KIOS

Research and Innovation Center of Excellence

ACTIVITY REPORT 2024

University of Cyprus

Imperial College London

Contents

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Forewords

Message from the Rector

> It is our mission to support our community in taking advantage of the opportunities, whilst being responsive to the new challenges

Dear Reader,

The higher education area, in both research and education, is rapidly evolving in response to the demands of a changing world. Artificial intelligence is transforming education, the economy, and society. The growing demand for remote learning, driven by technological advancements and the expectations of new generations underscores the need for our active engagement in this dynamic educational landscape.

The University of Cyprus enjoys a strong national reputation, consistently remaining the top choice for higher education in the country and being regarded as the most trustworthy institution by the society. Internationally, it has also gained significant recognition, ranking among the top 701–800 universities in the prestigious 2024 Shanghai List, 389th in the QS World University Rankings 2025 and among the top 401 – 500 institutions in Times Higher Education World University Rankings.

We fully recognize that for UCY to remain competitive both locally and internationally, we must stay committed to academic excellence, driven by innovative research, and dedicated to societal impact. We continue to enhance the quality of our academic programs, secure competitive research funding, and generate knowledge that not only advances sciences, but also addresses real-world challenges. In this context, the role of our Centers of Excellence is vital. These Centers serve as drivers of innovation — fostering interdisciplinary collaboration, bridging academia and industry, and generating tangible economic and societal value.

A prime example of this success is the KIOS Research and Innovation Center of Excellence - the first Center of its kind in Cyprus. In 2024, KIOS proudly celebrated 16 years of impactful research and innovation. Over this period, the Center has stimulated the creation and growth of a regional research and innovation ecosystem, delivering significant economic and societal benefits not only for Cyprus but for Europe at large.

I would like to extend my sincere congratulations to the entire KIOS team for their outstanding dedication and interdisciplinary mindset. The Center's work stands as a testament to what can be achieved when excellence, vision, and collaboration converge.

Sincerely,

Tasos Christofides,
Rector, University of Cyprus

Message from the Director

I am deeply honored to serve as the Acting Director of the KIOS Center of Excellence, taking over from Professor Marios M. Polycarpou, whose hard work and remarkable dedication have laid a strong foundation of excellence, enabling KIOS to become a vibrant hub of innovation and a model of impactful research. I would like to take this opportunity and sincerely thank Prof. Polycarpou for his contributions which have shaped KIOS into the strong, dynamic, and internationally recognized Center it is today. Prof. Polycarpou has taken over as Chair of the KIOS International Advisory Board, while at the same time he remains active in all activities of the Center. I look forward to continuing collaborating with him as well as the other members of the Advisory Board and all members of the KIOS Team to take the Center to new heights.

During 2024, the KIOS CoE continued to grow its research capacity and collaborate with partners in Cyprus and abroad to address major challenges facing our society. This research excellence is reflected by the Center's successful record in attracting competitive research funding, producing high-impact publications in prestigious scientific journals and conference proceedings and establishing new collaborations through the KIOS Innovation Hub, as well as receiving several awards and distinctions at a national and international level. This collective effort has strengthened our role as a leading research and innovation center in Cyprus and Europe.

Another high priority for the Center in this period was the development of the KIOS Strategic 10-year Plan, which presents the main strategic intents and goals for the upcoming 10-year period (2024-2034). In the coming years we will focus on advancing our research and innovation, strengthening our economic stability and sustainability, maximizing our societal impact, fostering excellence in human resources and becoming a model in organizational management. These efforts will help us address new challenges, sustain success, and achieve financial stability for the long term.

This Activity Report offers a glimpse at some of the achievements of the Center in the last year. It recognizes the collective effort of our researchers in developing innovative tools and solutions that address real-world problems in critical infrastructures and creating value for the society.

I would like to take this opportunity to thank all KIOS personnel for their dedication, enthusiasm and professionalism throughout this year - it is the driving force behind KIOS' success. I also extend our heartfelt thanks to the University of Cyprus for their continuous support. We look forward to another year of excellence and achievement. I am confident that, together, we will continue to push boundaries, achieve excellence, and lead KIOS into an even brighter future.

We hope that you will find this report informative. For further information about the Center, please visit the KIOS website: www.kios.ucy.ac.cy.

Prof. Christos Panayiotou,
Director, KIOS Research and Innovation Center of Excellence
Professor of Electrical and Computer Engineering, University of Cyprus

In brief

The KIOS Research Center was established in 2008 at the University of Cyprus and was upgraded into a European Research and Innovation Center of Excellence in 2017 (KIOS CoE), through the EU strategic Horizon 2020 Teaming project. The Center collaborates strategically with Imperial College, London, as well as with a plethora of local and international research organizations and other stakeholders.

The mission of the KIOS CoE is to solve real-life problems by delivering innovative solutions for intelligent monitoring, control, management, and security of Critical Infrastructure Systems. These infrastructures include large-scale, complex systems such as power and energy systems, water systems, transportation systems, telecommunication networks, healthcare systems, and emergency management and response systems.

The Center's vision is to be a global leader in enabling society and economy to be more resilient, greener, and safer, through research and innovation in Critical Infrastructures.

KIOS CoE's approach is guided by six enduring values: Excellence, Impact, Integrity, Inclusivity, Community, and Sustainability.

Research in high-tech areas important to Cyprus and the global economy

SCIENTIFIC FOUNDATIONS

- Control Theory, Automation and Robotics
- Artificial Intelligence, Machine Learning and Analytics
- Information Technology, Systems and Engineering
- Software/Hardware System Design & Integration
- Cyber-Physical Security

APPLICATION AREAS

- Power & Energy Systems
- Water Systems & Environmental Monitoring
- Intelligent Transportation Systems
- Telecommunication Systems & Networks
- Healthcare Systems
- Emergency Management & Response

RESEARCH OUTCOMES

- Intelligent Monitoring & Control
- Resilience, Adaptation & Reconfiguration
- Security, Safety & Trustworthiness
- Embedded Real-time Algorithms
- Big Data Analysis & Management
- Performance & Energy Optimization

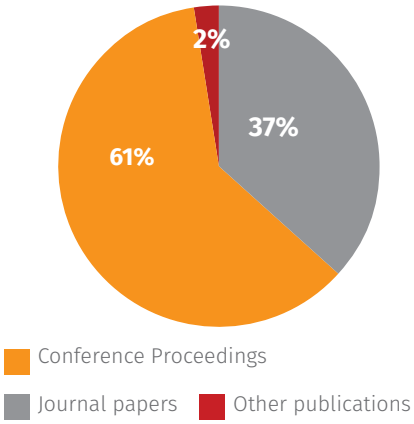
Research Activities

Scientific Dissemination

Scientific dissemination is an important and integral part of the KIOS CoE, since it fosters the transfer of knowledge and results within the international scientific community.

In 2024, the KIOS Faculty and the wider KIOS research team published 49 journal and 81 conference papers as well as 3 other publications.

KIOS CoE Publications 2024



Peer-reviewed journal publications

Academic journals serve as one of the principal forums for researchers to disseminate their research work within the scientific community. The KIOS CoE researchers continue to target high-quality and high-impact journals, whose topics of interest cover the research activities of the Center. In 2024, the KIOS research team published **49** peer-reviewed papers in academic journals, with their areas of expertise.

Conference proceedings

Conference proceedings facilitate fast scientific dissemination, allowing researchers to present their research at conferences, workshops, and symposia, aiming at the fast and wide adoption of their research ideas by their peers in the scientific community. In 2024, the KIOS research team published **81** peer-reviewed papers in scientific conference proceedings.

