



2022

ACTIVITY REPORT



University
of Cyprus

Imperial College
London



Contents

Forewords	2
In Brief...	4
Research Activities	5
Awards	10
Competitive R&I Funded Projects	11
KIOS Innovation Hub: Collaboration with Industry	18
KIOS CoE Research Infrastructures	21
Education & Training Activities	23
Communication & Dissemination Activities	25

Published by:
KIOS Research and Innovation Center of Excellence

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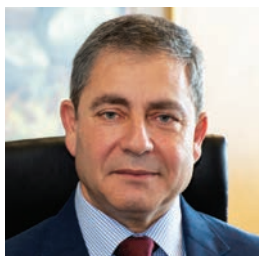
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Forewords



Message from the Rector

“ At the University of Cyprus, we are committed to driving positive change for our students, our academic community, and the society at large

Dear Reader,

The year 2022 marked the completion of 30 years since the admission of the first students at the University of Cyprus in 1992. It is an anniversary that reminds us of how much the University has progressed and what more it can achieve. Thirty years and more since its establishment in 1989, University has become locally and internationally recognized as a leading educational institution that delivers world-class education and excellence in research and innovation.

We are well aware that our world is characterized by uncertainty and change, as we are still recovering from the global pandemic and at the same time, we are dealing with the effects of climate change and the war in Ukraine. However, this is when universities come at the forefront of transforming lives and societies through research and innovation.

At the University of Cyprus, we are committed to driving positive change for our students, our academic community, and the society at large at the local and international level. Our vision is guided by the priorities set out in our Strategic Plan 2021-2025, which serves as a blueprint for action to achieve a better and more sustainable future for all. In the next years we will focus on strengthening our participation in networks and projects and linking research and teaching to UN Sustainable Development Goals.

The KIOS Center is a flagship Research and Innovation Center of Excellence at the University of Cyprus and continues to evolve by developing new knowledge and producing excellent outcomes to improve the quality of our lives. The Center's outcomes prove that investment in research undertaken at universities and research centers has a positive impact on the society, economy, and environment at the local and international level.

I would like to recognize the exceptional work of KIOS faculty and researchers and congratulate them for their dedication and commitment to making a positive change and creating a value for society through their outstanding research and innovation outcomes.

Sincerely,

A handwritten signature in blue ink, which appears to read 'Tasos Christofides'.

Professor Tasos Christofides,
Rector, University of Cyprus



Message from the Director

“ KIOS utilizes such disruptive technologies to produce new knowledge and tools for improving the operation, efficiency, resilience and security of critical infrastructure systems

Disruptive technologies, such as artificial intelligence, automation and robotics, and internet of things (IoT), are affecting our social and economic well-being, and transform the way we work, behave, and interact with each other.

KIOS is a dynamic and forward-thinking Research and Innovation Center of Excellence, that utilizes such disruptive technologies to produce new knowledge and tools for improving the operation, efficiency, resilience, and security of critical infrastructure systems, and create value for society.

The past year was important for our research objectives since the Center attracted highly competitive research funding and participated in several multidisciplinary research projects. Furthermore, KIOS researchers continued publishing their research work in high impact journals and international conference proceedings and some of them have attained significant awards and distinctions.

The KIOS Innovation Hub enhanced its collaboration with governmental organizations and several companies in Cyprus and abroad through new research and innovation projects. An important activity is KIOS contribution towards the implementation of the Cyprus Recovery and Resilience Plan, by participating in national projects alongside its industrial partners and developing smart solutions to support Cyprus' green and digital transition. In addition, KIOS has joined forces with other relevant organizations in Cyprus to develop the Cyprus DiGital INNOvation Hub, which will act as one-stop-shop, aiming to accelerate Cyprus' digital transformation.

These achievements would not have been possible without the dedication and hard work of KIOS personnel throughout yet another challenging year. I would like to take this opportunity to thank them for their collective efforts and teamwork. I would also like to thank the leadership of the University of Cyprus for their ongoing support.

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, or visit us in person.

Prof. Marios M. Polycarpou,
Director, KIOS Research and Innovation Center of Excellence
Professor of Electrical and Computer Engineering, University of Cyprus
Visiting Professor, Imperial College London, U.K.
Member of the Cyprus Academy of Sciences, Letters, and Arts

In brief



The KIOS Research Center was established in 2008 at the University of Cyprus and was subsequently selected by the EU to advance into a Research and Innovation Center of Excellence in 2017.

The mission of the KIOS Research and Innovation Center of Excellence (KIOS CoE) is to conduct multidisciplinary research and innovation in the area of Information and Communication Technologies (ICT) with emphasis on the monitoring, control, management and security of critical infrastructures. 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 provide an inspiring environment for conducting excellent, cutting-edge research at a global scale, producing new knowledge and advanced engineering and management tools that can be applied to solve timely and real-life problems in the considered Critical Infrastructure Systems, bringing multiple benefits to society at large.

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 2022, the KIOS Faculty and the wider KIOS research team have published 125 journal and conference papers, 4 book chapters, and 3 other publications.

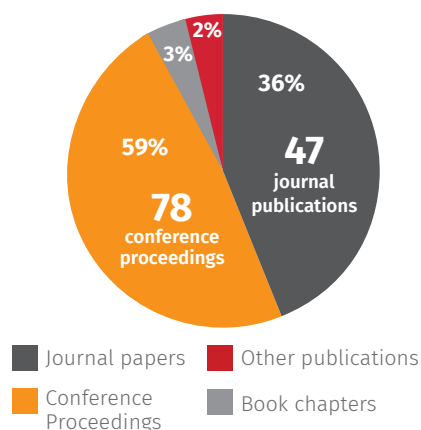
Peer-reviewed journal publications

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 2022, the KIOS research team has published 47 peer-reviewed journal papers in academic journals within 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 2022, the KIOS research team has published 78 peer-reviewed papers in scientific conference proceedings.

KIOS CoE Publications 2022



KIOS CoE Open Science Activities

The KIOS CoE has recognized the significance of openly disseminating scientific results. Towards that goal the KIOS Open Knowledge Portal¹ was launched in 2017. This is an online repository hosted on Zenodo that stores and manages all research-related 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.

In addition, the KIOS CoE Repository on Github² is another channel for making the software code and associated datasets available to the research community.

Finally, the KIOS CoE follows the best practices in Open Science and actively contributes to reproducible research initiatives. To this end, a number of scientific results produced at KIOS CoE can be easily reproduced online by other researchers using the relevant software code and accompanying data that are publicly available on the KIOS CoE Reproducible Research Platform on Code Ocean³.



