

9th Innovation &  
Entrepreneurship Forum

# ***WHAT DOES IT TAKE TO SCALE UP A BUSINESS?***

***The Importance of Management Capital***

IEF 2024 | November 28





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Entrepreneurship Forum

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SCALE UP A BUSINESS?***

***The Importance of Management Capital***

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This booklet was prepared by the **Centre for Entrepreneurship of the University of Cyprus and the Research and Innovation Support Service.**

**Editorial Team:** Andreas Soteriou, Anastasia Constantinou, Pantelitsa Eteokleous, Christiana Karkoti, Constantinos Savvides

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What Does It Take to Scale Up a Business? The Importance of Management Capital. Any arguments, findings, conclusions expressed in this booklet do not necessarily reflect the views of the Centre for Entrepreneurship, nor do they guarantee the accuracy of data and information provided by the included work.

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## WELCOME MESSAGE

### From Rector Tasos Christofides

Dear all,

It is my pleasure to welcome you to the University of Cyprus and the 9th Innovation & Entrepreneurship Forum.

We are grateful for the long-lasting partnership and support of our major sponsor, PwC

Cyprus. Their commitment has been invaluable to the Center for Entrepreneurship and the University of Cyprus, helping us bring this forum to life and supporting our mission to empower innovation across our community.

Since its inception in 2015, the Center for Entrepreneurship has been a pioneering force within the university, serving as a bridge between academic exploration and real-world entrepreneurial pursuits.

Our efforts over the past eight years reflect our mission to empower students, researchers, faculty, and staff, nurturing the skills and knowledge necessary to lead in creative, entrepreneurial endeavors. Through a variety of initiatives, we foster an ecosystem where innovative ideas can evolve into impactful ventures.

This year's theme, scaling up a business, addresses a critical growth phase in the entrepreneurial journey. Building a business is no small feat, but scaling it to sustainable profitability, often within global markets, is a challenge that requires specialized management capabilities. Effective scaling depends not only on a robust business model but also on the strength of its management team and the strategic deployment of resources. This is precisely what we aim to explore today—how the right management capital can turn potential into progress and vision into lasting impact.

We are honored to have Dr. Nicodemos Damianou, Deputy Minister of Research,

Innovation and Digital Policy, who will deliver a special address on the national perspective on innovation and the strategic importance of digital transformation in scaling Cypriot businesses on the global stage.

On this occasion, I would like to emphasize the importance of investing in basic research, having a long-term and an ambitious vision for our contribution to the future generations.

Dear Minister, you are aware of our strong stance on this matter, which we stressed on many occasions. Investment in basic research is an important factor for a truly impactful innovation.

Additionally, we are honored to welcome Professor Stelios Kavadias as this year's keynote speaker for the PwC Distinguished Lecture.

An expert in entrepreneurship and strategy, Professor Kavadias brings a wealth of knowledge on guiding businesses through growth and innovation. He will be joined by a distinguished panel of experts, each sharing insights into the factors that contribute to scaling up successfully.

We will also showcase the finalists of the Cyprus Entrepreneurship Competition, an initiative by the Center for Entrepreneurship with support from the Ministry of Energy, Commerce, and Industry. This competition accelerates promising new ventures by providing resources, mentorship, and training, positioning them for success within the local and global economies.

During the break, we invite all guests to visit the Research Exhibition, where recent projects and innovations from across the University of Cyprus will be displayed. This exhibition provides a unique opportunity to explore the breadth of research underway at our institution, highlighting the pioneering spirit and innovative efforts of our academic

community.

Through forums like these, the University of Cyprus remains committed to supporting cultural, social, and economic advancement across our nation. We believe that progress comes through the creation of new knowledge and through inspiring our graduates to drive innovation in our economy, society, and cultural pursuits.

Today's discussions reflect this commitment, and I am confident that the insights shared

here will be both enlightening and inspirational, equipping each of us with valuable

perspectives on scaling businesses effectively.

Thank you for joining us, and I wish you all a productive and engaging experience at the 2024 Innovation & Entrepreneurship Forum.

Professor Tasos Christofides,

Rector,

University of Cyprus

## FOREWORD

### From the Director of C4E

It is with great pleasure and excitement that I welcome you to the 9th Entrepreneurship and Innovation Forum held at the University of Cyprus. It is a great honor for our Center of Entrepreneurship (C4E), to host and organize this exciting recurring event, that brings together a remarkable assembly of seasoned entrepreneurs, industry leaders, policy makers, researchers, students and, of course, aspiring innovators.

Over the years, this Forum has grown into a proud tradition and has become a cornerstone of our Centre's mission: to inspire and educate on issues that can bring about economic and social impact, and to help connect the next generation of visionary entrepreneurs, researchers, leaders and changemakers. This year, the Forum's theme is centered around the challenges of Scaling-Up, a critical and exciting phase in the entrepreneurial journey. Entrepreneurship is not just about starting a business; it's about building and shaping sustainable and impactful ventures. Scaling up is not just a growth phase; it is a phase where vision meets execution, and opportunities meet challenges. The path to growth is almost never an easy one; it is often filled with nothing but obstacles—whether it be managing capacity and resources, navigating markets, accessing more funding, building the necessary and effective teamwork, or maintaining a company's culture, all while expanding. Our mission is to empower our researchers, students and the broader entrepreneurial community with the tools, insights, and networks necessary to overcome these hurdles and achieve sustainable growth.

To this end, we are grateful and honored to have with us the Deputy Minister of Research, Innovation and Digital Policy, Dr. Nikodemos Damianou, whose keynote will provide us with important policy and strategy insights. The Director of the Centre of Entrepreneurship of the University of Cambridge, Professor Stylianos Kavadias, will deliver the PwC Distinguished lecture, sharing with us insights and perspectives on Scaling Up and addressing related challenges from his own experiences at Cambridge. In the panel discussion of experts that will follow, which will be moderated by Professor George Kassinis, these challenges will be explored further. Joining our speakers in the

discussion and sharing their experiences will be Mr. Philippos Soseilos, CEO & Chairman, PwC Cyprus, Ms. Maria Tsiakka Olympiou, General Manager at Tsiakkastel Office Line Ltd & Chairman of the BoD of CYTA, and Ms. Despina Panayiotou Theodosiou, CEO Tototheo Global.

Alongside the keynote, lecture and the panel discussion, the Research Results Exhibition, organized by the Research and Innovation Support Service, showcases impressive groundbreaking research work from various Centers of Excellence and research groups across the University of Cyprus, that have attracted millions of euros from EU funds. By highlighting projects with high commercialization potential, we aim to connect innovative research with entrepreneurs, investors, and industry experts who can help bring these ideas to market, solve real problems and drive progress and economic growth. I encourage you to spend some time, meet our researchers, engage with their projects and ideas, and explore potential partnerships and possibilities.

This Forum also serves as the culmination of the highly anticipated Cyprus Entrepreneurship Competition CyEC 2024. Ten promising finalists, ten unique ventures with potential to make a significant impact, are now reaching a significant milestone in their transformative journey; a journey to which they committed a few weeks ago, with the help and guidance of our business mentors and trainers, who contributed their time and expertise to help accelerate the teams' progress, and to which, of course, we are grateful.

In the following pages of this booklet you will also find short descriptions of the research projects highlighted at this year's Forum and a short description of the business models of the Cyprus Entrepreneurship Competition finalists.

We are grateful to all the individuals and organizations that worked closely with the Centre for Entrepreneurship and the Research and Innovation Support Service of the University of Cyprus to bring about this multifaceted event.

Most importantly, I would like to extend our gratitude to our corporate sponsors and



especially to our major sponsor, strategic partner and long-term collaborator of the Centre for Entrepreneurship and University of Cyprus, PwC Cyprus, as well as to the Ministry of Energy Commerce and Industry, main sponsor of the Cyprus Entrepreneurship Competition.

Ladies and Gentlemen, as we move through the Forum's activities, I invite you to think and reflect on the main insights and conclusions. Scaling up helps us dream bigger, research drives us to push boundaries, awards can help recognize the passion that powers it all. I am hoping that this forum will inspire new connections, collaborations, and ideas that continue to push the limits of what we can achieve together. Thank you, and welcome to the Forum of Innovation and Entrepreneurship!

Professor Andreas Soteriou

Director,

*C4E*

## ABOUT THE ORGANIZER

### The Centre for Entrepreneurship

The Centre for Entrepreneurship (C4E) of the University of Cyprus (UCY) aspires to:

- foster a culture of innovative entrepreneurship within the University and to develop relevant in-house expertise;
- provide the entire University community with high-quality services and the connections required to bring scientific innovations and novel ideas produced inside the University to global marketplaces and
- contribute to the creation of a sustainable innovation ecosystem in Cyprus. C4E strives to provide the training, expertise, mentorship, support and connections that UCY's students and young scientists need to become effective entrepreneurs.

C4E considers Entrepreneurship in its broadest sense, namely as a mind-set in scientific and scholarly work that embraces creativity, critical thinking, imagination, risk-taking and the bold experimentation with new ideas and transformative scientific approaches.

C4E aspires to turn new knowledge into real "value" that can serve the common good through novel products, processes and services, implemented by new or existing ventures, private or public organizations, governmental institutions or non-governmental initiatives.

C4E serves the entire University of Cyprus community, namely undergraduate, postgraduate and doctoral students, researchers and young scientists, faculty, and staff. Beyond the University, we contribute to the emergence of Cyprus' "start-up" ecosystem, participating in relevant initiatives and liaising with people and support structures, such as accelerators, incubators and makerspaces.