KIOS CoE Open Science Activities

The KIOS CoE recognizes the significance of openly disseminating scientific results and for this reason it has launched the KIOS Open Knowledge Initiative in 2017, consisting of the following tools:

1) the KIOS Open Knowledge Portal , an online repository hosted on Zenodo that stores and manages all research papers, open research data, and open-source code produced at the KIOS CoE. The majority of the Center's journal and conference publications are available to the scientific community following the "green" open access model through this Portal.
2) the Software Repository on GitHub for making the software code available to the research community.
3) the Reproducible Research Platform on Code Ocean for encouraging reproducible research, i.e., code/data accompanying scientific publications.

1. https://zenodo.org/communities/kios-coe/
2. https://github.com/KIOS-Research
3. https://codeocean.com/explore/capsules?query=kios

OPUS kick off meeting, January 2024

Other Open Science Initiatives

In 2024, the KIOS CoE was selected by the University of Cyprus to participate in the EU-funded project OPUS (Open and Universal Science) as one of the three Research Performing Organizations to pilot the implementation of the Research Assessment Framework.

In addition, KIOS awarded the “Open Science Annual Award”, to KIOS Senior Research Associate, Dr. Stelios Vrachimis, for his contributions to KIOS open water data sets. Moreover, the Open Source Observatory, under the European Commission, has designated KIOS as the strategic actor on Open Science in Cyprus for 2024.

Welcome Remark at the Conference on "Democracy and Cybersecurity" by the KIOS Director

International Conference on Democracy and Cybersecurity in the age of AI

On October 23, 2024, the KIOS CoE co-organized the international conference on “Democracy and Cybersecurity in the Age of Artificial Intelligence”, together with the University of Southern California, the CYENS Centre of Excellence and the European Digital Innovation Hub in Cyprus (DiGiNN). The conference was held under the auspices of the Deputy Ministry of Research, Innovation, and Digital Policy of Cyprus, and attracted more than 120 participants, including academics, policymakers, IT professionals, and officials from the public sector in Cyprus.

KIOS CoE Participation in EU Level Networks

In 2024, the KIOS research team participated in several EU level networks, platforms, and strategic partnerships, aiming to increase the visibility of the Center and to exploit future collaborations. This enables the KIOS CoE team to reach potential partners and increase access to proposal consortiums.

A sample of networks in which KIOS researchers participated:

- UNIMED Subnetwork on Safety and Security of Critical Infrastructures
- ERTICO
- TN-ITS Map Update Exchange
- The European Water Platform - WssTP (WATER EUROPE)
- Union Civil Protection Knowledge Network
- Disaster Risk Management Knowledge Network
- AI Connect Network
- Connecting Education and Research Communities for an Innovative Resource Aware Society (CERCIRAS) COST ACTION

Sample Publications

Sizzler: Sequential Fuzzing in Ladder Diagrams for Vulnerability Detection and Discovery in Programmable Logic Controllers

Programmable Logic Controllers (PLCs) constitute the basis of Industrial Control Systems (ICSs) underpinning sectors ranging from nuclear, up to energy and manufacturing. Currently, PLC vulnerability assessment practices employed by ICS operators are limited due to their reliance on empirical observations of visible code crashes prompted by PLC compilers. In parallel, the prevalent PLC firmware dependency on proprietary vendor routines restricts the composition of generic vulnerability detection or discovery schemes for zero-day threat vectors. In this work, we propose Sizzler: a novel vendor-independent vulnerability discovery framework specific to PLC applications operating with logic realised through ladder diagrams.

K. Feng, M. M. Cook and A. K. Marnerides, "Sizzler: Sequential Fuzzing in Ladder Diagrams for Vulnerability Detection and Discovery in Programmable Logic Controllers," in *IEEE Transactions on Information Forensics and Security*, vol. 19, pp. 1660-1671, 2024.

Balancing Efficiency and Fairness in Resource Allocation for Optical Networks

Traditionally, the bandwidth allocation problem is solved by maximizing network efficiency, which may however leave some connections unserved. This clearly leads to an unfair solution from the user's point of view, rendering fair bandwidth allocation algorithms of paramount importance, especially in the presence of congested network links. To alleviate limitations of known fairness measures, this work proposes a multi-objective optimization function that simultaneously optimizes both QoS fairness and network efficiency, aiming to derive an allocation that is as fair as possible to the extent that network utilization is not degraded for the sake of fairness.

T. Panayiotou and G. Ellinas, "Balancing Efficiency and Fairness in Resource Allocation for Optical Networks," in *IEEE Transactions on Network and Service Management*, vol. 21, no. 1, pp. 389-401, Feb. 2024.

Successive Convexification Algorithms for Optimizing Power Systems With Energy Storage Models

Energy storage systems (ESSs) are increasingly used in power system optimization. Different ESS mathematical models are developed that consider nonlinear functions for power losses. However, these models require non-convex constraints to represent the ESS losses, resulting in challenging optimization problems. To reduce the complexity, convex relaxation models are often derived but generate infeasible solutions when the relaxation exactness is violated. To deal with this issue, this work develops two successive convexification algorithms that generate fast and high-quality feasible solutions when the derived solution is not exact. The first algorithm handles general loss functions, while the second algorithm enhances performance when piecewise-linear loss functions are used.

L. Tziovani, L. Hadjidemetriou and S. Timotheou, "Successive Convexification Algorithms for Optimizing Power Systems With Energy Storage Models," in *IEEE Transactions on Smart Grid*, vol. 15, no. 2, pp. 1807-1820, March 2024.

An Optimization Framework for Task Allocation in the Edge/ Hub/ Cloud Paradigm

With the advent of the Internet of Things (IoT), novel critical applications have emerged that leverage the edge/hub/cloud paradigm, which diverges from the conventional edge computing perspective. A growing number of such applications require a streamlined architecture for their effective execution, often comprising a single edge device with sensing capabilities, a single hub device (e.g., a laptop or smartphone) for managing and assisting the edge device, and a more computationally capable cloud server. To this end, we propose a complete, binary integer linear programming (BILP) based formulation for an application-driven design-time approach, capable of providing an optimal task allocation in the targeted edge/hub/cloud environment.

A. Kouloumpris, G. L. Stavrinides, M. K. Michael, T. Theocharides, “An optimization framework for task allocation in the edge/hub/cloud paradigm”, *Future Generation Computer Systems*, vol. 155, pp. 354-366, 2024.

Risk Assessment and Mitigation of Cascading Failures Using Critical Line Sensitivities

Security concerns have been raised about cascading failure risks in evolving power grids. This article reveals, for the first time, that the risk of cascading failures can be increased at low network demand levels when considering security-constrained generation dispatch. This occurs because critical transmission corridors become very highly loaded due to the presence of centralized generation dispatch, e.g., large thermal plants far from demand centers. This increased cascading risk is revealed in this work by incorporating security-constrained generation dispatch into the risk assessment and mitigation of cascading failures.

Y. Dai, M. Noebels, R. Preece, M. Panteli and I. Dobson, "Risk Assessment and Mitigation of Cascading Failures Using Critical Line Sensitivities," in *IEEE Transactions on Power Systems*, vol. 39, no. 2, pp. 3937-3948, March 2024.

Secure State Estimation of Networked Switched Systems under Denial-of-Service Attacks

This paper studies the problem of secure state estimation of networked switched systems in the presence of denial-of-service (DoS) attacks, as well as disturbances and measurement noise. Firstly, a state transformation rule is designed to partition the original system into two subsystems, facilitating the design of discrete and continuous state observers. Secondly, by modifying the traditional super-twisting sliding-mode method and taking into account the frequency and duration characteristics of DoS attacks, we employ dynamic differential properties between different modes to design a switching law identification strategy. Thirdly, based on the identified activated mode, a set of mode-dependent continuous state sliding-mode observers is designed, that achieves continuous state estimation in finite time.

Q. Meng, A. Kasis, H. Yang, M. M. Polycarpou, “Secure state estimation of networked switched systems under denial-of-service attacks”, *European Journal of Control*, vol. 80, part A, 2024.

