

*IntelliCIS Action IC0806*

*5<sup>th</sup> Workshop, Milan – Italy*

*26-27 September 2011*

*Program-at-a-glance*

<b>Monday, 26 September 2011</b>	
09:00 – 10:00	<b>KEYNOTE LECTURE 1: Vladimir Terzija</b>
10:00 – 10:30	COFFEE BREAK
10:30 – 11:45	<b>Session I - Critical Infrastructures: Risks and Challenges</b>
11:45 – 12:45	<b>Session II – Fault Detection and Diagnosis</b>
12:45 – 14:00	LUNCH
14:00 – 16:00	<b>Special Session – Energy Storage</b>
16:00 – 18:00	<b>IC0806 Management Committee Meeting</b>
20:00 – 23:00	DINNER

<b>Tuesday, 27 September 2011</b>	
09:00 – 10:00	<b>KEYNOTE LECTURE 2: Jose R. Marti</b>
10:00 – 10:30	COFFEE BREAK
10:30 – 11:45	<b>Session III - Applications</b>
11:45 – 12:45	<b>Session IV – Critical Infrastructures: Protection and Monitoring</b>
12:45 – 14:00	LUNCH
14:00 – 16:00	<b>Free time for research meetings/networking</b>

# *IntelliCIS Action IC0806 – Detailed Program*

**Monday, September 26<sup>th</sup>**

**09:00 AM - 10:00 AM**

**KEYNOTE LECTURE 1**

***“A Roadmap to a Smarter Grid,”*** Vladimir Terzija  
(The University of Manchester, United Kingdom)

***“Napoleonica Room”***

**Chair: Elias Kyriakides (University of Cyprus, Cyprus)**

**10:00 AM -10:30 AM**

**COFFEE BREAK**

**10:30 AM - 11:45 AM**

**Session I: Critical Infrastructures: Risks and Challenges**

***“Napoleonica Room”***

**Chair: Christos Panayiotou (University of Cyprus, Cyprus)**

***Critical infrastructure interdependencies with the water sector as a starting point - examples from Norway***

Jon Rostum (SINTEF, Norway)

***Challenges in designing and testing critical infrastructures: the “Smart Grid” case***

Antonello Monti (E.ON Energy Research Center, RWTH Aachen University)

***MIMESIS: a multi-data system for risk evaluation of critical infrastructures under extreme natural events***

Vittorio Rosato (ENEA Casaccia Research Centre, Italy)

**11:45 AM – 12:45 PM**

**Session II: Fault Detection and Diagnosis**

"Napoleonica Room"

Chair: Ke Chen (The University of Manchester, United Kingdom)

***Model-based Sensor Fault Detection and Diagnosis***

Vasso Reppa (University of Cyprus, Cyprus)

***Wildfire Smoke Detection using Computational Intelligence Techniques and Synthetic Smoke Clouds Generation***

Fabio Scotti (Universita' degli Studi di Milano, Italy)

***Fault Tolerant Target Localization and Tracking in Wireless Sensor Networks Using Binary Data***

Michalis P. Michaelides (University of Cyprus, Cyprus)

**12:45 PM – 2:00 PM**

**LUNCH**

**2:00 PM – 4:00 PM**

**Special Session – Energy Storage**

"Napoleonica Room"

Chair: Vladimir Terzija (The University of Manchester, United Kingdom)

***Thermal storage and distributed multi-energy systems: opportunities and challenges***

Pierluigi Mancarella (The University of Manchester, United Kingdom)

***The Storage Component in Active Distribution Grids***

Mihaela Albu (University Politehnica of Bucharest, Romania)

***Role of buildings and city quarters in the energy storage problem***

Antonello Monti and Marco Cupelli (E.ON Energy Research Center, RWTH Aachen University)

***Operation of Pumping Storage Facilities in Hydroelectric Plants for Increasing the Wind Penetration in Large and Isolated Power Systems***

Evangelos N. Dialynas (National Technical University, Athens, Greece)

