"All the Intelligent News That's Fit to Print"

Intelligent Times

The Official Newsletter of the KIOS Research Center for Intelligent Systems and Networks

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ERC ADVANCED GRANT AWARDED

KIOS DIRECTOR, M. POLYCARPOU, RECEIVES THE PRESTIGIOUS EU GRANT

European Research Council

Professor Marios Polycarpou, Director of the KIOS Research Center, has been awarded the ERC Advanced Grant, the most prestigious research funding award given by the European Research Council (ERC). The ERC Advanced Grant provides attractive long-term research funding to a small number of exceptional researchers to undertake highly ambitious, pioneering and unconventional research projects at the frontiers of their fields. According to the official web site for the program, (http:// erc. europa.eu / advanced-grants), the main aim of ERC Advanced Grants is to allow established research leaders, with exceptional scientific achievements, to pursue ground-breaking, high-risk projects that open new directions in their respective research fields or other domains.

Each year, ERC Advanced Grants are awarded, on average, to 8 scientists in all areas of Electrical and Computer Engineering, following an extremely competitive selection process. To date, several awards have been granted to scientists from countries such as Germany, France and the UK. This is the first time that a Cypriot scientist has been awarded an ERC Advanced Grant.

The ERC Advanced Grant awarded to Professor M. Polycarpou attests to his excellent international academic standing and impressive research contributions. Hosting this unique research activity is, also, an honor for the University of Cyprus and a testament to its outstanding reputation for research excellence.

The research grant of over €2 million will finance a team of about 10 researchers at the University of Cyprus, who will pursue pioneering fundamental research aimed at designing and analyzing "smart" algorithms for real-time data processing, capable of improving the performance and fault tolerance of critical infrastructures such as power distribution systems, drinking and waste water systems, and transportation networks. More specifically, Professor Polycarpou's research team will develop tools and design methodologies that would facilitate early detection and accommodation of any "small" faults or unexpected events, before they cause significant disruption or complete system failures in complex distributed dynamical systems.

Professor Polycarpou returned to Cyprus in 2001, following a long academic career in the USA, to assist with the creation of the School of Engineering at the University of Cyprus. Between 2001-2008, he served as founding Chairman of the Electrical and Computer Engineering Department. He is currently serving a 2-year term as the President of the IEEE Computational Intelligence Society, the most prestigious international technical organization in the area of computational intelligence.

This is the 4th ERC grant awarded to the University of Cyprus. This particular ERC award is an Advanced Grant, which is aimed for experienced researchers. Previously, the University was awarded 3 ERC Starting Grants which are geared towards researchers in the early stages of their academic careers. In total, the University of Cyprus has received €4.5 million research funding from ERC Grants.

KIOS University of Cyprus

In this edition of the Intelligent Times

EUROPEAN UNION REPUBLIC OF CYPRUS STRUCTURAL FUNDS of the European Union in Cyprus our ideas, actions for development Research Promotion Foundation ΔΕΣΜΗ 2008

DIRECTOR'S MESSAGE

Marios Polycarpou

Director of the KIOS Research Center
Professor of
Electrical and Computer Engineering
IEEE Fellow

KIOS Research Center – making sense out of huge amounts of data

The *KIOS Research Center for Intelligent Systems and Networks* contributes to the advancement of knowledge in the areas of computational intelligence and intelligent networked embedded system design, and the application of these methodologies in monitoring, controlling, and optimizing the operation of complex and safety-critical systems. Computational intelligence is at the heart of many new technological developments since it provides the necessary software for modern, "smart", devices to function. As technology advances, we are able to generate massive amounts of data. In fact, the amount of data generated is increasing by 50 percent every year. One can only imagine the amount of data that will be generated in 10 or 20 years.

This data can be generated not only locally, but with communication networks it can be transmitted almost instantaneously to just about anywhere we wish. Data comes from everywhere, including traditional sources such as sensors that measure temperature, humidity, movement, or more advanced sensors that measure chemical/biological changes, heart rate, vibrations. There are data coming from records of online purchases, video data, audio, click streams, etc. We are moving towards the so-called "Internet of Things", where sensors and actuators are embedded in physical systems (e.g., appliances, mobiles phones, automobiles) and connected by networks to computing devices. Moreover, everyday new sensors are being developed in almost all the application domains for generating even more data.

What does one do with so much data? A few years ago there was the issue of data storage. Nowadays, data storage has become extremely cheap. With cloud computing technology, data access will become even cheaper and more convenient. The grand challenge in the years ahead is to be able to process and make sense out of the available data. The objective is to be able to find correlations and patterns in time and space, to develop models in real time and to extract useful knowledge that can be used, for example, to improve productivity, to enhance safety or to create more energy efficient environments.

The KIOS Research Center is developing various algorithms and tools for intelligent data processing. The tools are used in several application domains, such as power systems, water systems, telecommunication networks, image processing, biomedical engineering, etc. The computational intelligence approaches that are being developed at the Center provide key tools for future development of new technologies related to intelligent systems and networks.

For more information regarding the activities of the KIOS Research Center, please visit the KIOS webpage: www.kios.ucy.ac.cy

Inspiring Research Potential

The KIOS Research Center for Intelligent Systems and Networks provides an inspiring environment for highly motivated researchers to pursue interdisciplinary research in the area of information and communication technologies (ICT). During the last year, the Center has continued to grow in terms of employing young promising researchers, producing high quality research and attracting external research funding.

Currently, the KIOS Research Center employs more than 55 researchers (and growing!), who are conducting high quality research on various topics of interest to the Center. Their research is supported by more than 30 external research programs, funded by the European Union, the Research Promotion Foundation of Cyprus and by industry. The funded research programs are totaling more than 10 million euro, with the share for the KIOS Research Center being approximately 8 million euro. Almost 70% of the funding comes from EU projects.

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CENTER NEWS

KIOS at "Researcher's Night" a Great Success!

Dissemination activities which target the public at large, serve as important mechanisms for informing the wider public on how research projects funded by the EU can offer real solutions to contemporary challenges. Very often specific awareness raising activities can also prove to be effective for the dissemination of research results to providers, policymakers, and end users.

