"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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GRAND CHALLENGES OF COMPUTATIONAL INTELLIGENCE

LEADING RESEARCHERS EXPLORE CURRENT & FUTURE TRENDS

What is Computational Intelligence? Why is it Important?

Computational Intelligence is a new and developing field within the area of Information and Communication Technologies. It involves the design of computing systems and software algorithms which are nature-inspired and can imitate human perception and reasoning, to solve complex real-world problems.

Computational Intelligence is at the heart of many new technological developments. It provides the "brain" behind modern smart devices, helping them to function intelligently. Computational Intelligence methods are employed in devices of everyday use, such as cars, cameras, washing machines and video games. They are also an integral part of the smooth operation of complex engineering systems, upon which modern society relies on, such as electric power systems, water distribution networks, manufacturing processes, transportation systems, robotic systems, etc.

Modern society relies on the availability and uninterrupted operation of complex engineering systems. As such engineering systems are becoming more complex, large-scale and distributed, the need for advanced monitoring and control algorithms is becoming more crucial and challenging. Moreover, the issues of fault detection, diagnosis, and automatic recovery are especially important as these engineering systems are required to operate under more demanding operating conditions and more unstructured environments.

The Workshop on Grand Challenges of Computational Intelligence took place at the University of Cyprus in September 2012. The workshop, organized by the international organization IEEE Computational Intelligence Society and the KIOS Research Center, was dedicated to the exploration of existing and future trends and provided an inspiration about upcoming grand challenges in Computational Intelligence.

In the future, Computational Intelligence will continue to have a significant impact in people's daily lives. We are already seeing some of this technology in the development of smart cars, smart energy grids, intelligent buildings, telemedicine, intelligent transportation, robotics, etc. There will also be significant advances in intelligent manufacturing, which will facilitate more efficient production of goods, with less energy consumed. We will further start to see the "Internet of Things" which will connect the cyberspace with real devices, such as refrigerators, buildings, factories, etc. The first generation of the internet allowed people to connect, the second generation of internet allowed commerce through the web, while the third generation of internet, called "Internet of Things," will provide a new dimension of connecting the internet to real devices.

With such a crucial role in our societies, and to respond to technological advancements and future trends, Computational Intelligence researchers face several "grand challenges". For example, research to better understand how the human brain works can help us to design more efficient and reliable computing devices. There are certain tasks, such as visual perception, which the human brain performs very accurately without much effort, while computing systems struggle greatly and do not perform satisfactorily.

(cont. p.3)

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
President, IEEE Computational Intelligence Society

KIOS Research Center – providing opportunities for highly motivated young researchers

The KIOS Research Center for Intelligent Systems and Networks was officially established five years ago, on 28 February 2008. During these five years, the KIOS Research Center has grown to more than 70 researchers and participated in 54 research projects. Currently, the Center has 31 active research projects, all of which are externally funded. These research projects are used to fund the salaries and research activities of highly motivated young researchers.

It is a significant challenge for a relatively young institution, such as the University of Cyprus, or a new research center such as the KIOS Research Center, to be able to compete with established institutions/centers around the world. However, according to a recent press release of the European Research Council (ERC) http://erc.europa.eu, among EU countries, the Netherlands, Denmark, UK and Cyprus host the greatest number of the prestigious ERC research programmes in relation to population size. According to the ERC press release, "this reflects the high quality of the research in these countries, which generally follows from long-term investment in research."

The most significant asset of the KIOS Research Center is its people (see a KIOS team photo below). As the Center grows, we make every effort to establish a synergy that would help to elevate the quality of the generated research. We also strive to establish an inspiring environment for conducting high quality, interdisciplinary research, according to the vision of the Center. We hope that you will enjoy reading about the activities of the KIOS people in this issue.

For more information regarding the activities of the KIOS Research Center, please take a look at our webpage, www.kios.ucy.ac.cy, or come and visit us.

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KIOS Research Center
University of Cyprus
P. O. Box 20537,
1678 Nicosia Cyprus
Email: kios@ucy.ac.cy

Tel: +357 22-893450/51
Fax: +357 22-893455
Web: http://www.kios.ucy.ac.cy

Editor-In-Chief: Constantinos Pitris

CENTER NEWS

Computational Intelligence (from p.1)

Another grand challenge in the years ahead is to be able to process and make sense out of the available data, helping us to handle large volumes of data in real time. As the amount of data generated is increasing by 50 percent every year there is a need 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 design of methods for human-computer interaction is another significant research challenge in the area of Computational Intelligence. Attention to human-machine interaction is important since it provides the framework to develop electronic assistive devices for humans.

The keynote speakers of the Workshop included:

- P. Bonissone, General Electric Global Research, USA "Analytics, Cloud-Computing, & Crowdsourcing – or How To Destroy My Job"
- X. Yao, The University of Birmingham, UK "What Can Evolutionary Computation Do For You?"
- J. Suykens, Katholieke Universiteit Leuven, Belgium "Models from Data: A Unifying Picture"
- J. Si, Arizona State University, USA, "Computing with Neural Spikes"
- F. Lecue, IBM Research, Ireland, "Smarter Cities: How Can Big Data Analytics Shape Future Cities?"
- G. Yen, Oklahoma State University, USA, "Multi-objective Optimization & Performance Metrics Ensemble"
- H. Ishibuchi, Osaka Prefecture University, Japan, "Scalability Improvement of Genetics-Based Machine Learning to Large Data Sets"
- P. Estevez, Universidad of Chile, Chile, "Computational Intelligence Applied to Time Series Analysis"

The panel discussion was coordinated by the Director of KIOS Research Center, Prof. Marios Polycarpou.

Cyprus Research Profile Praised

European Research Council (ERC) Cypriot grantees speak at the EU informal Competitiveness Council

KIOS Director Professor Marios Polycarpou and Assistant Professor Marios Avraamides of the University of Cyprus were invited to speak at the EU Informal Competitiveness Council (Research), a high level ministerial meeting organized as part of the Cyprus Presidency of the Council of the European Union. This is the first time ever that ERC grantees were invited to speak to the EU research ministers, as they gathered for the Council meeting in Nicosia on 19 July 2012.

