstances.

NOVELTY

Distinctive folk textile technologies are employed in the workshops of Ukrainian and Lithuanian artisans or museums, though only some were previously documented, with limited publicly accessible information on those from other countries. Old textile manufacturing technologies are examined through scientific comparative analysis. The Institute of Ethnology of the National Academy of Sciences of Ukraine played a key role in facilitating interdisciplinary studies on universal and unique folk textile technologies, as well as their potential applications in innovative contexts.

MORE INFORMATION

Exhibition "Weave, Sister, Towels" in Rumšiškės

Exhibition "When the Birds Return" in New York (USA)

Exhibition "Spring Callers" in Kaunas

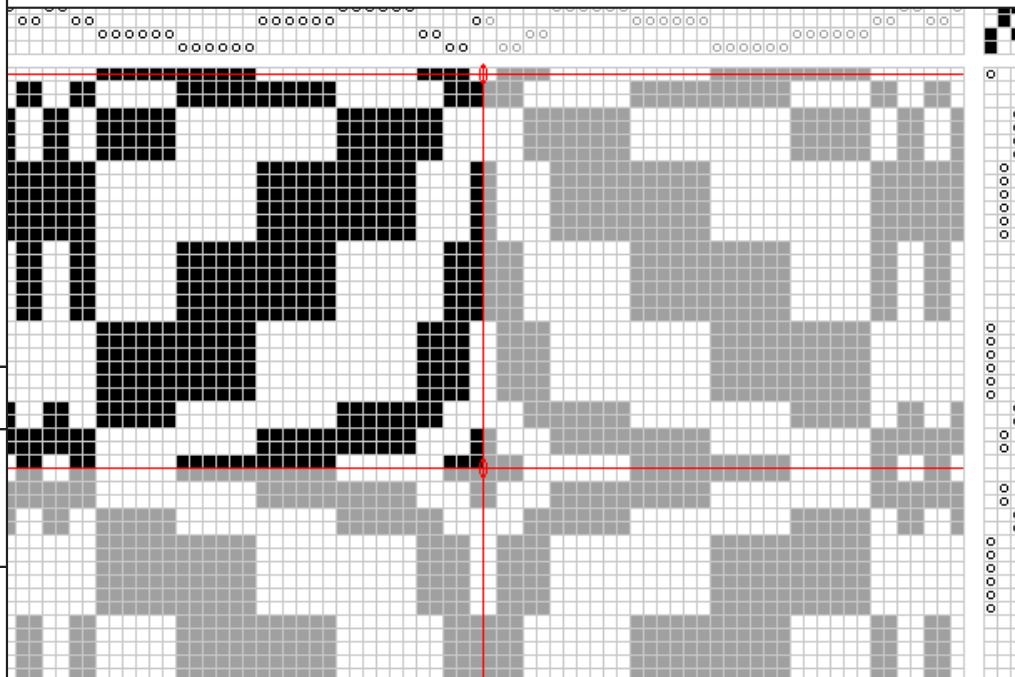
International database of old textiles "EuroWeb Digital Atlas" (together with partners)

Fibres & Textiles in Eastern Europe, 2024, DOI: 10.2478/ftee-2024-0016

Fibres & Textiles in Eastern Europe, 2023, DOI: 10.2478/ftee-2023-0013

PARTNERS

Institute of Ethnology of the National Academy of Sciences of Ukraine



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Health technologies, biotechnologies and safe food

2 chapter

3D-printed finger foods targeting malnutrition, sarcopenia, dysphagia and frailty prevention in the elderly

DESCRIPTION

Nutrient-dense, 3D-printed foods were developed to address malnutrition, sarcopenia, and frailty in the elderly. The nutrient composition included: 19-21 g protein, 6-8 g fibre, 8-9 g fat, 11 mg iron, 14 mg zinc, and 70 µg selenium per 100g. The foods were enriched with branched-chain amino acids, including leucine, isoleucine, and valine. Sensory evaluation was performed on geriatric clinic residents (≥60 years). The elderly rated the finger foods as very easy to handle, soft, easy to swallow, with moderate flavour intensity and weak aftertaste.

RELEVANCE

The increased life expectancy of the world's population has led to a phenomenal expansion of the older cohort (≥60 years) – a so-called "silver tsunami". A common problem faced by older people is nutrition: their nutritional needs are often underestimated and inadequately met. In addition, older people are naturally frailer, have weaker immune systems and are more susceptible to infections than younger people. In this context, a nutrient-dense diet is essential for older people to maintain their health and well-being.

NOVELTY

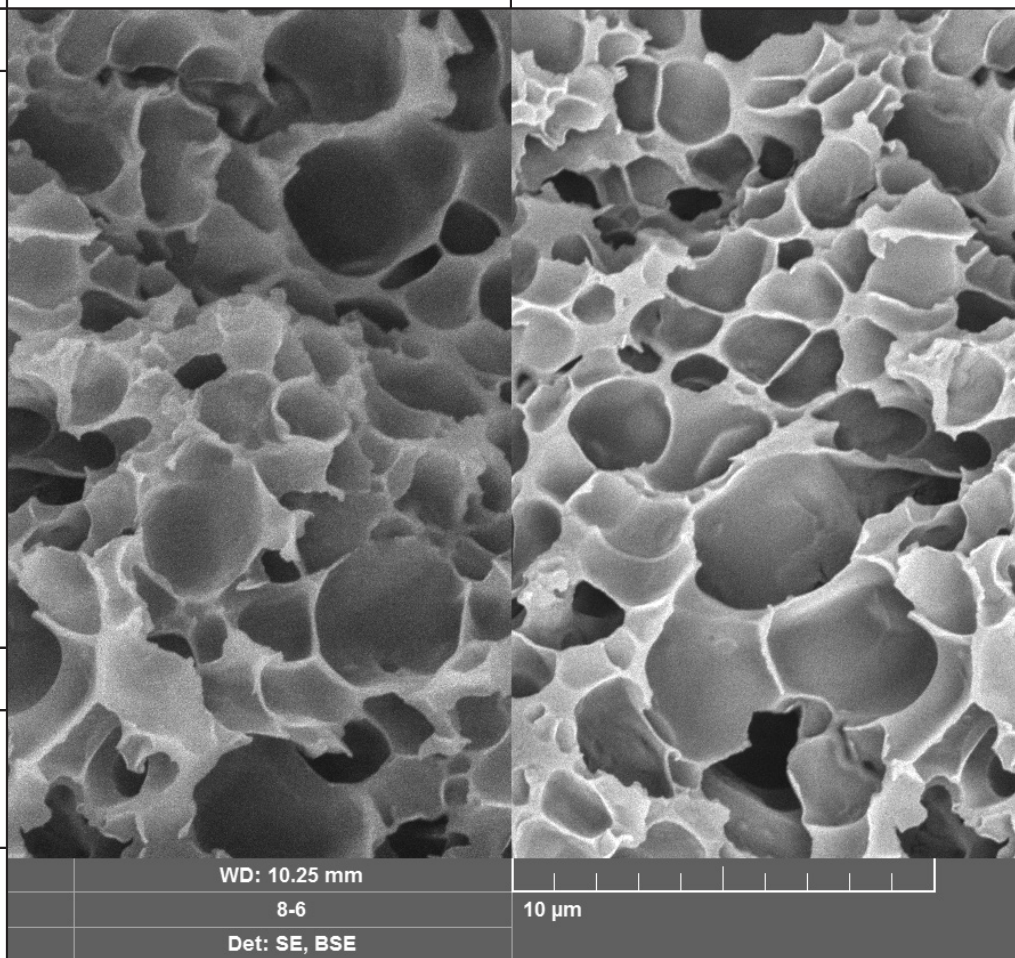
3D printing of food has the potential to be used to customise food for people with special dietary needs. However, 3D-printed foods are characterised as ultra-processed, meaning that their encapsulated micronutrients are subject to a number of processing steps that may affect their stability. Stability and bioavailability studies are currently lacking. Here we evaluated the role of collagen, monoglyceride and diglyceride structured gels as delivery systems for bioactives. We measured their stability during technological processes and under in vitro digestion by first encapsulating them in Bigel and then incorporating them into 3D-printed foods.

MORE INFORMATION

Patent application, 2023, US 18/332,052,

Food Bioscience, 2024, DOI: 10.1016/j.fbio.2024.104789

Journal of the Science of Food and Agriculture, 2024, DOI: 10.1002/jsfa.13463



CONTACT PERSON

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Advancing antimicrobial drug discovery: a translational pipeline to combat antimicrobial resistance and emerging infectious diseases

DESCRIPTION

This initiative employs advanced synthetic and medicinal chemistry to develop novel molecules targeting multidrug-resistant pathogens, emerging viruses such as COVID-19, and drug-resistant fungi such as Candida auris. The team of expert organic chemists is pioneering innovative methods to synthesise small molecules that target microbial proteins and enzymes. By addressing antimicrobial resistance and emerging infectious diseases, the program aims to create a diverse pipeline of candidates capable of combating drug-resistant bacteria, viruses, and fungi, contributing to global efforts against these critical health threats.

RELEVANCE

This programme tackles critical medical needs by addressing antimicrobial resistance and emerging infectious diseases. Combining organic synthetic and medicinal chemistry, it aims to discover small molecules that overcome resistance mechanisms, improving drug effectiveness. Focused on emerging pathogens like COVID-19 and drug-resistant fungal infections such as Candida auris, it aims to address both current and future health crises. The team's pioneering methods offer new therapeutic solutions where traditional approaches have stalled, advancing effective treatments for infectious diseases and better preparedness for public health challenges.

NOVELTY

This initiative introduces a novel approach to small molecule synthesis using advanced organic chemistry, distinct from traditional drug discovery. It focuses on developing compounds that target resistance mechanisms across various microbial pathogens. By exploring novel chemical scaffolds and biological pathways, the team creates candidates that bypass common resistance strategies. Highly adaptable synthetic routes allow rapid modifications to address specific resistance patterns, keeping the programme at the forefront of drug discovery and impactful in infectious disease treatment.