KIOS Researchers participated in an event organized in Cyprus as part of an EU wide campaign entitled Researcher's Night. The campaign, which takes place every year, is organized to highlight the added value of research and innovation to the public and to demonstrate the benefits these can bring to society and to the economy. This year the campaign took place in more than 320 European cities on the 23rd of September 2011.

In Cyprus, Researcher's Night involved a research fair housed in the ancient historical Famagusta gate. The event attracted over 1500 people of all ages, including key policy makers, civil servants, students, young people, and children etc.

The KIOS Research Center was represented by KIOS Researchers Guillaume Garreau, Alexandros Kyriakides, Christos Kyrkou, Dr. Nicoletta Nicolaou, Agathoklis Papadopoulos, and Christos Ttofis.

The KIOS research team demonstrated to fascinated visitors, the capabilities of new research technology which they are working on. Demonstrations included a number of technological prototypes from research projects funded by the EU and the Cyprus Research Promotion Foundation. The technology was presented in a format that would easily attract the attention of participants, who were given the opportunity to sample the new technology for themselves.

1st Prize for KIOS Post-doctoral Researcher

Dr. Demetrios Eliades, a post-doctoral Researcher at KIOS and the company Zedem Media were awarded the First Prize ($3,000), in an international competition for an on-line educational video. The winning video entitled "An Egg Boiling Fuzzy Logic Robot," successfully uses animation to explain Fuzzy Logic and the applications of this methodology in everyday life.

The competition was sponsored by the Computational Intelligence (CI) Society of IEEE. It is the world's largest professional association dedicated to advancing technological innovation and excellence for the benefit of humanity. The video competition was organized by the CI Society to encourage a wider understanding of the Fuzzy Logic approaches to CI.

CI is a set of nature-inspired computational methodologies and approaches to address complex problems of the real-world applications to which traditional methodologies and approaches are ineffective or infeasible. Fuzzy Logic is one of the most successful CI technologies applied, and involves the application of human reasoning to computers and decision making.

"Best Paper Award" at the IEEE ISCAS 2011

A collaborative effort between the KIOS researchers, Prof. Julio Georgiou and Charalambos Andreou, and the Sensory Communications Group of Professor Andreas Andreou, of Johns Hopkins University, has led to the design and fabrication of the world's lowest power image sensor. The chip was fabricated in a Taiwan Semiconductor Manufacturing Company process, via EUROPRACTICE

The resulting image sensor was presented at the 2011 IEEE International Symposium on Circuits and Systems (ISCAS 2011), and was awarded a Best Paper Award. The power drain of this image sensor is so small that it can take 20 photos per second continuously for 250 days when powered on a small hearing aid battery!

KIOS Meets with the European Defense Agency to Discuss Related Research

The Chief Executive of the European Defense Agency (EDA), Ms. Caulde-France Arnould, met with academics at the University of Cyprus during her first official visit to Cyprus. The meeting was organized by the Ministry of Defense of the Republic of Cyprus on May 21st, 2012. The meeting was attended by the Rector of the University of Cyprus Prof. Constantinos Christofides, the Permanent Secretary of the Ministry of Defense Mr. Christos Malikkides, and by KIOS faculty and other academics from the University of Cyprus. The purpose of the meeting was to discuss the role of the University of Cyprus in defense - related research and explore the various possibilities for collaboration at a research level with the EDA and the Ministry of Defense.

During the meeting the Director of the KIOS Research Center, Prof. Marios Polycarpou, gave a presentation on the research activities of the Center, emphasizing that issues of monitoring, management, control, and security of critical infrastructures, such as power, telecommunication, transportation and water networks, are relevant to the areas of interest of the EDA. The University of Cyprus currently participates in 3 projects funded by the EDA.

The meeting concluded on a positive note and a keen interest from all involved to promote the continued participation of Cyprus in European defense-related research.

RESEARCH RESULTS

Monitoring Awareness During Anesthesia

"*I was awake, aware, paralyzed, utterly terrified, unable to do anything about it no matter how hard I tried, and I wished I could die. […] This was the most traumatizing experience of my life.*" Diana Todd, awake during a hysterectomy surgery. "Under the knife yet wide awake", R. Davis, USA Today, 12/4/2007.

Approximately 0.11% to 0.8% of patients become aware during surgery every year. Despite the relatively small incidence of awareness, the psychological consequences for those patients who do regain awareness are vast. This is related to the co-administration of muscle-paralyzing drugs together with anesthetic agents. As a result, patients who become conscious during surgery are paralyzed and cannot alert the anesthetist. The more traditional methods of patient monitoring, such as heart rate, are not reliable in identifying cases of awareness. Recently, devices that monitor the patients' state of hypnosis through the electrical brain activity (EEG) recorded by a pair of sensors placed on the forehead, have been made commercially available.

The research project "Monitoring awareness during surgery," led by Prof. Julio Georgiou and Dr. Nicoletta Nicolaou, aims at investigating the transient changes in the ECG related to anesthetic administration. Our research has identified a number of measures that can be used to identify between wakefulness and anesthesia with high accuracy (98 %). These findings have important implications for understanding the general mechanisms behind the observed changes in EEG activity during anesthesia, and pave the way for the development of more robust and reliable monitors of awareness during anesthesia. A paper by Dr. N. Nicolaou, S. Hourris, P. Alexandrou and Prof. J. Georgiou recently appeared in PLoS ONE.

Optical Fiber Communications

KIOS researcher Tania Panayiotou presented a paper at the Optical Fiber Communications Conference (OFC 2011), the premier conference on fiber-optic systems and networks, on the protection of multicast sessions in optical networks utilizing a novel segment-based protection algorithm called Level Protection. Protecting a multicast session against a link failure requires finding alternate paths for all failure scenarios prior to the occurrence of the fault. Various approaches exist for multicast protection. This work investigates the problem of segment-based protection of multicast connections in mesh optical networks, since they are reported to have better performance than other known schemes. The proposed algorithm was compared to other algorithms described in the literature and it was shown to improve performance.

KIOS researcher Costas Constantinou presented a related paper at the European conference on Optical Communications (ECOC 2011), the premier European conference on fiber-optic systems and networks, on a new multicast protection technique for optical WDM mesh networks based on a novel Steiner tree algorithm. It was shown through simulation studies that the new technique has lower blocking probability and cost, compared to conventional protection methods for both single-link and single-link/node failure scenarios. The results from this work were subsequently published in a journal article in OSA Optics Express.