The two academics were specifically selected to present their research activities at this high level meeting of the Ministers representing EU member-states and European Free Trade Area (EFTA) countries.

As stated in the official press release of the European Research Council (ERC), announcing the participation of the two academics, these ERC funded research projects are a "tribute to excellence" and "demonstrate the dynamism, excellence and creativity of science in Cyprus."

The official ERC press release also goes on to state that Cyprus has been highly successful in acquiring ERC Grants and points out that it has, comparatively, nearly three times more ERC grants than would be expected. It must be noted that the 4 of the 5 ERC Grants that were allocated to Cyprus-based researchers were given to academics at the University of Cyprus. This included the 1st for Cyprus, ERC Advanced Grant to Professor Polycarpou.

Further details can be found on the ERC's website: http://erc.europa.eu

Cyprus research makes an impression on the ERC Scientific Council

On the 4th and 5th of October 2012, the governing body of the European Research Council (ERC) – its Scientific Council - met in Limassol, Cyprus, for its plenary session. This was the first ever meeting of the Council to be held in Cyprus. The Scientific Council is composed of 22 renowned scientists and scholars including two Nobel Prize winners. The Council met three of the Cyprus-based ERC Grantees (Dr. Elena Andreou, Dr Antonis Kirmizis and Prof. Marios Polycarpou) from the University of Cyprus and the Rector, Prof. Constantinos Christofides.

To mark the occasion, the quarterly Newsletter of the European Research Council focused on Cyprus, stating that *"Cyprus has been highly successful in the ERC schemes, in spite of the relatively small size of its research system. With a total number of five ERC grantees funded for an amount of €6.7 million, Cyprus is performing well"*.

"... even relatively small countries can claim to excellence, as long as they continue to invest in research. A pool of high caliber researchers are present in Cyprus, keen to see their country emerging as one of the next centers of scientific excellence in the Mediterranean area. Let's help them to make it happen." The European Research Council President Professor Helga Nowotny.

RESEARCH RESULTS

Intelligent Operation & Security of Water Distribution Systems

Modern societies consider water systems as part of their critical infrastructures. Consumer well-being and productivity depends on the continuous supply of drinking water of good quality. Supervisory control and data acquisition (SCADA) systems are commonly used by water utilities to monitor and control water distribution as well as to measure water quality parameters (such as turbidity, pH, chlorine concentration). For these measurements a variety of sensors must be strategically placed in order to guarantee good monitoring coverage.

As part of the KIOS research project "ΑΧΕΛΩΟΣ", a framework suitable for monitoring hydraulic and quality conditions was developed. The project was coordinated by Prof. Marios Polycarpou and KIOS researcher Dr. Demetrios Eliades worked on the project.

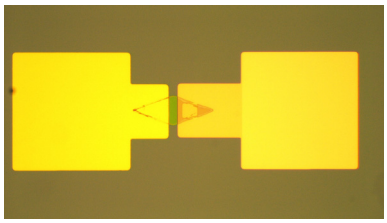
A typical water distribution system may have thousands of kilometers of pipe length, and deciding at which locations to install the quality sensors is a challenging task, as usually only a small number of these specialized sensors are available due to high cost.

Leakages are also an important issue in water distribution systems, and may correspond to more than 30% of lost revenues. Small or incipient leakages sometimes remain undetected and, for this reason, more intelligent approaches are required to detect them under uncertain conditions. A methodology was developed which is comprised of adaptive learning of the periodic water consumption dynamics and a leakage detection algorithm wad developed.

Finally, when a contamination has occurred in the system, it is crucial to isolate its source as soon as possible and to determine the population exposure. For this, an adaptive manual water quality sampling methodology was developed to determine with the smallest number of water samples, the area where the contaminant originated.

"ΑΧΕΛΩΟΣ", *was funded by the Cyprus Research Promotion Foundation through the Framework Program for Research, Technological Development and Innovation 2008 (DESMI 2008), co-funded by the Republic of Cyprus and the European Regional Development Fund.*

Memristors for Bio Circuit Design



California, 2007. Cars driving in George Air Force Base are suddenly immobilized for no apparent reason. Others are running amok in a parking lot. While others are crashing into each other (The Brain of a New Machine, IEEE Spectrum, Dec 2010) DARPA (the United States Department of Defense's funding agency) challenge to the scientific community to create intelligent cars had failed miserably!

Why is it that we have yet to build an intelligent car (or other intelligent machines for that matter) that can navigate itself in everyday traffic in a way people can generally accomplish as teenagers? The answer might lie in the classical segmentation of hardware components and software, which is very different to the "wetware" that drives biological brains. And this is where neuromorphic architecture comes in; instead of using the classical machine architecture to try to mimic biological intelligence, maybe we should be using nature's magnificent paradigm where information storage and information processing happen at the same place, the synapse.

A KIOS Research project, led by Prof. Julius Georgiou, aimed to create intelligent circuit building blocks, has developed cutting edge memristor technology, which offers viable artificial intelligence solutions where neural circuits match the performance of biological systems. The Memristor, postulated in 1971 and stumbled upon in 2008, is a resistor with memory, which behaves like components found in models of the neuron. Hence, it can be used to build a low-cost, low-power circuit equivalent of neurons. These devices can be used to build not only the "brick" of the neuromorphic structure, but also more advanced circuits that can perform intelligent tasks.

The KIOS Research Team collaborated with École Polytechnique Fédérale de Lausanne to fabricate new types of memristors using their state-of-the-art clean room facilities.

The results appear in the paper "Low-cost, CMOS compatible, Ta_2O_5-based hemimemristor for neuromorphic circuits," Electronics Letters , vol.48, no.23, pp.1451-1452, November 8 2012.", authored by Evripides Kyriakides, Sandro Carrara, Giovani De Micheli, and Julius Georgiou.