***Degradation Intelligent Monitoring of Hybrid Systems - Flywheel Energy Storage***

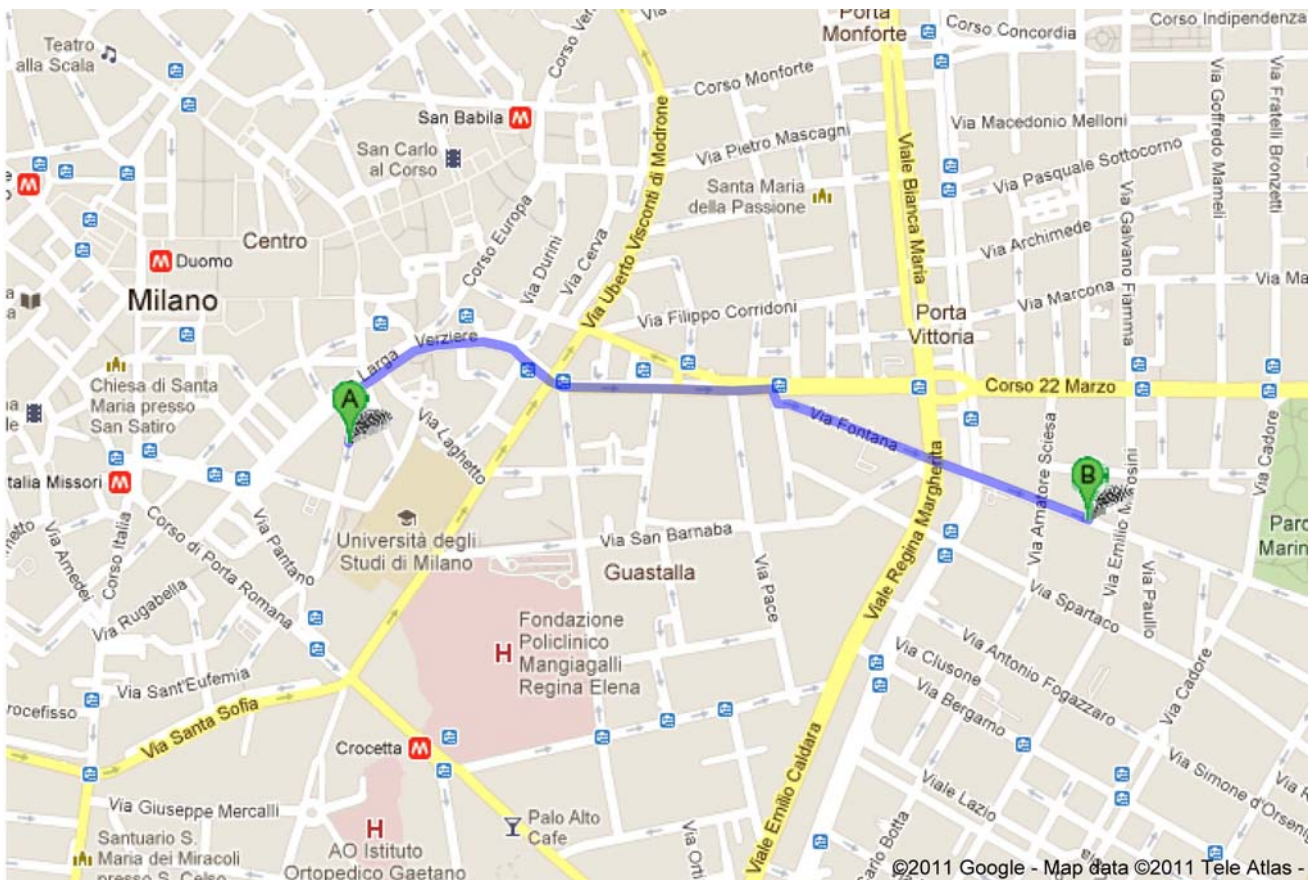
Claudia Maria García (Universitat Politècnica de Catalunya, UPC Spain)

**4:00 PM –6:00 PM**

**IC0806 Management Committee Meeting**  
“Piccola Room”

**8:00 PM – 11:00 PM**

**DINNER (at “Isola dei Sapori”, 10 Anfossi Street, Milan)**



**A:** Workshop Venue, 10 Sant' Antonio Street

**B:** Restaurant “*Isola dei Sapori*”: 10 Anfossi Street

**Tuesday, September 27<sup>th</sup>**

**9:00 AM - 10:00 AM**

**KEYNOTE LECTURE 2**

***"I2Sim DR-NEP Simulation Platform for Worldwide Access to Disaster Preparation, Response, and Recovery,"*** Jose R. Marti

(The University of British Columbia, Canada)

"Napoleonica Room"