Wireless Sensor Networks with Mobile and Static Nodes

Over the recent years, research in Wireless Sensor Networks (WSNs) has gained great momentum due to the advantages that they offer, e.g., they can monitor the spatial as well as the temporal dynamics of the monitored environment, they are low cost and easy to deploy. WSN capabilities are further enhanced by introducing some mobile sensor nodes which are able to move closer to areas of interest.

The work of Dr. Theofanis Lambrou and Prof. Christos Panayiotou at KIOS involves the development of an efficient distributive collaborative path planning framework for a team of autonomous mobile sensor nodes which enables them to navigate through a sparse WSN with stationary nodes searching for events and improving area coverage. The mobile sensor nodes have limited communication and sensing ranges and collaborate in order to autonomously plan their trajectories, adapt to the local region they monitored, and enhance the area coverage over time under constrains like obstacles, collisions, distance travelled, and limited communication.

The trade-off between area coverage and the distance traveled by the mobile sensor has been addressed by proposing an adaptive speed model which minimizes the distance the mobile sensors move and hence the energy needed for mobility. In addition, the trade-off between information exchange and area coverage is investigated and several communication schemes have been proposed to reduce information exchange between mobile sensors without significantly affecting coverage performance. Moreover, the performance of the proposed framework has been evaluated under dynamic event occurrences and sensor nodes' positioning uncertainty. The experimental evaluation and demonstration of the proposed algorithms has been conducted to validate the proposed framework using a mixed WSN test-bed. Apart from the general proposed framework, the solution of the optimal search path that minimizes the average detection delay was found for a single mobile node searching two spatially separated regions with different areas.

The framework developed integrates sensor networks and autonomous mobile robots technologies for the assessment of air and water quality in environmental monitoring applications. The methodologies proposed can also be applied commercially for applications like autonomous robotic vehicles for automated container terminals, agricultural operations, geophysical explorations, etc.

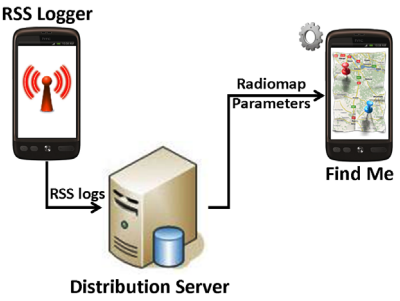
RESEARCH RESULTS

Indoor Positioning and Tracking on Android Smartphones

The main objective of this work was to build an Android smartphone platform for real-time positioning and tracking inside buildings featuring WiFi infrastructure, as well as to assess the performance of several Received Signal Strength (RSS) fingerprint-based algorithms in terms of Execution Time, Positioning Accuracy, and Power Consumption.

Our system follows a mobile-based network-assisted architecture to eliminate the communication overhead (i.e., avoids uploading the observed RSS fingerprint to a network side for estimating location) and respect user privacy (i.e., location is estimated by the user and not by the positioning server). A typical positioning scenario comprises three steps: (i) a user enters an indoor environment, covered by several WiFi Access Points (APs), (ii) the user's smartphone obtains the RSS radiomap and parameters from the local distribution server in a single communication round, and (iii) the client positions itself independently using only local knowledge and without revealing its personal state.

The system architecture consists of the RSS Logger application, the Find Me application and the Distribution Server. The RSS Logger application is developed around the Android RSS API for scanning and collecting measurements by clicking on floorplan maps, while users can contribute their RSS log files to our system for building and updating the radiomap in a crowdsourcing fashion. The Find Me application connects to the server for downloading the radiomap and algorithm parameters and the user may select any of the available algorithms, including some novel algorithms developed in-house. The current user location can be plotted on the floorplan map for real-time positioning (Online mode) or an external file with test RSS fingerprints can be loaded from the SDCARD to evaluate the performance of different algorithms (Offline mode). Our Distribution Server is mainly responsible for the construction and distribution of the RSS radiomap to the clients. The server parses all available RSS log files and merges them in a single radiomap, while another interesting feature in our implementation is a methodology for fine tuning algorithm-specific parameters automatically.



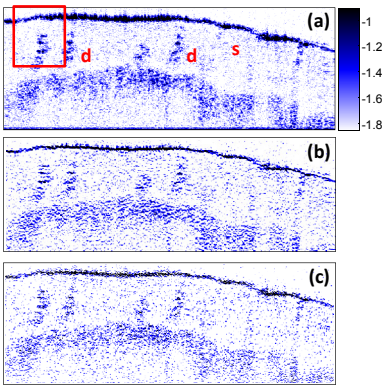
This platform was designed and developed by the group of Prof. Christos Panayiotou and researcher Christos Laoudias, jointly with the Data Management Systems Laboratory (DMSL) at the Computer Science Department of University of Cyprus. A successful demonstration of the platform was performed at the 2011 Indoor Positioning and Indoor Navigation (IPIN) conference. This generated great interest from both the research community and industry to test and extend our platform. In addition, interest was expressed to combine our solution with other approaches for indoor positioning (e.g., using the embedded smartphone accelerometer and gyroscope) to create hybrid solutions with enhanced accuracy.

Improved Imaging Resolution of Microstructural Tissue Imaging

Optical coherence tomography (OCT) is an optical imaging technique that can provide non-invasive, cross-sectional, imaging of biological tissue with micrometer spatial resolution and intermediate (1-3mm) depths. With the introduction of fast, high-resolution OCT systems, OCT technology has significantly improved over the past few years and is now well-suited for in vivo applications. However, further improvements in resolution are required for the detection of many disease changes, such as those associated with early stage cancer, which are in the micrometer and sub-micrometer range.