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

The effect of parameter and measurement uncertainties on hybrid state estimation

The state estimator constitutes the cornerstone of the Supervisory Control and Data Acquisition (SCADA) system since it provides the power system operators the operating condition of the power system in consecutive time intervals. Therefore, the accuracy of the state estimator is a very crucial issue for the power system monitoring schemes. The two major sources that have an impact on the accuracy of the state estimator are the uncertainty in the measurements and the limited knowledge of the network parameters.

KIOS researcher Markos Asprou has examined the two sources of uncertainty for determining which impacts more on the state estimator accuracy. Based on the research results, the limited knowledge of the network parameter affects more the performance of the state estimator compared to the uncertainty in the measurements.

This implies the need for better knowledge of the network parameters and updating the obsolete databases of electric utilities. For this purpose, the use of the Synchronized Measurement Technology seems to be the only solution to have a more accurate representation of the power system network.

The results of this research work have been presented in the IEEE Power and Energy Society General Meeting that was held in San Diego, California in July 2012. The research paper was titled, "The effect of parameter and measurement uncertainties on hybrid state estimation" and the authors were Markos Asprou, Elias Kyriakides and Mihaela Albu.

RESEARCH RESULTS

A New Hybrid PLL for Interconnecting Renewable Energy Systems to the Grid

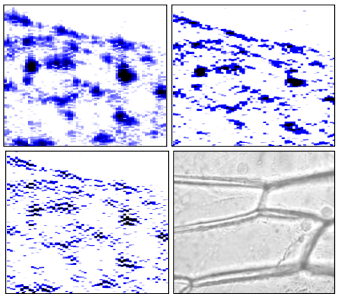
KIOS researcher Lenos Hadjidemetriou presented a paper at the IEEE Energy Conversion Congress and Exhibition in Raleigh, NC, USA on September 2012, one of the top conferences on power electronics and industry applications. The presented paper "A New Hybrid PLL for Interconnecting Renewable Energy Systems to the Grid" was a co-operation with Prof. Elias Kyriakides and Prof. Frede Blaabjerg of Aalborg University, Denmark.

In this work, a new algorithm for a Phase-Locked Loop (dαβPLL) controller is proposed, which provides an accurate and fast time response when a balanced or unbalanced grid fault occurs. The outstanding performance of the new dαβPLL is verified through simulation and experimental results. The proposed phase-locked loop controller may be the most beneficial solution to use on the control of the grid side converter of a renewable energy system with ride through fault capability. This new controller provides voltage support to the power system under grid disturbances, as demonstrated through experimental results.

Resolution Improvement of Optical Coherence Tomography

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 (1-3 mm) 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.

In a recent paper (E. Bousi, C. Pitris, "Axial resolution improvement by modulated deconvolution in Fourier domain optical coherence tomography", J. Biomed. Opt. 17, 071307, 2012), a novel technique that effectively improves the axial resolution of OCT is demonstrated. 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-scans 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. In FDOCT the real part of Fourier transform of each interferogram is modulated by a frequency which depends on the position of the interferogram in the k space. If a signal is slightly shifted numerically, the frequency of the real part of the Fourier transforms changes. By adding two shifted interferograms, beating will appear in the A-scans. If the carrier frequencies are appropriately selected, the resulting interferogram will have a narrower width. Subsequent deconvolution, with suitable kernels, provides significant resolution improvement of a factor of ~7 times.



REMACORE: Reliable Many-core Chips

The KIOS project "System Validation via Intelligent Collaboration for Reliable Next-Generation Manycore Chips" (ReMaCore), funded by the Cyprus Research Promotion Foundation under the National Framework Programme for Research and Technological Development, involved the design of reliable next-generation many-core chips. On-chip many-core systems, containing hundreds to thousands of small cores, are expected to enter mainstream computing systems and devices, expanding on the current trend of Chip Multi-Processors.

Research on on-chip parallel architectures has recently attracted increased world-wide attention from both academia and industry. Computation and information processing hungry applications in scientific (e.g. bioinformatics), personal (e.g. multimedia & entertainment), and business (ex. financial modeling) computing will all benefit from on-chip many-core parallel architectures, in terms of performance improvements. Besides performance, energy-efficiency and reliability will also improve. Scaling increases the complexity of the chips, which, in turn, poses challenges in design verification and manufacturing tests. Such effects manifest as inherent unreliability of the components, redefining the design and test paradigm for reliable systems.

The project investigated the design of reliable next-generation (hundreds to thousands of cores) many-core chips and proposed a resilient system architecture and operation, where transient and/or permanent errors can be accommodated during the lifetime of the chip. A number of self-testing and/or fault-tolerant design mechanisms were introduced for each of the architectural components (computation/control cores, memory, interconnection network), along with an innovative system-level methodology for monitoring the system status. This enables the system to constantly detect errors, isolate and confine them, or tolerate them, thus, allowing it to adapt. Another important innovation of the proposed project was the investigation of intelligent collaboration between the system components to provide necessary feedback to the system and allow it to learn and adapt.

The project was coordinated by the KIOS research team led by Prof. Maria Michael, in collaboration with University of Bristol, Cyprus University of Technology, and SignalGeneriX Ltd.