We promote the uptake of innovative results, the exploitation of scientific know-how and the use of advanced research infrastructures of UCY by existing private and public organizations, contributing to the competitiveness and growth of the Cypriot economy. We work with policy makers and the government to promote policies that support research, innovation, and entrepreneurship. We invite alumni to participate and contribute to our activities. We engage the Cypriot diaspora of entrepreneurs and

institutions or non-governmental initiatives.

C4E serves the entire University of Cyprus community, namely undergraduate, postgraduate and doctoral students, researchers and young scientists, faculty, and staff. Beyond the University, we contribute to the emergence of Cyprus' "start-up" ecosystem, participating in relevant initiatives and liaising with people and support structures, such as accelerators, incubators and makerspaces.

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Our Guiding Principles comprise the pursuit of excellence, an emphasis on collaboration, networking and mentorship, a philosophy of experimentation, embracing diversity and pursuing honesty and transparency.

# PARTNERS

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Organizer



Strategic Partner



Research Results Exhibition Organiser



Forum Sponsor



CyEC Partners



CyEC Sponsor



Website Sponsor



IREROBOT



# AGENDA

<b>IEF 2024 Keynote And Discussion</b>		<b>Auditorium B108 (Basement) Anastasios Leventis Council &amp; Senate Building University of Cyprus</b>
09:45 - 09:50	Opening remarks, Professor Andreas Soteriou - C4E Director	
09:50 - 09:55	Welcoming Note, Professor Tasos Christofides - Rector of the University of Cyprus	
09:55 - 10:00	Welcoming Note, Philippos Soseilos – CEO PwC Cyprus & President of PwC Foundation	
10:00 - 10:10	Keynote speech, Dr. Nicodemos Damianou - Deputy Minister of Research, Innovation and Digital Policy	
10:10 - 10:45	The PwC Distinguished Lecture, Professor Stelios Kavadias - Co-Director of the Entrepreneurship Centre, University of Cambridge «What does it take to Scale up a business? The Importance of Management Capital»	
10:45 - 11:00	Q&A	
11:00 - 12:00	Panel Discussion	
12:00 - 14:30	Networking Lunch and Research Exhibition The Research Exhibition will be opened to the public from 11:30 until 17:30	
<b>The CyEC 2024 Session</b>		<b>Auditorium B108 (Basement) Anastasios Leventis Council &amp; Senate Building University of Cyprus</b>
<b>CyEC 2024 Finalists Pitching presentation</b>		
14:30 - 14:35	Welcoming Note, Minister of Energy Commerce and Industry	
14:35 - 16:30	Pitching Session (10 teams)	
16:30 - 17:00	Launch Pad	
17:00 - 17:20	Awards Ceremony	
17:30 - 19:30	VIP Cocktail	

## PwC DISTINGUISHED SPEAKER



**Stylianos Kavadias**

Margaret Thatcher Professor of Enterprise Studies in Innovation & Growth

**“What does it take to Scale up a business? The Importance of Management Capital”**

### Bio

Diploma (National Technical University of Athens),

MSc, PhD (INSEAD)

His research interests include strategy operationalisation, deployment, and execution through innovative business models and processes. He studies larger corporates as well as smaller companies and startups, utilising different methodologies ranging from qualitative case research to lab experiments, econometric analysis, and mathematical economic modelling.

Stylianos Kavadias is a member of the Operations and Technology Management subject group at Cambridge Judge Business School, which focuses on practice-based research through partner organisations to address a wide spectrum of management challenges.

## KEYNOTE SPEECH



**Nicodemos Damianou**

Deputy Minister of Innovation, Research and Digital Policy

### Bio

Mr Nicodemos Damianou was born in Lefkosia in 1973.

He holds a Sc.B Degree in Computer Science from Brown University USA, a Ph.D in Computer Security & Policy-based Management of enterprise-wide Computer Networks from Imperial College UK, a Diploma of Information Security from Imperial College, and an MBA from the University of Cyprus.

He is an IT and Information Security professional with many years of experience in Payment Systems and Fintech, Risk Management Methodologies and Digital Transformation Technologies.

He served at managerial positions within the Bank of Cyprus Group. From November 2017 to January 2024 he was the General Manager of JCC Payment Systems Ltd.

He is married to Rodoula Damianou and has two daughters, Eleni and Sophia.

## PANEL

### “CHALLENGES OF SCALING UP”

#### COORDINATOR



**George Kassinis**  
Professor, University of Cyprus

#### PANEL MEMBERS



**Philippos Soseilos**  
CEO & Chairman, PwC Cyprus



**Maria Tsiakka Olympiou**  
General Manager at Tsiakkastel Office Line Ltd



**Stylianos Kavadias**  
Margaret Thatcher Professor at Cambridge Judge Business School



**Despina Panayiotou Theodosiou**  
CEO Tototheo Global



**Nicodemos Damianou**  
Deputy Minister of Innovation, Research and Digital Policy



2024





The background is a dark teal color with several overlapping, organic, light teal shapes that create a sense of depth and movement. In the bottom left corner, there are several thin, white, wavy lines that resemble a topographical map or a stylized landscape.

# **CYPRUS ENTREPRENEURSHIP COMPETITION**





The Cyprus entrepreneurship competition (CyEC) is a startup competition designed to help early-stage entrepreneurs transform their ideas into world-changing companies. Participants will have the unique opportunity to develop their ideas, grow their business skills and network through a series of carefully designed workshops by local and international partners, mentoring sessions, and networking events.

Our focus is on sustainable solutions that respond to real and global challenges through entrepreneurship, technology and innovation and have the potential to compete on a global scale.

We are looking for ambitious teams who want to develop their ideas quickly and who are both agile and adaptive in pursuit of finding the best problem solution and product-market fit.

**Team/Start-up Name**

NEEMA Labs

**Team members**Angelos Evangelou,  
Michalis Georgallas

Sector	Business Model
Sustainable Materials	B2B


**Business Idea**

NEEMA (Nature Enhanced Engineering Materials) is an innovative startup focused on the valorization and exploitation of natural and naturally derived materials to develop high-value products. NEEMA's flagship product, VELO, is a 100% bio-based "vegan leather" made from the trimmings of Prickly Pear (Opuntia) cactus. VELO is currently in the prototype phase and aims to provide a sustainable alternative to traditional leather, targeting SMEs and craftsmen in the leather goods industry with plans for expansion to larger segments like fashion designers and automotive manufacturers.

**Team/Start-up Name**

GLOBAL IFRS NAVIGATOR

**Team members**Frixos Zempylas,  
Andreas Angelides,  
Constantina Georgiou,  
Maria Michaelidou

Sector	Business Model
FinTech	B2B

**Business Idea**

Global IFRS Navigator is a SaaS platform designed to provide expert guidance on International Financial Reporting Standards (IFRS). This innovative solution leverages advanced machine learning and natural language processing (NLP) techniques, fine-tuned on a proprietary dataset, to deliver precise and context-aware advice on complex IFRS topics in multiple languages. Our focus on providing multilingual, context-aware advice uniquely positions us to serve the global accounting sector, addressing their compliance challenges with ease and accuracy.

**Team/Start-up Name**

AEOTECH

**Team members**

Poss Kondeatis, Alex Fanthome

Sector	Business Model
EdTech	B2B


**Business Idea**

Aeontech is developing AEONS, a versatile digital encyclopedia app for primary school teachers and students. AEONS is designed to bridge gaps in early education, particularly in history and geography, and promote critical thinking and analysis. Its Google Earth-like globe interface makes exploring the world through time easy and engaging, especially for neurodivergent and neurotypical learners. Optimized for low-power devices and digital whiteboards, AEONS aims to bring high-quality, low-cost education to schools globally, focusing on accessibility and inclusivity.

**Team/Start-up Name**

OASISXR

**Team members**Polys Chrysouliotis,  
Markos Demetriou**Sector**Spatial  
Computing  
XR/VR**Business Model**

B2B


 The logo for OasisXR features the word "oasis" in a bold, lowercase, sans-serif font, followed by "XR" in a smaller, uppercase, sans-serif font. The text is dark blue and set against a white background within a yellow-bordered box.
**Business Idea**

OasisXR allows users to create and share spatial experiences within hours without coding or a PC. Users can upload content like photos, videos, documents, and 3D scans via a smartphone app and manipulate objects using hand gestures and voice commands in a VR headset (Quest 3). AI tools generate additional content like 3D objects, backgrounds, and interactive characters, making it easy for individuals and businesses to enter the XR/Spatial market.

**Team/Start-up Name**

GROOVIT

**Team members**Iraklis Fragkos,  
Constantinos Toumbas,  
Giorgos Constantinou,  
Panayiotis Savva,  
Konstantinos Yiasemi**Sector**

FinTech

**Business Model**

B2B


 The Groovit logo consists of a circular icon on the left, made of horizontal lines of varying lengths that create a sense of rotation or a stylized 'G'. To the right of the icon, the word "Groovit" is written in a clean, sans-serif font. The entire logo is centered within a green-bordered box.
**Business Idea**

Groovit is a marketplace for curated music, connecting DJs with businesses to manage their background music. DJs can take full responsibility for a venue's music, allowing business owners to save time while ensuring high-quality, personalized audio experiences. Through subscription fees, DJs earn steady income by providing tailored music that aligns with each business's brand and atmosphere. The global accounting sector, addressing their compliance challenges with ease and accuracy.