Chair: Elias Kyriakides (University of Cyprus, Cyprus)

**10:00 AM - 10:30 AM**

**COFFEE BREAK**

**10:30 AM – 11:45 PM**

**Session III: Applications**

"Napoleonica Room"

Chair: Mihaela Albu, (University Politehnica of Bucharest, Romania)

***Power Systems with high wind penetration: A reserve scheduling problem***

Kostas Margellos (ETH Zurich, Switzerland)

***SEE HYDROPOWER, targeted to improve water resource management for a growing renewable energy production***

Bogdan Popa (University Politehnica of Bucharest, Romania)

***Electricity demand characterisation and flexibilisation***

Gianfranco Chicco (Politecnico di Torino, Italy)

**11:45 AM – 12:45 PM**

**Session IV: Critical Infrastructures: Protection and Monitoring**

"Napoleonica Room"

Chair: Khaled Boussetta (University of Paris 13, France)

***Hybrid and Wireless monitoring technologies: the PoliMi experience***

Antonio Marullo (Politecnico di Milano, Italy)

***The problem issues of intelligent monitoring and control of CIS in Latvia***

Anatolijs Zabašta (Riga Technical University, Latvia)

**12:45 PM – 2:00 PM**

**LUNCH**

**2:00 PM – 4:00 PM**

***Free time for research meetings/networking***

## ABSTRACTS & BIOGRAPHIES

# A Roadmap to a Smarter Grid

**Prof. Vladimir Terzija**

## **Abstract:**

A broad spectrum of advanced technology solutions and novel protection and control techniques will deliver new modes of integrated and smarter power system protection and control. Supported by the Global Positioning System, the Synchronized Measurement Technology (SMT) is one of those key technologies. While the SMT is already commercially available, the development of its applications is still in its infancy. The focus of the keynote address is to discuss the challenges related to the development of such applications, the need for them in terms of the structure of future networks, the deployment of architectures for multi-purpose applications given different grid topologies, generation mixes and diverse operational challenges. The presentation will discuss the challenges how to conduct a successful multidisciplinary research with specialists from different background being involved. Several examples of such multidisciplinary research projects will be presented.

## **Biography:**

**Prof Vladimir Terzija** is the EPSRC Chair Professor in Power Systems Engineering in the School of Electrical and Electronic Engineering at The University of Manchester. Before joining the School in July 2006, he has spent six years with ABB, Germany, where he provided technical expertise on switchgear, power system protection and distribution automation. He is currently principal investigator (PI) on a number of industry and UK government funded projects related to the topic Wide Area Monitoring, Protection and Control Systems. His main research interests are in the application of intelligent methods for power system monitoring, control, and protection, as well as switchgear and DSP applications in power systems. Prof Terzija is Humboldt Research Fellow, Senior Member of the IEEE, and Member of the IET and Cigré. He is an active member of the North American SynchroPhasor Initiative (NASPI). He is currently convenor of the Cigré Working Group B5.14 “Wide Area Protection and Control Technologies” and a contributing member of several IEEE working groups. Prof Terzija has published over 240 peer-reviewed papers in international journals and in proceedings of international conferences. In his research team he has currently 5 MSc project students, 11 PhD students and 2 Postdoctoral Research Associates.

## Critical infrastructure interdependencies with the water sector as a starting point - examples from Norway

**Jon Rostum**

SINTEF, Norway

### Abstract:

The functioning of today's society is completely dependent on various networks of critical infrastructures, such as electricity supply, water supply, telecom ICT etc. So there is an increasing need and requirement for carrying out detailed risk and vulnerability analyses of these "lifelines". These analyses become quite complex and require great interdisciplinary skills. One reason for this is the strong interdependencies both within and between the infrastructure systems, which can cause consequences of failures to spread to other infrastructures. In this presentation examples will be given on such interdependencies by using the water supply system as the starting point for the analysis. Examples and procedures from Norway will be presented.