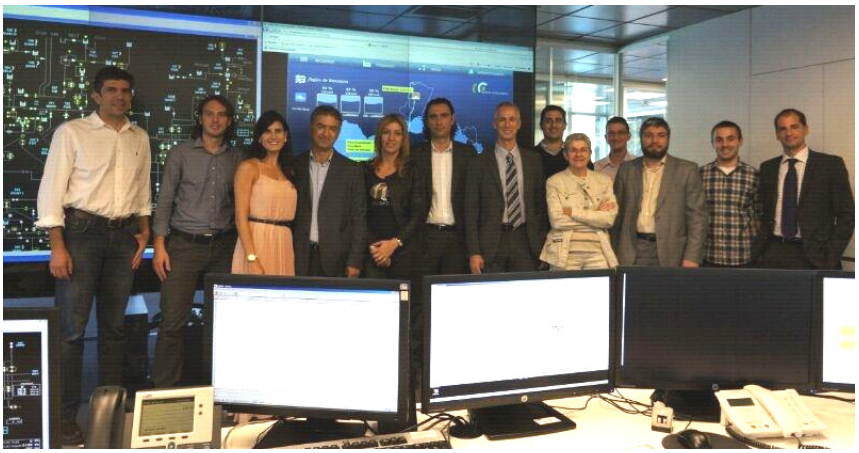
RESEARCH NEWS

ICT Solutions for Fast and Efficient Management of Water Distribution Networks

The KIOS Research Center is taking part in a new EU FP7 project to help address significant challenges in the management of urban water distribution systems. The project, with the acronym EFFINET (Efficient Integrated Real-time Monitoring and Control of Drinking Water Networks), involves the development of an integrated software package to enable water utilities to monitor and control the distribution of drinking water more efficiently. The software will offer an integrated solution to the management of supply and demand of water, reduce consumption and decrease energy costs. The system will help water utilities to manage the challenges posed by limited water supplies, and the complexities of infrastructure to make the supply of water to meet rising consumer needs / demands, with appropriate flow pressure and quality levels. Water conservation and sustainability policies are also a key concern for water utilities.

The system capabilities will include:

1. Real-time optimal control to meet demand with the use of sustainable sources and reduced electricity cost using stochastic model predictive control techniques.
2. Real-time monitoring of water quantity and quality with continuous detection and location of leakage and water quality problems using fault detection and diagnosis techniques.
3. Demand forecasting and management using smart metering techniques and modeling of consumption patterns.



The viability of the system will be piloted and tested on distribution networks in Spain and Cyprus.

The project partnership is multidisciplinary with participation of nine organizations, from Spain, Italy, Germany, and Cyprus. The Limassol Water Board is also participating in the project, where the system will be piloted. The Cyprus based SME, SignalGeneriX, is also a partner in the project.

The KIOS project research team, is being led by Professors M. Polycarpou and C. Panayiotou and will be responsible for the development of the algorithms vital to the monitoring capabilities of the EFFINET software solution.

The project is funded by the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013) – Information Communication Technologies.

Research for the Internal Security of the EU

KIOS is participating in a research project to enhance measures for the internal security of the Europe Union. Internal security concerns major internal threats which have a direct impact on the lives, safety, and well-being of citizens (e.g. terrorism, cybercrime, as well as natural and man-made disasters such as forest fires, earthquakes, floods and storms).

A key concern and policy priority for the internal security of the EU, is the security of our Critical Infrastructures. Whilst most Europeans are able to go about their daily lives in relative safety, our societies are facing serious security challenges that are growing in scale and sophistication. As critical infrastructures (e.g., water distribution networks, power distribution networks, transportation networks, health care delivery systems) and the vital services they provide become increasingly dependent on technology, they are more susceptible to attacks and failures.

Disruptions to one of these systems – through deliberate "cyber" attacks, natural disasters, or technical failures – could cause major economic and social damage. For example, if there is an attack on the water distribution network or a failure in the transportation network this may lead to potential health hazards and a heavy economic cost. To complicate matters, a failure in one infrastructure could cascade to failures in other sectors as well, because of the interdependencies between critical infrastructures. If a large geographical area experiences a blackout for an extended period of time, this may cause problems in the transportation, telecommunication, as well as water distribution networks, resulting in potentially huge economic and societal costs. Such interdependencies often transcend borders as well as sectors, thus making it very difficult for a single EU country to tackle such attacks or failures individually.

The project "FACIES" (Failure and Attack on interdependent Critical InfrastructurES), will develop and validate techniques for precise identification of critical infrastructure failures. The techniques will help detect, isolate, and accommodate faults within interdependent critical infrastructure, thus reducing the proliferation of risks posed by the failures and attacks of critical infrastructures.

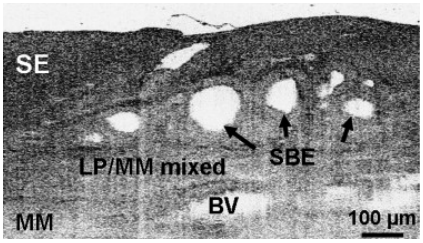
The tools could assist operators of critical infrastructures, to avoid any serious repercussion of failures and attacks by helping with the early detection of faults and thus preventing "small" fault events from escalating into major failures.

The project involves many organizations from EU member states, Professors M. Polycarpou, G. Ellinas, C. Panayiotou, and E. Kyriakides, along with a number of researchers from KIOS, comprise the research team from Cyprus.

Financial support is provided by the Prevention, Preparedness and Consequence Management of Terrorism and other Security-related Risks Programme, European Commission – DG Home Affairs.

RESEARCH NEWS

Novel Technology Development for Super-Resolution Optical Coherence Tomography



For most types of cancer, the chances of successful therapy increase dramatically when they are diagnosed early. At the stage of early neoplastic transformation, characteristic cellular and subcelluar changes appear. Currently, these changes are detectable only by histopathologic examination. Optical Coherence Tomography (OCT), an emerging medical imaging technique, can achieve sufficient penetration (~ 2-3 mm) with a resolution in the micrometer scale (~ 2-15 μm) and can, thus, adequately display microstructural changes in normal and dysplastic tissues. However, many of the hallmark changes associated with early cancer are not discernible even at this high resolution.

The main objective of this project is to develop novel techniques which will lead to significantly improved OCT resolution. To achieve this goal a combination of both optical enhancements and post-processing will be employed. Properly designed diffractive elements that shape the Point Spread Function (PSF) of the imaging system, such as pupil-plane phase masks and binary filters, can completely reshape the spatial light intensity distribution. Higher resolution in the axial or transverse directions and, even, three-dimensional super-resolution is, thus, possible. Moreover, some novel off-line numerical processing methods will be developed to remove some of the adverse effects of the proposed filters, e.g., sidelobes, and, at the same time further improve the axial and lateral resolution.