**Team/Start-up Name**

IPC (IDEAL PORTABLE COOLING)

**Team members**Constantinos Charalambous,  
Nicos Angastiniotis,  
Evangelos Samiotis,  
Savvas Temereas**Sector**

Sustainability

**Business Model**

B2B2C


 The IPC logo features a stylized blue snowflake or starburst icon at the top. Below it, the text "IPC (Ideal Portable Cooling)" is written in a blue, sans-serif font, followed by the tagline "The Cleaner It Gets" in a smaller font. The logo is centered within a yellow-bordered box.
**Business Idea**

IPC offers an innovative solution for cooling and refrigeration without traditional mechanical components like compressors. The system uses natural heat exchange with the environment and solar radiation to provide a sustainable, energy-efficient cooling method. This product, which generates cooling without a carbon footprint, is initially targeting portable cooling applications, with plans for broader applications in various industries.

**Team/Start-up Name**

ELYSIA SOLUTIONS

**Team members**Evangelia Athanasiou,  
Katerina Rigana, Samuel Håkansson,**Sector**

Digital Health

**Business Model**

B2B2C

**Business Idea**

Elysia Solutions is a digital platform that provides personalized health recommendations based on individual biomarkers. We leverage a causal approach to identify the most effective interventions to improve longevity, rather than relying solely on population averages. By analyzing unique biological data, we suggest tailored lifestyle changes such as dietary adjustments, exercise routines, or supplements to optimize health and well-being.

**Team/Start-up Name**

RENTIE

**Team members**Zenon Chrysostomou,  
Panagiotis Andreou**Sector**Real Estate  
Technologies**Business Model**

B2B2C

**Business Idea**

Rentie is a full-service platform that simplifies property management and enhances tenant-landlord relationships by streamlining listings, legal agreements, payments, accounting, communication, and maintenance in one place. It provides a comprehensive solution for the entire rental lifecycle, eliminating the need for multiple third-party services and improving both tenant satisfaction and landlord efficiency.

**Team/Start-up Name**

WATTZ

**Team members**

Andreas Panayi, Sotiris Kyprianou

**Sector**Renewable  
Energy**Business Model**

B2B and B2C

**Business Idea**

Wattz is a platform that allows anyone to easily invest in renewable energy projects by tokenizing renewable energy assets using blockchain technology. The platform enables businesses to transition to renewable energy affordably, while offering retail investors the opportunity to invest in renewable energy projects for financial gains and environmental impact. Wattz is in the MVP stage, with future features including a peer-to-peer marketplace and AI-based energy forecasting.

**Team/Start-up Name**

PRAGMA BIOTHERAPEUTICS

**Team members**

Juliana Saavedra, Paula Bucci,  
Georgina Cardama, Juan Garona,  
Daniel Alonso, Diana Arcila

**Sector**

Biotechnology

**Business Model**

B2B

**Business Idea**

Pragma Biotherapeutics is an innovative startup that harnesses the power of biotechnology, nanotechnology, rational design, and artificial intelligence to create advanced topical drug delivery systems. Our mission is to transform the landscape of topical treatments by providing more effective and safer solutions for a diverse range of dermal and mucosal conditions. Our specialization lies in the design and formulation of vehicles and excipients that are meticulously crafted to optimize the delivery of drugs and active ingredients.

2024





# RESEARCH RESULTS EXHIBITION

- Medical and Biomedical Innovations
- Energy, Environment, Materials and Manufacturing
- Smart Infrastructure and Urban Management
- Advanced Computing and Artificial Intelligence





## **Innovation Management Sector, Research and Innovation Support Service (UCY)**

The Innovation Management Sector is the third pillar of the Research and Innovation Support Service at the University of Cyprus (UCY). The Sector plays a central role in providing IPR protection, management and valorisation services, developing policies, and supporting initiatives that transform research into impactful innovations. Its mission is to empower the UCY research community to realize the commercial and societal potential of their research work and intellectual outputs. Notable initiatives are the bi-annual Research Results Exhibition at the annual Innovation and Entrepreneurship Forum (IEF) organised by the Centre for Entrepreneurship, coordination of the participation of UCY in the Pan European Seal Programme, support in entrepreneurial innovation development activities etc. In the 2024 edition of the Research Results Exhibition, 22 projects from UCY's research centres, labs, and departments are showcased. The projects span four broad categories: Medical and Biomedical Innovations; Energy, Environment, Materials, and Manufacturing; Smart Infrastructure and Urban Management; and Advanced Computing and Artificial Intelligence, with technology readiness level (TRL) above 3.

The Sector also offers critical support in Intellectual Property Right (IPR) protection and management, industry collaboration agreements, and entrepreneurial innovation development, ensuring that pioneering work from UCY has pathways to sustainability making real business and societal impact. Through its Knowledge Valorisation services, it identifies intellectual property rights (IPR) from research results, provides support for IP protection and management, and develops strategies to maximize the valorisation potential. Additionally, the Sector supports the research community with participation in innovation-intensive funding programmes and through its Research & Innovation Contracts service, streamlines collaboration with business & industry by supporting the development and negotiation of agreements for Research Collaboration, Contract Research, Sponsored Research, Research & consulting and the licensing of UCY IPR. The sector develops and implements the policies and guidelines related to Innovation, from the IPR protection and management to the valorisation of research results. The Innovation Management Sector is the executive arm of the UCY Innovation Committee.

The Sector also leads the implementation of the YUFE Alliance European University, a strategic project for UCY, coordinating all UCY activities within the YUFE Alliance and leading the activities related to innovation, entrepreneurship, and knowledge valorisation. Finally, the Sector has established a robust network of partnerships both within Cyprus and Internationally, enhancing its impact and expanding its reach for the internationalisation and the valorisation of UCY Research & Innovation.

## Medical and Biomedical Innovations

### Mechano-Modulation of Cancer Microenvironment to Optimize Nano-Immunotherapy

#### AUTHORS' DETAILS

Fotios Mpekris, Myrofora Panagi, Antonia Charalambous, Chrysovalantis Voutouri, Triantafyllos Stylianopoulos

#### RESEARCH UNIT DETAILS

Tumor Mechanopathophysiology Lab & Cancer Biophysics Laboratory, Department of Mechanical and Manufacturing Engineering

#### DESCRIPTION

Inefficient drug delivery to tumors can reduce dramatically treatment efficacy and thus, affect negatively the life of cancer patients. This is particularly evident in desmoplastic cancers where interactions among cancer cells, stromal cells and the fibrotic matrix cause tumor stiffening and accumulation of mechanical forces that compress tumor blood vessels. Indeed, in subsets of pancreatic cancers and sarcomas, 95% of intra tumoral blood vessels may be compressed and up to 80% totally collapsed leading to reduced blood flow (hypo-perfusion) and drug delivery. Hypo-perfusion also leads to hypoxia that helps cancer cells evade the immune system and increase their invasive and metastatic potential. Use of mechanotherapeutics and ultrasound sonopermeation are two mechano-modulation strategies that separately have been employed to treat vascular abnormalities in tumors. Even though these strategies have reached the clinic, their promise has yet to be realized by cancer patients owing to limitations of the methods. In our project these strategies are not uniquely complement each other and have not only additive, but highly multiplicative synergistic effects on modulating the desmoplastic tumor microenvironment and improving the efficacy of nano-immunotherapy. We employed a mixture of cutting-edge computational and experimental techniques. We performed in vivo mice studies in breast cancers and sarcomas and showed that these mechano-modulation strategies can be combined to improve treatment efficacy, prevent metastasis and increase survival. Our project introduce novel therapeutic strategies for the treatment of drug resistant tumors leading to better therapies.