Path-Based Origin-Destination Matrix Estimation Utilizing Macroscopic Traffic Dynamics

The origin-destination (OD) matrix is a crucial requirement for transportation management and planning. Efficient OD matrix estimation is important to enhance the advancement of intelligent transportation systems. We present a novel approach for the estimation of static OD matrices using within-day traffic flow dynamics. The signalised cell transmission model (CTM) is utilised to capture the dynamics of a specific network and associate road segment count observations with path demands. This model is extended to capture per-path densities, yielding a path-based OD matrix problem formulation that results in a nonlinear optimisation problem. Efficient solution methodologies, based on convex and nonconvex optimisation theory, are developed for free-flow and congested conditions, respectively.

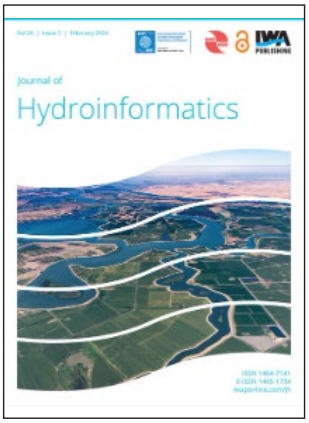
Y. Englezou, S. Timotheou and C. G. Panayiotou, "Path-Based Origin-Destination Matrix Estimation Utilizing Macroscopic Traffic Dynamics," in *IEEE Transactions on Intelligent Transportation Systems*, vol. 25, no. 8, pp. 8819-8836, Aug. 2024.

Cooperative Multi-agent Jamming of Multiple Rogue Drones using Reinforcement Learning

The wide adoption and use of unmanned aerial vehicles (UAVs) has created not only opportunities but also threats to the security of sensitive areas. Thus, effective and efficient counter-drone systems are required to protect these areas. This work tackles this issue by developing cooperative multi-agent jamming techniques using reinforcement learning (RL) to counter the operation of one or multiple rogue drones flying over a sensitive area. The aim of the proposed RL approach is to optimize the joint mobility and power control actions of the pursuer UAVs in order to maximize the received jamming power at the rogue drones aiming at disrupting communication links and sensing circuitry, while at the same time keeping the interference to surrounding pursuer agents below a predefined threshold.

P. Valianti, K. Malialis, P. Kolios and G. Ellinas, "Cooperative Multi-Agent Jamming of Multiple Rogue Drones Using Reinforcement Learning," in I*EEE Transactions on Mobile Computing*, vol. 23, no. 12, pp. 12345-12359, Dec. 2024.

Disinfection scheduling in water distribution networks considering input time-delay uncertainty



A significant challenge when attempting to regulate the spatial-temporal concentration of a disinfectant in a water distribution network is the large and uncertain delay between the time that the chemical is injected at the input node and the time that the concentration is measured at the monitoring output nodes. Existing approaches cannot guarantee that the concentration of the disinfectant will remain within a specified range at the output, even though bounds on time-delay uncertainty may be known. In this work, given bounded water-flow uncertainty, we use the input–output modeling approach to develop a disinfectant scheduling methodology that guarantees a bounded output disinfectant concentration.

S. Vrachimis, D. Eliades, M. Polycarpou, “Disinfection scheduling in water distribution networks considering input time-delay uncertainty”, *Journal of Hydroinformatics*, vol. 26, issue 2, pp. 386–396, 2024.

201
RESEARCHERS EMPLOYED
by KIOS CoE at the end of 2024

KIOS CoE Personnel

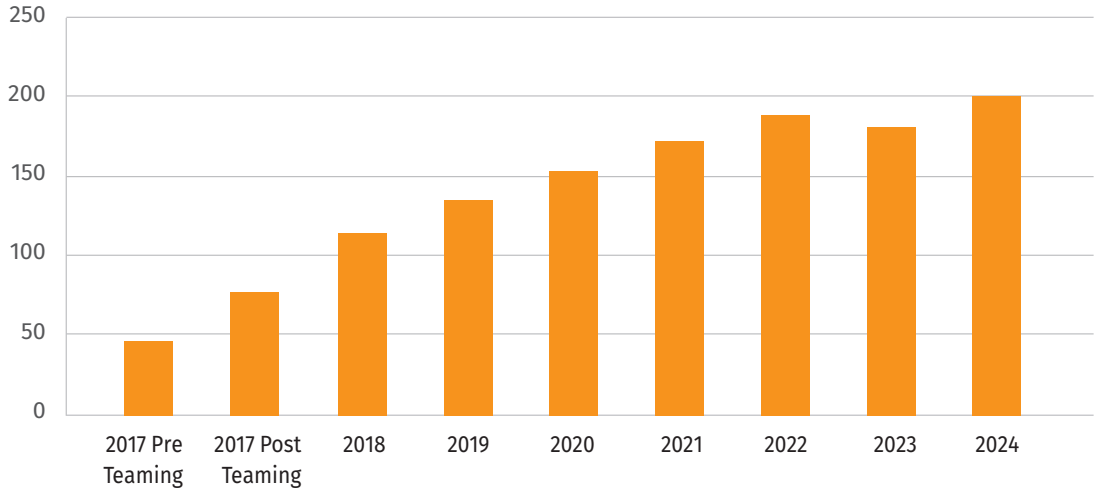
Human capital is the most important asset of the KIOS CoE, thus the Center places particular emphasis on recruiting high-caliber researchers who will contribute significantly to the development of the Center.

The KIOS CoE places also particular emphasis on promoting diversity, equal opportunities, and gender balance at all levels of its research and innovation teams.

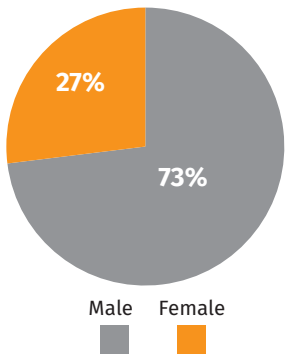
Towards this end, the Center aims to increase gender balance among its research personnel by offering all researchers an attractive working environment. In addition, the KIOS CoE has developed recruitment initiatives to attract highly- qualified personnel from Europe and the Middle East - North Africa (MENA) region.

At the end of 2024, 201 researchers were employed by the KIOS CoE including full-time and part-time employees. This number includes Faculty, Affiliated Faculty, Research Faculty, Postdoctoral Researchers, PhD Students, Research and Software Engineers, Interns, Data Analysts and Administrative Personnel. At the KIOS CoE spoke at Imperial College London 13 Researchers were employed. Finally, the KIOS Alumni network comprises of more than 450 people.

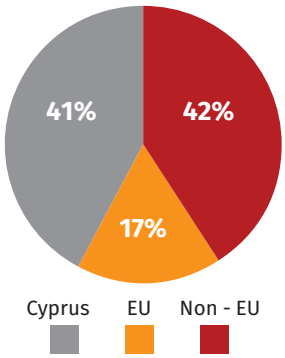
Personnel Growth Per Year



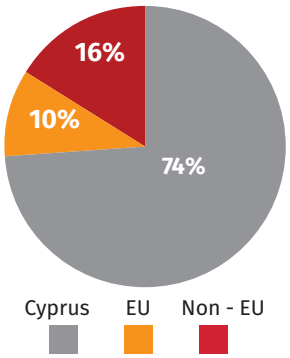
Gender



Country of Highest Academic Degree



Country of Origin



Awards

Digital Water Award 2024

The KIOS research team has received the “Digital Water Award” 2024 by Water Europe for the research, development, and demonstration in field exercises of an innovative software tool for investigating pathogen contamination events in water systems, “PathoINVEST”. This tool was developed by KIOS in collaboration with KWR Water Research Institute and PHOEBE Innovations Ltd within the framework of the EU H2020 research project “Pathogen Contamination Emergency Response Technologies” (PathoCERT).