### Biography:

**Dr. Jon Røstum** holds a M.Sc. from Norwegian Institute of Technology in water and wastewater engineering and a PhD in statistical modelling of pipe failures in water networks. Røstum has been/are involved in several EU projects on water and wastewater (e.g. CARE-W, CARE-S, TECHNEAU, PREPARED and TRUST). The focus has been on asset management, information system, risk analysis, rehabilitation planning and benchmarking. Røstum has previously held a part time position as assistant professor at the Norwegian University of Science and Technology. He also has worked as a consultant engineer with planning of different types of water and wastewater infrastructure. Røstum was MC member of COST action C18 "Performance assessment of urban infrastructure services: The case of water supply, wastewater and solid waste" (2004-2008) and was the chairman of COST C19: "Proactive crisis management of urban infrastructure" (2004-2008). As a senior researcher at SINTEF, Røstum has been involved in several projects with the water industry both in Norway and abroad. Some selected assignments have been:

- Project leader for the risk and vulnerability analysis project of the whole Urban water cycle of Oslo municipality Norway. The analysis covers all subsystems, catchment, water treatment, distribution, wastewater collection system, wastewater treatment and ICT systems.
- WA leader in EU 6FP Techneau "Operation and Maintenance"
- Member of the accident investigation commission after the *Giardia*-outbreak in the water supply in Bergen 2004. Including secretary. (2006).

## Challenges in designing and testing critical infrastructures: the “Smart Grid” case

**Univ.-Prof. Dr.-Ing. Antonello Monti**

**Director of the Institute for Automation of Complex Power Systems  
E.ON Energy Research Center  
RWTH Aachen University**

### **Abstract:**

Design and testing of innovative solutions for critical infrastructures is a challenging task and, as result, risks associated with new deployments may stop or delay innovation. At the same time, external factors may push for revolutionary changes in the management of the infrastructure.

The concept of “Smart Grid” is a perfect example: while it is clear that the power grid must evolve towards a more intelligent and “real-time” type of operation, it is also equally clear that is not acceptable to test such completely new concepts in the existing infrastructure without a satisfactory, comprehensive and realistic preliminary testing process. The question may be phrased this way: how do we achieve a comprehensive validation of a new technology without affecting the reliability of the infrastructure, in this case of the power grid?

At the E.ON Energy Research Center at RWTH Aachen we are developing an innovative infrastructure to tackle this challenge. We leverage simulation and in particular real-time simulation to a new level, achieving multi-physics power hardware in the loop testing.

This approach allows the testing of devices in a context that is extremely realistic and can fill the gap between traditional laboratory test and field test. In some cases the testing with our approach is even more comprehensive than in a real case scenario, given the repeatability and controllability of the boundary conditions.

This presentation will introduce first of all the underlying concept of the proposed approach and then will provide details about the unique infrastructure available and under development at RWTH Aachen.

Finally, some real-life applications of the technology will demonstrate its use.

### **Biography:**

Antonello Monti received his M.Sc degree (summa cum laude) and his PhD in Electrical Engineering from Politecnico di Milano, Italy in 1989 and 1994 respectively.

He started his career in Ansaldo Industria in Milano where he was responsible for the development of the digital control of large electrical drives. In 1995 he went back to academia to join Politecnico di Milano as Assistant Professor.

In 2000 he became Associate Professor at the Department of Electrical Engineering of the University of South Carolina (USA). During 2008 he was elevated to the position of Full Professor within the same department.

In the same year he accepted an offer from RWTH Aachen University (Germany) to start and direct the Institute for Automation of Complex Power System within the E.ON Energy Research Center.

Dr. Monti is author or co-author of more than 200 peer-reviewed papers published in international Journals and in the proceedings of International conferences. He is a Senior Member of IEEE and Associate Editor of the IEEE Transactions on Smart Grids and IEEE System Journal.

## **MIMESIS: a multi-data system for risk evaluation of critical infrastructures under extreme natural events**

**Vittorio Rosato**

**ENEA Casaccia Research Centre, Roma**

### **Abstract:**

In many countries, natural (and extreme) events are the most frequent causes of Critical Infrastructures outages. Direct events (such as earthquakes) or indirect ones (such as flooding due to intense rainfalls or tsunamis induced by earthquakes) are at the origin of more or less catastrophic events which produce from single-node failures, with low impact on services and citizens, to more dramatic events where combined failures and interdependent cascading trigger severe outages able to destroying vital services and severely striking citizens.

MIMESIS is a complex software system which combines meteo-climatological predictions, a number of information (historical and geo-physical data, social and economical data) on the specific area under control and the results of single-domain or federated Critical Infrastructures simulators. The appropriate combination of these elements are able to dynamically predict the state of risk of the different elements of the infrastructures present in a given area. MIMESIS is able to predict the natural event (mainly abundant rain and snowfalls, with a given range of confidence, in a specific areas), to set up a crisis scenario induced by the predicted natural event and to evaluate the impact that the scenario could possibly have (in terms of reduction of the services provided by stricken infrastructures, with possible estimate of social and economical costs).