### CAT-BRAIN

#### AUTHORS' DETAILS

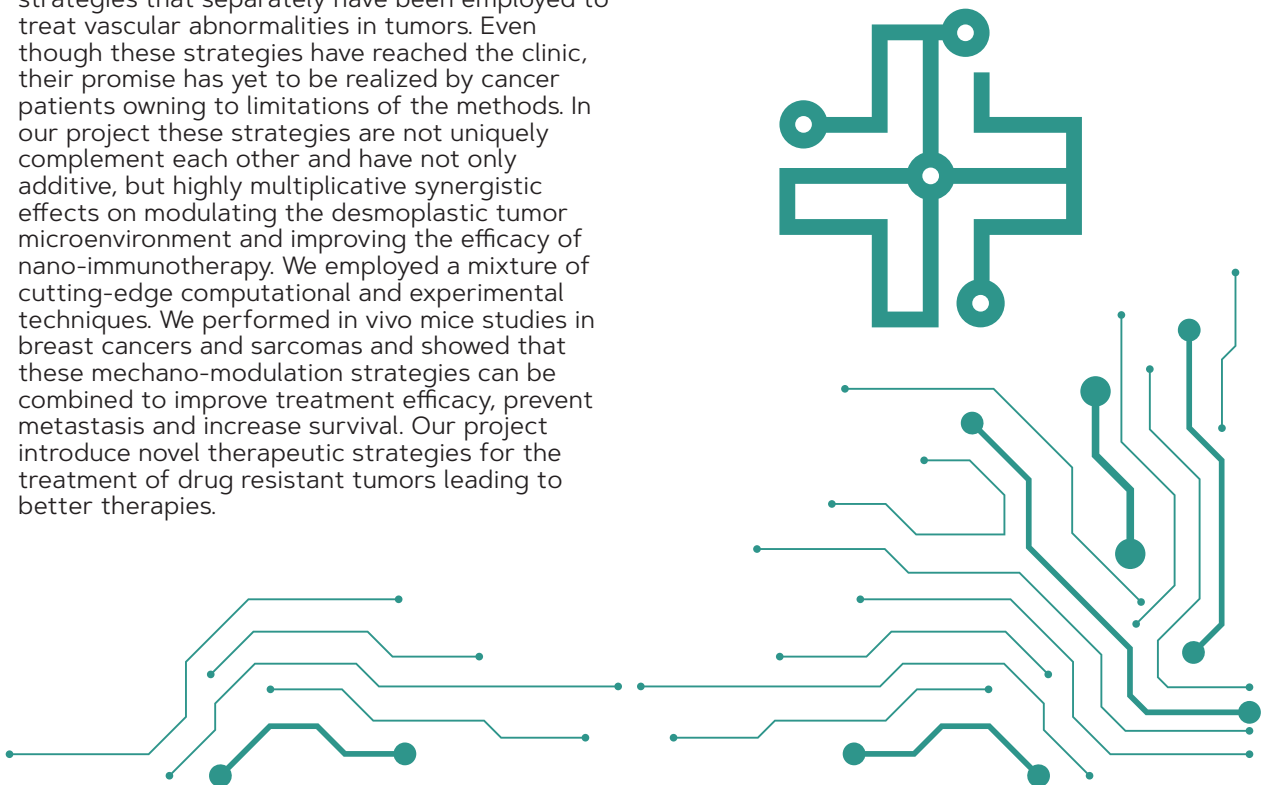
Fofi Constantinidou, Ioulia Solomou

#### RESEARCH UNIT DETAILS

Centre for Applied Neurosciences, Department of Psychology

#### DESCRIPTION

Cognitive Rehabilitation is a form of therapy designed to enhance brain function which may be impaired due to injury or disease. It involves specific exercises that improve vital cognitive skills like memory, problem-solving, and other aspects of critical thinking necessary for everyday activities. CAT-BRAIN introduces an innovative approach to CR by offering a digital platform tailored for healthcare professionals. This platform incorporates the Categorization Program® (CP), a comprehensive hierarchical cognitive rehabilitation program. This program focuses on a structured, progressive approach to rehabilitation that emphasizes decision-making, memory enhancement, categorization, problem-solving, and executive functioning. The program was created by Professor Fofi Constantinidou who owns the copyrights. Furthermore, the Categorization Program® is registered with the copyright office of the US Library of Congress since 2006.



## InvasiCell

### AUTHORS' DETAILS

Paris Skourides, Adonis Hadjigeorgiou, Neophytos Christodoulou

### RESEARCH UNIT DETAILS

Cell and Developmental laboratory, Department of Biological Science

### DESCRIPTION

Cancer is one of the leading causes of death globally, with metastasis accounting for over 90% of cancer-related deaths. However, many aspects of the metastatic cascade and its molecular mechanisms remain poorly understood. While cancer research is advancing rapidly there has been a notable shift from traditional 2D cell cultures and animal models to 3D in vitro cancer research platforms. Specifically, although in vivo models better represent the complexity of metastasis, they are costly, time-consuming, labor-intensive, and pose ethical challenges. In vitro assays, on the other hand, offer better control over experimental conditions and enable precise quantitative analysis. However, currently available in vitro models lack physiological relevance and fail to fully capture the tumor microenvironment (TME). The TME plays a critical role in cancer progression, metastasis, and treatment outcomes. As a result, there is a growing demand for more physiologically relevant in vitro models to study tumor progression and evaluate anti-cancer drugs. To address this, we developed InvasiCell, a novel device that replicates the TME and enables the study of cancer progression while evaluating potential anti-cancer medications. InvasiCell holds significant promise as a standard tool for cancer research, a platform for reliable anti-metastatic drug screening, and potentially as a diagnostic tool. It can be introduced to three major markets: 1) academic and research institutions, 2) pharmaceutical companies, and 3) the diagnostic industry. InvasiCell could revolutionize the way we study and treat cancer, offering a more relevant and practical model for understanding tumor progression and developing effective therapies.

## Music informed Psychoeducational Program for the Inclusive Development of Soft Skills in Higher Education

### AUTHORS' DETAILS

Georgia Panayiotou, Marios Theodorou, Potheini Vaiouli, Thekla Constantinou

### RESEARCH UNIT DETAILS

Center for Applied Neuroscience/Department of Psychology, Clinical Psychology and Psychophysiology Laboratory.

### DESCRIPTION

Higher Education (HE) instructors and industry partners and employers alike, underscore that while university graduates are well educated in their specific scientific field, they often lack core

competencies that would allow them to thrive in the real world and adapt effectively to the work environment. "Soft" skills like the ability to collaborate, communicate effectively, cope with stress, resolve conflict, assert one's wishes, make effective decisions, and regulate one's emotions and behaviors are often lacking. HE settings, by constituting the transition between schooling and work/adult life, are the natural setting in which such skills could be effectively developed, often in collaboration with industry partners (e.g. during internships). However, many HE institutions have not developed an effective strategy for including such skills training into their curricula, while the required format and content of such programs that would serve the needs of graduates for future successful employment, personal and social wellbeing is still under-investigated. Our overall research venture, funded by 2 Erasmus+ projects, aimed to develop and test across 5 EU universities a comprehensive program for the development of soft skills, mainly socio-emotional skills, in higher education settings, and test the feasibility of implementation in different systems and educational environments. We developed a psychoeducational program, focused on a set of skills that emerged as most critical from focus groups and consultations with stakeholders across 5 EU countries. We also tested various forms of implementation and educational aids (e.g. use of music, and digital means) to make the program acceptable, feasible, and inclusive.

## Aesthesis – Rapid Gas-Phase Detection of Bacterial Infections

### AUTHORS' DETAILS

Christoforos Panteli, Marios Stylianou, Andreas Anastasiou, Chrysafis Andreou

### RESEARCH UNIT DETAILS

Nanotechnology Image and Detection Laboratory, EMPHASIS Research Centre, Electrical and Computer Engineering, Department of Mathematics and Statistics, CyLabs Ltd

### DESCRIPTION

Urinary tract infections (UTIs) are a global healthcare challenge affecting 150 million people annually. These infections can be fatal. In the EU alone, 4 million hospital-acquired cases are reported annually, with 20-30% deemed preventable. Beyond the human impact, the economic burden of UTIs is estimated at US \$16 billion per year. The current standard for diagnosis, the urine dipstick test, provides rapid results within 1-2 minutes but lacks specificity and is prone to inaccuracies. In contrast, the clinical standard, the pathogen cultures, offer precise identification but require 24-48 hours and specialized expertise. During this waiting period, broad-spectrum antibiotics are often administered, contributing to antimicrobial resistance. Our innovation aims to revolutionize UTI diagnostics. We have invented a solution that slashes the current detection protocol from 48 hours to less than 10 hours and identifies UTI-related pathogens. We have integrated electronic gas sensors within culture dishes to continuously

monitor the bacterial growth through their gas emissions. Using an advanced statistical methodology, we can detect changes in the signal and therefore infection in the sample with immense efficiency and accuracy. We are developing a next-generation smart incubator that will transform pathogen diagnostics. Our device will maintain the accuracy of traditional culture methods while automating and drastically accelerating the pathogen detection and identification process. Designed for hospitals and laboratories worldwide, this solution will enhance patient care, reduce the costs associated with UTIs, and play a critical role in the fight against antimicrobial resistance.

## PathoINVEST: Pathogen Contamination Investigation Digital Twin

### AUTHORS' DETAILS

Demetrios Eliades, Marios Kyriakou, Stelios Vrachimis, Marios Polycarpou, Christos Panayiotou

### RESEARCH UNIT DETAILS

KIOS Research and Innovation Center of Excellence

### DESCRIPTION

PathoINVEST is a software tool developed to enhance the response capabilities of water utilities during pathogen contamination events in drinking water networks. It offers real-time modeling of contamination, enabling effective emergency response and informed decision-making. PathoINVEST uses computational models for contamination spread prediction, health risk assessment, and contamination source identification. It also provides actionable mitigation strategies, including valve manipulation, booster disinfection, and system flushing, and assists in optimal water quality sensor placement. PathoINVEST was developed as part of the H2020 PathoCERT Project which was coordinated by the KIOS CoE, University of Cyprus, in collaboration with KWR (NL), and was demonstrated in 5 full-scale exercises. PathoINVEST received the "Digital Water Award" from Water Europe in 2024.