1. <https://zenodo.org/communities/kios-coe/>

2. <https://github.com/KIOS-Research>

3. <https://codeocean.com/explore/capsules?query=kios>



KIOS CoE Mobile Application

The KIOS CoE developed a mobile application where crowdsourcing data collection tools are provided to engage different communities around the globe such as the general public, researchers and scientists. Through these tools the citizens can easily visualize and share their data, connect with other communities, and engage in new type of collaborations, collect data in specific digital formats, and facilitate the process of finding specific scientific data. The application is available on Google and Apple app stores.

Scientific Conferences

During 2022, the KIOS CoE successfully organized three international conferences in Cyprus: the 11th IFAC Symposium on Fault Detection, Supervision and Safety for Technical Processes (SAFEPROCESS 2022), the 20th IEEE Computer Society Annual Symposium on Very Large – Scale Integration Technology (ISVLSI 2022), and the tinyML EMEA Innovation Forum 2022 (in collaboration with the tinyML Foundation).

The aim of the conferences was to attract academic and industrial professionals, scientists and professional engineers from all over the world and give them the opportunity to present their work, to discuss with peers, to exchange ideas and transfer knowledge, as well as to expand their networks and explore future collaborations.

The organization of scientific conferences helps to increase the reputation of both KIOS CoE as a center that promotes excellence in research, and Cyprus as a country that is an ideal destination for hosting high-quality scientific events.



SAFEPROCESS 2022



TinyML EMEA Innovation Forum 2022

KIOS CoE Participation in EU Level Networks

In 2022, 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
- Crowdhelix Network
- The European Water Platform - WssTP (WATER EUROPE)
- Union Civil Protection Knowledge Network
- Disaster Risk Management Knowledge Centre
- AI Connect Network
- Connecting Education and Research Communities for an Innovative Resource Aware Society (CERCIRAS) COST ACTION

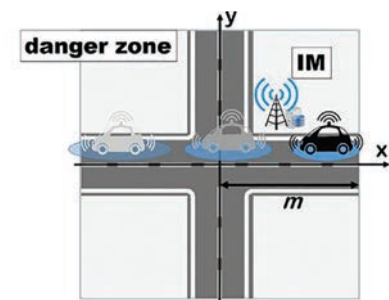


Research News

Autonomous Intersection Crossing with Vehicle Location Uncertainty

Connected Autonomous Vehicles (CAVs) introduce a potentially disruptive and highly beneficial dimension to transportation networks. CAVs' major social impacts can be quantified in the form of collision savings, travel time reductions, and fuel efficiency. To date, a large body of the literature has investigated the problem of autonomous intersection crossings facilitated by CAVs. Nevertheless, existing approaches assume that CAVs know their exact location and system state. This work presents a novel framework that allows for an optimized intersection management, that considers uncertainty in the location of the CAVs. A family of integer linear programming optimizations are presented that can set, sequentially or simultaneously, the acceleration profiles of all vehicles in the intersection. Extensive simulation results are presented, proving that the proposed framework represents a real-time near-optimal approach that maximizes intersection throughput with probabilistic collision avoidance guarantees.

C. Vitale, P. Kolios, and G. Ellinas, "Autonomous Intersection Crossing with Vehicle Location Uncertainty", *IEEE Transactions on Intelligent Transportation Systems (T-ITS)*, vol. 23, no. 10, pp. 17546-17561, October 2022.



AirCamRTM: Enhancing Vehicle Detection for Efficient Aerial Camera-based Road Traffic Monitoring

The article proposes a framework, called AirCam-RTM, which combines road segmentation and vehicle detection to improve real-time traffic monitoring using drones. The framework is designed to address the challenges of monitoring traffic from UAV imagery due to large image sizes and the presence of non-relevant targets. By focusing only on relevant vehicles, the proposed framework can improve monitoring performance by approximately two times and provide an 18% accuracy improvement. The article presents qualitative evaluations of the proposed approach using a real experimental setup and demonstrates how it can be used for real-time traffic monitoring with UAVs. The use of UAVs equipped with cameras for traffic monitoring can provide a flexible and infrastructure-free solution for efficient road traffic monitoring in cities.

R. Makrigiorgis, N. Hadjittoouli, C. Kyrkou and T. Theocharides, "AirCamRTM: Enhancing Vehicle Detection for Efficient Aerial Camera-based Road Traffic Monitoring," *2022 IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)*, Waikoloa, HI, USA, 2022, pp. 3431-3440.



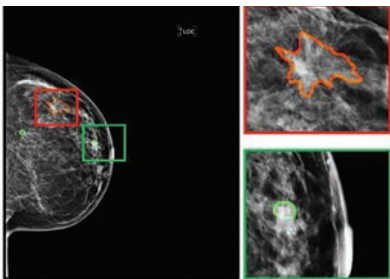
A Modular End-to-End Framework for Secure Firmware Updates on Embedded Systems

Firmware is a device-specific, read-only, piece of code found in embedded systems of all kinds. This code includes crucial instructions on how such embedded systems should function and thus firmware updates are a crucial part of a device's lifecycle. The ability to update the firmware gives a device the chance to patch vulnerabilities, address operational issues and/or improve performance. This process is also often targeted by malicious actors in order to inject infected firmware into embedded devices.



These kinds of attacks can have catastrophic consequences, especially when various devices integrated in critical infrastructures are targeted. In this work, we propose a secure firmware update framework based on hardware primitives and cryptographic modules to help secure firmware updates for embedded systems in insecure environments.

S. Falas, C. Konstantinou, M. Michael, "A Modular End-to-End Framework for Secure Firmware Updates on Embedded Systems", *ACM Journal on Emerging Technologies in Computing Systems*, vol. 18, no. 1, 2022.



Automatic Breast Mass Segmentation and Classification using Subtraction of Temporally Sequential Digital Mammograms

The introduction of mammography for the diagnosis of breast abnormalities, significantly decreased their mortality rates. However, accurate detection and classification of breast masses is especially challenging even for experienced radiologists. For this reason, various Computer-Aided Diagnosis (CAD) systems are being developed to assist with the accurate classification of breast abnormalities. In this study, subtraction of temporally sequential digital mammograms and machine learning are applied to the automatic segmentation and classification of masses. The detection of masses was 99.9% accurate. The classification accuracy of the masses being benign or suspicious increased from 92.6%, using the state-of-the-art temporal analysis, to 98%, using the proposed methodology. This work has the potential to substantially contribute to the development of automated breast cancer CAD systems with significant impact on patient prognosis.

Loizidou Kosmia, et al. "Automatic breast mass segmentation and classification using subtraction of temporally sequential digital mammograms", *IEEE Journal of Translational Engineering in Health and Medicine*, vol. 10, pp. 1-11, 2022.