MORE INFORMATION

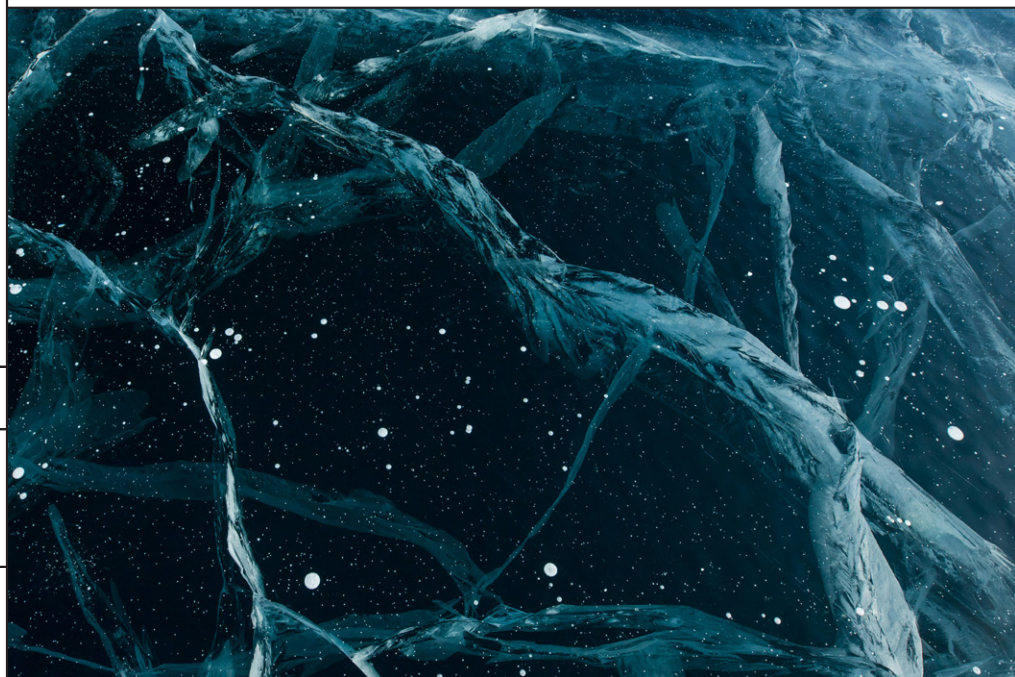
International Journal of Molecular Sciences, 2024, DOI: 10.3390/ijms25105079

Antibiotics, 2024, DOI: 10.3390/ antibiotics13020193

International Journal of Molecular Sciences, 2023, DOI: 10.3390/ijms241713491

PARTNERS

Center for Discovery and Innovation (USA), Weill Cornell Medicine of Cornell University (USA), University of Padua (Italy), Lithuanian University of Health Sciences, Institute of Infectious Diseases and Pathogenic Microbiology



CONTACT PERSON

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Advancing photodynamic therapy: synthesis and investigation of photosensitising compounds with anticancer activity

DESCRIPTION

Photodynamic therapy (PDT) is a non-invasive treatment combining light-sensitive drugs (photosensitisers), a light source, and oxygen to produce cytotoxic reactive oxygen species (ROS) that destroy abnormal cells. It is used to treat skin conditions like psoriasis, acne, and oral infections, as well as cancers such as basal cell carcinoma and cancers of the lung, head, mouth, and larynx. Developing effective photosensitisers for PDT is challenging, requiring low toxicity in the absence of light, strong photocytotoxicity, absorption at long wavelengths, and selective targeting of diseased cells while sparing healthy tissue.

RELEVANCE

The synthesis of novel photosensitisers remains an important area of contemporary organic chemistry. Despite the huge potential of PDT over classical treatments, only a few photosensitisers have been commercialised to date, while others are being tested in clinical trials. By far the most studied photosensitisers are derivatives of porphyrins. In addition, other types of elongated conjugated systems have been reported to possess photodynamic properties, such as cyanines, BODIPYs, aza-BODIPYs, rhodamines, etc. In collaboration with partner institutions, several series of photosensitisers have been synthesised and evaluated for their photodynamic activity.

NOVELTY

The synthesis, structure determination, and biological investigation of pyrazoleindole, 2-phenylethenyl-1H-benzo[e]indole, and N-aryl-2,6-diphenyl-2H-pyrazolo[4,3-c] pyridin-7-amine derivatives identified them as novel photosensitizers. These compounds showed cytotoxicity on melanoma G361 cells when irradiated with blue light (414 nm), with minimal or no cytotoxicity in the dark. Further investigation in melanoma (G361) and breast cancer (MCF-7) cells revealed anti-cancer activity at sub-micromolar concentrations, inducing reactive oxygen species and cell death, influenced by concentration and irradiation.

MORE INFORMATION

Patent, 2023, EP 4107145 B1

Patent, 2022, CZ 309070 B6

Patent application, 2025, US 2025066301 A1

Patent application, 2024, EP 4446386

European Journal of Medicinal Chemistry, 2024, DOI: 10.1016/j.ejmech.2024.116777

Archiv der Pharmazie, 2024, DOI: 10.1002/ ardp.202400282

Bioorganic Chemistry, 2022, DOI:10.1016/j.bioorg.2021.105570

Synthesis, characterization and biological evaluation of novel fused heterocyclic systems (HetSYs), S-MIP-23-51, 2023–2026

PARTNERS

Palacký University Olomouc (Czech Republic)

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BrainProtect technology for transformation of heart and lung machine from brain-damaging into brain-protecting device

DESCRIPTION

Neurological complications after cardiopulmonary bypass (CPB) surgeries are a major global challenge, with up to 1.2 million CPB surgeries performed annually. In high-income countries, the average is 123.2 procedures per 100,000 people. Post-operative cognitive dysfunction and delirium affect 30–70% of patients, hindering recovery. In the U.S., CPB-induced delirium costs the healthcare system up to $2.52 billion annually, extending hospital stays by 2.5–10.4 days. Our innovative BrainProtect technology transforms the heart-lung machine from a "brain-damaging device" into a "brain-protecting device," addressing this critical issue.

RELEVANCE

BrainProtect technology addresses the global challenge of reducing neurological complications after CPB surgery, offering a groundbreaking solution to improve patient outcomes. The potential market for integrating our innovative technology into the existing global infrastructure of over 20,000 heart-lung machines across more than 100 countries is estimated at up to €540 million. Additionally, annual revenue from the use of the disposable component of our Cerebral Autoregulation Monitor in every CPB procedure worldwide is expected to reach €750 million, showcasing the significant impact and market potential of our technology.

NOVELTY

BrainProtect technology, with US and EU patents and new patents pending (2022–2024), is clinically validated through studies on 173 CPB surgery patients. It introduces personalised medicine into CPB surgery, with no direct competitors. The BrainProtect device monitors cerebral blood flow autoregulation in real time, detecting ischemic and hyperemic insults within seconds. By managing individual cerebral perfusion, it optimises blood flow, eliminates insults, and minimises post-operative neurological complications. This innovative approach significantly improves patient outcomes and transforms neurological risk management in CPB surgery.

MORE INFORMATION

Patents, 2024: US 2024197175, EP 4385403

Patents, 2023: US 20230109678, EP 4166069

Patents, 2023: US 202318129887, EP 4252637

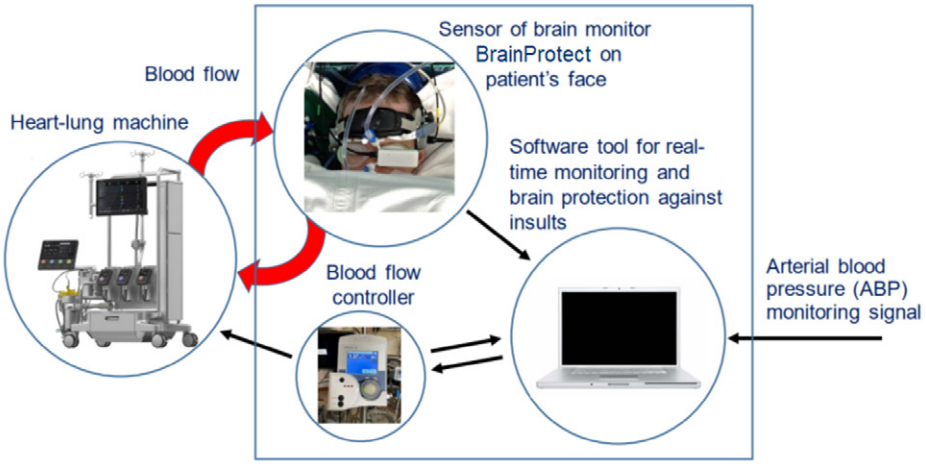
Medicina, 2024, DOI:10.3390/medicina60081337

Plos One, 2024, DOI: 10.1371/journal.pone.0296780

Scientific Reports, 2022, DOI: 10.1038/s41598-022-22566-6

PARTNERS

Lithuanian University of Health Sciences, Vilnius University Hospital Santaros Klinikos (Lithuania), ScienceForBrain (Lithuania), ScienceForBrain (Lithuania), Vaizduote (Lithuania)



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Combination of wet extrusion and fermentation processes for the improvement of protein quality and digestibility of matrices based on plant byproducts (TECHNOGEST)

DESCRIPTION

The TECHNOGEST project will design the combined matrices based on plant processing by-products, using hempseed press cake from hemp oil production (50% protein) as a structural base, while oat and/or soybean press cake from beverage production could be used as plasticisers. The aim of the project is to model a combination of multi-stage treatment by high moisture extrusion cooking and fermentation of the combined matrices with the aim of improving their protein quality and digestibility and ensuring sensory properties similar to those of fibrous meat structure.

RELEVANCE

The project investigates the mechanisms behind combined fermentation and high-moisture extrusion cooking processes to enhance the protein quality and structure of native hempseed, oat, and soybean press cake blends, collectively known as combined matrices. By exploring how these two techniques interact, the study aims to optimise the nutritional and functional properties of plant-based proteins. The findings could lead to more efficient methods for producing high-quality, sustainable plant proteins, offering significant benefits for the food industry, particularly in developing healthier and more versatile plant-based products.