The project will include both simulations and experimental evaluation of the above techniques. Finally, the combination of these techniques will be tested in a clinical setting to evaluate their true potential as a diagnostic tool for the identification of cancerous lesions. The results of the imaging and the analysis will be compared to histopathology and are expected to confirm the efficacy of the proposed technology for the non-invasive identification of cancer.

The proposed project will result in new technology which will significantly improve the resolution of OCT images revealing sub-cellular level features. When these results are incorporated into clinical OCT systems, they will offer unprecedented imaging resolution thus increasing the effectiveness of OCT as a tool for the diagnosis of very early cancer and other disease processes.

The proposed research will be performed in the Biomedical Imaging and Applied Optics (BIAO) Laboratory of the University of Cyprus. The principle investigator is Prof. Costas Pitris and research associate Evgenia Bousi is the leading researcher. Other partners are the National Technical University of Athens (NTUA) through the Institute of Communication and Computer Systems (ICCS) and the Nicosia General Hospital (NGH).

More information appears on the projects website:
http://www.eng.ucy.ac.cy/biaolab/Research/projects/Superresolution/

This project is funded by the Cyprus Research Promotion Foundation through the Framework Programme for Research, Technological Development and Innovation 2009-10 (DESMI 2009-2010), co-funded by the Republic of Cyprus and the European Regional Development Fund.

Enhancement of Power System Integrity and Stability Using Novel Sensing Technologies

Power system security and control is the backbone of the reliable and uninterruptible operation of power systems. As power systems are complex interconnected systems, they often suffer from temporary or permanent faults or contingency scenarios.

The aim of the project is to develop methodologies for the enhancement of power system integrity and stability using novel sensing technologies. The use of unconventional and innovative sensors in power systems will be investigated. Methodologies will be developed for the use of synchronized measurement technology for effective monitoring of the voltage stability of power systems. The voltage stability will then be enhanced by further novel techniques and methodologies to be developed by the research team. The prevention of voltage instability phenomena that lead into blackouts will be a main subject of the project, achieved through the development of novel controlled islanding methodologies.

The KIOS research team in this project is led by Prof. Elias Kyriakides.

This project is funded by the Cyprus Research Promotion Foundation through the Framework Programme for Research, Technological Development and Innovation 2009-10 (DESMI 2009-2010), co-funded by the Republic of Cyprus and the European Regional Development Fund.

Knowledge and Technology Transfer

Generating new knowledge and turning it into new products and services is important to maintaining and enhancing Europe's competitiveness. Researchers and industry must work closely together so as to maximize the social and economic benefits of new ideas.

Transforming research results into new commercial products is a complex process, involving a broad range of stakeholders. It is not enough to simply increase public investment in research; it is important to create a framework to facilitate the process of knowledge transfer by removing the barriers which hinder collaboration between research and industry in order for Europe to operate as a single market for knowledge.

In its broad-based innovation strategy, the European Commission has identified the importance of improving the transfer of knowledge between public research institutions and third parties, including industry and civil society organizations, as one of the key areas for action.

The KIOS Research Center actively encourages collaboration between industry, academia, and research organizations in high-tech areas of both global and local importance. Our goal is to apply the results and methodologies developed through our research to partner industries and organizations, to enable a mutually beneficial collaboration.

Hi-Tech Company Interested in Award-Winning Smart Phone Technology

"Airplace", a new award-winning, technology, enables very precise identification of the location of a person or objects in large indoor spaces (e.g., airports, museums, shopping malls, universities), where the use of GPS is not possible. Developed specifically for operation via smartphones, "Airplace" operates using existing WiFi infrastructure within buildings and exploits signal strength measurements from surrounding WiFi access points which are received by the mobile device. These features enable easier and cheaper indoor positioning systems in large buildings, while at the same time facilitating fast and efficient access to anyone who owns a smartphone and wishes to use the system.

The "Airplace" technology can be particularly useful in large indoor spaces. The system can, for example, assist with the location of medical equipment in hospitals during an emergency. It can be used in museums or exhibitions, to help visitors locate the position of particular exhibits, whilst simultaneously accessing the relevant audio descriptions. It is even capable of helping to locate a child lost in a large busy area.

This innovative technology is being exploited for commercial purposes by a large international hardware and software company in Taiwan.

The research effort was led by Prof. C. Panayiotou, at KIOS and Prof. Demetris Zeinalipour responsible for the Data Management Systems Laboratory (DMSL) of the Department of Computer Science, at the University of Cyprus.

The "Airplace" indoor positioning system, won the Best Demo (1st prize) at the 13th IEEE International Conference on Mobile Data Management (MDM'12), IEEE Computer Society, which took place in Bangalore India on July 23-26 2012. The award was given to the research team coordinated by KIOS PhD Candidate Christos Laoudias and comprising of undergraduate students from the Computer Science Department, G. Constantinou, M. Constantinides, and S. Nicolaou.

A demonstration video for the "Airplace" system can be seen at:

http://www2.ucy.ac.cy/~laoudias/pages/platform/videos/Airplace_Demo/Airplace_Demo.html

This work was initially funded by the Cyprus Research Promotion Foundation through the Framework Programme for Research, Technological Development and Innovation 2008 (DESMI 2008), co-funded by the Republic of Cyprus and the European Regional Development Fund.

Intelligent Water Irrigation System

The "WaterBee", a prototype intelligent irrigation system is capable of significant water savings, is an example of a marketable product.

The system offers a complete, resilient, cost-effective, smart irrigation and water management system, allowing public authorities and landscape managers to optimize their operations. The efficient management of water use occurs through an intelligent irrigation modeling and scheduling system which is smart, flexible, easy-to-use, with low operating costs. This product is particularly significant for the agricultural sector since it maximizes the efficiency of irrigation.

For the precise detection of the need to irrigate, "WaterBee" uses sensors that measure soil water content, appropriately distributed over the cultivated area. This data is sent to a central web service which uses intelligent software to automatically analyze it and act by selectively activating irrigation nodes only in the areas required.