MIMESIS is based of GIS databases; it jointly elaborates data according to weather (short time-scale) and climatologic (medium time scale such as 6-12 months) predictions. Flooding predictions are made according to accurate hydrological models of river basins. Crisis scenarios are then modeled by using appropriate simulators of electrical networks (SimCal), telecommunication networks (NS2, now NS3), railways simulators (OpenTruck) which estimate the impact of the faults on the services. From these data, estimate of costs and impact on population are also provided.

At the end, MIMESIS should be customized on specific areas (regional or wider scales) for providing an useful Decision Support System for managing complex infrastructures faults.

### **Biography:**

Vittorio Rosato received the “Laurea” degree in Physics at the University of Pisa (1979) and the Ph.D. in Physics at the University of Nancy (1986). He has been Research Assistant at the Chemistry Dept. of the University College of Wales in Aberystwyth (UK), Boursier CNRS at the Centre de Calcul Atomique et Moléculaire in Orsay (France), EURATOM Fellow at the Saclay Centre d’Etudes Nucleaires Saclay of the Commissariat à l’Energie Atomique (CEA, France). Since 1990 he is Staff Scientist at the ENEA Casaccia Research Centre.

He is currently Head of the ENEA Laboratory of Technological and Computing Infrastructure, President of the Industrial Spin-Off Commission of ENEA, Member of the Scientific Board of CASPUR (Consortium for Supercomputing for University and Research) in Roma.

He is co-founder and current President of the Ylichron Srl. a spin-off company of ENEA.

He is author of more than 90 scientific papers on peer reviewed journals.

# Model-based Sensor Fault Detection and Diagnosis

**Vasso Reppa**

**KIOS Research Center for Intelligent Systems and Networks,  
University of Cyprus**

## **Abstract:**

Monitoring and control were always essential for specifying in real time the operating conditions of a physical system or process by acquiring and recording information, which is further utilized in sophisticated control loops for achieving the desired performance. Due to the inevitable occurrence of system/process faults, these procedures are enhanced with fault management capabilities and incorporated in supervisory schemes that take the proper actions for the fault tolerant system/process operation. However, the accomplishment of these tasks is jeopardized when sensors are malfunctioned, provoking fault propagation and control instability that seriously affect the process operation and lead to wrong decision making. The goal of this presentation is to provide a methodology for detecting and diagnosing faults in sensors, used for monitoring and control of nonlinear systems, characterized by modeling errors and unknown disturbances. Under the a priori knowledge of a system model and using the noise-corrupted measurements of one sensor or a set of sensors, a bank of observers is designed to estimate the system output. The decision making for the occurrence of sensor faults relies on the comparison of uncertain residuals with adaptive thresholds, while the residuals are extracted in order to ensure the isolation of multiple, concurrent sensor faults.

## **Biography:**

Vasso Reppa obtained her Doctorate in Electrical and Computer Engineering in 2010 from the University of Patras, in Greece, with her doctoral thesis entitled "Fault Detection and Diagnosis: Application in Microelectromechanical Systems". In 2009, she joined the Storage Technologies Department of IBM Zurich Research Laboratory in Switzerland, as a student intern dealing with the experimental analysis of sensor-loss detection of atomic force microscope. Concurrently with her doctoral studies, she worked at Patras Scientific Park S.A. in Greece, as external scientific collaborator responsible for the design and implementation of expert systems and decision support systems.

Currently, she is a post-doctoral researcher at KIOS Research Center for Intelligent Systems and Networks in Cyprus, participating in the project "i-Sense", dealing with fault detection, isolation and identification applied in distributed environments.