NOVELTY

The combination of fermentation and high-moisture extrusion cooking (HMEC) offers a novel approach to enhancing the nutritional quality of sustainable protein sources, such as press cakes. The goal is to create a protein-rich food that meets essential amino acid requirements while improving its nutritional profile by blending various plant-based sources. This innovative method aligns with environmental, economic, and health considerations, addressing consumer preferences for sensory quality, cultural significance, and animal welfare. It provides a sustainable, nutritious alternative in the growing demand for plant-based food solutions.

MORE INFORMATION

Heliyon, 2024
DOI: 10.1016/j.heliyon.2024.e32614

Combination of wet extrusion and fermentation processes for the improvement of protein quality and digestibility of matrices based on plant byproducts (TECHNOGEST), Nr. S-MIP-22-64, 2022-2025

PARTNERS

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CONTACT PERSON

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Complex analysis method of spectrophotometric and ultrasound data for the automatic differential diagnosis of early stage malignant skin tumours

DESCRIPTION

The objective of our research is to develop an automated method for the differential diagnosis of early-stage malignant skin tumours. This method is based on a comprehensive analysis of spectrophotometric and high-frequency ultrasound data. To achieve this, we have conducted an in-depth examination and selection of the most pertinent qualitative and quantitative parameters of non-invasive visualisation techniques. These techniques, including spectrophotometric analysis and ultrasonic examination, are crucial for the early and accurate diagnosis of malignant skin tumours, improving early detection and patient outcomes.

RELEVANCE

Skin melanoma (MM) is the most aggressive skin tumour, resulting from DNA damage to melanocytic cells. MM incidence is rapidly rising globally (Garbe et al., 2016). In Lithuania, MM cases tripled between 1978 and 2002, reaching 11.6 per 100,000 people (National Cancer Prevention and Control Programme 2014–2025). In Europe, MM incidence is about 10–20 cases per 100,000; in the USA, 20–30; and in Australia, 50–60 cases per 100,000 annually (Garbe et al., 2016). Early diagnosis is vital for improving patient survival and treatment outcomes.

NOVELTY

The diagnostic accuracy could be enhanced by employing a sophisticated automatic analysis of the parameters derived from two non-invasive imaging modalities (spectrophotometer and ultrasound) of the skin tumours. A novel approach to clinical decision support has been devised, to increase the accuracy of melanoma differential diagnosis. This is expected to curtail the incidence of superfluous surgical procedures and pathological examinations, while simultaneously reducing the risk to patients, the financial burden and the time commitment associated with periodic examinations.

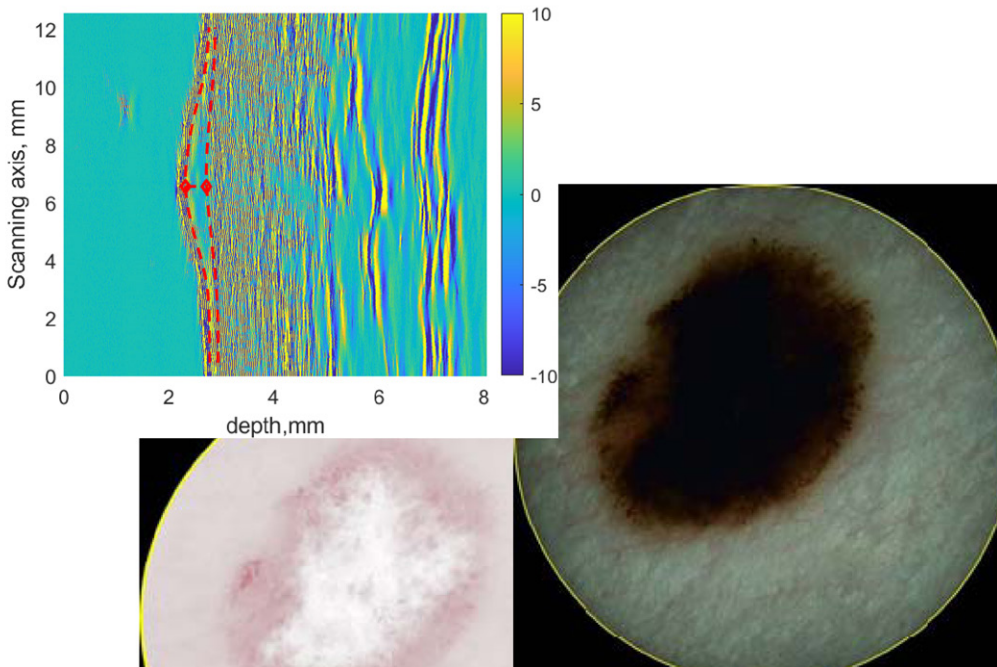
MORE INFORMATION

Patent, 2023, US11723584 B2

Patent, 2019 LT6670 B

PARTNERS

Department of Skin and Venereal Diseases of Lithuanian University of Health Sciences (Lithuania)



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Development of a soft sensor system for biotechnological process monitoring and an intelligent automation platform for high-yield recombinant protein synthesis

DESCRIPTION

In this research, platform and pilot scale cultures dedicated to recombinant proteins E.coli, yeast, mammalian cells, stem cells, microbes, bacteria (including methanotrophs), organoids and cultivated meat (rabbit fybroblasts) are being developed. Full-scale digital twins are created and technology transfer is performed. Bioreactor sizes from 50mL to 1000L. Both continuous and specialised custom aerobic and anaerobic biosynthesis applications are possible.

RELEVANCE

This study optimizes fed-batch cultivation processes by precisely controlling the specific growth rate (SGR), addressing COVID-19 challenges in producing vaccines and therapeutic proteins. Efficient production of recombinant proteins, such as monoclonal antibodies and antigens, is critical for pandemic response. Advanced control systems improve yield, quality, and consistency, aiding scalable biomanufacturing. Digital twins for microorganisms and solutions for scale-up/down challenges, along with clinical trials, support individualized medicine and bioengineering innovations.

NOVELTY

Pilot-scale demonstrations integrating hybrid models and optimal bioprocess control have been conducted end-to-end, yielding promising results. Some findings have already been published and patented, while additional patents are pending. A standout achievement involves the development of custom hardware solutions that replace traditional mass spectrometry equipment, significantly enhancing efficiency and reducing costs. This advancement, featured in the prestigious science journal Talanta, underscores the potential of this technology to transform analytical workflows and set new benchmarks in bioprocessing and beyond.

MORE INFORMATION

Patent application, 2022, EP 4083185

Computational and Structural Biotechnology Journal. Amsterdam: Elsevier, 2023, DOI: 10.1016/j.csbj.2023.11.033

Talanta Amsterdam: Elsevier, 2023, DOI: 10.1016/j.talanta.2022.124121

PARTNERS

GSK (United Kingdom), Biotechpharma (Lithuania), Celltechna (Lithuania), Lithuanian University of Health Sciences, Hospital of Lithuanian University of Health Sciences Kauno Klinikos, Cumulatis (Lithuania)

CONTACT PERSON

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Digital healthcare innovations for value-based healthcare

DESCRIPTION

Multisides is a digital healthcare platform designed for remote patient monitoring, enabling the collection, analysis, and application of real-world data. It advances participative, preventive, predictive, and personalised healthcare through a human-centred approach that integrates patient-generated health data with advanced analytics. This empowers patients and healthcare providers to collaborate in real time, enhancing proactive management and the tailoring of healthcare, ultimately improving outcomes and delivering value-based care. The platform supports both patients and providers in managing healthcare more effectively.

RELEVANCE

Remote Patient Monitoring (RPM) platforms enable continuous, real-time tracking of patients' health conditions from home, improving access to care, particularly for those with chronic conditions or in remote locations. These platforms collect vital health data (e.g., heart rate, blood pressure) for early detection of changes, allowing timely interventions to prevent complications and reduce hospitalisations. RPM supports cost-effective healthcare by reducing the need for frequent in-person visits, empowering patients to manage their health, and facilitating improved care coordination through integration with digital health tools, enhancing patient outcomes.

NOVELTY

The Remote Patient Monitoring Platform (RPMP) is based on a novel digital healthcare model that connects critical components for value-based healthcare. Despite its multisided nature, the platform is patient-centred, allowing patients to collect, manage, and share their health data with healthcare professionals. This enhances patient engagement, self-management, and integrates with digital health ecosystems, paving the way for personalised, predictive, and preventive healthcare. The platform uses AI to address unmet needs, transforming chronic disease management and healthcare delivery, making it more efficient and accessible.

MORE INFORMATION

IEEE Transactions on Engineering Management, 2024,
DOI: 10.1109/ TEM.2023.3281722

Journal of Business Research, 2023,
DOI: 10.1016/j.jbusres.2023.113701

California Management Review, 2022,
DOI: 10.1177/00081256221099326

PARTNERS

Lithuanian University of Health Sciences (LSMU), LSMU Hospital Kauno Klinikos

CONTACT PERSON

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Innovation in forestry biomass residue processing: towards circular forestry with added value products (CeForestry)

DESCRIPTION

The Baltic Sea region has vast amounts of under-utilised forest biomass residues (e.g., bark, needles, cones), with countries at different stages of utilising forest side streams. Often used a low-value products like bioenergy, these residues can be a valuable resource for extracting high-value compounds with various applications. The CEforestry project aims to develop innovative circular economy practices and solutions for utilising forestry side streams in the BSR. This will involve cross-sectoral collaboration among researchers, SMEs, large companies, and other relevant actors, demonstrated in pilot facilities.

RELEVANCE

The CEforestry project develops innovations in processing forest biomass residues to support circular forest management and create value-added products. It addresses challenges for forest owners and companies by developing new practices and policy recommendations. The project explores environmentally friendly extraction methods and applications like food analogues and biocides from forestry by-products, such as spruce needles and bark. It has also created an online map of under-utilised biomass and is conducting a techno-economic analysis to optimise resource use in the Baltic Sea region.

NOVELTY

The novelty of the CEforestry project lies in its innovative approach to converting forest biomass residues into valuable resources, thus promoting circular forestry in the Baltic Sea region. By developing environmentally friendly extraction methods and creating new applications, such as food analogues from spruce needles and tannins for biocides, the project turns “waste” into valuable products. In addition, the creation of an online map of underutilised sawmill residues and ongoing techno-economic analyses demonstrate the project’s forward-looking strategy to optimise resource use, promote sustainability and drive innovation in forestry.