The axial resolution depends on the coherence length of the light source and is, thus, enhanced by the use of broadband sources. However, because the relationship between bandwidth and resolution is inversely proportional and asymptotic, there is a limit to the resolution improvement that can be achieved even by these state-of-the-art OCT systems. Increasingly broader, often unattainable or unsustainable bandwidths are required for marginal improvements in resolution. Also the system complexity and cost increase as the source bandwidth is extended and loss of sensitivity and power attenuation may ensue. A paper recently published in the Journal of Biomedical Optics by Evgenia Bousi and Prof. Costas Pitris of KIOS, demonstrates the application of modulated deconvolution in FDOCT to achieve superior resolution without the need of a broader bandwidth light source. The resolution improved significantly, by approximately a factor of 7.

The technique is based on the modulation and subsequent deconvolution of the interferometric OCT signal. The basis of this concept is the summation of more than one A-scan with different carrier frequencies and their subsequent deconvolution with appropriate kernels. This represents a method of achieving super-resolution by oversampling with both A-scans collected at the same sample location. However, the additional information which appears in the form of beating permits



modulated deconvolution which significantly increases the resolution of the system.

Despite the limitations of this very preliminary implementation of modulated deconvolution, it is evident that this technique has the potential to dramatically enhance the resolution of OCT systems. In addition, different forms of encoding can be implemented in the future which will not suffer from the limitations uncovered in these experiments.

Joint Solutions to Joint Problems

European Territorial Co-operation programs (formerly the INTERREG programs) are designed to strengthen economic and social cohesion in the European Union (EU) by promoting cross- border, transnational and interregional cooperation. There are a number of related finding programs to encourage regions and cities from different EU Member States to work together and learn from each other through joint programs, projects and networks.

KIOS research teams are working on two new research projects (YPERTHEN and EVAGORAS) funded by the European Union's Cross-border Co-operation Program for Greece and Cyprus. This program is part of the EUs Regional Policy aiming to improve economic well-being in the regions of Samos, Lesbos, Chios, Dodecanese, Heraklion, Lasithi, Rethymno, and Chania in Greece, as well as the whole of Cyprus. Due to their remote geographical position the regions have marked socio-economic disparities and a number of projects are being funded to contribute to improved competitiveness in the areas.

KIOS research teams are collaborating with universities and research centers in these regions of Greece to offer technological solutions to issues prevalent in these regions, with strong potential to contribute to global research arenas.

Cross-border Cooperation Program "INTERREG" 2007-2013

YPERTHEN (ΥΠ.ΕΡ.ΘΕ.Ν)

Technology for Improved Diagnosis and Personalized Optimal Therapy of Oncological Diseases

Cancer is one of the most serious global health problems, particularly in developed countries such as Cyprus and Greece, where it exhibits increasing trends. One of the most active research areas related to oncological diseases is the utilization of advanced computational methods and tools for better understanding the underlying mechanisms, early diagnosis of the disease, as well as the optimization of cancer therapy in a personalized (patient-specific) context. This field is collectively termed computational oncology and its importance has been recognized in several research initiatives in Europe and the United States. Despite the undeniable progress that has been achieved, the wide use of such tools in practice has not yet been realized, partly due to the lack of validation of the mathematical models that have been developed with experimental and clinical data.

Within this context, the aim of the project is to develop computational tools to assist with the diagnosis and personalized optimal therapy of oncological diseases. This involves the creation of a framework capable of developing multi-scale dynamic models of cancer progression which will take into account of several important factors and scenario. These include patient characteristics, the response of the immune system, metastatic effects, etc. The model will utilize all of these to design patient-specific optimal treatments which will take into account drug toxicity and the development of drug resistance, and incorporate these in a computational environment in order to generate virtual scenaria. The project, also, incorporates magnetic resonance and computer tomography image processing methods (segmentation, 3D visualization) in the same environment. The project will involve collaboration with clinical and medical partners.

The project is coordinated by the KIOS Research Center (Professors G. Mitsis – Principal Investigator and C. Pitris) and also includes the Biology Department of the University of Cyprus, the Foundation of Research and Technology (FORTH), Greece and the Technical University of Crete as partners.

EVAGORAS (ΕΥΑΓΟΡΑΣ)

High-Performance, Cost Effective Supercomputer for Biological, Ecological and Medical Research

Advancements in healthcare and ecology, key aspects of improving the quality of life, are heavily dependent on high-performance, real-time, computation systems. Such systems are necessary to compute extremely complicated algorithms, used by biologists and doctors worldwide, for example in the development of more effective drugs and accurate prediction models for ecosystems.

Supercomputers or large clusters of computers are the only solutions capable of providing the ever-increasing computational power required by these applications. However, such systems are large and expensive, with high energy consumption. Recent advancements allow the integration of multiple reconfigurable hardware modules, such as Field Programmable Gate Arrays (FPGAs), in a single high-performance computation system. Computational intensive algorithms used in biomedical and ecological applications can therefore take advantage of the inherent flexibility and available parallelism, with significant performance gains while minimizing power consumption.

The project aims to create a high-performance, green, supercomputer, exploiting recent advances in FPGA technology, which will be utilized for analyzing computationally intensive biological and ecological models. The resulting EVAGORAS supercomputer will be a powerful computational engine that will further improve the quality of research in the fields of biology, medicine and ecology. Besides the performance gains, the proposed system is a green technology as well, as it will consume around 20% less energy and has significantly lower maintenance cost than other systems used for the same purposes.

The project is coordinated by the Technical University of Crete and includes as partners the University of Cyprus and the Hellenic Center for Marine Research. KIOS faculty Prof. T Theocharides is the coordinator of the research team at the University of Cyprus. *The Projects are co-financed by the European Union (ERDF) and national funds of Greece and Cyprus.*

RESEARCH NEWS

KIOS Participates in Research for Space Technology: Development of Rad Hard Non Volatile Flash Memories for Space Applications

SkyFlash is a European research project that aims to develop a strong rad-hard by design (RHBD) methodology, for the realization of non-volatile flash memories, in standard CMOS processes. The methodology will be explored initially on a standard 180nm CMOS silicon process that includes floating trap ONO (Oxide-Nitride-Oxide) flash memory cells. The focus will be on environments, such as low and high orbits (satellites) or deep space (probes), that are affected by radiation due to protons, electrons and high-energy ions (heavy ions).