Optimal Secondary Frequency Regulation With ON-OFF Loads in Power Networks

Load-side participation can provide support to the power network by appropriately adapting the demand when required. In addition, it enables an economically improved power allocation. This study considers the problem of providing an optimal power allocation among generation and ON-OFF loads within the secondary frequency control timeframe. In particular, we consider a mixed-integer optimization problem, which ensures that the secondary frequency control objectives are satisfied. We present analytic conditions on the generation and ON-OFF load profiles such that an epsilon-optimality interpretation of the steady-state power allocation is obtained, providing a nonconservative value for epsilon. Moreover, we develop a hierarchical control scheme that provides ON-OFF load values that satisfy the proposed conditions. We study the interaction of the proposed control scheme with the power network dynamics and provide analytic stability guarantees.

A. Kasis, S. Timotheou and M. Polycarpou, "Optimal Secondary Frequency Regulation With ON-OFF Loads in Power Networks," *IEEE Transactions on Control Systems Technology*, vol. 30, no. 6, pp. 2490-2505, Nov. 2022.



KIOS CoE Personnel

The human capital is the most important asset of an organization. Thus, the KIOS CoE places particular emphasis on recruiting high-caliber researchers who will contribute significantly to the development of the Center.

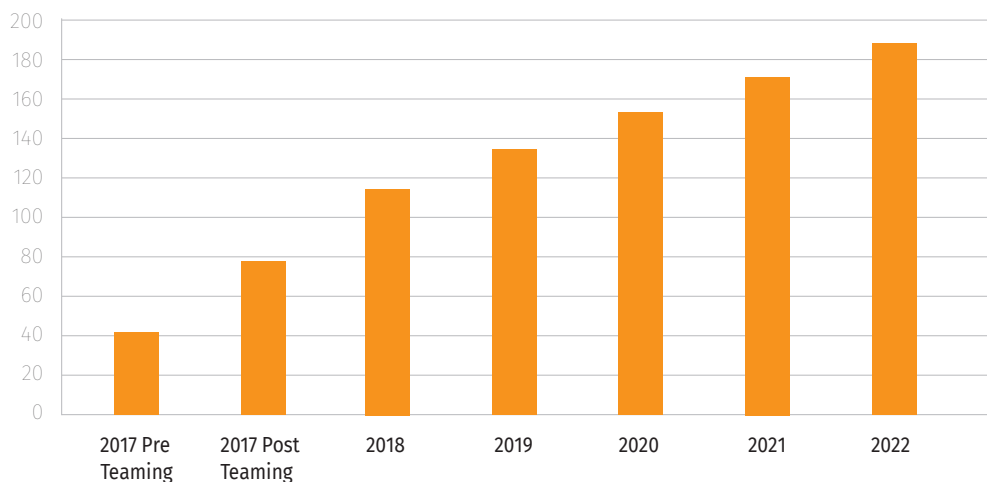
The KIOS CoE places also particular emphasis on promoting diversity, equal opportunities, and gender balance at all levels of its research and innovation teams.

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.

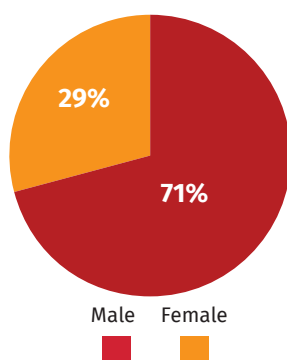
At the end of 2022, 189 researchers were employed by the KIOS CoE including full-time and part-time employees. This number includes Faculty, Affiliated Faculty, Research Faculty, Postdoctoral Researchers, PhD Students, Research and Software Engineers, Interns, and Administrative Personnel. At the KIOS CoE spoke at Imperial College London 13 Researchers were employed. Finally, the KIOS Alumni network comprises 248 people.

189
RESEARCHERS
EMPLOYED
by KIOS CoE
at the end
of 2022

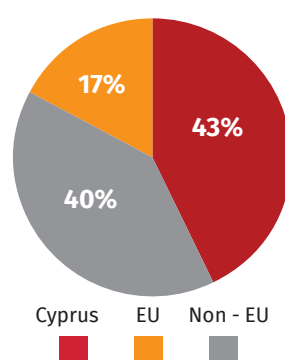
Personnel Growth Per Year



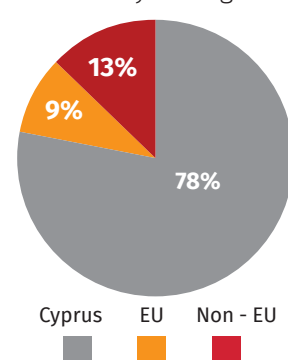
Gender



Country of Highest Academic Degree



Country of Origin



Awards



Young Researcher Award

Dr. Lenos Hadjidemetriou, Research Lecturer at the KIOS Center of Excellence, received the "2022 Young Researcher Award" from the Cyprus Research and Innovation Foundation, under the Physical Sciences and Engineering category. His recent research work has focused on advancing the integration of renewable energy resources in smart grids by developing multifunctional inverters, flexible energy storage systems, and intelligent methods for active distribution grid management.



Best Conference Paper Award

The KIOS CoE research team consisting of the Research Associate Dr. Giannis Savva, the Research Fellow Dr. Kostas Manousakis, and Prof. Georgios Ellinas, in collaboration with the Senior Researcher Dr. Vasilis Sourlas from the I-Sense Research Group of the National Technical University of Athens, has won the Best Paper Award for the paper entitled "Joint Content Placement and Secure Lightpath Provisioning in EONs Supporting Anycast Traffic". This paper was presented at the 27th IEEE International Workshop on Computer-Aided Modeling and Design of Communication Links and Networks, in Paris, France.



Young Author Conference Award

The KIOS PhD Candidate, Antonios Georgantas, received the Young Author Conference Award by the International Federation of Automatic Control (IFAC), for his paper entitled "Highway traffic control with ramp metering utilizing variational autoencoders". His paper was presented at the 6th IFAC Conference on Intelligent Control and Automation Sciences, which featured keynote talks and technical presentations on all aspects of Intelligent Control and Automation Science.



2nd prize in the Competition "Shape the Future of ITS"

The KIOS PhD Candidate, Christos Makridis, received the 2nd prize in the competition "Shape the Future of Intelligent Transportation Systems (ITS)", under the undergraduate and postgraduate students' category, for his futuristic ITS Vision entitled "A Flexible Framework for a Futuristic Traffic Management Scheme". The competition was organized by the IEEE Intelligent Transportation Systems Society.



Best TN-ITS Engagement Award 2022

The KIOS Senior Research Engineer, George Christou, received the "Best TN-ITS Engagement Award 2022" from the Transport Network ITS Spatial Data Deployment ERTICO Innovation Platform, for his active contribution in promoting the exchange of spatial road data between road authorities and data users within Europe through this platform. The award ceremony took place on the 15th and 16th of December 2022 in Brussels, during the TN-ITS General Assembly meeting.