MORE INFORMATION

Molecules, 2023,
DOI: 10.3390/molecules28207085

Innovation in forestry biomass residue processing: towards circular forestry with added value products (CEforestry), C023, 2023-2026

PARTNERS

Swedish University of Agriculture (Sweden), Umea University (Sweden), GreenBack (Poland), Mineral and Energy Economy Research Institute of the Polish Academy of Sciences (Poland), Aalto University (Finland), Finnish Forest Centre (Finland), Centria University of Applied Sciences (Finland), Natural Resources Institute Finland, Biolat (Latvia), University of Latvia

CONTACT PERSON

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Low-frequency ultrasound for rapid non-invasive reduction of blood pressure and pulse

DESCRIPTION

In a pioneering study in medical practice, a blood analyser was used in conjunction with AI algorithms to investigate the impact of low-frequency ultrasound of varying intensity and duration on haemodynamic parameters. The findings revealed the potential for RBC aggregates to dissociate. To further advance this research, a low-frequency piezoelectric transducer has been developed and patented, operating in a radial mode of vibration. Notably, it was demonstrated that the penetration of the ultrasonic waves through the biological tissues emitted by our developed device is four times higher than that of the devices previously used in this field of research.

RELEVANCE

It is estimated that 1.3 billion people worldwide are currently affected by circulatory health issues, a growing concern for global public health. The ability to rapidly and effectively reduce blood pressure, lower pulse rates, and facilitate respiration is critical in managing these conditions. Addressing these issues promptly can prevent further complications, improve patient outcomes, and enhance the overall quality of life for those affected. Effective interventions are essential in reducing the strain on healthcare systems, particularly in managing chronic conditions related to circulatory health.

NOVELTY

When a developed and patented low-frequency ultrasound transducer was applied to human blood, the shear forces generated by the emitted traveling acoustic waves dissociated aggregated erythrocytes into individual cells. As a result, the entire surface area of each erythrocyte became available for gas exchange, significantly facilitating respiration, and due to the gaps formed between individual erythrocytes, blood viscosity was reduced, lowering blood pressure and pulse rate. In addition, the penetration of acoustic waves generated by the developed transducer into biological tissues increased severalfold, affecting deeper human internal organs.

MORE INFORMATION

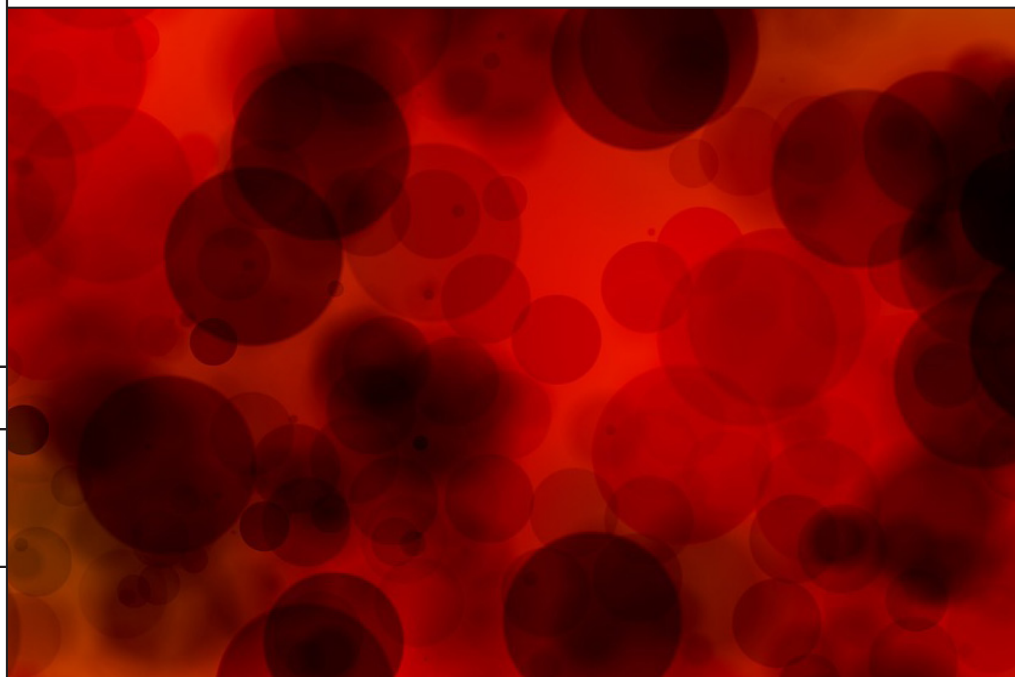
Respiratory Research, 2024, DOI: 10.1186/s12931-024-02713-5

Appl Syst Innov, 2023, DOI: 10.3390/asi6060099

Sensors, 2023, DOI: 10.3390/s23073608

PARTNERS

Lithuanian University of Health Sciences, Free University of Brussels (Belgium)



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Nano- and microfibrous fibrous matrices for biomedical engineering, biotechnological applications and environmental sciences

DESCRIPTION

Nano- and microfibrous matrices are innovative materials designed for a wide range of applications in life sciences, environmental and technological sciences. These advanced scaffolds support tissue engineering, regenerative medicine and in vitro cell models, providing physiologically relevant environments for biomedical research. In environmental studies, they support cytotoxicity assessments and contaminant impact studies. In biotechnology, they enhance drug discovery and cell culture processes. These matrices provide a versatile tool for diverse fields, enabling significant advances in both health and environmental research.

RELEVANCE

In the life sciences, Nano- and microfibrous matrices provide more accurate 3D models for studying tissue regeneration, disease mechanisms and drug interactions, filling critical gaps in traditional 2D systems. These matrices facilitate breakthroughs in drug discovery by providing realistic environments for cell culture and testing. For environmental research, they support contaminant impact studies and cytotoxicity assessments, helping to address pressing environmental challenges. Their multi-functionality makes them very interesiting and promissing for the development of innovative solutions in biotechnology, medicine and environmental science.

NOVELTY

The novelty of nano- and microfibrous matrices lies in their ability to mimic the complex architecture of natural tissues, offering a dynamic environment for cell growth, tissue regeneration, and drug testing compared to traditional models. Customisable physical and chemical properties, such as fibre size and surface modifications, enable personalised applications in tissue engineering, regenerative medicine, and environmental studies. These materials enhance in vitro cell models, drug discovery, and toxicity assessments, providing a versatile platform for interdisciplinary research.

MORE INFORMATION

Patent, 2024, EP 4 119 169 B1

Patent application, 2023, EP 4194596 A1

Journal of Environmental Chemical Engineering, 2025, DOI: 10.1016/j.jece.2025.116515

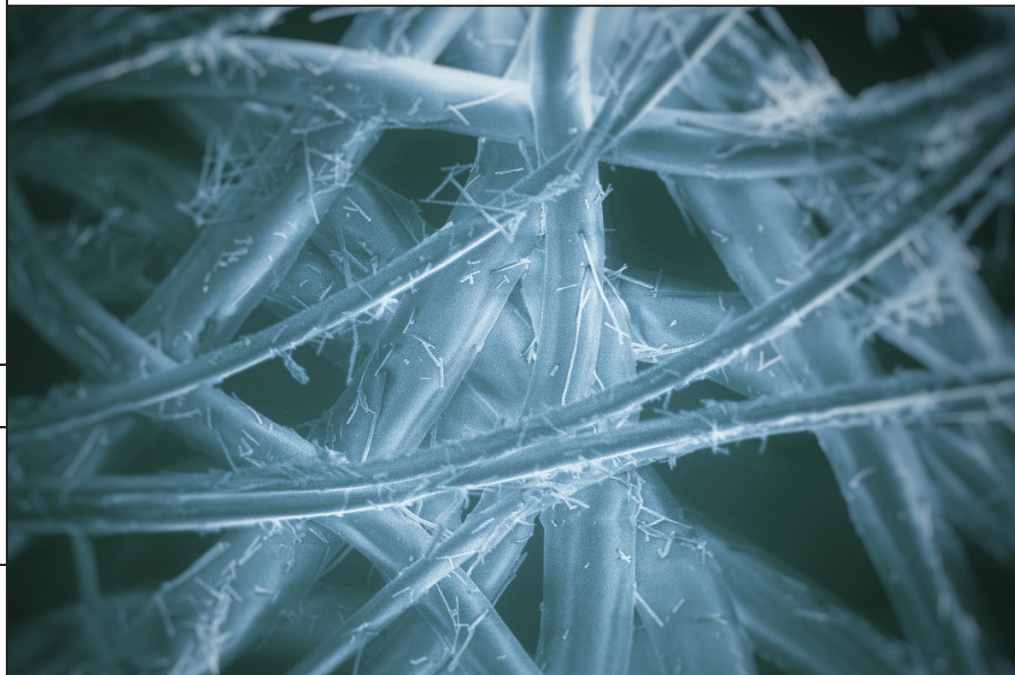
Journal of Drug Delivery Science and Technology, 2024, DOI: 10.1016/j. jddst.2024.106213

Environmental Pollution, 2024, DOI: 10.1016/j.envpol.2024.124870

Journal of Aerosol Science, 2023, DOI: 10.1016/j.jaerosci.2022.106118

PARTNERS

Lithuanian University of Health Sciences, State Research Institute Centre or Innovative Medicine (Lithuania), Pažangiosios Technologijos (Lithuania)



CONTACT PERSON

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New materials and equipment for radiation shielding

DESCRIPTION

Materials and methods for the fabrication of lead-free radiation protection equipment are being developed to enhance safety in radiation medicine procedures. These innovations include the development of modular, transparent radiation shielding screens that permit the passage of visible light while effectively blocking harmful radiation. Additionally, the research addresses the development of radiation protection equipment for medical staff and patients undergoing radiation therapy, personalised radiation treatment supporting devices, and facility-specific radiation shields.