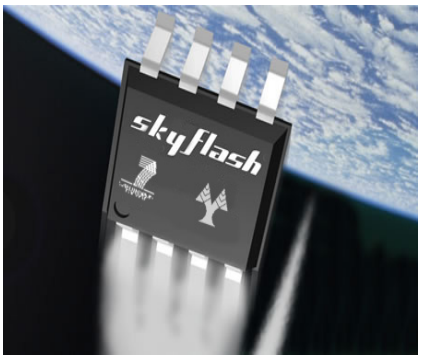
The technological research undertaken in the SkyFlash project is expected to make a significant contribution to the EU Framework Program (FP7) research agenda for space. In particular, Skyflash will provide prototype technology to increase space-based systems' resilience to radiation. This is an important global concern as our reliance on space-based systems has grown to include different fields. Satellite communication and earth observation are ubiquitous, as is satellite navigation.

Electronics built for aerospace applications must be resilient to various types of radiation, since these circuits do not enjoy the protection of the earth's atmosphere and are constantly being bombarded by high-energy particles (electrons, protons, high energy ions), in addition to being exposed to higher levels of background radiation. This exposure can either cause transient effects that can be recovered or can permanently damage devices leading to the failure of the asset and consequently of its expected services. The traditional solution to this problem is to implement the circuits in a radiation-hardened semiconductor process. SkyFlash will build the circuits in a conventional process but the effects of radiation will be mitigated by the actual circuit design. The project will focus on "Flash Memories" as a pilot application.

Radiation hardening by design is not only suitable for space applications but could also find applications in other niche markets, such as in nuclear power generation equipment and high-energy physics experiments. Although the SkyFlash project focuses on circuits related to non-volatile silicon memories, it is expected to offer an important base technology for other silicon devices, which are required for other space applications, such as A/D or D/A converters, microprocessors, voltage regulators, and so on.

The SkyFlash project, funded by the FP7 program SPACE, is being delivered by a partnership of 8 organizations in Italy, Israel, Finland, Cyprus, Sweden, and Spain. Academic, industrial, and research-oriented organizations are combining their specializations, bringing together expertise in design and fabrication, as well as radiation testing. The KIOS team participating in this project is led by Prof. Julio Georgiou.

For more information refer to the project web site:
http://www.skyflash.eu/index.htm



ASCLEPIUS: Accelerating Bioinformatics and Biomedical Applications via Massively Parallel Reconfigurable Systems

High-performance, real-time computation systems are becoming necessary to compute extremely complicated biomedical and bioinformatics algorithms used by bioengineers and doctors worldwide and come in the form of supercomputers, i.e. large clusters, which are the only capable solution keeping up with the application demands. However, the excessive cost of implementing and maintaining such systems, limits their presence only to a small number of research facilities world-wide. The ASCLEPIUS project aims to create a low-cost, high-performance biomedical and bioinformatics computation platform which can be utilized by small-and-medium scale biomedical research facilities world-wide. Research will focus on the creation of a heterogeneous, cost-effective, high-performance computational platform that facilitates reconfigurable hardware fabric through FPGAs, the speed of GPUs, and the generality of CPUs, in a seamless interface. The resulting system will benefit researchers working in the fields of biology, medicine, and biomedical engineering, by providing an alternative, cheaper, faster and more energy-efficient solution compared to supercomputer solutions currently being explored. ASCLEPIUS aims to provide a transparent, user-friendly, high-end processing platform that will accelerate the computations needed for advancing research, and will be able to dynamically reconfigure itself to adjust to the application and user requirements.

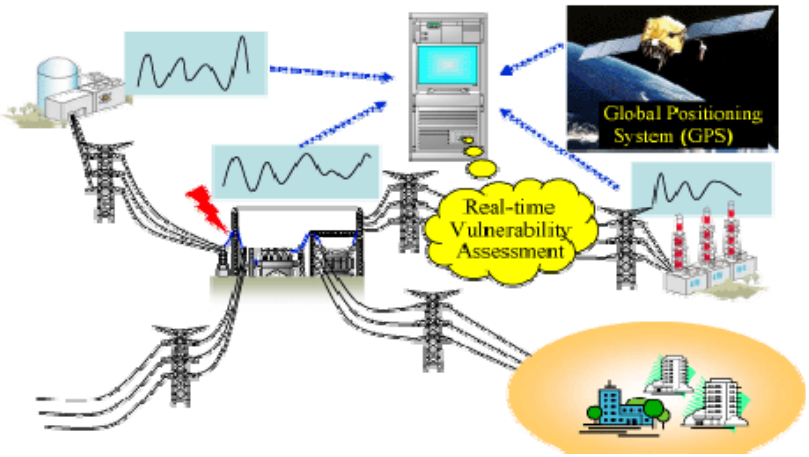
Recent advancements allow the integration of reconfigurable hardware (FPGAs) and graphics processing units (GPUs), alongside with general-purpose processors (CPUs). The project will use state-of-the-art technologies and hardware/software co-design methodologies, in creating a fully functional hybrid prototype that will be the first of its kind in Cyprus. The project research team is led by Prof. Theocharis Theocharides and the main student researcher is Agathoklis Papadopoulos. This project is funded by the Cyprus Research Promotion Foundation through the Framework Program for Research, Technological Development and Innovation 2009-10 (DESMI 2009-2010), co-funded by the Republic of Cyprus and the European Regional Development Fund.

RESEARCH NEWS

The Use of Telecommunications and GPS Technology for the Real-Time Wide-Area Monitoring and Control of Power Systems

The operating conditions as well as the network topology of a power system may change frequently due to complex interconnections and deregulated energy markets. The real-time information regarding the operating states is therefore very important for reliable and secure operation. The supervisory control and data acquisition (SCADA) system based on conventional measurements such as the power flow, power injection, voltage, and current measurements is inherently slow in nature, and fails to provide a real-time picture of the power system. The integration of the Global Positioning System (GPS) technology with the measurement units of power system quantities has led to the design of an advanced measurement unit, known as Phasor Measurement Unit (PMU). The PMU is an innovative measurement unit that due to the integrated GPS receiver can measure extremely accurate voltage and current phasors. Further, disbursed PMUs in the power system can be synchronized via the GPS signal providing a real time visualization of the power system operating condition. Therefore, the Synchronized Measurement Technology (SMT) has set the beginning of a new era in monitoring and control applications of the power system operation by the exploitation of the GPS technology. This project will contribute to the advancement of knowledge in the areas of security, monitoring and control of power systems by utilizing the SMT technology. The methodologies developed, will be tested on IEEE test systems and on the Cyprus power system. It is envisioned that with the completion of this project, the reliability of the power system will be further enhanced, promoting the quality of life and welfare of the citizens.