The system can be operated easily via smartphone and web apps and support crop irrigation decisions with real-time data. The system enables the user not only to optimize the use of water by irrigating only where and when it is needed, but also to enhance plant growth and quality.

The "WaterBee" system has been showcased by the European Commission on several occasions, referring to it as a success story made possible via EU research funding. It also attracted the attention of Euronews and was demonstrated at the International Agricultural & Gardening Machinery Exhibition, Italy 2012, to more than 196,000 visitors.

"WaterBee" was developed from a collaboration between companies and Universities in the EU. The 1st phase focused on the development of the technology and the 2nd phase on developing a marketable product. The KIOS research team, led by Prof. Christos Panayiotou, was responsible for the development of algorithms, an essential element to the operation of the system.

Project website:
http://www.waterbee.eu/

TECHNOLOGY TRANSFER AND ENTERPRISE

International Patent for Electricity Generation System with Zero CO_2 Emissions Awarded

A research team at the KIOS Research Center, led by Assistant Professor E. Kyriakides, has successfully developed an innovative method for generating electricity with zero CO_2 emissions. The technology is cutting edge with a distinguishing feature: the power output can be regulated, unlike the power output of conventional renewable energy systems whose output varies depending on the availability of wind or solar irradiation. Due to the novel configuration proposed, the electric energy out of this system will be clean, green, and regulated. The technology has been awarded an international patent.

The successful development of this technology contributes to the target set by the European Union for energy generation using renewable sources, as well as targets for CO_2 emissions, not only in Cyprus, but also in the rest of Europe.

The prototype system includes a wind turbine with an output power of 225 kW and fuel cells of 50 kW, electrical machinery, and other electrical equipment. The system relies on electricity generated from renewable sources (in this case, wind energy), the production of hydrogen via electrolysis and its subsequent storage, as well as the use of fuel cells to produce dc electricity.

The connection to the grid of the Electricity Authority of Cyprus (EAC) is achieved by converting the dc electricity into ac, via the patented technology. The system is being tested at various operating conditions to test the response of individual equipment, as well as to test its response to input variations or load changes, and assess the system interaction with the electricity grid.

This innovative technology was developed as part of a research project, entitled ZeroCO$_2$ financed by a grant from Norway through the Norwegian Financial Mechanism, the Republic of Cyprus, and the University of Cyprus.

Special thanks are also due to the Electricity Authority of Cyprus (EAC) for its support in connecting and testing the system and its cooperation throughout the project. The EAC has supported the KIOS Research Center since its establishment and the EAC-KIOS collaboration in various research projects has been continuous. The research results arising from these collaborations are available for use by the EAC.

Further information on the research project is available on the following web site:
http://www.kios.ucy.ac.cy/zeroco2/

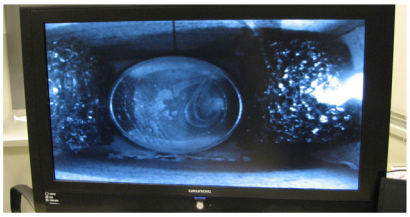
SAFEMETAL: Innovative Intelligent Signal Processing Systems for Euro-coin Validation and Metal Quality Testing

Over 80 types of counterfeit coins and corresponding tooling and working methods can be identified for Euro coinage. Also, conductivity measurements are widely used for characterization of heat treatment of aluminum alloys and other non-destructive testing, especially for safety-critical applications in aerospace industry, nuclear reactors, etc.

KIOS is participated in an EU FP7 project alongside several European universities and companies to develop metal validation technology required to distinguish between increasingly sophisticated counterfeit and genuine coins and to characterize the metal quality. This involves the development of advanced signal processing and data fusion techniques, and planar electromagnetic sensors and pulse eddy-current measurement techniques with increased field sensitivity. The market being addressed includes coin validators, aerospace, and nuclear industries. For example, such technologies can be used to design specialized coin validators for coin mints and banks around Europe, but also can have a more widespread use when used to develop more efficient parking meters or vending machines. Furthermore, the metal quality technologies developed for measuring the metal quality can find application in the aerospace and nuclear industries.

It is possible to analyze different properties of a coin in order to determine if it is a genuine one. Two of the approaches that have been investigated in the SAFEMETAL project involve examining the metal conductivity properties of the coin, as well as visual information of the coin. The two approaches complement each other well since it is possible to detect both visually distinct differences between a genuine and a fake coin and also inspect if its metal properties meet the standards provided by the European Union.

As a partner in this project, the University of Cyprus has developed a coin identification system prototype using Field Programmable Gate Array (FPGA) technology. The developed prototype analyzes images of coins



captured by a video camera and determines what coin is present in the image (e.g., 1 euro coin or 2 euro coin). The prototype developed by KIOS is intended to work alongside other coin identification systems developed by the Tallinn Technical University (TTU), and the Telecommunication Systems Research Institute from the Technical University of Crete in order to provide a state-of-the-art high performance coin validation system that is robust against different forms of counterfeit coins.

The SAFEMETAL project was funded by the EU 7th Framework Programme (FP7, 2007-2013) under the Specific Programme "Capacities" (Research for the Benefit of SMEs).

TECHNOLOGY TRANSFER AND ENTERPRISE

LEARN STARTUP
Beating Unemployment Through Entrepreneurship

The KIOS Research Center supported the IEEE GOLD Affinity Group of Cyprus, who in collaboration with the Association of PhD Candidates in Cyprus, organized the workshop "LEARN STARTUP". The event, which took place in November 2012, at the University of Cyprus, was dedicated to the promotion of entrepreneurship in Cyprus.

The IEEE GOLD Affinity Group of Cyprus and the Association of PhD Candidates, with many members who are professional researchers, felt that the workshop would help the young and highly educated Cypriot workforce to pursue alternatives avenues of employment.

Organizers from the IEEE Gold Affinity Group believe that with recent unemployment statistics showing that almost 30% of Cypriots under the age of 30 are unemployed, becoming more creative by transforming an opportunity into a business maybe a viable option. They believe that "Running your own business is a personal achievement second to none."