RELEVANCE

It is essential to ensure the provision of relevant radiation shielding to guarantee the safety of staff and patients against unnecessary radiation exposure during the operation of radiation facilities and diagnostic examinations of patients. The use of lead-free recyclable materials for specific radiation installation shielding, modular transparent protection screens, lightweight radiation protection garments for staff, and patient-specific immobilisation equipment with integrated radiation protection features in radiotherapy plays a pivotal role in ensuring the radiation safety of individuals and is instrumental in achieving the EU green strategy goals.

NOVELTY

New polymer-based, lead-free composites with metal/metal oxide additives offer radiation attenuation comparable to lead, addressing health and environmental concerns. Advanced fabrication techniques, including physical/chemical synthesis and additive manufacturing, enable development of 3D-printed shielding materials. They are designed for cyclotron target shielding, staff protection, and targeted shielding of healthy tissues during repeated CT scans for radiotherapy adjustments. Their integration into patient-specific support devices enhances treatment precision, ensuring safety and effectiveness throughout the radiotherapy cycle.

MORE INFORMATION

Patent, 2021, LT 6838 B

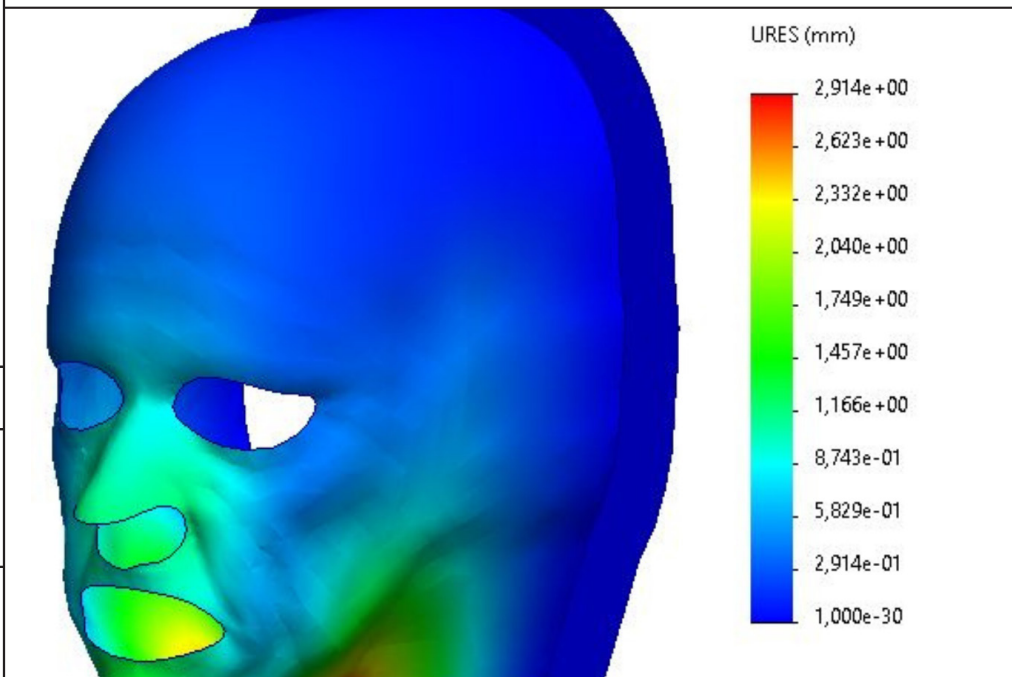
Nuclear instruments and methods in physics research section B: Beam interactions with materials and atoms, 2024, DOI: 10.1016/j.nimb.2024.165298

Polymers, Basel, 2022, DOI: 10.3390/polym14091696

Development of lead-free adaptive modular radiation protection constructions against mixed high-energy radiation in nuclear medicine (ADAM), S-CERN-24-1, 2024-2027

PARTNERS

Lithuanian University of Health Sciences



CONTACT PERSON

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Non-invasive fully passive intracranial wave sensor and monitor Archimedes 02

DESCRIPTION

The latest inventions, awaiting patent approval in the US and EU, include the Archimedes 01/02 intracranial volumetric wave non-invasive sensor and monitor. These devices work through mechanical contact between the closed eyelid and a sealed chamber attached to the patient's face. The chamber contains a digital wireless pressure sensor and non-compressible liquid. This innovative technology opens new pathways for neuroprotection. The passive pressure sensor converts slow movements and vibrations of the eyeball, caused by intracranial volume and pressure changes, into an electrical output signal.

RELEVANCE

The Archimedes 02 is a mobile, wireless device for patients with conditions such as normal tension glaucoma or traumatic brain injury. It works through both eyes, enabling use in intensive care units, cardiac and organ transplantation surgeries, sports medicine facilities, emergency settings, and even space stations. This two-channel device independently monitors intracranial pulse wave morphology in both hemispheres, providing valuable insights into cerebral region responses. This innovation delivers critical diagnostic and treatment capabilities for brain injuries or illnesses, marking a breakthrough in brain compliance monitoring.

NOVELTY

The Archimedes 01/02 intracranial volumetric wave sensor is a groundbreaking innovation in the global market. It is the first fully passive, non-invasive intracranial volume dynamic monitor, offering a cost-effective solution with a disposable component that gently touches the closed eyelids. This technology provides a reliable, non-intrusive method for monitoring intracranial pressure and volume changes. The intellectual property for Archimedes technology is protected by US and EU patents, ensuring its uniqueness and reinforcing its potential to revolutionise neurology and brain health monitoring.

MORE INFORMATION

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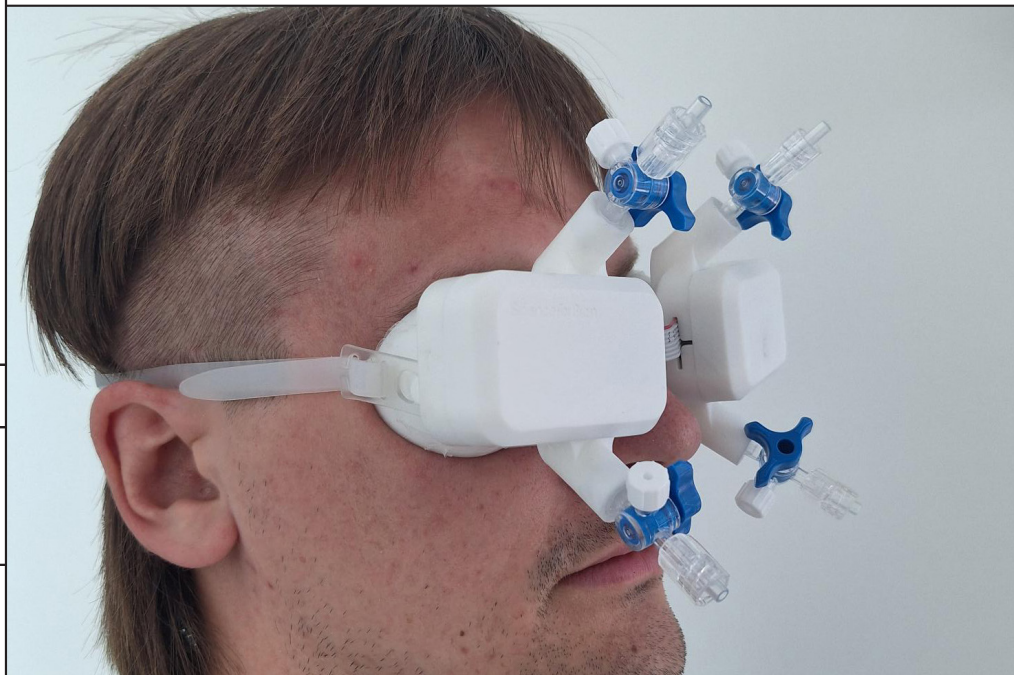
Research and development of innovative non-invasive high temporal resolution intracranial pressure waves monitoring technology, S-MIP-23-68, 2023-2025

PARTNERS

Lithuanian University of Health Sciences, Vilnius University Hospital Santaros Klinikos (Lithuania), ScienceForBrain (Lithuania), Vaizduotė (Lithuania), Techlinija (Lithuania)



CONTACT PERSON

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Technology for obtaining an innovative antimicrobial, non-active medical dressings

DESCRIPTION

A novel technology for medical dressings for acute and chronic wounds has been developed based on electrospun nano-microfibres. The compositions for electrospinning were prepared using hydrolysates of proteins (collagen, keratin) with high concentration and good spinnability, obtained from by-products of the wool, leather and meat industries. The antioxidant and anti-inflammatory effects of the nano-microfibres were attributed to the phytochemicals present in the herbal extracts, while the antimicrobial activity was mediated by the silver nanoparticles, biosynthesised from the plant extracts.

RELEVANCE

Wound dressings must protect wounds from mechanical and microbial contact, absorb exudate, stimulate keratinocyte proliferation, and possess antimicrobial properties, especially for chronic injuries. The effectiveness of these dressings depends on factors such as material type, porosity, biocompatibility, and active ingredients. Many are fortified with antibiotics and analgesics to prevent infections and reduce pain. However, the overuse or misuse of antibiotics significantly contributes to the development of antibiotic-resistant bacteria, which are a major risk factor for hospital-acquired infections, complicating treatment and endangering patient health.

NOVELTY

New antimicrobial medical dressings have been developed which are both efficient and based on protein nanostructures loaded with non-active antimicrobial agents (without antibiotics). This enhances access to healthcare and allows the overcoming of some of the limitations associated with the increase in antibiotic resistance. The innovative products are produced by electrospinning technology utilising indigenous natural resources, including collagen derived from bovine hides, rabbit skin glue and keratin sourced from by-products of the fur and leather industry. Additionally, biologically active antioxidant additives are obtained from the agrocultural industry.

MORE INFORMATION

EUREKA Innovation Award 2024

PARTNERS

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Wearable-based technology for identifying personal triggers of paroxysmal atrial fibrillation

DESCRIPTION

Technological advances in the early detection of self-terminating atrial fibrillation episodes have the potential to enhance clinical care by introducing transformative treatment approaches. The accurate identification of atrial fibrillation triggers using wearable-based systems enables targeted interventions. Combined with the implementation of behavioural changes, this approach serves as an effective strategy to complement conventional pharmaceutical treatments. By integrating technology and lifestyle modifications, these innovations promise to improve patient outcomes and provide a more personalised approach to managing atrial fibrillation.