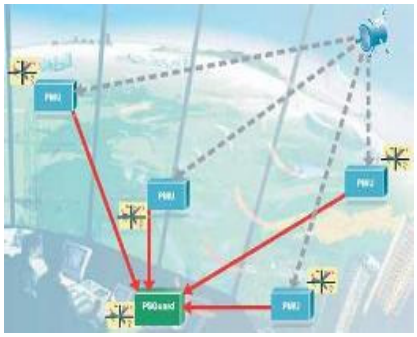
This project is funded by the Cyprus Research Promotion Foundation through the Framework Program for Research, Technological Development and Innovation 2009-10 (DESMI 2009-2010), co-funded by the Republic of Cyprus and the European Regional Development Fund. The KIOS research team in this project is led by Prof. Elias Kyriakides. The project partners are the Cyprus Transmission System Operator, Arizona State University, the University Politehnica of Bucharest, and the University of Manchester.



The Formulation of the Next Generation State Estimator by Utilizing Synchronized Phasor Measurements

There is a need to provide real-time, accurate and reliable information for the states of the power system through an advanced state estimator that could be the cornerstone of a future real time wide area monitoring system. This project will concentrate on developing a concrete methodology for incorporating the synchronized phasor measurements into the existing conventional state estimator. The proposed state estimator is expected to have enhanced accuracy as well as better convergence, immunity to bad measurements, and high adaptability in abrupt changes in the power system network configuration. Further, in this project a concrete methodology for enhancing the performance of the hybrid state estimator by determining the optimal Phasor Measurement Unit (PMU) placement in the power system is aimed to be developed. The state estimator and the methodologies developed in this project will be tested on the IEEE test bed systems and will be validated using the power system of Cyprus, where four PMUs have already been installed. It is expected that the full packet of the developed state estimator could be eventually used by the local Transmission System Operator (TSO) whose collaboration in this project is active, enhancing the reliability of the power system of Cyprus.

This project is funded by the Cyprus Research Promotion Foundation through the Framework Program for Research, Technological Development and Innovation 2009-10 (DESMI 2009-2010), co-funded by the Republic of Cyprus and the European Regional Development Fund. The KIOS research team in this project is led by Prof. Elias Kyriakides and the main student researcher is Markos Asprou. The project partners are the Cyprus Transmission System Operator and the University Politehnica of Bucharest.



RESEARCH NEWS

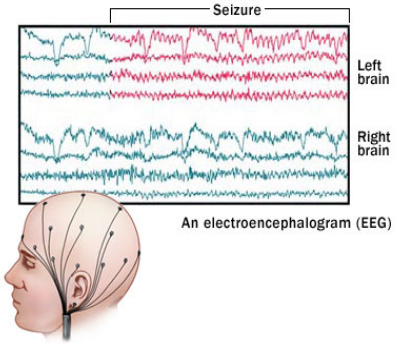
Multimodal Epileptic Seizure Prediction From Long-Duration EEG and ECG Measurements

Epilepsy is a condition that affects 0.6-0.8% of the world population, rendering it the most common neurological disorder after stroke. It is characterized by recurrent unprovoked seizures, due to abnormal, excessive or synchronous neuronal activity in the brain and by a vast range of causes, triggering events, symptoms and brain locations where the seizures originate. In 25% of the affected population, seizures cannot be controlled by antiepileptic drugs or surgery. However, it has been suggested, that at least some types of seizures are predictable. Many researchers have extensively sought to characterize this transition from the inter-ictal to the ictal state (pre-ictal phase) in quantitative terms and develop automated seizure prediction algorithms based on electroencephalographic (EEG) measurements. However, the reported results have not always proven to be reproducible and further foundational research is required for this purpose. Apart from the studies related to seizure prediction based on continuous EEG measurements, physiological signals such as heart rate variability have been considered as predictors of epileptic seizures.

Seizures compromise the quality of life of patients with epilepsy to a great extent and may result in serious self-injuries from various causes. Epilepsy has been also associated with a sudden death rate that is at least 10 times the rate for the general population (sudden unexplained death in epilepsy - SUDEP). Therefore, the importance and usefulness of seizure prediction cannot be overstated, as it would increase epileptic patients' autonomy, drastically reduce accidents and self-injuries related to epileptic seizures and, as a whole, improve the patients' quality of life dramatically. In this context, the objective of the present project is to perform multimodal seizure prediction from long-term EEG and electrocardiographic (ECG) data, by also considering subjective prodromal information. To this end long-term simultaneous video-EEG and ECG measurements will be collected at the Cyprus Institute for Neurology and Genetics and the occurrence of prodromal symptoms will be recorded. Subsequently, the performance of existing and novel patient-specific EEG and ECG seizure prediction algorithms will be assessed and efficient data fusion schemes will be designed to integrate the aforementioned multimodal information in order to improve the overall prediction performance.

The project is coordinated by the Department of Electrical and Computer Engineering, University of Cyprus and the KIOS Research Center (Prof. G. Mitsis – Principal Investigator) and it also includes the Cyprus Institute for Neurology and Genetics and the National Technical University of Athens as partners.

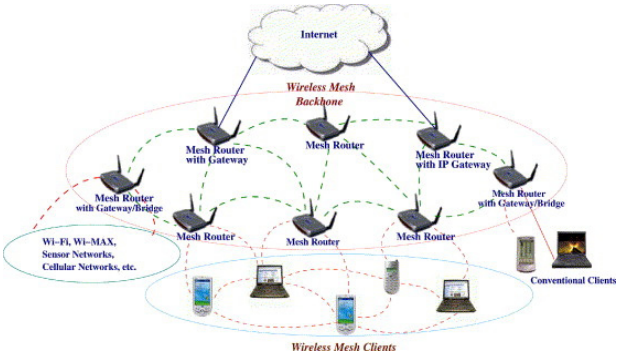
This project is funded under the Cyprus Research Promotion Foundation's Framework Program for Research, Technological Development and Innovation 2009-10 (DESMI 2009), co-funded by the Republic of Cyprus and the European Regional Development Fund.