Honorary Mention in the 2022 IEEE ComSoc Student Competition

The KIOS research team consisting of the PhD Candidate Nicolas Souli, the Software Engineer I Rafael Makrigiorgis, the Research Assist. Prof. Panayiotis Kolios, and Prof. Georgios Ellinas, received an Honorary Mention in the 2022 IEEE ComSoc Student Competition "Communications Technology Changing the World" for their project entitled "ORION: Autonomous unmanned aircraft counter-drone system".



Competitive R&I Funded Projects

In 2022 the KIOS CoE participated in a number of collaborative research and innovation projects funded by various competitive funding programmes, including Horizon H2020, the Cyprus Research and Innovation Foundation (RIF), other EU funding programmes, such as INTERREG and SolarEranet Co-fund, as well as EU funding programmes tackling specific EU policy and objectives, such as emergency response. These projects which involve multidisciplinary international consortiums address important global challenges for critical infrastructure systems such as power and energy systems, water networks, transportation networks, telecommunication networks, and emergency management and response systems."

42
**FUNDED
RESEARCH
PROJECTS**
in 2022

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 ARTION	Development of a world class network for knowledge sharing in the area of Artificial Intelligence (AI) for disaster management	EU CIVIL PROTECTION	Coordinator
4 ΘΗΣΕΑΣ	Development of an electronic situational awareness and decision support system to improve the Cyprus National Guard's operational capabilities	Cyprus Ministry of Defence	Coordinator
5 PathoCert	Development of technologies for detecting and managing pathogen contamination events during emergency response situations	EU - H2020	Coordinator
6 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 ¹	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

7	EMPOWER	Empowering the Cyprus power system with sustainable and intelligent technologies to enhance its stability and reliability, under high penetration of renewable energy sources	Cyprus RIF	Coordinator
8	BITS	Development of Bayesian statistical methodologies and tools in the area of Intelligent Transportation Systems - MSCA Research Fellowship	EU - H2020 - MSCA	Coordinator
9	C-AVOID	Development of a realistic fully-fledged transportation architecture based on the new generation of cellular networks (5G) - MSCA Research Fellowship	EU - H2020 - MSCA	Coordinator
10	SmarTher Grid	Design of control schemes for thermostatic loads to provide effective, efficient, and reliable ancillary support to the power network - MSCA Research Fellowship	EU- H2020 - MSCA	Coordinator
11	GLADIATOR	Next-generation theranostics of brain pathologies with autonomous externally controllable nanonetworks: a trans-disciplinary approach with bio - nanodevice interfaces	EU - H2020 FET OPEN	Coordinator
12	GLADIATOR Complementary	Complementary infrastructure to support the development of a working prototype of a complete, autonomous and clinically applicable, nanonetwork-based, Molecular Communications platform	Cyprus RIF	Coordinator
13	AIDERS	Deployment of artificial intelligence techniques for the improvement of emergency response	EU CIVIL PROTECTION	Coordinator
14	AIRMOS	Implementation of intelligent real-time drone monitoring tactics to safeguard sensitive facilities	Cyprus Seeds	Coordinator
15	ACTING	Development of a network of advanced interconnected domain oriented cyber ranges for training and exercises	European Defence Fund	Partner
16	HVDC-WISE	Design and validate grid architecture concepts to foster the development of large High Voltage Direct Current (HVDC)-based transmission grid infrastructures	EU Horizon Europe	Partner
17	DiGiNN (EDIH)	Creation of an one-stop-shop for all companies and public sector in Cyprus to improve their processes, products, or services using digital technologies	DIGITAL EU	Partner



18	TRANSIT	Provide training, skilling and education for current and future generations to enable the energy transition	EU Horizon Europe	Partner
19	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
20	DIMPE	Fostering internationalization by offering quality practices and introducing a digitalization framework in Higher Education Institutions that offer or are planning to introduce multilingual programs	EU-ERASMUS+	Partner
21	SESAME	Development of a new generation of Multi-Robot Systems (MRS), utilizing AI/ML among other approaches, to design dependable and secure multi-robot systems for key European sectors including Healthcare, Manufacturing, Agri-food, and Infrastructure Inspection	EU-H2020	Partner
22	EnerMan	Create an energy sustainability management framework collecting data from the factory and holistically process them to create dedicated energy sustainability metrics	EU-H2020	Partner
23	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
24	DigiWATER	Development of an intelligent “Digital Water Twin” software to monitor the quality of water in distribution networks	CYRPUS RIF - ENTERPRISES	Partner
25	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
26	OneNet	Development of new generation of grid services able to fully exploit demand response, storage and distributed generation	EU-H2020	Partner
27	CORONASENSE	Development of an innovative software to assess in real-time the Indoor Air Quality specifically for conditions that enable the spread of COVID-19 in large public indoor spaces	Cyprus RIF - Seed-COVID	Partner

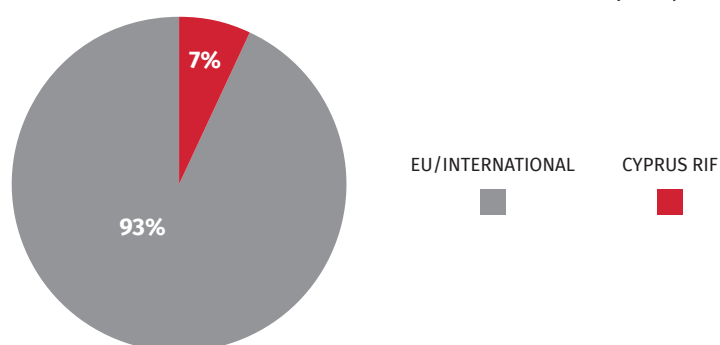
28	Malloc	Development of a software solution that protects users' data by safeguarding their mobile devices against unauthorised or unattended data recordings or transmissions	NextGenerationEU -Pre-Seed	Partner
29	WiseStorage	Development of an innovative web-based solution to optimize the operation of Battery Energy Storage Systems (BESS) installed in buildings and maximize the prosumers' profit	NextGenerationEU - Pre-Seed	Partner
30	MariSense	Development of a maritime cognitive decision support system	Cyprus RIF	Partner
31	AURA	Development of an innovative software for the improvement of the indoor air-quality monitoring in large, energy efficient buildings	NextGenerationEU - Pre-Seed	Partner
32	SWIFTERS	Enable local and international security organizations to build, manage, and scale their drone programs, and leverage the full capabilities of drones in their own missions	Cyprus RIF - Pre-Seed	Partner
33	KIOS CoE - HUAWEI	Development of an information fusion radio location algorithm with Tango-aided floor plan and signal mapping	HUAWEI Technologies Ltd	Partner
34	REVERSE Mentoring	Guidance and training of adult educators in the implementation of quality education and training for the upskilling and reskilling of adult learners to overcome skills mismatches within the EU labor market	EU-ERASMUS	Partner
35	CUREX	Address the protection of the confidentiality and integrity of health data by producing a novel, flexible, and scalable situational awareness-oriented platform	EU - H2020	Partner
36	DOMOGNOSTICS +	Conduct industrial research, develop and evaluate an innovative low-cost intelligent software/hardware solution designed for building operators to better monitor and control their building systems	Cyprus RIF	Partner
37	Pvgnosis	Development and demonstration of technical novel solutions to advance the operation, maintenance, and lifetime of photovoltaic plants	Cyprus RIF and EU -SOLAR ERANET ²	Partner
38	CERETAB	Utilization of new, state-of-the-art border surveillance technologies for border monitoring and security	EU Internal Security Fund Borders and Visa	Partner