RELEVANCE

The management of atrial fibrillation is often limited to oral anticoagulants and antiarrhythmic drugs, both associated with serious side effects. Our system for identifying atrial fibrillation triggers serves two essential purposes. Firstly, it empowers patients to manage atrial fibrillation non-pharmacologically by identifying and controlling individual arrhythmia-triggering factors, reducing reliance on medications. Secondly, it provides a research tool to explore the physiological mechanisms behind each trigger, offering insights into atrialfibrillation's complexities. This dual approach promotes personalised care and advances understanding of the condition.

NOVELTY

The exploration of atrial fibrillation triggers has traditionally relied onquestionnaires, which are prone to confirmation and recall biases. A less biased approach has been proposed, linking atrial fibrillation triggers identified in long-term physiological signals to arrhythmia episodes. The system detects triggers such as physical exertion, stress, lying on the left side, and sleep disturbances in physiological signals. Additionally, it enables patients to log other potential triggers, such as alcohol consumption, through a dedicated mobile application, offering a more accurate and personalised management tool.

MORE INFORMATION

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Physiological Measurement, 2024, DOI: 10.1088/1361-6579/ad79b3

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PARTNERS

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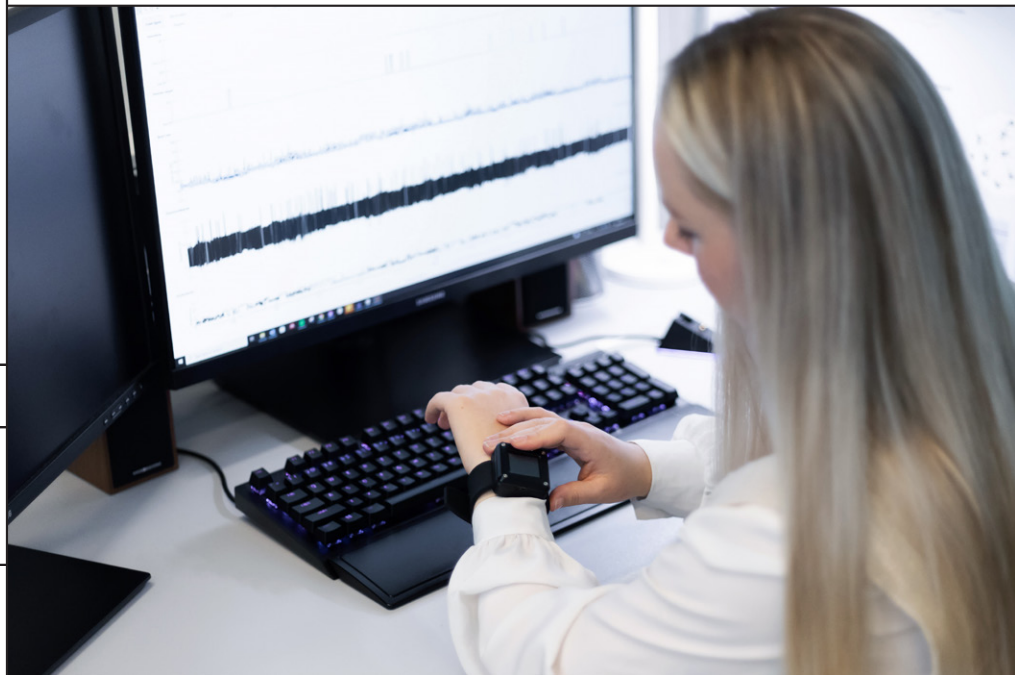

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New production processes, materials and energy efficiency

3 chapter

Advanced organic molecules for new generation solar cells

DESCRIPTION

Organic non-fullerene semiconductors capable of self-assembly and composed of naphthalenediimide central fragments have been developed as electron-selective materials for regular-structure (n-i-p) perovskite solar cells (PSCs).The self-assembled monolayer molecules contain phosphonic acid as an anchoring group, which allows covalent bonding with indium tin oxide surfaces. As a result, low-temperature processed n-i-p PSCs with these molecules as the electron-selective bottom contact exhibited a maximum power conversion efficiency of 21.5%, the highest efficiency among n-i-p PSCs with organic electron transport layers.

RELEVANCE

Researchers who previously developed record-breaking solar cells have expanded their invention by applying self-assembled monolayers (SAMs) in regular perovskite solar cells (PSCs). These self-assembling molecules form a single-molecule-thick layer, acting as an electron-transporting layer in solar cells. Earlier work focused on molecules facilitating positive charge transfer, significantly advancing next-generation solar cells. The next logical step is to develop analogous molecules capable of carrying negative charges and integrating them into PSCs, further enhancing their performance and efficiency.

NOVELTY

Generally, the class of organic electron transport layers is dominated by fullerene derivatives. Nonetheless, the application of fullerene-based electron transporting layers for solution processing is limited by the poor solubility of unmodified fullerenes in organic solvents. Moreover, synthesising and purifying modified fullerenes are challenging, necessitating complex and costly multistage processes. Naphthalenediimide-based small molecules offer favourable ETL properties, such as high electron affinity, electron mobility, and photochemical stability, coupled with simple synthesis procedures, which motivates the design of new electron-selective molecules.

MORE INFORMATION

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ACS Energy Letters, 2024, DOI: 10.1021/acsenergylett.4c00306

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High-Efficiency Perovskites on Flexible Substrates for Sustainable Applications (HEPAFLEX), 101122345, 2023-2027

PARTNERS

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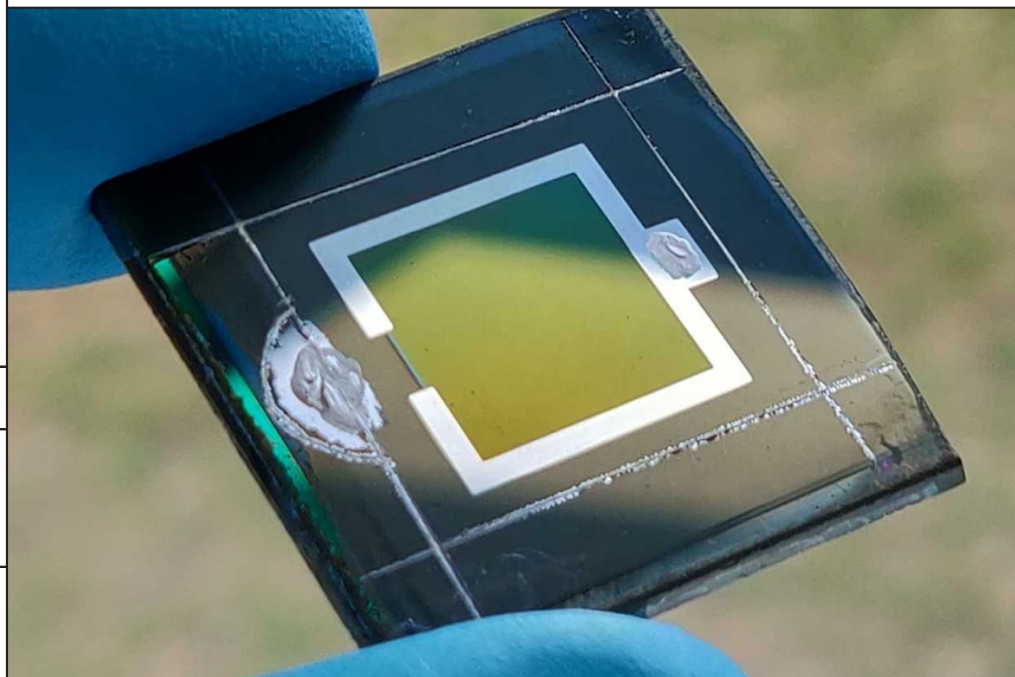

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Anti-fogging precise optical scales and limbs

DESCRIPTION

The objective of the project is the development of a technology capable of preventing fog formation on optical scales. The combined technique, which comprises a CF4/O2 gas mixture plasma nanotexturing of the glass surface and the deposition of a SiOx-containing diamond-like carbon film on the grating scale, followed by an O2 plasma treatment, was designed for the long-lasting protection of optical grating scales from fogging. An experimental study by project partner Precizika Metrology demonstrated that the proposed technique ensures the long-term functionality of the encoder with the optical grating scale below the dew point temperature.

RELEVANCE

Encoders are essential for measuring minute displacements, positions, and movement velocity in metrology instruments, motion systems, and precision machining tools. Optical scales offer the highest accuracy but can form a foggy coating when the environment nears the dew point, which disrupts or prevents signal registration. Magnetic encoders are less affected by environmental factors, but they are less accurate than optical scales. To ensure accurate measurements in humid environments, a new generation of non-fogging optical scales is necessary, offering both high precision and resilience against environmental influences.

NOVELTY

Superhydrophilic amorphous diamond-like carbon (DLC) nanocomposite films with SiOx were developed using advanced techniques. Atmospheric oxygen plasma treatment modified the films to achieve exceptional hydrophilicity. Reactive magnetron sputtering with a graphite target deposited SiOx films, resulting in contact angles of 4–6°. To prevent fogging of optical grating scales, a combined method was designed: CF4/O2 plasma nanotexturing of glass, SiOx-containing DLC film deposition, and O2 plasma treatment. This approach ensures durable hydrophilic performance and environmental resistance, advancing optical and material science.