## A Nanoparticle for Targeting Triple Negative Breast Cancer

### AUTHORS' DETAILS

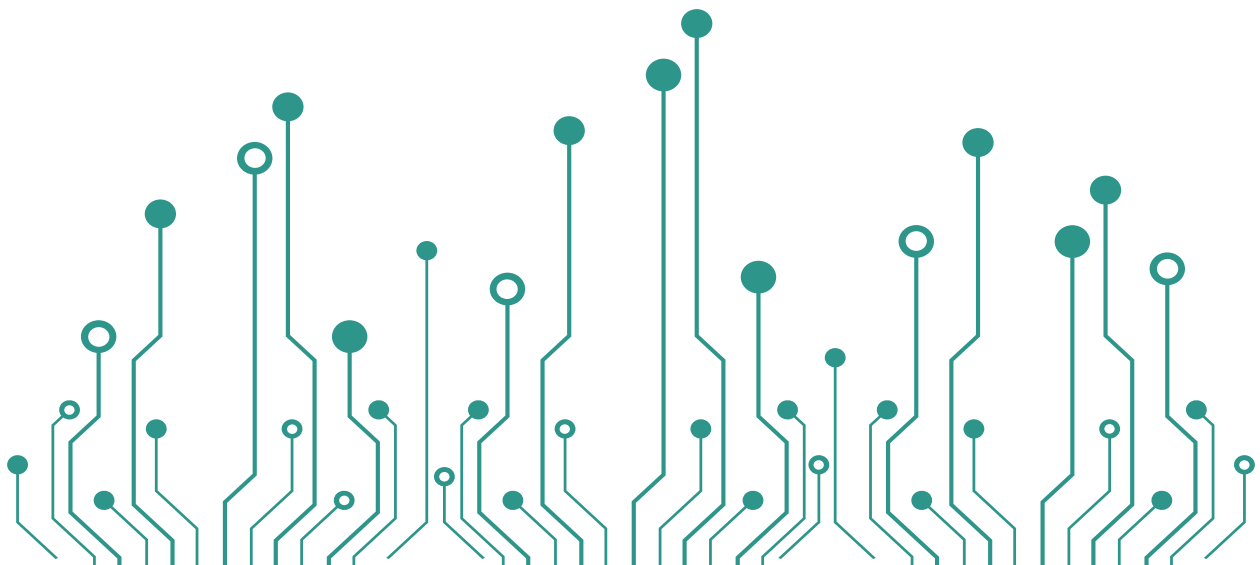
Panayiota Gregoriou

### RESEARCH UNIT DETAILS

biobank.cy CoE, Molecular Medicine Research Center

### DESCRIPTION

Triple-negative breast cancer (TNBC) is an aggressive form of cancer, accounting for 10-15% of all breast cancer cases and characterized by high metastasis rates. Current treatment options for TNBC are limited, with chemotherapy being the primary approach. However, chemotherapy is associated with toxic side effects and increasing drug resistance. Given the high unmet medical need, there is a significant demand for more targeted therapies. We have developed and patented (US Patent application - US20210378978) a novel therapeutic nanoparticle specifically designed to target TNBC. This nanotechnology-based drug delivery system selectively targets TNBC cells while reducing the systemic cytotoxicity typically caused by chemotherapy. By exploiting the overexpression of p-glycoprotein in TNBC cells, we created a nanovehicle system using biodegradable, biocompatible materials, including Pluronic F127, Vitamin E TPGS, and Resveratrol—each with known anticancer properties. Our nanocarrier can deliver both therapeutic and diagnostic agents, such as an anticancer drug and coumarin-6, enabling simultaneous treatment and diagnosis. Studies have shown that this system offers superior uptake and specificity to TNBC cells compared to control epithelial cells, significantly improving treatment efficacy. Importantly, our nanocarrier does not enter healthy cells, mitigating the harmful side effects associated with chemotherapy. This innovation offers a promising solution for treating TNBC by delivering targeted, effective, and safer therapies. The technology could also be adapted for use with various therapeutic and diagnostic agents, making it a versatile tool in cancer treatment.





## Energy, Environment, Materials and Manufacturing

### Real-Time Visualization Tool for Phasor Measurement Unit Data

#### AUTHORS' DETAILS

Titos Avraamides, Markos Asprou, Lenos Hadjidemetriou, Angelos Christofi, Christos Panayiotou

#### RESEARCH UNIT DETAILS

KIOS Center of Excellence, H. Wise Wire Energy Solutions Limited

#### DESCRIPTION

The Real-Time Visualization Tool for Phasor Measurement Unit (PMU) Data is designed to provide an intuitive and user-friendly interface for retrieving and visualizing crucial electrical parameters from power systems. The tool enables operators and engineers to monitor real-time information provided by PMUs, offering insights into the grid's stability and efficiency. The tool facilitates the visualization of time-series data for parameters such as voltage, current, active power, reactive power and frequency. This feature aids in identifying trends, patterns, and anomalies, while phasor diagrams offer critical insights into phase relationships between electrical quantities, helping diagnose synchronization and imbalance issues. Additionally, the tool includes robust data management, allowing users to archive retrieved PMU data for detailed analysis and research on system behavior during disturbances or equipment failures. This supports long-term studies aimed at improving grid resilience. An important feature of this tool is also the frequency anomaly detection, which uses a threshold-based approach to detect deviations from the nominal frequency, signaling potential grid issues. The tool incorporates algorithms for estimating transmission line parameters like resistance and reactance. This tool was applied to the Cyprus power system for collecting and analyzing data from 18 PMUs installed in selected substations of the Cyprus transmission system, while it is already used in the Transmission System Operator of Cyprus.

### Development of green-tech functionalized, biodegradable fibrous plant nursery bags in ecological seedlings cultivation

#### AUTHORS' DETAILS

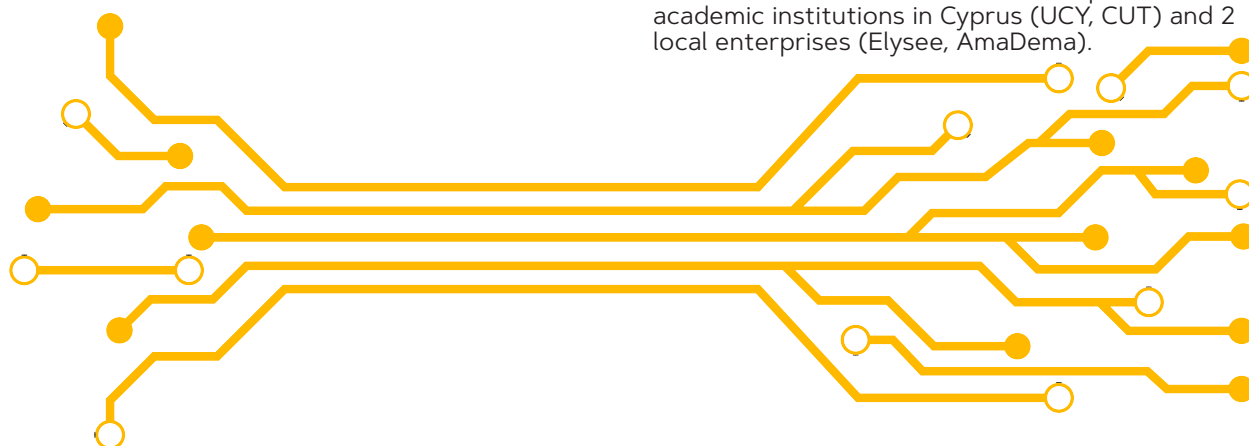
Theodora Krasia, Petri Papaphilippou, Christos Christou, Ioanna Savva, Maria Karouzou, Vassilis Drakonakis, Andreas Grigoriou, Andreas Chimaris, Kritonas Onoufriou, Panos Protopapas, Vasileios Fotopoulos, Roghayyeh Mahmoudi

#### RESEARCH UNIT DETAILS

Department of Mechanical and Manufacturing Engineering

#### DESCRIPTION

Plant nursery bags that are typically used in seedlings production mainly consist of low-density polyethylene which is a non-biodegradable plastic material. As a consequence, upon seedling planting, a large amount of plastic waste ends up in the environment. The primary objective of PlantNGreen is the development of innovative biodegradable nano/microfibrous "green" plant nursery bags that will further functionalized with selected plant growth promoters for use in ecological seedlings cultivation, thus promoting both, environmental protection and seedlings growth promotion. The implementation of this project is based on a strong and effective collaboration established between 2 public academic institutions in Cyprus (UCY, CUT) and 2 local enterprises (Elysee, AmaDema). Plant nursery bags that are typically used in seedlings production mainly consist of low-density polyethylene which is a non-biodegradable plastic material. As a consequence, upon seedling planting, a large amount of plastic waste ends up in the environment. The primary objective of PlantNGreen is the development of innovative biodegradable nano/microfibrous "green" plant nursery bags that will further functionalized with selected plant growth promoters for use in ecological seedlings cultivation, thus promoting both, environmental protection and seedlings growth promotion. The implementation of this project is based on a strong and effective collaboration established between 2 public academic institutions in Cyprus (UCY, CUT) and 2 local enterprises (Elysee, AmaDema).



## A Comprehensive Investigation of Microplastics as Secondary Pollutants in Radionuclide Dispersion and Their Magnet-Assisted Removal Along with Radionuclides from Water.

### AUTHORS' DETAILS

Ioannis Ioannidis, Ioannis Pashalidis

### RESEARCH UNIT DETAILS

Department of Chemistry

### DESCRIPTION

This study investigates microplastics (MPs) as secondary pollutants for the dispersion of radionuclides in the environment. Specifically, the adsorption behavior of various MPs, such as PN6, PE, PET, PVC, PU, and PLA, for a range of (radio)toxic metals (Ra, Am, Eu, Th, Np, U), spanning oxidation states from +2 to +6, has been investigated. Experiments were conducted at both trace and relatively high concentrations to investigate factors affecting the adsorption and desorption processes, including pH, ionic strength, temperature, the presence of complexing ligands, and the type and size of MPs. The adsorption onto modified MPs (e.g., biofilm-coated, natural organic matter (NOM)-coated, oxidized MPs, magnetic MPs) and the desorption in simulated human digestive systems were also studied. Key findings show that MPs can adsorb radionuclides even at ultra-trace levels, with PN6 demonstrating the highest adsorption capacity, particularly for uranium. Adsorption values reached up to  $\log(K_d)$  of 3.4 L/kg and  $q_{max}$  of  $\sim 0.03$  mol/kg at higher concentrations. Desorption studies revealed that up to 100% of radionuclides can be released in complexing agents and simulated digestive systems, suggesting that MPs may serve as "Trojan horses" for radionuclides transport in the environment and living organisms. Finally, the results of this study indicate that magnetic MPs can be removed from environmental aqueous solutions using a magnet, achieving a removal capacity of around 97% for radionuclides.