(2) Horizon 2020/FP 7 SOLARERA.NET Cofund and the Cyprus Research and Innovation Foundation

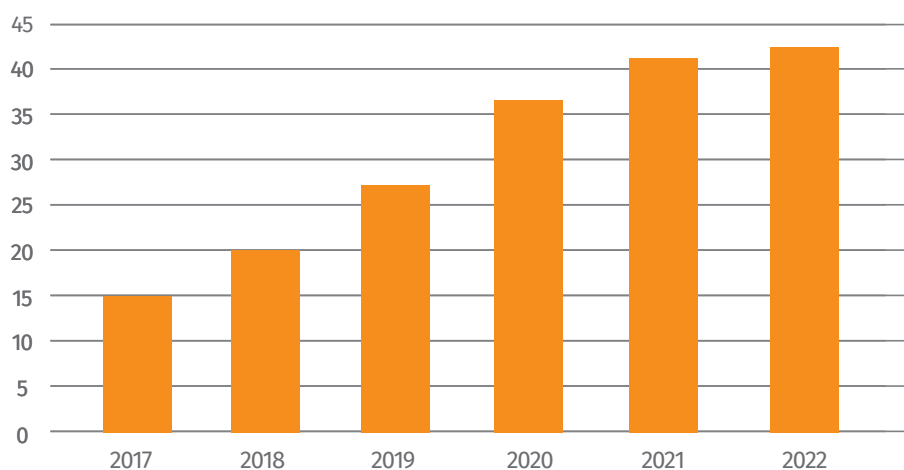


39	DiMPAH	Aggregate, connect, and make widely available, novel open education resources on selected digital methods	EU - ERASMUS	Partner
40	CybPhys	Upgrade bachelor/master-level curricula and study programs in Belarusian and Ukrainian universities in the area of cyber-physical systems modelling and simulation	EU - ERASMUS+	Partner
41	FLEXITRANSTORE	An integrated platform for increased flexibility in smart transmission grids with storage entities and large penetration of renewable energy sources	EU - H2020	Partner
42	RONDA	Help transport stakeholders better assess the condition of the roadway network and its vulnerabilities, mitigate associated risks, and manage transport networks	Cyprus RIF	Partner

Funding sources for Research and Innovation projects for 2022



Competitive funding projects per year



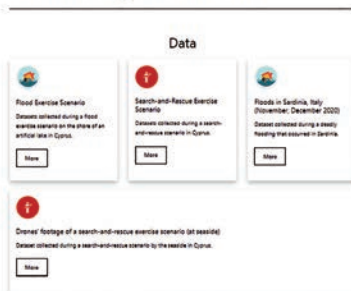
A Sampling of Projects' Outcomes



PathoCERT: Pathogen Contamination Emergency Response Technologies

The PathoCERT project partners have developed more than 20 technologies that can be used by first responders to manage waterborne pathogen contamination events during emergency situations. These include an early warning system with smart portable and wearable sensors for the rapid water testing, a system for autonomous drone flight and a water sampling prototype device, tools for analyzing contamination event data from satellites, social media, and smart cameras, platforms for real-time data processing, analytics, and decision support systems for contamination threat assessment and event investigation. In addition, the project has established the Communities of Practice in 6 countries with more than 120 first responders, experts and stakeholders attending the meetings.

Disaster Management AI Portal



ARTION: Disaster Management AI Knowledge Network

A Disaster Management Artificial Intelligence (AI) Portal was developed within the context of the ARTION project to enable the broad sharing of material, knowledge, and best practices among stakeholders across Europe. In addition, AI algorithms were developed to build the capacity and competencies of first responders in the use of AI technology and consequently help them manage large-scale disasters efficiently and effectively.



FLEXITRANSTORE: Groundbreaking Technologies for the Evolution of the European Power System

The project's partners have developed ground-breaking solutions for intelligent management of energy storage systems, as well as a new approach for a wholesale electricity market to accelerate the integration of renewables into the European energy system and increase the cross-border electricity flows across Europe. Among others, the activities of the project included the installation of battery energy storage systems in two European power systems, the installation of two power flow controllers to efficiently tackle congestions by redirecting power flows, and the development and operation of a new scheme for a wholesale electricity market. The project outcomes contribute towards the improvement of the reliability, security, and resilience of the European energy system.



Research career development for KIOS researchers through MSCA Actions

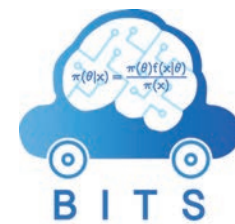
For more than 25 years, the Marie Skłodowska-Curie Actions (MSCA) programme of the EU has funded the research of more than 145,000 PhDs and postdocs from all over the world, providing them the opportunity to acquire new knowledge and skills through advanced training and international, interdisciplinary, and inter-sectoral mobility. Four postgraduate researchers working at KIOS CoE have been awarded prestigious MSCA research fellowships, following a highly competitive selection process, to work on research projects related to critical infrastructure systems.



Dr. Kleanthis Malialis worked on the research project “FAULT-LEARNING”, which proposed novel online learning algorithms, with an application focusing on fault detection and isolation in critical infrastructure systems. He said: *“This fellowship gave me the unique opportunity to enrich my research skills and expertise in the areas of online machine learning, and learning-based fault detection in critical infrastructure systems. Furthermore, the fellowship allowed me a secondment visit to Polytechnic University of Milan in Italy, thus enabling me to work with top researchers in the field and enhance my network of collaborators”.*

FAULT-LEARNING

Dr. Yiolanda Englezou worked on the interdisciplinary project “Bayesian Intelligent Transportation Systems”, which developed solutions for efficient decision-making and fault diagnosis capabilities of intelligent vehicles, as well as for improving their collective behavior when interacting with other vehicles and the road infrastructure. According to Dr. Englezou, *“during the fellowship, I have gained invaluable experience in science communication, research dissemination, project management, and, by overseeing practical and scientific aspects of the project, I have enriched my professional profile towards facilitating my future independence as a researcher in the field”.*