MORE INFORMATION

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Anti-fogging precise optical scales and limbs (RASA), 01.2.2-LMT-K-718-03-0058, 2020-2023

PARTNERS

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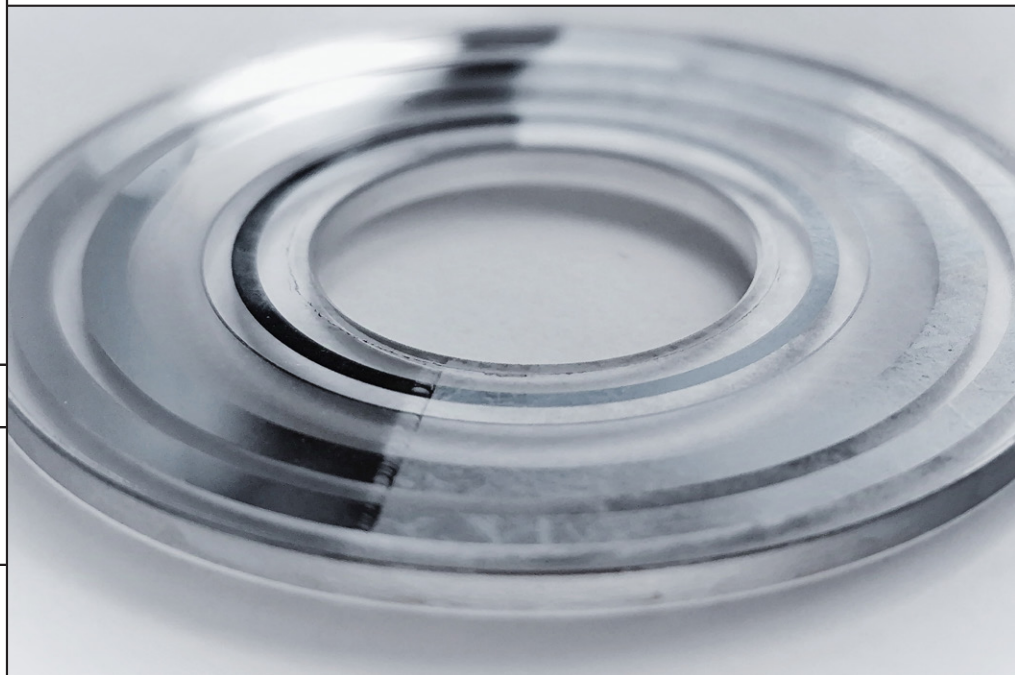

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Battery energy storage system and power-to-heat hybrid energy system: demonstration of synergy

DESCRIPTION

This project focuses on developing a hybrid energy system (HES) integrating power-to-heat (P2H), renewable energy sources (RES), energy storage, and advanced controls (BESS & P2H HES). The aim is to build a sustainable energy infrastructure that reduces dependence on conventional power while providing key services such as frequency restoration (mFRR/aFRR) and flexibility. Demonstrations highlight maximising local energy use, optimising economic efficiency through energy price arbitrage, balancing energy responsibilities, and delivering both balancing and flexibility services, showcasing a reliable, cost-effective approach to modern energy challenges.

RELEVANCE

The project seeks to highlight the importance of intelligent energy use at the local level, exploring strategies for cost optimisation and demonstrating the system's ability to adapt to fluctuations in solar power. Beyond local benefits, it emphasises the system's crucial role in enhancing the stability of the broader electricity grid. While validating its technical functionality, the project's core focus is to showcase the technology's economic viability and flexibility, making it adaptable to a wide range of applications and environments.

NOVELTY

Success in this venture promises to transform how we view and harness renewable energy, paving the way for a more sustainable and resilient future. By redefining energy practices, it encourages a shift toward environmentally conscious solutions that balance efficiency and reliability. This progress not only supports the transition to greener energy sources but also strengthens the foundation for a cleaner, more adaptable energy system, ultimately benefiting both communities and the planet.

PARTNERS

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Conceptual methodology for multi-apartment renovation with combined performance and life cycle approach

DESCRIPTION

We propose a novel methodology for describing the critical areas and actions needed for a full building renovation. The gathered data on key factors and indicators provides valuable insights into the renovation project. Although 26 indicators were initially proposed, the methodology is flexible, allowing for the addition or removal of indicators based on specific project objectives. The process includes comprehensive data collection through reviews, site visits, desktop studies, surveys, and stakeholder interactions. This data enables baseline appraisals, gap analysis, and the evaluation of various measures to assess their relevance and performance.

RELEVANCE

The proposed method can be employed as a decision-support tool to assess performance at both the planning and post-occupancy stages of building renovation projects. It provides valuable insights for optimising renovation processes and ensuring that all key factors are considered throughout the project lifecycle. Furthermore, the methodology is applicable to a wide range of users, including researchers, architects, consultants, operational and management teams, and authorities. By offering a comprehensive approach, it facilitates collaboration and ensures informed decision-making, improving project outcomes and long-term sustainability.

NOVELTY

The primary scientific novelty is the assessment of the environmental impact of renovated buildings through the utilization of life cycle analysis. This approach allows for a thorough evaluation of the environmental footprint, considering all stages of a building's life cycle. The methodology has been developed by integrating multi-decision criteria and life cycle assessment to evaluate the renovation of residential buildings. This comprehensive framework helps assess not only environmental sustainability but also economic and social factors, providing a holistic perspective for informed decision-making in building renovation projects.

MORE INFORMATION

Advances in Civil Engineering, 2022,
DOI: 10.1155/2022/9947920

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DOI: 10.3390/ su13031542

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MEMS based gas sensors with enhanced sensitivity and selectivity

DESCRIPTION

MEMS technology behind the gas sensor innovation enhances the specificity of gas detection while offering the cost benefits of point gas sensors in remote gas emission monitoring systems. It enables lower detection limits for environmentally significant gases such as carbon dioxide, methane, and other hydrocarbons. Additionally, it has paved the way for innovations in hydrogen slip detection. This technology is being applied in consumer products and as an integral part of environmental safety systems in the oil, gas, and mining industries.

RELEVANCE

Highly sensitive, autonomous, IoT-enabled, and cost-effective gas sensors with high detection specificity are crucial for improving quality of life and controlling environmental pollution. These sensors also drive technological advancements in personal and industrial safety, particularly in energy industries such as hydrocarbons, coal, and crude oil. The growing demand for methane and hydrogen slip sensors in transportation emphasizes their importance, especially as the energy sector shifts towards carbon-free production. Their ability to provide real-time data and enhance safety makes them vital for both environmental protection and industrial innovation.

NOVELTY

The microelectromechanical system (MEMS) invented by us consists of electrostatically actuated micromembranes, which are enhanced with polymers, graphene oxide, and mesa materials. This innovative design ensures exceptional sensitivity and selectivity, allowing the device to distinguish between chemically similar gases such as CO2, SO2, CH4, and others with great precision. Offering sub-part per million sensitivity, high specificity, and low production costs, our technology significantly outperforms the conventional gas sensors currently used, providing a more efficient and cost-effective solution for various applications.

MORE INFORMATION

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Sensors and Actuators B: Chemical, 2023, DOI: 10.1016/j.snb.2023.134178

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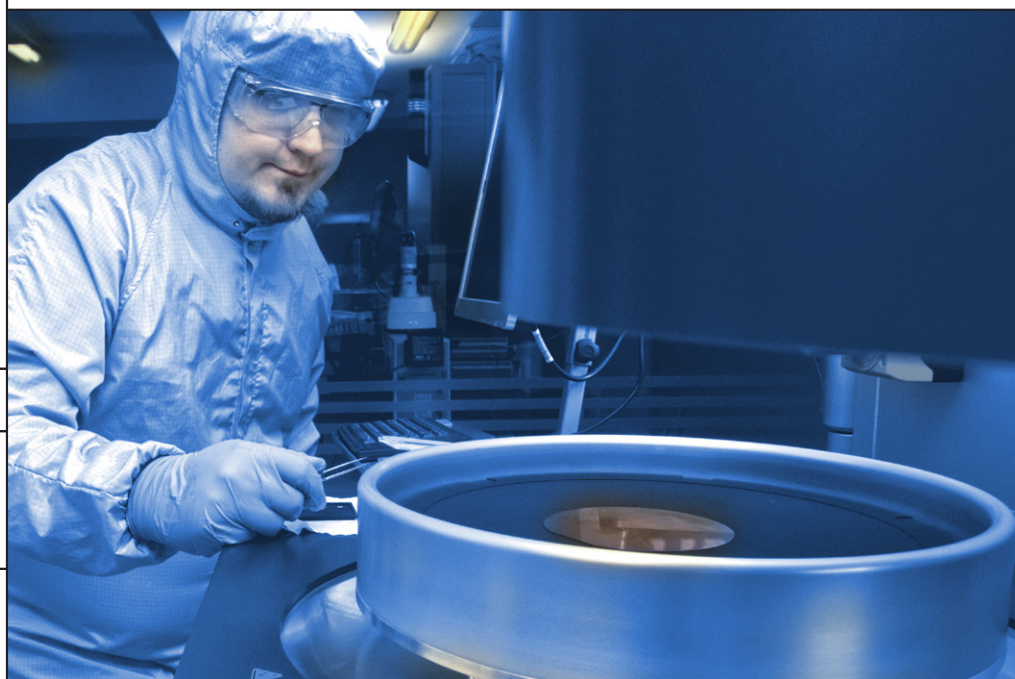
European Sails Award 2023

PARTNERS

Orius Tech (Lithuania)



CONTACT PERSON

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Nanoparticle lattices for sensing, lasing, photocatalytic, and anticounterfeiting applications

DESCRIPTION

The Capillary-assisted particle assembly (CAPA) technology evolved from research into a start-up, offering products like monodisperse nanoparticles, assembly templates, the CAPA device, wavelength-tailored SERS substrates, and nanolasers. Plasmonic nanoparticle lattices, or metasurfaces, were created through colloidal self-assembly onto soft lithography replicated elastomer templates over 1 cm^2. Noble metal nanoparticle lattices couple localized surface plasmons into high-Q surface lattice resonances, enabling applications like nanolasing, Raman scattering enhancement, and photocatalysis.

RELEVANCE

The detailed silver nanoparticle colloid studies, nanoparticle deposition into regular two-dimensional nanostructures employing CAPA, design and investigation of surface lattice resonance (mixed mode of localised surface plasmon resonance and light diffraction in a regular structure), and manifold of practical plasmonic lattice applications were explored including sensing, lasing, photocatalytic, and anticounterfeiting. Seeded growth in wet nanoparticle synthesis ensured precise average size control, high monodispersity, and reproducibility of plasmonic nanoparticles empowered a range of top-down-made photonic devices.