## ML-assisted Dynamic Security Assessment of Energy Systems

### AUTHORS' DETAILS

Georgios Paphitis, Marios Shimillas, and Mathaios Panteli

### RESEARCH UNIT DETAILS

KIOS Research and Innovation Center of Excellence  
Department of Electrical and Computer Engineering

### DESCRIPTION

Power system asset failures, caused by various reasons, for example extreme weather, often result in power interruptions and electricity customers disconnected. These interruptions occur when the power network is unable to meet the load demand. In some cases, failures can trigger a chain reaction, causing additional components in the network to fail and escalating into larger-scale power outages, often national-wide blackouts. System operators can intervene to

minimize the spread of such cascading failures, but these incidents can unfold rapidly, making timely responses critical. To enhance decision-making during these events, machine learning (ML) techniques unlock significant benefits and applications. This work presents a multimodal ML model designed to aid in real-time disaster management and decision-making—a tool or strategy that helps anticipate, mitigate, and respond to power system crises. Specifically, graph neural networks (GNNs) are employed to predict the path and propagation of cascading failures. In parallel, physics-informed neural networks (PINNs) and traditional ML models estimate the resulting demand not served based on the evolving status of the network. These outputs are seamlessly integrated with a reinforcement learning (RL) framework, which is tasked with determining the optimal set of actions to minimize demand not served. This multimodal approach can be applied in real-time operations to guide system operators toward the best course of action during emergencies, while also supporting long-term operational planning to build more resilient power networks. A key solution already developed is the reconfiguration of the network and the formation of networked microgrids (NMGs), which are essential for enhancing the resilience and reliability of the power system.

## Silicide Thermoelectrics for Energy Harvesting Developed by Recyclable Silicon

### AUTHORS' DETAILS

Panagiotis Mangelis, Panagiotis Ioannou, Savvas Hadjipanteli, Theodora Kyratsi

### RESEARCH UNIT DETAILS

Powder Technology Lab, Department of Mechanical and Manufacturing Engineering

### DESCRIPTION

Taking into account that ca. 66% of global energy consumption is emitted to the environment as waste heat, thermoelectric (TE) devices can offer a promising approach for waste heat recovery and energy savings when applied in combustion engines and industrial processes. Solid-state TE generators are able to provide great advantages since they directly convert heat into clean electrical power through the Seebeck effect, and operate without any CO<sub>2</sub> or toxic emissions, vibration, or noise. Silicide thermoelectrics have attracted considerable attention because these compounds consist of earth-abundant and eco-friendly elements, combining good TE properties and suitable stability for mid-temperature TE applications. From the point of view of materials, the TE efficiency is determined by the dimensionless figure of merit, ZT, depending on the Seebeck coefficient, the electrical conductivity, the absolute temperature, and the thermal conductivity. The European program ICARUS attempts to utilize effectively recycled Si from PV manufacturing industry for the development of silicide thermoelectrics. Two types of Si kerf are used for the synthesis of n-type Mg(Si,Sn)-based compounds and p-type Higher Manganese



Silicides (HMS) phases. A remarkable ZT of 1 is achieved for the kerf-based Mg(Si,Sn) materials. A prototype TE module (TEM) has been also fabricated and characterized in a TEM testing apparatus. High power density is achieved for the Si-kerf- based TEM device, and a good agreement between experimental and simulated performance is observed. ICARUS work is a successful paradigm of circular economy, providing sustainability and a strong silicon recycling solution in the field of green energy technologies. Taking into account that ca. 66% of global energy consumption is emitted to the environment as waste heat, thermoelectric (TE) devices can offer a promising approach for waste heat recovery and energy savings when applied in combustion engines and industrial processes. Solid-state TE generators are able to provide great advantages since they directly convert heat into clean electrical power through the Seebeck effect, and operate without any CO<sub>2</sub> or toxic emissions, vibration, or noise. Silicide thermoelectrics have attracted considerable attention because these compounds consist of earth-abundant and eco-friendly elements, combining good TE properties and suitable stability for mid-temperature TE applications. From the point of view of materials, the TE efficiency is determined by the dimensionless figure of merit, ZT, depending on the Seebeck coefficient, the electrical conductivity, the absolute temperature, and the thermal conductivity. The European program ICARUS attempts to utilize effectively recycled Si from PV manufacturing industry for the development of silicide thermoelectrics. Two types of Si kerf are used for the synthesis of n-type Mg(Si,Sn)-based compounds and p-type Higher Manganese Silicides (HMS) phases. A remarkable ZT of 1 is achieved for the kerf-based Mg(Si,Sn) materials. A prototype TE module (TEM) has been also fabricated and characterized in a TEM testing apparatus. High power density is achieved for the Si-kerf- based TEM device, and a good agreement between experimental and simulated performance is observed. ICARUS work is a successful paradigm of circular economy, providing sustainability and a strong silicon recycling solution in the field of green energy technologies.

## Additive Manufacturing and Advanced Materials at the University of Cyprus

### AUTHORS' DETAILS

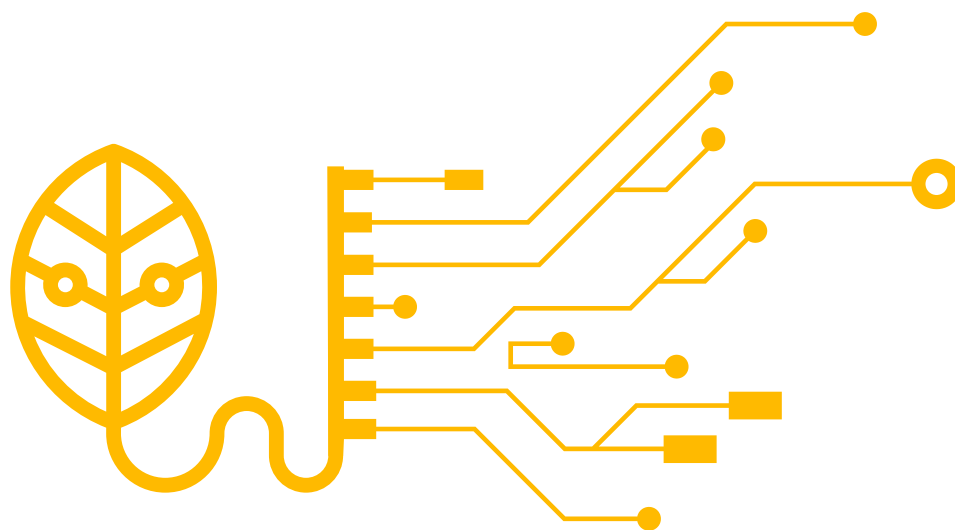
Theodora Kyratsi, Angelos Evangelou

### RESEARCH UNIT DETAILS

Powder Technology Lab, Department of Mechanical and Manufacturing Engineering

### DESCRIPTION

Since 2020, the Powder Tech Lab at the University of Cyprus has focused on advancing research in Additive Manufacturing (AM) of metals and the development of metal matrix composites (MMCs). Through a series of parametric studies, we successfully optimized the AM of 316L stainless steel and developed MMCs reinforced with oxides and ceramics. These efforts led to the synthesis of high-performance materials tailored to the needs of the maritime industry, addressing challenges such as corrosion and mechanical degradation. Utilizing techniques like ball milling and additive manufacturing, the lab has established itself as a hub for advanced materials research, contributing to the development of next-generation MMCs. Building on this foundation, the AM2C3 – Additive Manufacturing and Advanced Materials Competence Centre has now been launched as a Horizon Europe Twinning project. AM2C3 shifts our focus towards the development of innovative aluminium alloys and MMCs, with a strategic emphasis on serving the aerospace industry and the concept of New Space. These sectors demand advanced material solutions that can operate in extreme conditions, including thermal and structural loads. With the creation of a cutting-edge AM lab, the project will provide research and development services to regional SMEs and support Cyprus's efforts to build expertise in high technology readiness level (TRL) research. AM2C3 positions UCY as a key player in additive manufacturing and materials innovation, fostering competitiveness and collaboration both regionally and internationally.



## Smart Infrastructure and Urban Management

### Autonomous Drone-Based Power Infrastructure Inspection

#### AUTHORS' DETAILS

Antonis Savva, Yiannis Grigoriou, Panayiotis Kolios, Christos Panayiotou

#### RESEARCH UNIT DETAILS

KIOS Research and Innovation Centre of Excellence

#### DESCRIPTION

Autonomous inspection of power networks using Unmanned Aerial Vehicles (UAVs) has gained significant attention due to the rapid advances in embedded devices and UAV technology. In this context, UAVs equipped with high-end onboard processing units and camera payloads, are dispatched across the power network for acquiring high-quality data safely and fast. This task is particularly challenging especially in cases where the location of infrastructure components, i.e. poles, is unknown. In this work, we capitalize on breakthroughs on Jetson devices to develop a vision-based AI toolkit, which can process in real-time vision sensory input from the UAV's camera payload and detect poles whose location is unknown. Detection output is integrated with the flight controller for aligning the UAV directly above the pole marking its correct location. The proposed approach has been successfully applied to autonomously inspect ~3.5km of the medium voltage network in an unseen region.