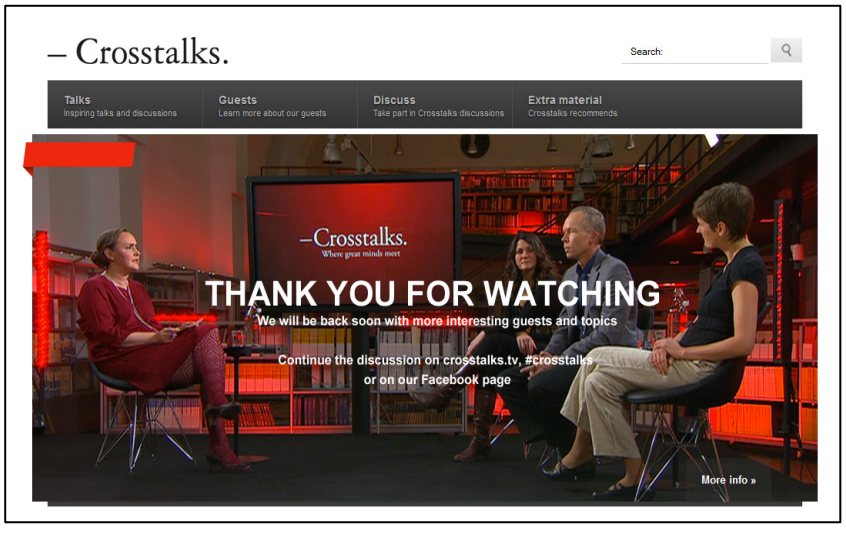
The workshop, attracted over 60 participants, the majority of whom were young people. It gave the opportunity to budding entrepreneurs to learn how to network, identify opportunities, raise funding, set-up a business and market it. Speakers included young Cypriot entrepreneurs and Business Incubator mentors. The participants also had the opportunity to network with young and dynamic entrepreneurs, who shared their experiences and offered tips on how to weather the economic crisis.

Event speakers: Stavriana Kofteros, CEO Diogenis Business Incubator University of Cyprus; Alexandros Michaelidis, CEO TALOS Development Organisation; Demetris Hadjisofocli, CEO HELIX Business Incubator; Nikos Ioannou, Officer at the Ministry of Commerce Industry and Tourism; Michael Tyrimos, Entrepreneur - The Cypriot Enterprise Link, synups, Bioland Energy; Andreas Kamilaris, Entrepreneur - Elevate-Me Promotions; George Milis, Entrepreneur - EuroCy Innovations

More details:

http://sites.ieee.org/cyprus-gold/activities/entrepreneurship/

Global Academic Live Talk Show – Crosstalks



Post-Doctoral Researcher, Dr. Constantinos Hadjistassou, represented the KIOS Research Center and the University of Cyprus in the first global debate taking place on a high quality and new form of international academic live talk show. The talk show, with the name of Crosstalks, is organized by Sweden's leading universities – KTH and Stockholm University.

Crosstalks brings together researchers to discuss topics that are important on a global scale and viewers from around the world have the opportunity to participate in discussions through Skype. The debate is broadcast on the website, www.crosstalks.tv, that acts as a global, live discussion forum.

Dr. C. Hadjistassou participated in a debate "The Battles for Entrepreneurs" where discussion focused on a number of issues related to the promotion of entrepreneurship (including how people initiate their own projects into successful businesses; how individual nations attract prime entrepreneurs; what are the best conditions for an entrepreneur; and what type of entrepreneurship we want and need in the future).

More Details:

http://crosstalks.tv/

Activities of the IntelliCIS ESF-COST Action

The fourth and last year of the IntelliCIS ESF-COST Action ("Intelligent Monitoring, Control and Security of Critical Infrastructure Systems", http://www.intellicis.eu), led by the KIOS Research Center, started with a successful workshop in Riga, Latvia in September 2012. More than 60 participants attended the two-day workshop and enjoyed both the technical part, as well as the social part in the beautiful city of Riga.

The Riga workshop was particularly focused on early stage researchers. Twelve out of the eighteen presentations in the workshop were given by Ph.D. students or early Ph.D. graduates. It was particularly exciting to observe the enormous amount of knowledge and talent of our young researchers. Several lively discussions took place during the workshops; these discussions often continued throughout the social events of the workshop.

The last (eighth) workshop of the Action will take place in Aachen, Germany on the grounds of the E.ON. Research Center at the RWTH Aachen University on 4 -5 March 2013. Concurrently, IntelliCIS will organize its Second Training School on 4-8 March 2013 in the same location. A record participation is expected to celebrate the many achievements of this Action, which boasts to be one of the largest COST Actions of the European Science Foundation.

IntelliCIS will officially finish its activities in May 2013, but our interactions, collaboration, and sense of community will live on, leading us to further research achievements and maintaining collaborations and friendships that started through the Action activities.

Summer Internship for KIOS Researcher at the European Organization for Nuclear Research (CERN)

Last summer, KIOS Researcher Yiannis Tofis was one of 100 young researchers selected to participate in the CERN (the European Organization for Nuclear Research) internship programme.

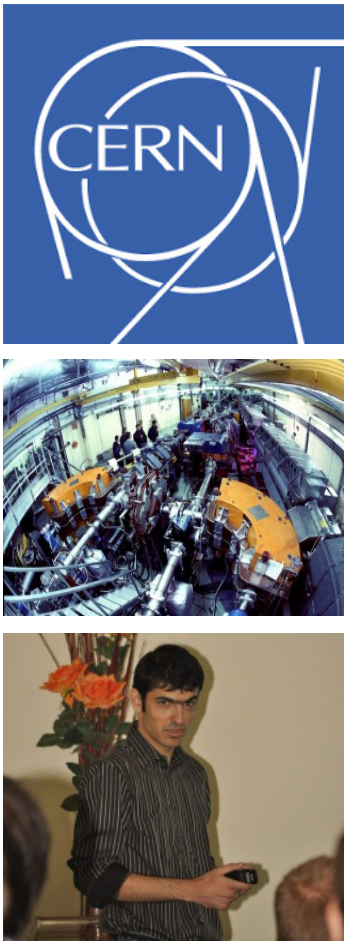
The European Organization for Nuclear Research (CERN) is one of the world's largest and most respected centers for scientific research. It is the world's top particle physics research center and the birthplace of the World Wide Web (WWW).