Dr. Andreas Kasis worked on the project “SmarTher Grid”, which led to the design of control schemes for thermostatic loads and on-off loads that enable improved efficiency and robustness in power networks. Dr. Kasis commented: *“During the fellowship, I have significantly strengthened my technical expertise, developed mentoring abilities, and gained significant management and administrative skills. Moreover, I had the opportunity to conduct research and industrial visits at the University of Groningen, Netherlands, and the Electricity Authority of Cyprus, acquiring significant expertise and expanding my network. This Fellowship enabled me to make a major step forward in my career, by taking a position as a Research Lecturer with the KIOS CoE”.*



Finally, Dr. Christian Vitale, worked on the “C-AVOID” project, which developed solutions to enhance safety for both human-driven and autonomous vehicles at urban intersections. By utilizing wireless communication to gather information on the vehicles' status, the project was able to predict potential collisions in advance and suggest optimal maneuvers for autonomous vehicles to cross the intersection safely and efficiently. Dr. Vitale mentioned: *“The Marie Curie Fellowship provided me with a unique opportunity to advance both my research and professional development. During the fellowship, I had the privilege of working at KIOS CoE, a top research institution in Europe, and collaborating with some of the best international researchers in my field, broadening my knowledge to new solution tools, such as Machine Learning. Moreover, the fellowship offered valuable training opportunities, including courses on project proposal writing, and the possibility to supervise Master and PhD students, which improved my skills as a researcher and mentor. Overall, the Fellowship was a transformative experience that helped me advance my career and grow as a researcher”.*



KIOS Innovation Hub: Collaboration with Industry

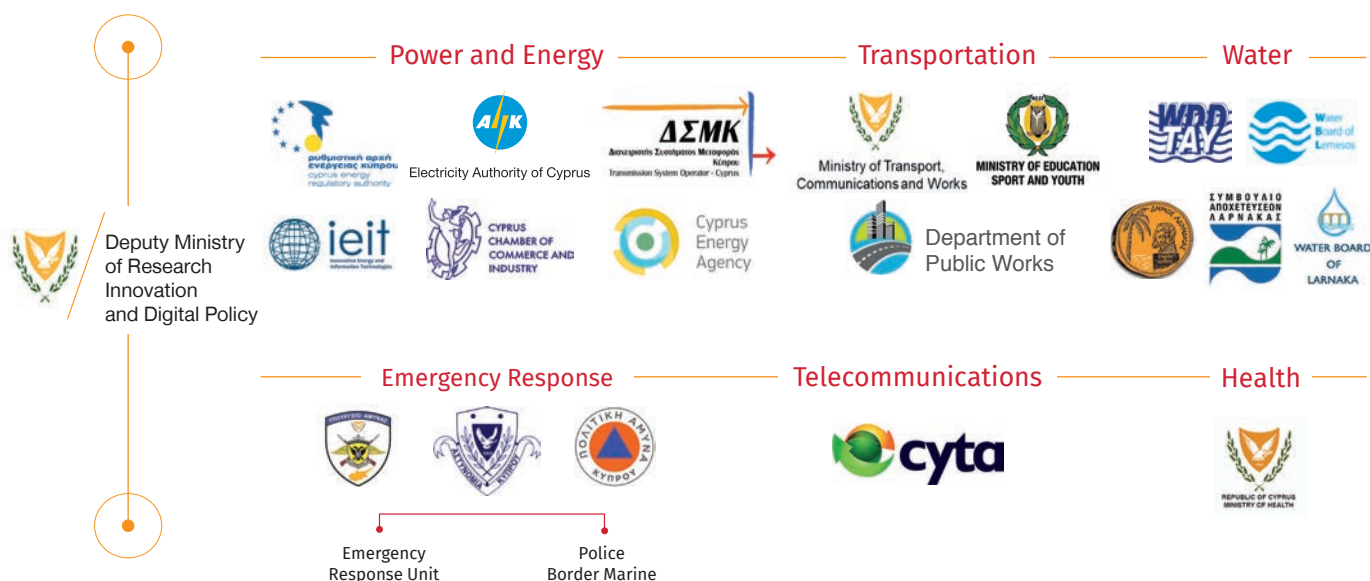
33
ACTIVE
PROJECTS
with the
INDUSTRY
in 2022

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).

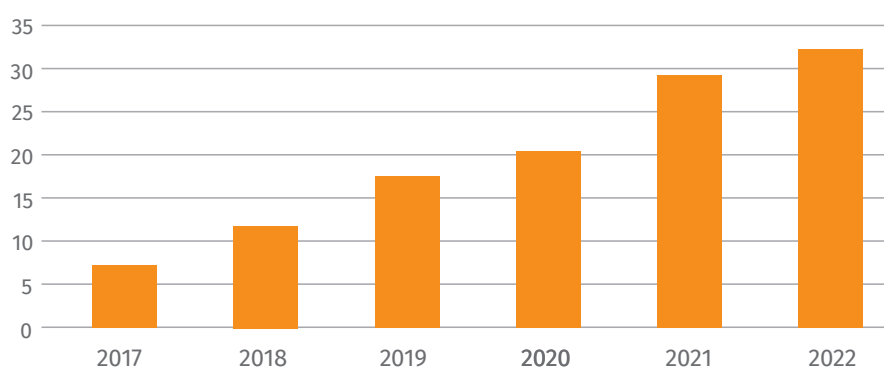
Its vision is to promote collaboration between academia, industry, operators of critical infrastructure systems, regulators, as well as governmental organizations with the ultimate goal to create an ecosystem that spans the entire innovation cycle from conception of an idea to its commercialization.

During 2022, the KIOS CoE contributed towards the implementation of the Cyprus Recovery and Resilience Plan by participating in national projects together with its industrial partners and developing smart solutions to support Cyprus' green and digital transition.

Innovation Hub Partners



Industrial projects per year





Industrial Collaboration Outcomes

Intelligent Technologies for Empowering the Cyprus Power System

The KIOS research team, in collaboration with Electricity Authority of Cyprus (EAC) and the Cyprus Transmission System Operator (TSO), have installed advanced measurement devices, called Phasor Measurement Units (PMUs) in key transmission substations of EAC to render the Cyprus power system fully observable by synchronized measurements. Furthermore, intelligent PMU-based methodologies for monitoring the Cyprus power system operation were developed by the KIOS research team in order to enhance the situational awareness of the Cyprus power system operators.