### TRACE: KIOS Tracking, Rescue, and Aerial Coordination Ecosystem

#### AUTHORS' DETAILS

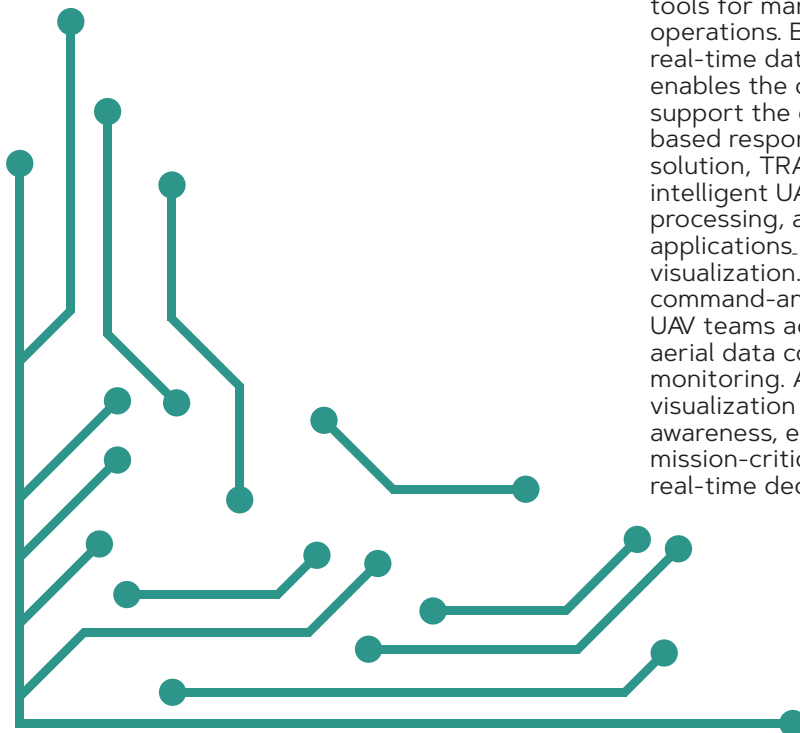
Michalis Demetriou, Christos Panayiotou, Panayiotis Kolios

#### RESEARCH UNIT DETAILS

KIOS Research and Innovation Centre of Excellence

#### DESCRIPTION

TRACE is a multi-agent AI toolkit designed to equip incident commanders and first responders with an advanced suite of tools for managing emergency response operations. By collecting, analyzing, and visualizing real-time data from UAV-mounted sensors, TRACE enables the creation of knowledge maps that support the development of effective, evidence-based response strategies. As an IoT-powered solution, TRACE offers both standalone tools for intelligent UAV-based data collection and processing, as well as advanced ground control applications for enhanced data analytics and visualization. The toolkit includes robust command-and-control capabilities for managing UAV teams across a range of missions, such as aerial data collection, search and rescue, and area monitoring. Additionally, the integrated visualization tools provide enhanced situational awareness, enabling users to remain focused on mission-critical tasks while making more informed, real-time decisions.



## FixCyprus: Leveraging Crowdsourced Smartphone Data for Road Safety Hazard Management

### AUTHORS' DETAILS

Andreas Georgiou, Christos Laoudias, Aristotelis Savva, Christos Panayiotou

### RESEARCH UNIT DETAILS

KIOS Research and Innovation Center of Excellence

### DESCRIPTION

Our work focuses on FixCyprus a crowdsourcing platform developed to address road safety hazards in Cyprus. The primary problem it tackles is the inefficiency and high costs of traditional road infrastructure monitoring methods, such as field inspections or sensor-equipped vehicles. FixCyprus enables citizens to report infrastructure defects (like potholes, damaged lighting, or blocked drainage) by submitting geolocated images through a mobile application. These reports are automatically forwarded to the relevant district's Public Works Department based on location, where they are reviewed and assigned to the appropriate public authority for resolution. The platform integrates multiple technical components, including a user-friendly mobile interface for citizen submissions, back-end systems for secure data storage and management, and dedicated portals for public authorities to manage and respond to reports. From a business perspective, FixCyprus offers a cost-effective solution for governments, reducing the need for costly field surveys and facilitating more efficient resource allocation for infrastructure maintenance. It also fosters civic engagement by involving citizens in public infrastructure upkeep.



## PAVEment SCANning with EGNSS technology for accurate assessment (PAVE-SCAN)

### AUTHORS' DETAILS

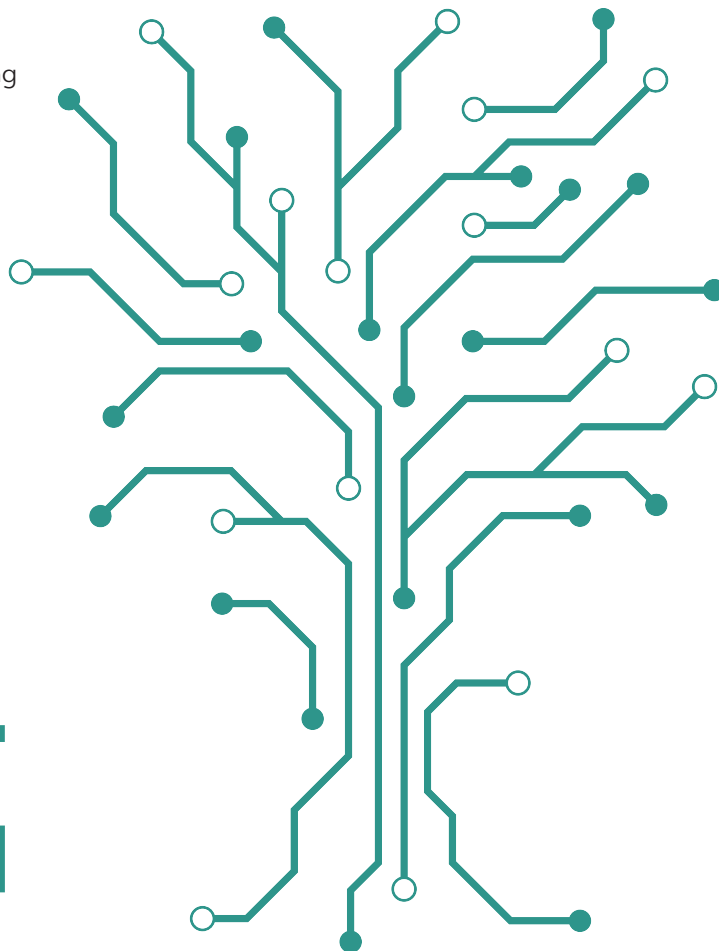
Symeon Christodoulou

### RESEARCH UNIT DETAILS

EUPALINOS Lab, Dept. of Civil and Environmental Engineering

### DESCRIPTION

PAVE-SCAN (1) aims for the development to market (TRL8-9) of an EGNSS-based integrated low-cost sensor technologies and artificial-intelligence-driven open-architecture software solution (machine learning (ML) and machine vision (MV)), for the detection, classification, and georeferencing of roadway pavement surface anomalies and for the low-cost assessment of roadway pavements using participatory sensing; (2) is based on past scientific and applied knowledge of the consortium's core technical partners, that has, to date, yielded a field-tested prototype of the proposed solution (TRL 6-7).



## Advanced Computing and Artificial Intelligence

### HoloCIM: An Ising Machine-as-a-Service Platform

#### AUTHORS' DETAILS

Moysis Symeonides, Michalis Kasioulis, Joanna Georgiou, George Pallis, Marios D. Dikaiakos, Haris Volos, Jason Sakellariou, Alexis Askitopoulos, Simos Tsintzos, Kyriakos Georgiou, Emmanouil Lioudakis, Andreas Othonos

#### RESEARCH UNIT DETAILS

Laboratory for Internet Computing, Department of Computer Science, and Laboratory for Ultrafast science, Department of Physics

#### DESCRIPTION

Combinatorial optimization problems present challenges across various domains, such as logistics, network design, and decision-making, since the computation of an optimal solution requires an exponential number of trials. Traditional computers struggle with these problems, which are known to be NP-hard, due to their high computational complexity. As finding optimal solutions to such problems is computationally intractable, heuristic algorithms are typically proposed to yield suboptimal solutions. An alternative approach involves physical-inspired hardware systems that can efficiently solve specific NP-hard problems. To use these solvers, the input problem must be mapped into a configuration compatible with the hardware, and the output must then be translated into a useful representation. One of the most common physical-inspired models is the Ising model. An Ising machine model is represented by a grid, with node values of either 1 or -1 and grid edges assigned static weights. The goal is to minimize the Hamiltonian equation on the grid, which is represented by the sum of the product of node values and their respective weights. By finding the set of node values that results in the lowest possible Hamiltonian output, we effectively solve the optimization problem encoded in the grid, leading us to the optimal solution. In HoloCIM, by utilizing interconnected physical components, such as laser beam generators, lenses, and monitoring devices, in a specific deployment, we can efficiently discover the solution to an Ising problem. Additionally, we offer extra capabilities like as-a-service offerings, providing a user-friendly interface, auto-compilation of NP problems, monitoring capabilities, permission management, programming interfaces, and more. End-users can utilize our platform through the HoloCIM Python library to solve their Ising model problems or any of HoloCIM's pre-designed problems like number partitioning and bin packing.