Second Prize at the International Cooperative Aerial Robots Inspection Challenge

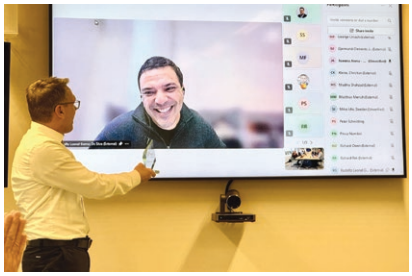
The KIOS research team has won the Second Prize in the competition on Multi-Robot Perception and Navigation Challenges in Logistics and Inspection Tasks, that took place during the prestigious 2024 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), on 14 – 18 October 2024, in Abu Dhabi, UAE. The team developed an intelligent decentralized control framework for coordinating a heterogeneous fleet of aerial robots in the inspection of complex structures in real-world-like environments.

FixCyprus Honorary Award

The “FixCyprus” app, developed by KIOS in collaboration with the Public Works Department of the Ministry of Transport, Communications, and Works, has received an Honorary Award from the Department of Labour Inspection at the Ministry of Labour and Social Insurance, as part of the National Competition for Examples of Good Practice in Safety and Health at Work. The app collects and manages crowdsourced data related to issues in the road network of Cyprus, with the aim of improving the country's road infrastructure and enhancing road safety.

Best TN-ITS Engagement Award 2024

The KIOS Research Engineer II, Rodolfo Da Silva, received the "Best TN-ITS Engagement Award 2024", from ERTICO ITS-Europe, for his dedication and significant contributions to advancing the exchange of spatial road data between road authorities and data users across Europe through the innovative TN-ITS (Transport Network ITS Spatial Data Deployment) platform, which is under ERTICO. The award ceremony took place on the 19th of December 2024 in Brussels, during the TN-ITS General Assembly.

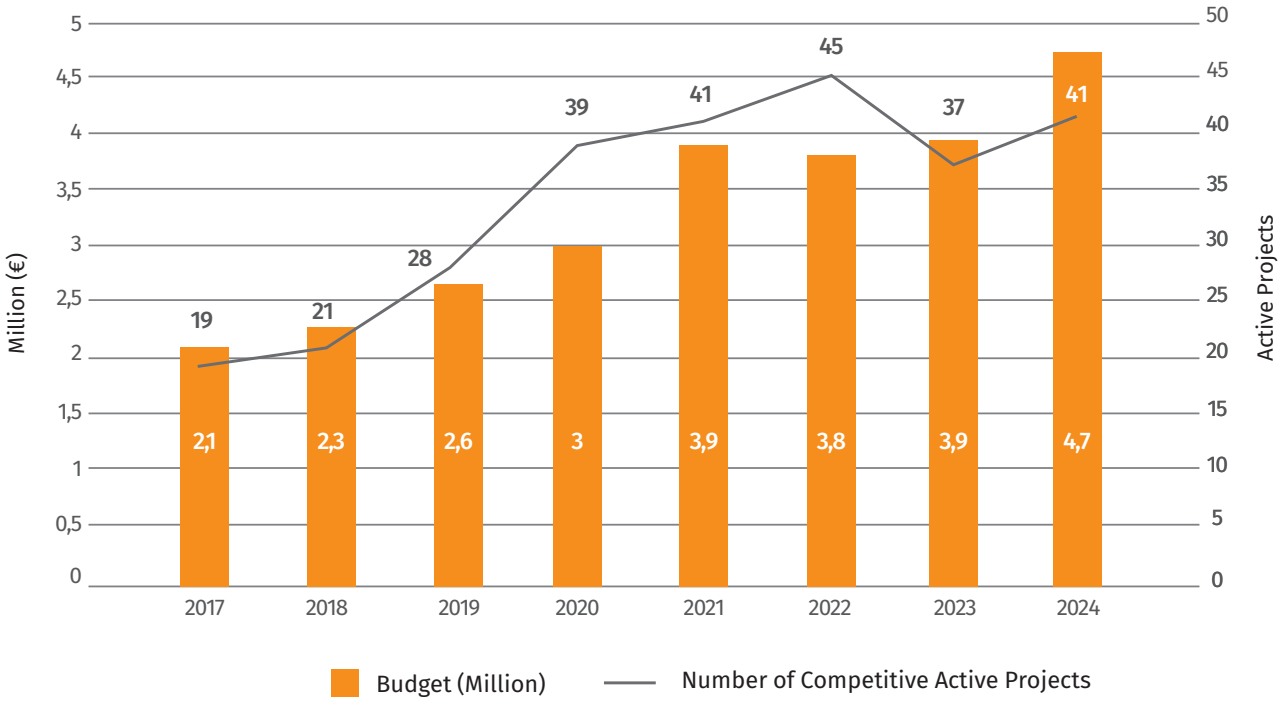


Competitive R&I Funded Projects

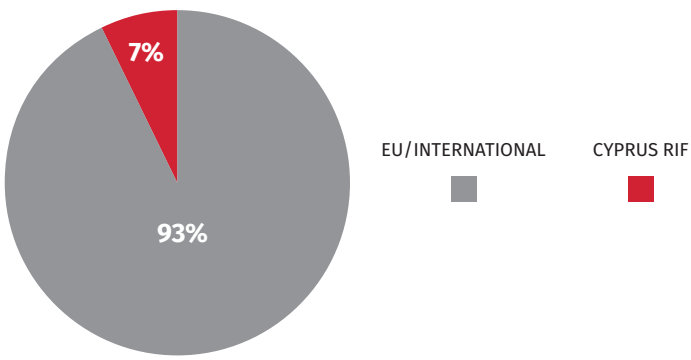
In 2024 the KIOS CoE participated in a number of collaborative research and innovation (R&I) projects funded by various competitive funding programmes, including Horizon Europe, Horizon H2020, the Cyprus Research and Innovation Foundation (RIF), as well as other EU funding programmes tackling specific EU policies and objectives, e.g. green and digital transition. These projects which involve multidisciplinary international consortiums, address important global challenges for critical infrastructure systems such as power and energy systems, water and transportation networks, telecommunication networks, healthcare systems as well as emergency management and response systems.

12 funded research projects coordinated by KIOS in 2024

Competitive funding and number of projects per year



Funding sources for Research and Innovation projects for 2024



	ACRONYM	FULL TITLE	FUNDING SOURCE	KIOS ROLE
1	KIOS CoE*	The KIOS CoE project focuses on the significant development of KIOS into a world-class research and innovation Center of Excellence. The project which is part of the EU's strategic program "Spreading Excellence and Widening Participation', is being implement in collaboration with Imperial College London.	EU - H2020 TEAMING*	Coordinator
2	Water-Futures	Development of a new theoretical framework for the allocation and development decisions on drinking water infrastructure systems, so that they are socially equitable, economically efficient and environmentally resilient.	EU - H2020 - ERC Synergy Grant	Coordinator
3	URANUS	Propose real-time, dynamic, and intelligent sensing of vehicular and pedestrian traffic via Unmanned Aerial Vehicles (UAVs), and the use of the collected information for urban mobility management.	EU - H2020 - ERC Consolidator Grant	Coordinator
4	COCOON	Delivering a practical cyberphysical systems solution for converged Electrical Power and Energy Systems by bridging secure networked systems research and innovation with power systems engineering.	Horizon Europe	Coordinator
5	SPARROW	Development of a platform representing a pioneering solution for enhancing societal resilience and crisis management in the face of digital breakdowns as well as empowering First Responders.	Horizon Europe	Coordinator
6	GuardAI	Development of innovative solutions to ensure the integrity, security, and resilience of Edge AI Systems, ultimately fostering trust and accelerating the safe adoption of AI-driven technologies.	Horizon Europe	Coordinator
7	OptimRes	Development of a groundbreaking platform to support the operation and decision-making of Renewable Energy Sources and Battery Energy Storage Systems plants.	Cyprus RIF[1]	Coordinator
8	GridGnosis	Development of a platform that will encompass innovative monitoring methodologies for accurately estimating the system states, the line parameters, and the system inertia.	Cyprus RIF	Coordinator
9	OMRES	Development of digitalized operating and maintenance solutions for hybrid renewable energy sources systems, including storage, with a focus on enhancing technology performance and contributing to zero-emission power production.	Cyprus RIF	Coordinator
10	PathoCert	Development of technologies for detecting and managing pathogen contamination events during emergency response situations.	EU - H2020	Coordinator
11	GLIMSE	Development of novel AI-based algorithms and cooperative control techniques to address fundamental challenges in the use of a fleet of drones in search and rescue missions.	Cyprus RIF	Coordinator

* Complementary funding for the KIOS CoE is provided by the Government of the Republic of Cyprus through the Deputy Ministry of Research, Innovation, and Digital Policy, by the University of Cyprus and Imperial College London.