CERN is an international organization whose purpose is to operate the world's largest particle physics laboratory. Established in 1954, the organization is based in the northwest suburbs of Geneva on the Franco–Swiss border and led by 20 European member states. The term CERN is also used to refer to the laboratory, which employs just under 2,400 full-time employees, 1,500 part-time employees, and hosts some 10,000 visiting scientists and engineers, representing 608 universities and research facilities and 113 nationalities.

Yiannis Tofis, who was one of 2000 applicants for the internship, had the opportunity to spend 8 weeks in Geneva and attend lectures given by some of the world's most renowned experts in the area of high energy physics. He was able to interact with these acclaimed researchers, engineers, and top tier students from the SCADA (Supervisory Control and Data Acquisition) Systems Group.

The internship at CERN's Laboratory for Particle Physics also included allocation of specific research tasks. Yiannis was given the responsibility of performing event-based real-time power flows on the DigSilent Power Systems Simulator. The data were collected from the PVSS SCADA Framework. PVSS and DigSilent PowerFactory were connected through the OPC interoperability standard for industrial control, exchanging data in real time, based on a client-server model. The aim of this research was to evaluate the performance of this scheme in terms of computational and memory requirements.

Furthermore the internship included the unique opportunity to visit major experiment sites such as the LHC (Large Hadron Collider) experiment, designed to study the physics of quark-gluon plasma and the CMS (Compact Muon Solenoid) experiment, designed to investigate a wide range of physics problems, including the search for extra dimensions, particles that could make up dark matter, and the Higgs boson (particle) that was recently announced that it has been discovered with high probability.

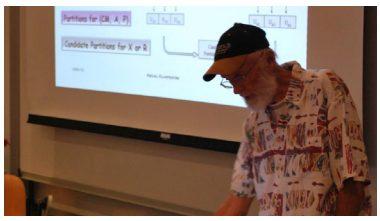


Everybody Talks About "Big Data" but Making Sense Out of It is No Easy Task

This was the topic of discussion during a special lecture by guest speaker Prof. James (Jim) Bezdek. Prof. Bezdek, an acclaimed veteran in the field of Computational Intelligence and an IEEE Distinguished Lecturer, who visited Cyprus in October 2012 to share his expertise on Visual Clustering and how it can help process Very Large Databases and Big Data in general. Professor Bezdek, who is internationally recognized for his outstanding research contribution, presented 3 algorithms for visual assessment of clustering tendency and their real-life applications in medical data analysis, social network analysis, and network access security. The lecture was extremely successful and was attended by about 60 academics, researchers, and students.

Prof. Bezdek is past president of NAFIPS (North American Fuzzy Information Processing Society), IFSA (International Fuzzy Systems Association), and the IEEE Computational Intelligence Society. He is the Founding Editor of the International Journal of Approximate Reasoning and the IEEE Transactions on Fuzzy Systems, and he He is the recipient of the IEEE 3rd Millennium Medal, the IEEE CIS Fuzzy Systems Pioneer Award, and the IEEE Rosenblatt Award.

The event was sponsored by the Computational Intelligence Society under its Distinguished Lecturer Program, the IEEE Cyprus Section, the IEEE UCY Student Branch, and the ECE Department of the University of Cyprus. The video of the event can be seen at: https://www.youtube.com/watch?v=bNFnbSB9ipE



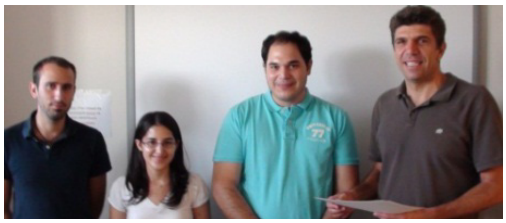
Undergraduate Research Opportunities Program 2012

Last summer six students participated in the Undergraduate Research Opportunities Program (UROP), run by the KIOS Research Center.

UROP aims to encourage young people to participate in research and to nurture the skills, experience, and confidence required for such an endeavor. The program has been running each summer for the last 4 years. Between 2009 and 2012, a total of 17 students successfully completed the program. The students participated in research spanning a variety of research areas such as renewable energy, ICT for health, and telecommunication.

According to UROP Scholar Christina Themistocleous: "*My participation in UROP has been a remarkable developmental experience. Having the opportunity to research different types of source material and to evaluate the credibility of different scientific claims has definitely helped to improve my research skills and to develop my knowledge in my study area. Sharing ideas, opinions and knowledge, has helped me to absorb, learn, and improve my skills.*"

The following students have graduated from the UROPs program this year: Marios Hadjiantonis, Andreas Kasis, Charalambos Menelaou, Martinianos Papadopoulos, Christina Themistocleous, and Ioannis Yiannaki.



Researchers' Night 2012

The KIOS Research Center participated, for the 2nd year, in the Researchers' Night 2012 organized in Cyprus as part of an EU-wide campaign. The campaign, which takes place every year in more than 350 European cities simultaneously, brings researchers directly into contact with the public, to show the important role research plays in society. The campaign took place on the 28th of September 2012.

The KIOS research team demonstrated the capabilities of a total of ten different types research initiatives and technological prototypes in a format that would easily attract the attention of participants. Demonstrations included technology for: Smart phones (indoor positioning system); Improved diagnosis and personalized optimal therapy of oncological diseases; Distinguishing between types of movements and modes of travel for use in situations where visual information may be unavailable and unobtainable; Intelligent irrigation for the efficient management of water; Distinguishing between the various types of infectious bacteria; Increasing space-based systems' resilience to radiation; High-speed image recognition inspired from biological systems; New memristive devices.