### Fogify: A Fog Computing Emulation Framework

#### AUTHORS' DETAILS

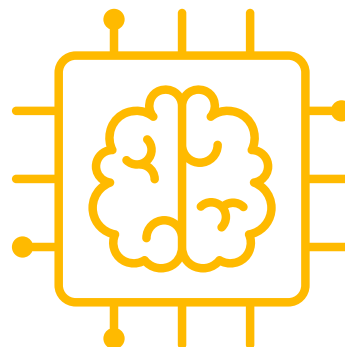
Moysis Symeonides, Zacharias Georgiou, Demetris Trihinas, George Pallis, Marios D. Dikaiakos

#### RESEARCH UNIT DETAILS

Laboratory for Internet Computing, Department of Computer Science

#### DESCRIPTION

Fog computing is a decentralized computing infrastructure that brings data processing and storage closer to the data source—at the edge of the network—to reduce latency and improve efficiency compared to the Cloud, and it is emerging as the dominant paradigm bridging the computational and connectivity gaps between IoT sensing devices and latency-sensitive services. However, experimenting and evaluating IoT services is a daunting task involving the manual configuration and deployment of a mixture of geo-distributed physical and virtual infrastructure with different resource and network requirements. This results in sub-optimal, costly, and error-prone deployments due to numerous unexpected overheads not initially envisioned in the design phase and underwhelming testing conditions not resembling the end environment. For all these reasons, we introduce Fogify, an emulator that eases the modeling, deployment, and large-scale experimentation of fog and edge testbeds. Fogify provides a toolset to (i) model complex fog topologies comprised of heterogeneous resources, network capabilities, and QoS criteria; (ii) deploy the modeled configuration and services using popular containerized descriptions to a cloud or local environment; (iii) experiment, measure and evaluate the deployment by injecting faults at runtime to test different "what-if" scenarios that reveal the limitations of an IoT service. In the evaluation, IoT services with real-world workloads are introduced to show the wide applicability and benefits of Fogify's rapid prototyping. Finally, on top of the Fogify framework, we create various libraries specialized for the evaluation of different problems and environments, like 5G deployments, Big Data systems, and Federated Learning, among others.



## Experimental waveform design for SWIPT using machine learning algorithms

### AUTHORS' DETAILS

Petros Stylianou, Elio Faddoul, and Ioannis Krikidis

### RESEARCH UNIT DETAILS

IRIDA Research Centre for Communication Technologies, Department of Electrical and Computer Engineering

### DESCRIPTION

Wireless power transfer (WPT) technology has the potential to revolutionize the powering of wireless devices, particularly in Internet of Things (IoT) applications where devices require both energy and information transmission. To this end, our project presents the design of a new waveform for simultaneous wireless information and power transfer (SWIPT) systems using software-defined radio (SDR) tools. In particular, by varying the number of multi-sinusoidal signals as well as the separation distance between the transmitter and receiver, we analyze both power transfer efficiency and the capacity to extract information from the received signal. This process allows us to develop a dataset derived from experimental measurements, which is then analyzed using machine learning algorithms. Our goal is to not only identify the received waveforms and extract information, but also evaluate the performance of different machine learning models. This approach offers a low-power solution for IoT networks, as the SWIPT receiver is composed of passive elements such as rectennas, eliminating the need for active components while still enabling efficient information and power transfer.

## FIMIScope: Software-supported Participatory Analysis of Disinformation

### AUTHORS' DETAILS

Marios Dikaiakos, Katerina Ioannidou, Demetris Paschalides, Kyriakos Nikos, Dimos Stefanidis, George Pallis

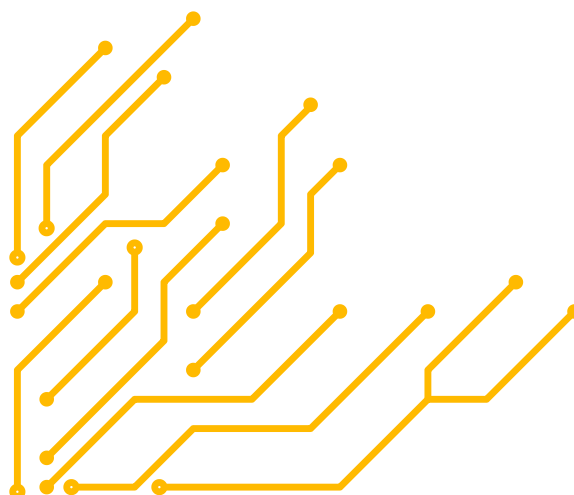
### RESEARCH UNIT DETAILS

Laboratory for Internet Computing, Department of Computer Science

### DESCRIPTION

The proliferation of fake news in online social media has been identified as one of the main problems in social media platforms. Many seminal studies have explored this phenomenon, documenting the potential impact of fake news on modern society, and the threat they pose to the democratic process and social cohesion. Recent incident analyses have provided evidence that fake news, and the underlying mechanisms that make them viral in online settings, are weaponized by state and non-state geopolitical actors who launch computational propaganda campaigns as part of psychological warfare seeking to achieve short-term objectives and/or long-term strategic goals. The potency of industrialized

misinformation, threatens to undermine the democratic fabric of EU countries. As a result, combatting disinformation is one of the three main pillars of the European Democracy Action Plan, and the European Parliament advocates for the development of "sound, robust and interlinked, systems to detect, analyze, track and map" incidents of online disinformation. In response to these concerns and initiatives, several research groups, NGOs, governmental and intergovernmental organizations, including the European External Actions Service, the Carnegie Endowment for International Peace, the Brookings Institute, and NATO, have proposed and developed methodological frameworks and tools to analyze and cope with "Foreign Information Manipulation and Interference" (FIMI) campaigns. Following a review of several such proposals and inspired by Design Thinking and Business Model Analysis methodologies, we have designed a methodology for the participatory analysis of FIMI campaigns. The methodology entails an analysis process and two "FIMI canvases," which facilitate the analysis of FIMI observables, incidents, and campaigns. The canvases can be printed, posted on a board, and used by teams of analysts in participatory, iterative analysis exercises of FIMI cases. To enhance the capturing of semi-structured, annotated data identified during the execution of such analyses, and to relieve expert analysts from the tedious work of encoding, collecting, and storing metadata about FIMI cases under examination, we designed and implemented FIMIScope, a software toolset prototype that implements the FIMI canvases as a graphical user interface running on a browser and supported by a back-end software system which provides services for: i) storing, managing, and exporting data and meta-data collected during the analysis process, in a simple JSON format; ii) supporting remote collaboration among analysts collaboratively analyzing cases, and iii) keeping snapshots of different stages of an analysis exercise and versioning. FIMIScope is enhanced with a Large-Language Module tool, which retrieves JSON data collected and creates narratives describing captured FIMI incidents and campaigns, and allows analysts to interact with the collected data through a natural language, dialogue interface.





# Möbius Trip Replay: Revolutionizing Film Analysis and Cultural Discovery Through AI

## AUTHORS' DETAILS

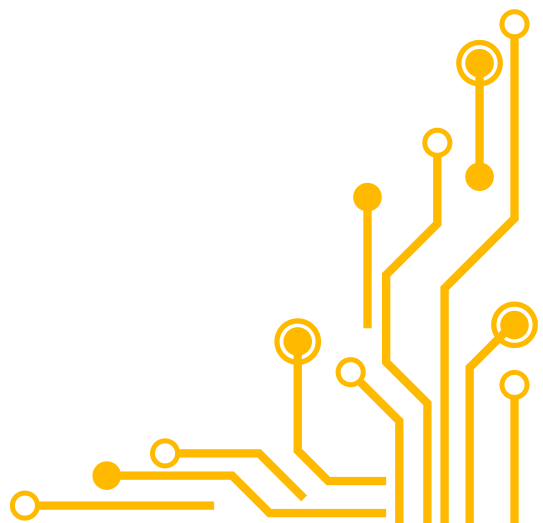
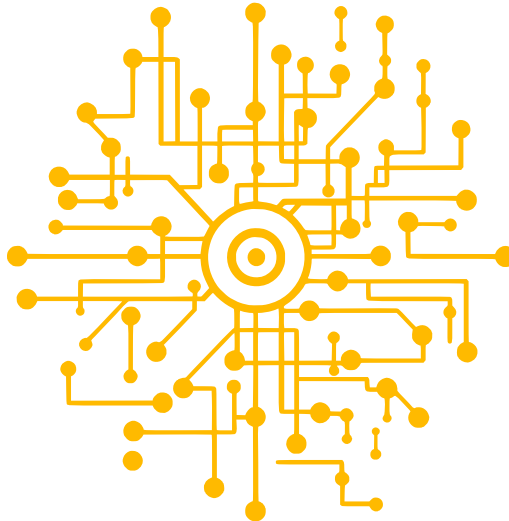
Landry Digeon

## RESEARCH UNIT DETAILS

Digital Humanities, Film, and Intercultural Communication; Department of French and European Studies

## DESCRIPTION

The Möbius Trip Replay is an advanced AI-driven multimodal deep-learning toolkit developed through the collaboration of a Humanities scholar and an AI engineer. This innovative solution automatically manages extensive datasets from movies and TV shows, enabling comprehensive digital analysis of cultural representations. Addressing the challenge of objectively deconstructing and measuring cinematic and cultural elements, Möbius Trip Replay combines cultural analytics, reverse-engineering, and distant reading methodologies to uncover intricate patterns and trends within audiovisual content. Technically, the platform is built on the Google Cloud Platform, utilizing custom configurations of GPU instances, specialized Cloud Run Functions running text, image, and audio algorithms under optimal parallel batch processing. We develop and use custom models to improve character tracking, camera angle and shot scale recognition, color detection and various additional advanced visual metrics, optimized through Bit Pair Encoding (BPE) for improved recognition accuracy. The user interface, developed with Looker Studio, offers interactive visualisations and customisable filters, facilitating both granular and broad-spectrum analyses. Scientifically, Möbius Trip Replay integrates theoretical frameworks from film theories, intercultural communication models, and multimodality, bridging digital humanities and artificial intelligence. This interdisciplinary approach allows for the validation and exploration of cultural models through large-scale data analysis. From a business perspective, The Möbius Trip LLC aims to serve diverse markets including academia, the film industry, social media influencers, and everyday users. By providing a scalable and comprehensive tool for film analysis, Möbius Trip Replay seeks to revolutionise how cultural and cinematic studies are conducted, fostering deeper insights and informed decision-making across various sectors.

















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