Novel Design and Simulation Software Tool for Provisioning and Restoration of Broadcast and Multicast Connections in Optical Mesh Networks

Optical communications has become the dominant medium for high-speed communication, mainly due to the vast amount of bandwidth available and the very low-bit error rates achievable, compared to their copper wire predecessors. Optical networking has also evolved with the introduction of intelligent optical nodes that can support features such as automated provisioning of optical services and automated protection/restoration capabilities to combat failure scenarios. As networks evolve to support more bandwidth-intensive applications, and as rich multimedia and real-time services become more popular, next generation infrastructures are expected to support traffic that will be heterogeneous in nature with both unicast and multicast applications (e.g., high-definition television, video conferencing, interactive distance learning, live auctions, distributed games, and video-on-demand, etc.). In this project we will investigate the problems of provisioning and survivability for transparent mesh optical networks that support multicast, as well as broadcast applications. Novel provisioning techniques will be developed that will provide solutions with lower blocking probability and lower cost compared to existing techniques. Furthermore, multicast/broadcast protection schemes will be devised that are capacity efficient and fast compared to traditional link- and path-based approaches. The algorithms designed will be incorporated in a software simulation/design tool that can be utilized by network designers and researchers to design and evaluate the performance of core mesh optical networks when such applications are present.

This project is funded under the Cyprus Research Promotion Foundation's Framework Program for Research, Technological Development and Innovation 2009-10 (DESMI 2009), co-funded by the Republic of Cyprus and the European Regional Development Fund. The project is coordinated by Prof. George Ellinas.



Activities of the IntelliCIS ESF-COST Action

The IntelliCIS ESF-COST Action ("Intelligent Monitoring, Control and Security of Critical Infrastructure Systems", http://www.intellicis.eu), led by the KIOS Research Center, has completed its third year of activities. As the Action enters into its fourth and final year, it can boast several achievements, such as successful national and EU FP7 collaborative projects, a successful Training School for young researchers, and a record enrollment of more than 175 participants from 33 countries and 75 institutions! The Action is coordinated by Prof. Elias Kyriakides.

During the third year of the IntelliCIS COST Action, two more workshops have been organized: one in September 2011 in Milan, Italy and one in May 2012 in Bucharest, Romania. Several sessions on different critical infrastructures, such as electric power systems, water distribution networks, and telecommunication systems, have been organized during these workshops. The IntelliCIS participants exchanged ideas and insight into the solution of several problems faced by critical infrastructures today.

A major event during this past year was the First IntelliCIS Training School that took place in Resort Albena, Varna, Bulgaria in October 2011. Thirty participants and seven lecturers took part in the training school. The theme of the school was "Intelligent Monitoring of Critical Infrastructure Systems". The trainees had the opportunity to get acquainted with new concepts in the field of monitoring of critical infrastructures, get new ideas for research, and also to develop new acquaintances and possible life-long collaborations with their fellow trainees that attended the event. A poster session on the last day of the training school allowed trainees and lecturers to mingle and discuss across a wide variety of research topics.

The next IntelliCIS workshop will be held in September 2012 in Riga, Latvia. The Second IntelliCIS Training School and the last IntelliCIS workshop will take place in early 2013.

KIOS Participates in a New ESF COST Action

The design of manufacturable and dependable systems has received wide attention in the past decades, especially within (safety-) critical scenarios, where the occurrence of a failure could jeopardize missions and/or the health of humans or impact the environment. In particular, several studies have been carried out to tackle the various phases of the design of a system, to guarantee its correctness, through validation and verification methods, as well as to introduce specific properties devoted to the detection and mitigation of the occurrence of faults.

Constant advances in manufacturing yield and field reliability have been important enabling factors for electronic devices pervading our lives, from medical to consumer electronics, from railways to the automotive and avionics scenarios. At the same time, both technology and architectures are today at a turning point; many ideas are being proposed to postpone the end of Moore's law such as extending CMOS technology as well as finding alternatives to it like CNTFET, QCA, memristors, etc, while at the architectural level, the spin towards higher frequencies and aggressive dynamic instruction scheduling has been replaced by the trend of including many simpler cores on a single die. These paradigm shifts imply new dependability issues and thus require a rethinking of design, manufacturing, testing, and validation of reliable next-generation systems. These manufacturability and dependability issues will be resolved efficiently only if a cross-layer approach that takes into account technology, circuit and architectural aspects is developed.

The new European COST Action MEDIAN (Manufacturable and Dependable Multicore Architectures at Nanoscale), with current representations from organizations in 17 countries, has been established to bring together a large network of European scientists with expertise on the reliability and dependability aspects of future digital systems development. The objectives of the network are to explore both the development and application domains of the field and promote a strong interaction between these domains, as well as to encourage collaboration between industry, academia, and research organizations.

COST is an intergovernmental framework for European Cooperation in Science and Technology. The emphasis is on the creation of specialists networks for collaboration between European and other scientists to address specific research challenges. The emphasis is on enabling breakthrough scientific developments leading to new concepts and products and ultimately helping to strengthen Europe's research and innovation capacities.

The KIOS Research Center is one of two partners from organizations in Cyprus participating in the MEDIAN COST Action. KIOS faculty member Prof. Maria Michael is part of the Action's Management Committee and Vice-Chair of one of the Technical Working Groups.

For further information please refer to the project website: www.median-project.eu/

PARTNERSHIPS

KIOS Signs Memorandums of Understanding with the Water Development Department and the Limassol Water Board

The management of water resources and their quality is an issue of increasing importance globally. In Cyprus, water management is of particular significance given the water shortages that burden the island. Due to their vital role, water systems are considered among the critical infrastructures; if their operation is disrupted, e.g., due to water contamination, vital societal functions and the economy could be affected.

The application of Information and Communication Technologies can offer new and improved possibilities for the enhanced management of Water Resources. They can especially benefit the efficient management and monitoring of water distribution systems (e.g., the detection and isolation of leakages, the energy efficiency solutions for water distribution networks, the improvements in the safety of the networks, and the detection, isolation and mitigation of possible contamination events).