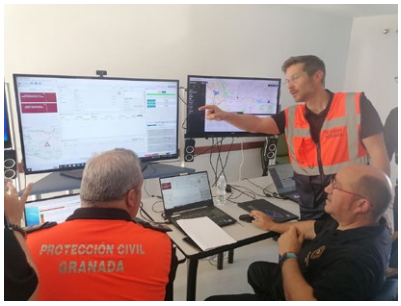
(1) Cyprus RIF - Cyprus Research & Innovation Foundation

12	Inverge	Establishment of a new research framework for a novel inverter-centric approach to enable the sustainable evolution of power systems and enhance the efficiency, power quality, and utilization of future power grid.	Cyprus RIF- Culture Award	Coordinator
13	HYNET	Tackling the challenges of integrating renewable energy sources and power electronics into traditional AC systems by developing innovative technologies.	Horizon Europe	Partner
14	AutoTRUST	Development and demonstrate a novel AI-leveraged self-adaptive framework of advanced vehicle technologies and solutions which optimize usability, perception, and experience on-board, and when boarding/off-boarding.	Horizon Europe	Partner
15	EvoRoads	AcceleratIion of the attainment of the EU's "Vision Zero" goal through a holistic framework of innovative models, tools and services that enable data-driven evolution of safety assessment frameworks.	Horizon Europe	Partner
16	TIRAMISU	Implementation of doctoral programmes by partnerships of organizations from different sectors across Europe and beyond to train highly skilled doctoral candidates and boost their employability in the long-term.	MSCA Network	Partner
17	CABLEGNOSIS	Development of innovative insulation and conductor design technologies, high performance and environmentally friendly cable insulation materials, to support the energy transition.	Horizon Europe	Partner
18	FINEX	Support the quick deployment and uptake of Cleantech solutions and the development of supporting regulatory frameworks through building on world class experimentation practices, networks and experience of its partners.	Horizon Europe	Partner
19	ProtectDome	Development of a Counter-Unmanned Aircraft System system that will be integrated with situational awareness tools for improving real-time monitoring, and will enable protection solutions against rogue drones in public space.	EU Internal Security Fund	Partner
20	ANTS	Design of a framework able to perform real-time optimization of the energy management at the building level through a multi-objective intelligent control framework for renewable resources, energy storage, and Heating, Ventilation and Air Conditioning systems.	CYPRUS RIF - CODEVELOP	Partner
21	Ideation	Creating a Digital Twin Ocean (DTO) of inland waters, linking rivers, lakes, and wetlands with the ocean.	Horizon Europe	Partner
22	GridEye	Development of a holistic solution for effective line protection, fulfilling the needs of the Transmission System Operators for managing the operation of the grid in an optimal and efficient way, while ensuring the grid integrity and stability.	Cyprus RIF - ENTERPRISES	Partner
23	REACTION	Development of a comprehensive border surveillance platform by integrating autonomous vehicles and AI for detection and classification, enhancing early threat identification.	EU-DG HOME Instrument for Financial Support for Border Management and Visa Policy (BMVI)	Partner
24	Selas View	Development of a credible, feasible, internationally competitive, and highly innovative personalized and multifunctional platform for minimally invasive, long-term, continuous monitoring of progression of metastasis in lung cancer.	CYPRUS RIF - ENTERPRISES	Partner

25	Screening for Barrett's Esophagus Progressors with Multimodality Tethered Capsule Image-Guided Biopsy	Usage of advanced machine learning methods and a novel tethered capsule with Optical Coherence Tomography to detect suspicious esophagus areas.	National Institutes of Health, USA	Partner
26	ReCHARGED	Development of a practical visualisation platform for optimisation and streamlining of climate resilience and whole-life carbon emission assessments for interdependent Transport, Energy, Systems, Lifelines, and Assets.	Horizon Europe - MSCA	Partner
27	R2D2	Improvement of the resilience and reliability of current Electrical Power and Energy Systems in Europe, against a growing number of threats and vulnerabilities.	Horizon Europe	Partner
28	LEMUR	Doctoral Network (DN) program, which offers innovative training and research to shape key Artificial Intelligent (AI) technologies of the present and the future with strong technological, scientific, economical, and societal impact.	MSCA Network	Partner
29	Collaris	Development of a sustainable European network of scientific, engineering, and end-user expertise related to unmanned aerial systems (UAS) in civil protection and disaster response.	EU Civil Protection Knowledge Network Partnership	Partner
30	IntoDBP	Development, testing, and validating of innovative tools and strategies to improve water quality management for safe human use and a healthy environment.	EU-H2020	Partner
31	EU-WISH**	Aims to support activities to strengthen and improve national capacities for wastewater public health surveillance by enhancing knowledge exchange and sharing best practices based on scientific evidence.	Horizon Europe	Affiliated Partner
32	ACTING	Development of a network of advanced interconnected domain oriented cyber ranges for training and exercises.	European Defence Fund	Partner
33	HVDC-WISE	Design and validate grid architecture concepts to foster the development of large High Voltage Direct Current (HVDC)-based transmission grid infrastructures.	Horizon Europe	Partner
34	TRANSIT	Provide training, skilling and education for current and future generations to enable the energy transition.	Horizon Europe	Partner
35	ARIDLL	Development of a cooperation partnership and a professional community of practitioners in Augmented Reality (AR) instructional design to promote language learning.	EU-ERASMUS+	Partner
36	ELECTRON	Development of a new-generation platform for Electrical Power and Energy Systems, capable of empowering the resilience of energy systems against cyber, privacy, and data attacks.	EU - H2020	Partner
37	DigiWATER	Development of an intelligent "Digital Water Twin" software to monitor the quality of water in distribution networks.	CYRPUS RIF - ENTERPRISES	Partner
38	Smart5Grid	Development of 5G solutions for building innovative and high performance smart grids able to feature online monitoring data and enable efficient, fast, and secure operation.	EU - H2020	Partner
39	OneNet	Development of new generation of grid services able to fully exploit demand response, storage and distributed generation.	EU-H2020	Partner
40	SIEQUA-CERT	Development of a web-based actionable decision support system, that combines real-time monitoring of Indoor Environment Quality and a quantifiable impact metric on occupants' health.	Cyprus RIF-Codevelop	Partner
41	KIOS CoE - HUAWEI	Development of an information fusion radio location algorithm with Tango-aided floor plan and signal mapping.	HUAWEI Technologies Ltd	Partner

** In the EU-WISH project, the Cyprus Ministry of Health is participating as a partner and University of Cyprus as an affiliated partner.