NOVELTY

The theoretical and experimental studies of surface lattice resonance in plasmonic lattices made from capillarity-assisted assembled silver and gold nanoparticles led to (i) the creation of wavelength-tailored surface-enhanced Raman scattering substrates with over 100 times higher sensitivity at the target excitation wavelength, (ii) a novel approach for a surface lattice resonance-based plasmonic nanolaser with a lower lasing threshold than lithography-made counterparts, and (iii) a patented method using laser-modified nanoparticle arrays for anticounterfeiting.

MORE INFORMATION

Patent, 2023, JP 7238226 B2

Patent, 2022, US 2022314682 A1

Patent application, 2022, EP 4067102 A1

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2D regular nanostructures for lasing and sensing applications (LaSensA), project8238, 2021-2024

Ultrasensitive sensors for the detection of Lithium Ion Batteries fails (NanoTRAACES), MERANET-22-2, 2022-2025

PARTNERS

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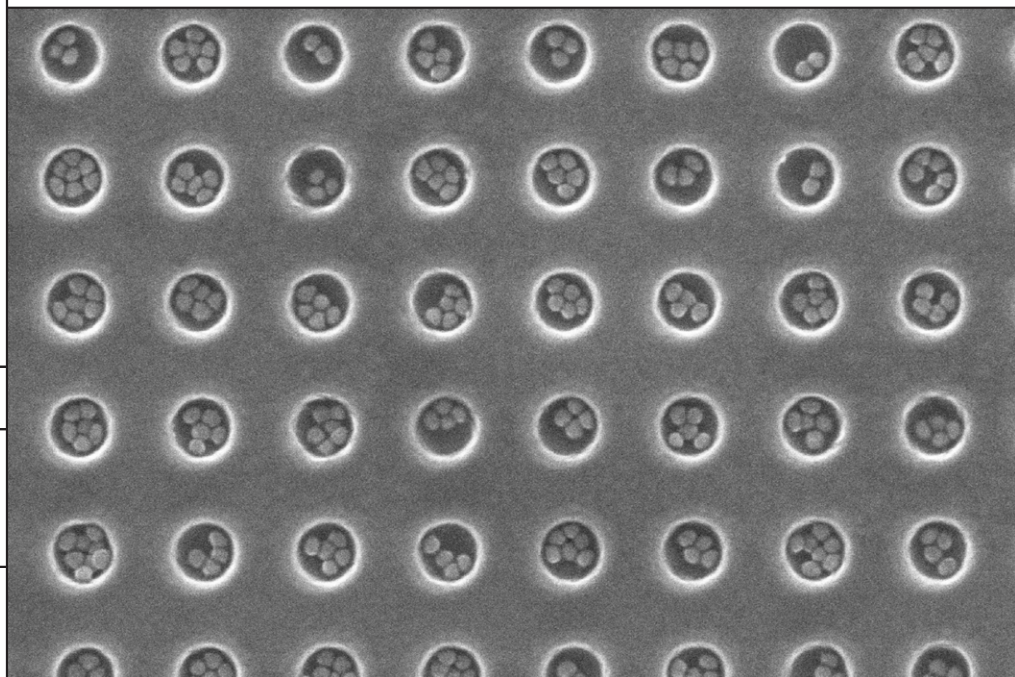

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Organic radicals for photovoltaic applications

DESCRIPTION

Stable radicals with a trityl carbon-centered moiety exhibit blue-shifted anti-Kasha doublet emission, high colour purity, and notable photoluminescence quantum yields. Their blue emission defies the Kasha rule by originating from higher excited states. These radicals efficiently passivate interfacial defects and enhance charge extraction when used as interlayer materials in perovskite solar cells. As a result, the cells achieve power conversion efficiencies exceeding 21%, alongside significant improvements in open-circuit voltage and exceptional long-term stability, demonstrating their potential to enhance both performance and durability in perovskite-based devices.

RELEVANCE

Studies on the application of stabilised radical molecules in perovskite solar cells are scarce. This study aimed to determine the role of the novel stable radicals as materials for hole-selective and interfacial layers of perovskite solar cells. The improvement in device performance was observed and the potential mechanisms underlying this improvement were explained. The results demonstrate the significant increase in stability of the perovskite solar cells containing radical compounds designed and synthesised by the research team. Our study is an important contribution to understanding the physical phenomena occurring at the perovskite-organic interfaces.

NOVELTY

The radical compounds can outperform currently used materials due to (i) the ability of active radical centers to form C(radical)-Pb bonds or attract uncoordinated Pb2+ ions, caused by geometrical deformations at the interface, and (ii) the tendency of the radical compounds to be reduced due to significant electron affinities ranging from 4.28 to 4.47 eV. The novelty of this work lies in the proposed device structure, where radical compounds are deposited below the perovskite layers in an inverted device structure. This approach enhances perovskite growth, reduces defects at the interface, and improves device performance.

MORE INFORMATION

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Self-assembling donor-acceptor materials for efficient electroluminescent devices, 01.2.2-LMT-K-718-03-0019, 2020-2023

PARTNERS

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System for the formation of microstructures in polymeric materials

DESCRIPTION

Our invention comprises a system for forming microstructures in polymeric materials. It includes a magnetostrictive vibrator, a sonotrode, a generator, a clamping mechanism, and a material tray. The magnetostrictive vibrator includes a core with two windings: the first is for achieving the magnetisation level of the magnetostrictor, while the second is for exciting the high-frequency oscillations in the magnetostrictor. The generation of high-frequency oscillations results in the heating of the sonotrode through the induction of eddy currents. A control unit regulates vibration and temperature via electrical signals, ensuring precise control of the polymer forming process.

RELEVANCE

This invention advances micro-electromechanical systems (MEMS) fabrication in healthcare, automotive, and electronics industries. As demand for miniaturisation and enhanced functionality grows, traditional piezoceramic methods face thermal and control limitations. This system overcomes these challenges by enabling intricate microstructure formation in polymers at high temperatures, expanding MEMS design possibilities. Its precise vibration and temperature control also support cleaner, faster, and more cost-effective production, aligning with the shift toward sustainable and innovative manufacturing techniques.

NOVELTY

Our invention aims to transform micro-electromechanical systems (MEMS) fabrication in healthcare, automotive, and electronics. With growing demand for miniaturisation and enhanced functionality, traditional piezoceramic methods face limitations due to thermal constraints and complex controls. This innovative system enables intricate microstructure formation in polymers at high temperatures, expanding MEMS design possibilities. Additionally, its precise vibration and temperature control supports cleaner, faster, and more cost-effective manufacturing, aligning with the shift toward sustainable and efficient production processes.

MORE INFORMATION

Patent, 2024, EP 4166245 B1

Patent application, 2024, EP 4368565 A1

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Ultrasound spectroscopy sensor for plant physiology studies

DESCRIPTION

The sensor is based on the physical parameters of the leaf determined by non-contact (air-coupled) ultrasonic spectroscopy, such as thickness, density, speed of sound waves, and frequency dependence of attenuation. The physical properties of the leaf correlate with the physiological state of the plant. The technique is successfully used to study the physical parameters of films and membranes. Sensor data is transmitted to the cloud for processing, with geolocation, photos and other information attached. Processed and stored in a cloud platform for generating parameter maps and time graph reports.

RELEVANCE

Drought is a growing challenge every year, affecting up to 55 million people worldwide and posing a major threat to animals and plants. Drought stress leads to biochemical and physiological changes in plants, reducing nutrient availability and damaging the ecosystem, thus affecting human health and creating vulnerability to livelihoods. Timely information on the physiological status of the plant is important to prevent disease, pests, climate change or pollution damage. The sensor provides information on the physiological status of the plant.

NOVELTY

Key technological innovations include wide bandwidth and high-energy signals, enabling precise data acquisition and enhanced performance across various applications. Efficient and compact electronics ensure seamless signal capture, optimising system size and energy consumption without compromising accuracy. Moreover, full automation of measurements and inverse solution processing guarantees faster, more accurate, and highly reproducible results, improving overall efficiency and reliability.

MORE INFORMATION

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DOI: 10.1109/ACCESS.2024.3509732

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DOI: 10.1109/JSEN.2024.3369508

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ZnO tetrapod synthesis, thin film formation and application for sensing and antireflection coatings

DESCRIPTION

Multifunctional coatings based on ZnO nanoparticles were developed, incorporating a novel method for large-scale synthesis and coating formation. These coatings were applied in two distinct contexts: a) as a solar panel multifunctional coating, providing self-cleaning properties, reducing reflection, and converting UV rays into visible light; and b) as a multifunctional gas sensor, which is sensitive, selective, and light-activated, thus requiring low power. Both devices are adaptable to any surface, offering versatile solutions for a wide range of applications, enhancing energy efficiency and environmental sustainability.

RELEVANCE

Our key innovation, commercialised via the spin-off Zinotech, is a self-cleaning coating for solar panels and windows. It reduces cleaning costs and improves panel efficiency, increasing electricity generation, which boosts solar plant profitability and reduces the payback period. Environmentally friendly, the coating uses an eco-conscious production process and minimizes detergent use. It can also be applied to facades, windows, and other surfaces, offering significant potential for energy savings, sustainability improvements, and cost reductions across various applications, making it an effective solution for a range of industries.

NOVELTY

The synthesis and deposition technology of ZnO nanoparticles offers key novelties, enabling high-yield production of tailored ZnO nanostructures for specific functions. It serves as an innovative platform for sensing applications like UV detection, gas sensing, and biosensing, expanding its potential across various fields. The technology also supports self-cleaning coatings, enhancing solar panel efficiency and reducing maintenance. Additionally, its controlled self-assembly techniques hold promise for advanced electronics, including sensing systems and neuromorphic computing applications.

MORE INFORMATION

Patent, 2023, JP 7238226 B2

Patent, 2022, US 2022314682 A1

Patent application, 2022, EP 4067102 A1

Journal of Materiomics, 2024, DOI: 10.1016/j.jmat.2023.08.009

Nanoscale Horizons, 2024, DOI: 10.1039/D4NH00263F

Sensors and Actuators B: Chemical, 2023, DOI: 10.1016/j.snb.2023.134418

2D regular nanostructures for lasing and sensing applications (LaSensA), project8238, 2021-2024

Ultrasensitive sensors for the detection of Lithium Ion Batteries fails (NanoTRAACES), MERANET-22-2, 2022-2025

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