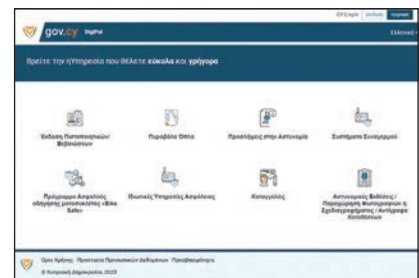
FixCyprus Mobile App

The FixCyprus mobile application was developed in collaboration with the Public Works Department of the Ministry of Transport, Communications and Works to improve the Cyprus road network infrastructure and road safety. The app collects and manages crowdsourced data related to problems in the road network of Cyprus, such as damages, vandalism, and other risks that can impact road safety. The development of the app is part of the Cyprus Digital Twin Intelligent Transport System Project, which is funded by the Cyprus Recovery and Resilience Plan.



DIGIPOL Platform

In collaboration with the Cyprus Police, the KIOS research team completed the first phase of the DIGIPOL project (Digital Police), which consists of a digital platform to provide online a plethora of services offered to the public by the Cyprus Police. The first phase included a needs analysis, a proposed architecture, and the definition of the functional and non-functional requirements of the new system. The project is funded by the Cyprus Recovery and Resilience Plan.



Research Study for the Design of an Integrated Monitoring and Control Management System

The KIOS research team contacted a research study on the design of an integrated monitoring and control management system for the Water Development Department to enable the efficient management of the country's water assets. The designed solution consisted of an Energy Management System, an Early Warning and Alerting System, a Potable Water and Irrigation Demand Management System and a Security Information Event Management System.



Influenza Sentinel Surveillance system

The KIOS research team in collaboration with the Cyprus Ministry of Health, has developed the first phase of the "CIPHIS" project (Cyprus Innovative Public Health ICT System), which consists of an Influenza Sentinel Surveillance system aiming to support public sector bodies in making data-driven evidence-based decisions for public health matters. The "CIPHIS" project aims to support the digital transition of the healthcare sector and strengthen the health system's effectiveness and resilience. It is funded by the Cyprus Recovery and Resilience Plan.





Intelligent Technologies for Cellular Drone Applications

A proof-of-concept Unmanned Aerial Vehicle (UAV)-based solution has been developed for autonomous inspection of the telecommunication infrastructure in collaboration with the Cyprus Telecommunications Authority. In this context, drones equipped with dedicated sensors were used to acquire high-quality data and algorithms were developed for the detection of antenna misalignment, liquid leakage, signs of corrosion and potential sources of fire around the premises, enabling prompt action for preventing equipment failure. Moreover, the developed solution leverages wireless communication networks (4G/5G) for real-time data transmission and monitoring.



Digital Innovation Hub to accelerate the digital transformation of Cyprus

The KIOS CoE joins forces with 15 prestigious Cypriot organizations with expertise in Artificial Intelligence, High Performance Computing, and Cybersecurity technologies, to accelerate the digital transformation of small and medium enterprises as well as of public sector organizations in Cyprus.

This strategic initiative will be implemented through the Cyprus DiGiTal INNovation Hub (“DiGiNN” project) funded by the EU, that will function as a one-stop shop to help companies improve their business/production processes, products, or services, using digital technologies, enabling them to respond to the digital challenges and become more competitive. “DiGiNN” will provide them an end-to-end experience in their digitization journey; from coaching and mentoring by reputable experts, access to the most advanced infrastructure and facilities, support to find investments, to networking and access to innovation ecosystems.

KIOS CoE will be actively participating in the project by leading the activities focused on “Test before Invest” which include, inter alia, access to the labs and experimental research facilities for testing existing or newly developed technologies, awareness raising, digital maturity assessment, demonstration activities, integration, adaptation and customization of various technologies, knowledge, and technology transfer. These activities will enable users to test and evaluate a specific technology and reach an informed decision regarding whether to invest in its adoption.

Towards this end, KIOS CoE will make available to external users its state-of-the-art research facilities and systems, investigating different aspects in monitoring, control, and security of critical infrastructures for experimental evaluation, testing, and prototyping, as well as intelligent technologies for emergency response.

In addition to the KIOS CoE, the partnership consists of the Cyprus Institute as the project’s coordinator, the CYENS Centre of Excellence as co-ordinator, the PWC, the Cyprus Chamber of Commerce and Industry, the Cyprus University of Technology, the Employers and Industrialists Federation, ELECTI Consulting Ltd, IDEA Innovation Center, Cyprus Seeds, Laboratory for Internet Computing and the Center for Entrepreneurship at the University of Cyprus, Chrysalis Leap, and the Cyprus Institute of Neurology and Genetics, as partners.

The DiGiNN project will be co-financed by the European Commission (through the Digital Europe Programme 2021-2027) and the Cyprus Deputy Ministry of Research, Innovation and Digital Policy.



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 a hardware in the loop framework. Three different energy storage pilots and a wide deployment of synchrophasor measurement units in Cyprus power substations 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

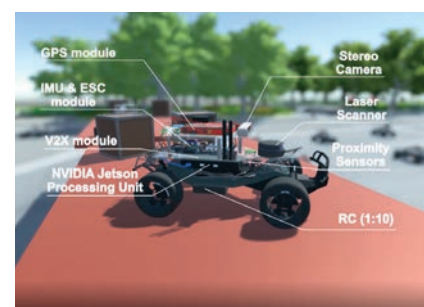
The Water Security Research Infrastructure is a small-scale representation of an urban water transport system, and is composed of a network of tanks, pumps, valves, as well as hydraulic and quality sensors. A key feature is the ability to reconfigure the topology and to emulate realistic water demands 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 of water distribution networks. 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.

The Transportation Research Infrastructure comprises various sensors installed to collect real-time measurements that allows the development and evaluation of novel management and control schemes related to 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, as well as reduction of person-hours and costs.

KIOS Virtual City

The KIOS Virtual City is a specially designed virtual platform to assist with the management and operation of interdependent critical infrastructure systems (e.g., water, power, telecommunications, transportation, and health systems) and can be used to assess the cascading effects of natural or man-made disasters (e.g., flooding, power blackouts) which can seriously impact people's everyday lives, affecting their safety and well-being.

The Virtual City emulates the actual operation of critical infrastructure systems (CIS) within the urban and sub-urban environment and offers a virtual decision support facility for assessing the security and efficiency of a city as well as its environmental footprint and operational costs.

This platform is ideal for use by policy makers, CIS operators, and other stakeholders to assist them towards their decision making with respect to the management of a smart city environment. It is accessible through the KIOS Control Room with custom interfaces and it is also available as a research tool to be downloaded by researchers.





Education & Training Activities

Education and training activities are essential for building and maintaining scientific excellence at the Center. During 2022, the MSc Program in Intelligent Critical Infrastructures run successfully for the fourth consecutive year. In addition, a number of activities have been implemented such as the 4th Graduate Training School on Intelligent Systems and Control, Distinguished Lecture Series, Workshops, and Seminars.