A Sampling of Projects' Outcomes



PathoCERT: Pathogen Contamination Emergency Response Technologies

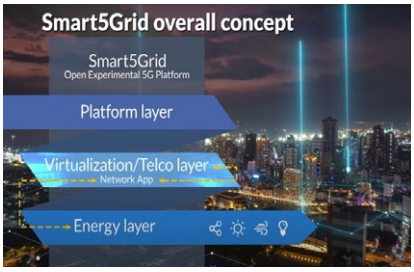
PathoCERT project partners developed innovative technologies to help First Responders and other authorities detect, control and manage water contamination events. These technologies include: 1) an early warning system with smart portable and wearable sensors for the rapid detection of pathogens in surface and drinking water; 2) autonomous drones with water sampling and mapping capabilities; 3) tools for analyzing contamination event data from satellites, social media and smart cameras; 4) platforms for real-time data processing, analytics, incidence management and information visualization; 5) decision support systems for contamination threat assessment and event investigation; and 6) wearable devices and augmented reality for enhancing situational awareness and information exchange. All technologies were tested and evaluated during large-scale emergency response simulation exercises in Granada, Amsterdam, Limassol, Thessaloniki and Sofia.

Funded by:

GLIMPSE: Innovative autonomous multi-agent systems for enhancing emergency response

The GLIMPSE project has pioneered the development of an innovative multi-drone framework for search-and-rescue missions, addressing numerous challenges in disaster response, including intelligent decision-making, accurate state estimation in uncertain environments, and efficient multi-agent cooperative control and planning for emergency response missions. The project also designed cooperative monitoring and learning algorithms for disaster environments using a fleet of autonomous drones and developed robust control techniques to ensure the reliable operation of these drones under challenging conditions.

Funded by:



Smart5Grid: Demonstration of 5G solutions for SMART energy GRIDs of the future

The Smart5Grid project delivered groundbreaking technological solutions to accelerate the digitalization of the electrical and power grid sector. The Smart5Grid solutions ranged from advanced cloud native solutions for optimal orchestration of 5G network resources from core to the edge, and to the development, testing and validation in actual operation grid environments of 5G-enabled digital services. A key outcome of the project is the development of the Smart5Grid platform, an integrated and fully automated platform, which includes an Open Service Repository with friendly user interface and a fully automated Verification and Validation (V&V) framework, which allows the development, testing and validation of any 3rd party developed Network Application.

Funded by:

KIOS Innovation Hub:
Collaboration with Industry

The KIOS Innovation Hub was created in 2017 with the aim to enable the technology transfer of the core research competencies of KIOS CoE in the area of ICT to organizations involved in the monitoring, control, security, and management of critical infrastructure systems (CIS).

Its vision is to promote collaboration between academia, industry, operators of critical infrastructure systems, regulators, as well as governmental organizations with the ultimate goal to create an ecosystem that spans the entire innovation cycle from conception of an idea to its commercialization.

From 2017 to 2024 the KIOS CoE was involved in 81 projects funded by industry, securing funding of more than 8 million euros. Through these projects the Center has developed smart solutions to support Cyprus' green and digital transition.

32
ACTIVE PROJECTS
with the
INDUSTRY
in 2024

Innovation Hub Partners

Deputy Ministry of Research Innovation and Digital Policy

Power and Energy

Cyprus Energy Agency

Electricity Authority of Cyprus

Cyprus Energy Regulatory Authority

Transportation

Ministry of Education Sport and Youth

Department of Public Works

Water

Επαρχιακός Οργανισμός Αυτοδιοίκησης Λεμεσού

ΕΟΑΛ

WWD TAV

Cyprus Chamber of Commerce and Industry

ieit

ΔΣΜΚ Διαχειριστής Συστήματος Μεταφοράς Κύπρου – Transmission System Operator - Cyprus

Department of Electrical and Mechanical Services

geoReplica.ai

Emergency Response

Telecommunications

cyta

Commissioner of Communications

Health

Republic of Cyprus Ministry of Health

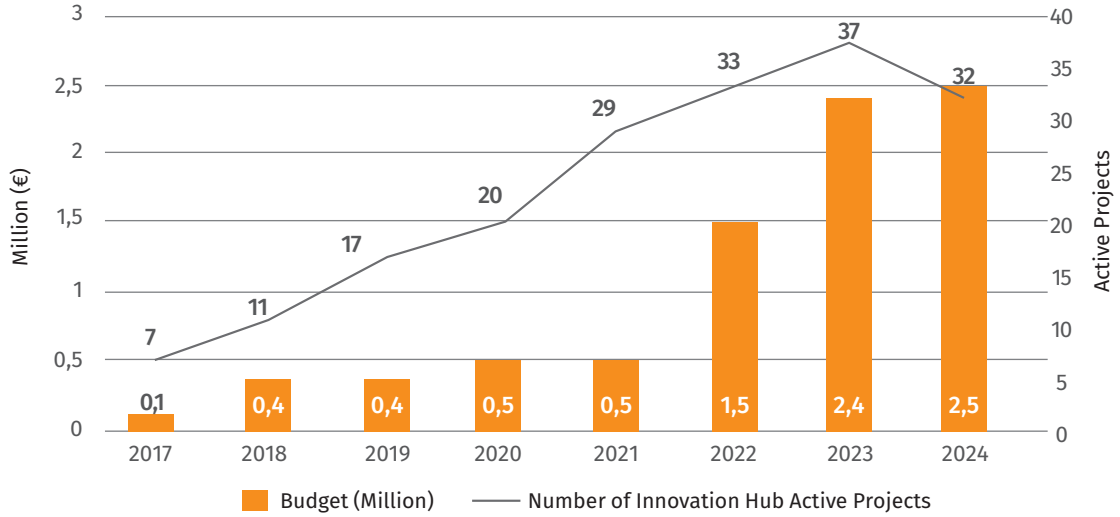
Center for Applied Neuroscience

Gemelli

Finance

Tax Department

Industrial funding and number of projects per year

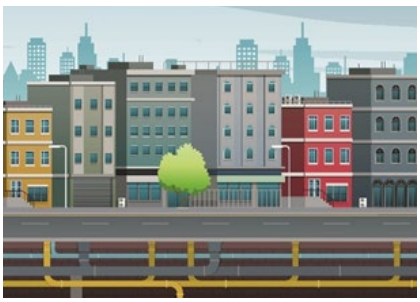


Industrial Collaboration Outcomes

Optimal Unit Commitment and Economic Dispatch Tool

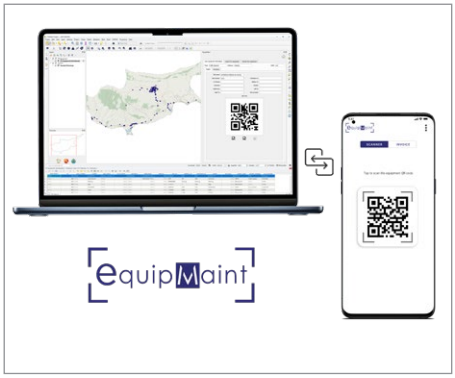
To enhance the integration of Renewable Energy Sources (RES) and reduce the operational costs of Cyprus's power system, the KIOS Power Team has developed a tool that incorporates optimization algorithms to determine the most cost-effective solution for the energy scheduling of conventional units and RES. This tool is widely used by the Cyprus Transmission System Operator and the Cyprus Energy Regulatory Authority. It is designed to maximize RES generation, minimize the daily operational cost of the power system, and ultimately reduce electricity costs for consumers.

Zenon Early Event Detection System

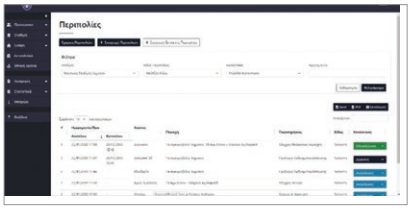


In September 2024, KIOS delivered a fully operational Early Event Detection System to the Sewerage Department of the Larnaka District Local Government Organisation. The system collects, cleans, and processes real-time data received every minute from 25 pumping stations, covering the entire Larnaka Sewerage Network. By continuously monitoring levels, flows, and pump operations, the system can detect malfunctions such as reduced pump efficiency, risk of overflows, failures in pump control systems, and unusually high inflows caused by infiltration or illegal sewage dumping. In addition to enabling real-time and historical visual monitoring of the network, the system generates automatic alarms for maintenance personnel, allowing them to take timely corrective action and prevent damage or environmental pollution.