In 2011, KIOS signed Memorandums of Understanding with two key organizations responsible for various aspects of water distribution management. The ultimate aim of these collaborations is to enable increased technology and knowledge transfer between these partners and contribute to the operation of an advanced water distribution system in Cyprus. Such a commitment is increasingly valuable for research and technological development in the field because it combines the expertise and know-how of world renowned researchers with expert practitioners with many years of experience in the management and operations of the water systems.

Water Development Department

KIOS and the Water Development Department of the Ministry of Agriculture, Natural Resources and Environment (Republic of Cyprus) signed a Memorandum of Understanding (MoU) for collaborative research in the area of water resource management.

The agreement was signed by the highest authorities of the two organizations during an official ceremony– the Minister of Agriculture, Natural Resources and Environment of the Republic of Cyprus, S. Aletraris, and the Rector of the University of Cyprus, Prof. C. Christofides. The agreement was countersigned by the Director of KIOS, Professor Marios Polycarpou, and the Director of the Water Development Department, Dr. Kyriakos Kyrou. The ceremony took place on the 25th of November 2011 at the University of Cyprus.

The Water Development Department was established in 1896 as a Section of the Public Works Department, with responsibility for domestic water supply and irrigation. It is responsible for implementing the water policy of the Ministry of Agriculture, Natural Resources and Environment. The main objective of this policy is the rational development and management of the water resources of Cyprus. In this context, the responsibilities of the department include:

a. the collection, processing, and classification of hydrological, hydrogeological, geotechnical, and other data necessary for the study, maintenance, and safety of the water development works,
b. the study, design, construction, operation, and maintenance of works, such as dams, ponds, irrigation, domestic water supply and sewerage schemes, water treatment, works, sewage treatment and desalination plants, and
c. the protection of the water resources from pollution.

Limassol Water Board

On the 9th of May 2011, KIOS signed a Memorandum of Understanding with the Limassol Water Board to highlight a commitment for collaborative research and to affirm a mutually collaborative approach. The Memorandum of Understanding represents a long-term commitment from both parties to work together to address research challenges related to the management of water resources.

The Limassol Water Board is a public utility. It was established and has been operating under the Water Supply (Municipal and Other Areas) Law. The main objective of the Board is to provide sufficient and good-quality water, at the lowest possible price, and to meet the domestic and industrial needs of its consumers. The objectives of the Board are accomplished by:

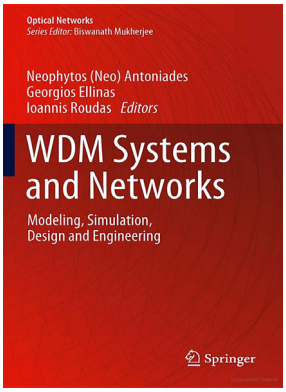
a. planning and execution of development projects,
b. maintenance of the water distribution network,
c. the determination of water rates in order to finance the operating expenses and development projects of the Board, while remaining a non-profit making organization.

Book Publication

Springer has announced the publication of a new book by KIOS Faculty Prof. G. Ellinas: N. Antoniades, G. Ellinas, and I. Roudas (Editors), WDM Systems and Networks: Modeling, Simulation, Design, and Engineering, Springer, 1st Edition, ISBN: 1461410924.

The aim of the editors is to present a body of work in this book that can provide the research scientist, company engineer, as well as the university professor/researcher with a better understanding on how to more efficiently design and engineer optical communication systems and networks. The intention is to demonstrate the effectiveness of computer-aided design when it comes to network engineering and prototyping.

Optical systems and networks have evolved enormously in the last three decades with the creation of next generation optical components, subsystems, systems, and networks that are now utilized in all aspects of the telecommunications network structure starting from the in-house/building and access networks, all the way up to the backbone and ultra long-haul infrastructures. This new book addresses a variety of issues related to next generation optical systems and networks, starting from the modeling and simulation and then proceeding to the design and engineering, enabling the reader to gain an understanding of the latest developments in the ever expanding field of optical communication systems and networks and of all the open technological and research issues. It presents the state-of-the-art architectures of optical systems and networks and takes a vertical approach to system/network modeling and design, starting from the transmission effects and component level and finally moving to the application level. Analysis is mixed with modeling/simulation and engineering approaches to present the current industry techniques, as well as the research state-of-the-art.



2nd KIOS Workshop

On the 9th of April 2012 the second KIOS workshop was organized following the success of the first one which took place last year, in April 2011. The KIOS workshops are organized annually by the KIOS Research Center to provide an opportunity to exchange ideas and foster further collaborations between KIOS researchers as well as the external collaborators.

The workshop was opened by Professors Marios Polycarpou and Christos Panayiotou. A short address was also made by Dr. Anna-Maria Christoforou from the Cyprus Research Promotion Foundation who stressed the importance of research collaborations, highlighting the positive work of the KIOS Research Center.

The morning session of the workshop included keynote presentations from

- Christos G. Cassandras, Boston University
  "An Optimal Control Approach for Cooperative Persistent Search Problems" and
  "Smart Parking: An Optimal Parking Assignment and Reservation System"
- Sergios Theodoridis, National and Kapodistrian University of Athens
  "Adaptive Learning in a World of Projections"
- Andreas Spanias, Arizona State University
  "Opportunities for Joint KIOS-SenSIP Research in Sensor Networks and Signal Processing"

The talks were followed by a "Poster Session" where 38 posters were presented by KIOS researchers and their collaborators, including other UCY research teams (Computer Science) and external partners from the USA, Switzerland and Italy. The posters demonstrated specific research activity covering a variety of research fields which spanned the range of expertise of the Center. The posters included presentations in novel applications of power systems monitoring, forecasting, dispatching, and interconnection as well as optical network architecture, traffic, and management. In addition, sensor network and distributed fault detection applications were presented in the areas of water and fire monitoring. In the area of health care, the posters covered areas as varied as optical diagnostics, nanoparticle applications, tumor growth and chemotherapy models, speech analysis, and EEG and fMRI analysis. Robotics, electronics, pattern recognition applications such as fingerprint detection, even smartphone and web apps were also presented.