MSc Program in Intelligent Critical Infrastructure Systems



Master of Science in
INTELLIGENT CRITICAL
INFRASTRUCTURE SYSTEMS

The innovative MSc Program in Intelligent Critical Infrastructure Systems is offered by the Department of Electrical and Computer Engineering at the University of Cyprus in collaboration with the KIOS Research and Innovation Center of Excellence and Imperial College London.

It is designed to train high-qualified engineers on the newest ICT approaches, in order to be able to deal with the challenges in monitoring, control, management and security of critical infrastructure systems, namely power systems, water distribution networks, telecommunication networks, and transportation systems. The coursework provides a blend of the necessary theory, tools, applications, transferable skills, and practical/ research experience, in a holistic approach which provides students with knowledge, skills, competencies and experiences relevant to the topic of the program. Furthermore, the program takes advantage of the state-of-the-art buildings and laboratory/testbed infrastructure facilities at the University of Cyprus campus.

The duration of the program is 3 semesters (1.5 years) and is also available for part-time students (6 semesters / 3 years). Courses are delivered by academics from the University of Cyprus and Imperial College London.

For more information about the program please visit the website: www.msccis.ucy.ac.cy

4th KIOS Graduate Training School

The KIOS CoE in collaboration with Imperial College London, organized the 4th KIOS Graduate Training School on “Intelligent Systems and Control”, on 5-7 October 2022 at the University of Cyprus Campus.

Three world-recognized experts in their fields, Prof. Karl H. Johansson (KTH Royal Institute of Technology, Sweden), Prof. Barbara Hammer (Bielefeld University, Germany) and Prof. Constantine Dovrolis (Georgia Institute of Technology, USA) lectured at the school.

More than 100 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 Machine Learning, Optimization, Control Theory, Network Science, and related areas.



Prof. Dovrolis talks about Network Science Methods



Prof. Hammer talks about Aspects of Trustworthy Machine Learning



Prof. Johansson talks about Cyber-physical Control Systems

6 DISTINGUISHED SCIENTISTS shared their knowledge and expertise with researchers in 2022

KIOS CoE Distinguished Lecture Series

During 2022, the KIOS CoE hosted six internationally recognized scientists who gave talks on cutting-edge research and innovation advances in their respective fields.

- Professor Petros Ioannou, from the University of Southern California, gave a talk on “Rejection of Vibrations with Unknown Frequencies using Robust and Adaptive Feedback” (photo 1).
- Professor Vijaykrishnan Narayanan, from Pennsylvania State University, talked about “Distributed Visual Analytics: Algorithm-Architecture Interactions”.
- Professor Youmin Zhang, from Concordia University, Montreal, presented the topic “Making Autonomous Systems Smarter, Safer, More Reliable and More Resilient” (photo 2).
- Professor Nikil Dutt, from University of California, talked about “Self-aware Memory Management for Emerging Energy-efficient Architectures” (photo 3).
- Professor Alberto Sangiovanni Vincentelli, from the University of California at Berkeley, gave a talk on “Cyber Physical System Directions and Challenges” (photo 4).
- Professor Zhong-Ping Jiang, from New York University, presented the topic “Small-Gain Theory for the Stability and Control of Nonlinear Network Systems”.



Personnel Learning, Training and Development

In 2022 the KIOS personnel had the opportunity to attend workshops, seminars, and talks covering a variety of topics such as Diversity, Equality and Inclusion, Innovation & Entrepreneurship, Project Management and Intellectual Property Management, Cybersecurity, QGIS Python Programming, Introduction to Web programming for GIS applications, Writing Django apps, JavaScript algorithms and Data Structures, etc.



Communication and Dissemination Activities

The KIOS Research and Innovation Center of Excellence places special emphasis on communication and dissemination activities in order to make its research activities and results accessible to its stakeholders, partners, and the general public.

For the year 2022, the Center's dissemination and communication activities included: High-profile visits, short videos, networking events with the industry, outreach activities, online presence, and media publicity.

High-Profile Visits

In 2022, 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 delegation from the European Commission (photo 1), 2) the visit by US Regional Hub Officers for Environment, Science, Technology and Health Affairs, 3) the visit by the Ambassador of Israel in Cyprus, H.E. Oren Anolik, and 4) the visit by the delegation from the Cyprus Ministry of Defence.



Networking Events with the Industry

During 2022, the KIOS CoE organized press conferences to announce its research and innovation collaborations with Limassol's Water Board (photo 2) and Larnaca's Sewerage and Drainage Board. KIOS also announced the launch of the FixCyprus mobile app, which was developed in collaboration with the Public Works Department of the Ministry of Transport, Communications and Works.

In addition, the Center in collaboration with Electricity Authority of Cyprus, organized a workshop and presented the research outcomes of their collaboration for the period 2021-2022. Finally, on the occasion of the International Day of Geographic Information Systems (GIS), the Center organized a workshop entitled "Towards living maps", which attracted more than 100 participants from several organizations of the public and private sector in Cyprus.



“ KIOS CoE gained significant national and international visibility through high-profile visits

Outreach Activities



7th European Civil Protection Forum

The KIOS CoE was selected by the European Commission's DG ECHO to participate in the 7th European Civil Protection Forum exhibition, by sharing its experiences and disseminating the key outcomes of the research projects AIDERS and ARTION, which are both related to the use of Artificial Intelligence tools to improve Emergency Response. The Forum took place on 28th and 29th June 2022 in Brussels.



Cyprus Forum 2022

The KIOS CoE Research Lecturers Lenos Hadjidemetriou and Markos Asprou, together with the Assistant Manager of Electricity Authority of Cyprus, Dr. Andreas Stavrou and the Deputy Spokesman of Cyprus Transmission System Operator, Dr. Rogiros Tapakis, participated in the Cyprus Forum 2022, discussing how intelligent technologies can facilitate the green and digital transition of the energy sector.



European Researcher's Night 2022

The KIOS CoE participated in the European Researcher's Night 2022, which took place on the 30th of September 2022, at Eleftheria Square, in Nicosia. Visitors to the KIOS virtual booths had the opportunity to learn about renewable energy technologies and smart water systems; how Artificial Intelligence improves drones for emergency response; and how smart technologies can be used for traffic management.



7th Conference on Sustainable Mobility & Intelligent Transportation Systems

The KIOS CoE research team participated in the 7th Conference on Sustainable Mobility & Intelligent Transportation Systems, organized by the Department of Public Works of the Ministry of Transport, Communications and Works, on the 8th and 9th of December 2023, in Nicosia. During the conference, researchers presented their work on sustainable mobility, traffic management and connected and autonomous vehicles.

School Visits

During 2022, young students visited KIOS premises and learned about the research and technology being undertaken at the Center. In addition, KIOS Researchers gave lectures to pupils at schools in various areas of Cyprus.



Online Presence

The KIOS CoE uses a number of 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 research 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.