ITS Equipment Management Tool



The KIOS Center of Excellence developed a GIS-based asset management tool to support the Public Works Department of the Ministry of Transport, Communications and Works in digitalizing internal procedures related to the maintenance of intelligent transportation systems. The tool includes both a mobile and a desktop application, enabling operators to install and maintain equipment directly through the mobile app, access real-time information in the field, and report preventive or corrective maintenance tasks on site. These capabilities accelerate task execution, improve productivity, and reduce human error.



RESPOnse platform

Advanced Technological Solutions for Cyprus Police Operations

In 2024, the KIOS Center of Excellence collaborated closely with the Cyprus Police on advanced research and innovation activities aimed at enhancing the operational effectiveness and preparedness of the Force. As part of this collaboration, the “RESPOnse” system—a decision support platform for the Port and Marine Police—became fully operational. It provides tools for information management, geospatial visualization, statistical analysis, and mission planning for both routine and emergency operations, optimizing response times. In parallel, the collaboration between KIOS and the Technology Department results in the development of machine learning algorithms for real-time image analysis using sensors mounted on Unmanned Aerial Vehicles (UAVs), enabling accurate detection and counting of several objects of interest, as well as conducting risk assessment during operations. Furthermore, to improve the reliability and safety of UAV operations, an autonomous response system was designed to maintain control in cases of lost connection with the remote controller, utilizing 4G/5G wireless networks to ensure continuous Command and Control (C2) communication between the operator and the UAV.

Emergency Response Technologies for Cyprus Civil Defence Aerial Observation Unit

Researchers working on emergency response technologies are part of the Cyprus Civil Defence Aerial Observation Unit. The Unit has been formed in 2018 as part of the DG ECHO LEAPFROG project and since then KIOS provides technical support and its members participate as volunteers in the Unit. Through digital tools developed by KIOS, the Unit is able to log and process information online to make actionable decisions in real time. In 2024, the Unit has participated in 2 search and rescue exercises and deployed 3 times in response to firefighting operations.

CAT-BRAIN Cognitive Rehabilitation Platform

In 2024, KIOS successfully delivered the CAT-BRAIN software platform, a clinically validated cognitive rehabilitation tool designed to support adults with cognitive impairments following traumatic brain injury, mild cognitive impairment, or other neurological conditions. Developed in collaboration with clinical experts and based on over 20 years of research (from Center for Applied Neuroscience and Prof. Fofi Constantinidou), CAT-BRAIN integrates evidence-based therapy protocols into a digital environment, enabling therapists to deliver structured, interactive, and personalized rehabilitation sessions. The platform provides a sequenced, level-based intervention that enhances cognitive functions such as memory, attention, and problem-solving skills. CAT-BRAIN is currently used by clinicians in EU and USA both in clinical settings and for remote home-based therapy under professional supervision. Find out more about CAT-BRAIN: https://thecatbrain.com/

KIOS CoE Research Infrastructures

The KIOS CoE, together with Imperial College London, develop physical and virtual research infrastructures for conducting rigorous and transparent testing on methodologies, tools, and new technologies related to the monitoring, control, management and security of large scale and complex critical infrastructure systems (CIS). These environments allow researchers to examine the reliability, safety, security, and resilience of a wide range of cyber-physical systems and add value to their research and innovation activities. Furthermore, these infrastructures can be utilized by the Center's collaborators and partners to advance the technological readiness levels of new concepts and tools, as well as promote the efforts towards the co-creation of new products and services.

Power Systems

The Power Systems Research Infrastructure targets high penetration of renewable energy sources to reduce greenhouse gas emissions. It aims towards modeling, simulation, emulation, and experimental validation of energy systems, with capabilities in the development of smart technology for the efficient and reliable integration of renewable resources both at the building and grid level. A real-time simulator is used to develop digital twins of actual power systems (i.e., the entire Cyprus power system) and investigate the interaction with smart grid controllers and actual power devices in hardware in the loop framework. Three different energy storage pilots and a wide deployment of sychrophasor measurement units in Cyprus power sub- stations are integrated to facilitate the development of intelligent monitoring and control solutions for smart grids. Further capabilities include the development of real-time control algorithms for power electronic converters to advance the grid integration of renewable energy sources, as well as testing of cyber security solutions in active distribution grids and in digital substations.

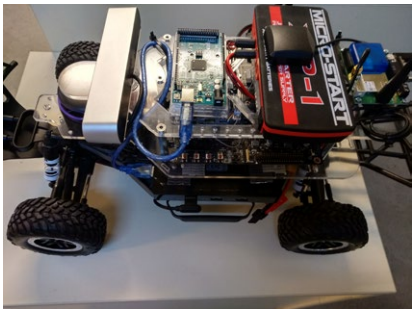
Smart Water Systems

The Water Security Research Infrastructure is a small-scale representation of an urban water transport system, and is composed of a network of tanks, pumps, valves, as well as hydraulic and quality sensors. A key feature is the ability to reconfigure the topology and to emulate realistic water demands through its controller. This infrastructure can be used as a benchmark to generate datasets that can be used by researchers to demonstrate results in the area of real-time monitoring, control, management, and cyber-physical security. In addition, it is complemented with a virtual city water distribution system, corresponding to 10,000 consumers, to be able to demonstrate, in a realistic environment, the impact of these technologies, for instance, in reducing water losses, improving security, and reducing greenhouse gas emissions.

Intelligent Transportation Systems

The Transportation Research Infrastructure is a small-scale physical plant that tests and evaluates Connected Autonomous Vehicle (CAV) technologies under real- life traffic conditions. The CAVs will play a significant role in future transportation systems and will provide enormous societal and environmental benefits in terms of reducing traffic accidents and greenhouse emissions, improving the efficiency, reliability, and costs of transportation systems and enhancing quality-of-life.

The Transportation Research Infrastructure comprises various sensors installed to collect real-time measurements that allows the development and evaluation of novel monitoring, management and control schemes related to the recently introduced CAVs within a low-cost, controlled, and safe environment.



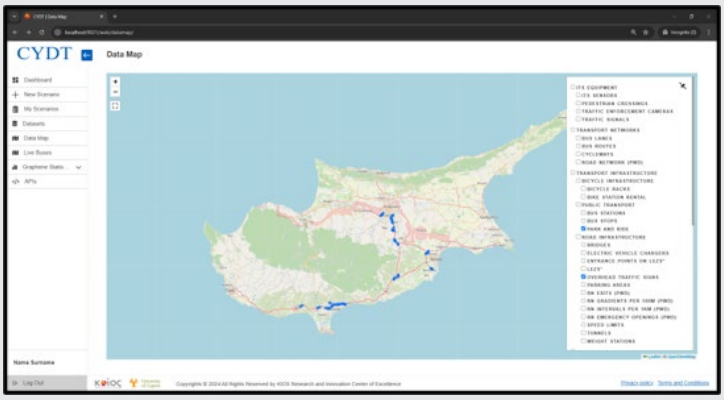
Emergency Response, Sensors, and Robotics

The KIOS CoE develops state-of-the-art tools and methodologies for emergency response management, as well as monitoring and inspection of critical infrastructures through the utilization of Unmanned Aerial Vehicle (UAVs), sensors, and robotics technologies.

These technologies are used for the development of intelligent functionalities including automated path-planning, real-time image analysis, and object detection and coordination architectures for multi-drone systems that ensure scalable and robust operations. The key benefits of such systems include the enhancement of public safety, improvement of CIS efficiency, safety of operations and hazards avoidance, reduction of person-hours and costs.

Cyprus Digital Twin

The KIOS CoE has evolved its Virtual City platform into the Cyprus Digital Twin (CyDT), expanding its capabilities to represent the entire country's Critical Infrastructure Systems (CIS), including power, water, transportation, and telecommunications. The CyDT offers a dynamic, data-driven virtual representation of Cyprus, integrating real-time and historical data with advanced simulation tools. It enables users to design and execute 'what-if' scenarios, assess risks, and analyze cascading effects across different infrastructure sectors. Through an interactive map-based interface and dashboards, users can visualize infrastructure performance and simulate complex events, supporting decision-making processes for infrastructure operators and policymakers. The platform also provides API access to facilitate data exchange with external systems and tools. Example applications include assessing the resilience of the power grid to windstorms and evaluating the impact of urban developments on water distribution networks, helping stakeholders to better plan, manage, and protect the country's critical infrastructure.



Education & Training Activities

Education and training activities are essential for building and maintaining scientific excellence at the Center. During 2024, the Center organized the 6th Graduate Training School on Intelligent Systems and Control, Distinguished Lecture Series, Workshops, and Seminars.

Prof. Jalal Kazempour

Prof. Awais Rashid

Prof. Florian Dörfler

6th KIOS Graduate Training School

The KIOS CoE in collaboration with Imperial College London, organized the 6th KIOS Graduate Training School on “Intelligent Systems and Control”, from 2-5 September 2024, at the University of Cyprus Campus.

Three world-recognized experts in their fields, Prof. Jalal Kazempour (Technical University of Denmark), Prof. Awais Rashid (University of Bristol, UK) and Prof. Florian Dörfler (ETH Zürich) lectured at the school. Prof. Kazempour talked about "Electricity market design and bidding strategy", Prof. Rashid about "Cyber Security of Industrial Control Systems” and Prof. Dörfler about "Data-Enabled Predictive Control of Autonomous Energy Systems".

More than 120 participants (researchers, PhD/MSc students and young professionals) from Cyprus and abroad participated in the school and had the opportunity to enrich their knowledge in Neural Networks, Data-driven Control, Optimization, Cybersecurity, and related areas.

Professor Alberto Sangiovanni Vincentelli

Dr. Andreas Poullikkas

KIOS CoE Distinguished Lecture Series

During 2024, the KIOS CoE hosted 2 internationally recognized scientists who gave talks on cutting-edge research and innovation advances in their respective fields.

- Professor Alberto Sangiovanni Vincentelli, from the University of California at Berkeley, USA, gave a lecture on “AI for Design: Panacea or Useful Tool?”.
- Dr. Andreas Poullikkas, ex-Chairman of the Cyprus Energy Regulatory Authority, talked about “The future electricity systems towards climate neutrality”. This lecture was organized in memory of Prof. Elias Kyriakides (1975-2019), who was a member of the faculty of Electrical and Computer Engineering Department at the University of Cyprus and a founding member of the KIOS Center of Excellence.

Personnel Learning, Training and Development

In 2024 the KIOS personnel had the opportunity to attend courses, workshops, seminars, and webinars covering a variety of topics such as innovation, project management, intellectual property, proposal writing, Python programming, FastAPI, GIS training, Django web application development, JavaScript algorithms, and other cutting-edge technologies.

Communication and Dissemination Activities

The KIOS CoE places special emphasis on communication and dissemination activities to make its research activities and results accessible to its stakeholders, partners, and the general public.

During 2024, the KIOS CoE has implemented numerous dissemination and communication activities such as high-profile visits, networking events with the industry, demonstrations/workshops/training sessions to engage stakeholders and end-users, outreach activities, online presence, and media publicity.

"KIOS CoE gained significant national and international visibility through high-profile visits, events, and outreach activities"

High Profile Visits

In 2024, the KIOS CoE gained significant national and international visibility through high-profile visits from national policy and decision makers, international experts, and enterprise and innovation experts.

Examples include: 1) The visit by the President of the European Research Council, Prof. Maria Leptin (photo 1), 2) the visit by the Minister of Education, Sports, and Youth of the Republic of Cyprus, Dr. Athena Michaelidou, 3) the visit by the Deputy Minister of Research, Innovation and Digital Policy, Dr. Nikodimos Damianou and the Chief Scientist of the Republic of Cyprus, Mr. Demetris Skourides and 4) the visit by a delegation from the Digital Cooperation Organization in Saudi Arabia.

Networking Events with the Industry

During 2024, the Center organized press conferences, workshops, demonstrations, and training sessions to engage its industrial partners. Examples include the signing of a new collaboration agreement with the Electrical and Mechanical Services Department to develop an Alternative Fuels Infrastructure Information System, the co-organizing of a multi-stakeholders' forum, on Digital Twins and Data Spaces as Tools for Developing Intelligent Systems Management of Water Resources in Cyprus, and the demonstration of AI tools in Emergency Management to civil protection experts from EU and first responders from Cyprus.

In addition, the KIOS CoE organized the workshop on GIS technologies and open science, which attracted more than 90 people from several organizations of the public and private sector in Cyprus.

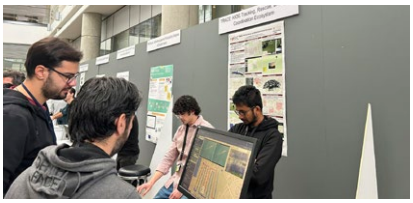
Outreach Activities

CERIS Disaster Resilient Societies Event 2024

The KIOS Research Faculty, Dr. Christos Laoudias and Dr. Demetris Eliades, attended the CERIS Disaster Resilient Societies Event 2024, on 5 -7 June 2024, in Brussels. They participated in the panel discussion about societal resilience – involvement of local authorities and citizens in Disaster Risk Reduction research, presenting the European projects SPARROW and PathoCERT.

Cyprus Forum Cities

The KIOS Research Lecturer Christos Laoudias, participated in the panel discussion at the Cyprus Forum Cities 2024 on 19 April 2024, in Limassol, and talked about KIOS CoE contribution to the development of smart cities through its projects on smart critical infrastructures.



9th Innovation & Entrepreneurship Forum

The KIOS research team participated in the Research Results Exhibition, as part of the 9th Innovation & Entrepreneurship Forum, organized by the Centre for Entrepreneurship - C4E, University of Cyprus with the support of PwC Cyprus, on 28 November 2024. KIOS showcased cutting-edge projects that push the boundaries of technology and innovation.

Researcher's Night

The KIOS CoE participated in the European Researcher's Night 2024, which took place on 27 September 2024, in Nicosia. Visitors to the KIOS booth had the opportunity, among others, to learn about renewable energy technologies, smart water systems and how Artificial Intelligence improves drones for emergency response.

School visits

During 2024, young students visited KIOS premises and learned about the research and technology being undertaken at the Center. In addition, KIOS Researchers have given lectures to pupils at schools in various areas of Cyprus

Online Presence

The KIOS CoE uses several online communication mediums to disseminate the Center's research results, news and events, achievements, etc. Examples include the KIOS CoE website, newsletter, as well as our social media pages (Facebook, Twitter, LinkedIn, Instagram, and YouTube).

Media Publicity

The research activity undertaken at the KIOS CoE has been widely published in the printed and electronic media. This includes a number of articles in newspapers and websites with large readership numbers.

The KIOS Center of Excellence has received funding from the European Union's Horizon 2020 recearch and innovation programme under the grant agreement No. 739551 (KIOS CoE).

The KIOS Center of Excellence has received funding from the Government of the Republic of Cyprus through the Deputy Ministry of Research, Innovation and Digital Policy.

Complementary funding for the KIOS CoE is also provided by the University of Cyprus and Imperial College London.