# Wildfire Smoke Detection using Computational Intelligence Techniques and Synthetic Smoke Clouds Generation

**Fabio Scotti**

Universita' degli Studi di Milano

## **Abstract:**

In this work we propose a method that uses image processing techniques in order to extract distinctive features of the wildfire smoke. Computational intelligence techniques are then used to classify the frames in case of the presence of smoke. The method is designed in order to work with low complexity hardware and to operate on low quality frame sequences. However, it can be very difficult and expensive to obtain frame sequences of the same environments both in normal situations and with the presence of a wildfire to test and train the system. For this reason, we propose a virtual environment for the computation of synthetic smoke frame sequences. The proposed technique simulates distant smoke clouds and integrates them with real environmental frame sequences taking into account the propagation, advection, diffusion, wind, low illumination, fog, and acquisition noise factor. The proposed method is tested by using both real and simulated frame sequences. Results show that the proposed classification method is feasible and obtains accurate results.

## **Biography:**

Fabio Scotti received the Ing. degree in Electronic Engineering in 1998 and the Ph.D. degree in Computer Engineering in 2003 from Politecnico di Milano, Italy. From 2003 he is an Assistant Professor at the Department of Information Technologies, Università degli Studi di Milano, Italy. From 2009 he is the director of the Biometric Systems Laboratory of the Department of Information Technologies, Università degli Studi di Milano, Italy. His research interests include biometric systems, biometric encryption and privacy-compliant biometric templates, contactless biometrics, multimodal biometric systems, signal and image processing, computational intelligence algorithms and related technologies for industrial applications, high-level system design. He published more than 50 papers in international journals and conference proceedings. He is an Associate Editor of the IEEE Transactions on Information Forensics and Security (2010). He served as guest co-editor for the IEEE Transactions on Instrumentation and Measurement (Special Section on Computational Intelligence for Measurement Systems and Applications, and the Special Issue on Biometric Instrumentation and Measurement). He is a reviewer of the following international journals: ACM Computing Surveys; IEEE Transactions on Neural Networks; IEEE Transactions on Instrumentation and Measurement; IEEE Systems Journal; IEEE Transactions on Systems, Man, and Cybernetics. He is Program Chair for the IEEE Biometric Measurements and Systems for Security and Medical Applications (2011) and General co-chair of the IEEE International Conference on Computational Intelligence for Measurement Systems and Applications (2011). He has served as Program co-Chair for the IEEE Workshop on Computational Intelligence in Biometrics and Identity Management (2011), the IEEE International Conference on Computational Intelligence for Measurement Systems and Applications (2006, 2008, 2010).

# Fault Tolerant Target Localization and Tracking in Wireless Sensor Networks Using Binary Data

**Michalis P. Michaelides**  
University of Cyprus

## **Abstract:**

In this talk, we investigate the use of a sensor network for localizing and tracking a moving target using only binary data. Due to the simple nature of the sensor nodes, sensing can be tampered (accidentally or maliciously), resulting in a significant number of sensor nodes reporting erroneous observations. Therefore, it is essential that any event tracking algorithm used in Wireless Sensor Networks (WSNs) exhibits fault tolerant behavior in order to tolerate a number of misbehaving nodes. SNAP (Subtract on Negative Add on Positive), is a simple event localization algorithm that we designed for WSNs applications which exhibits this fault tolerant behavior. Here, we propose to combine the decentralized implementation of SNAP with Kalman Filter techniques for tracking the movements of a target. This efficient tracking procedure provides fairly accurate results and turns out to be fault tolerant even when a large percentage of the sensor nodes report erroneous observations.

## **Biography:**

Michalis has received a PhD from the Department of Electrical and Computer Engineering (ECE), University of Cyprus (2009) and a MSEE (1998) and BSEE (1997) from the School of Electrical and Computer Engineering, Purdue University, West Lafayette, IN, USA. Since 2009, he has been employed as a Research Fellow at the KIOS Research Center for Intelligent Systems and Networks. His research interests include wireless sensor networks, event detection and localization, fault tolerance, fault detection and diagnosis, fault tolerant control, collaborative signal information processing, environmental monitoring, intelligent irrigation systems, intelligent buildings, fuzzy control and machine learning.

## Thermal storage and distributed multi-energy systems: opportunities and challenges

**Pierluigi Mancarella**  
**The University of Manchester**

**The University of Manchester, Department of Electrical and Electronic Engineering,  
M13 9PL, Manchester, UK**

[p.mancarella@manchester.ac.uk](mailto:p.mancarella@manchester.ac.uk)

### **Abstract:**

Future energy systems with increasing penetration of renewable energy sources and inflexible generation will face more and more challenges in terms of balancing supply and demand. In this context, storage is likely to play a key role to support low carbon energy systems development. However, direct electricity storage is often uneconomical so that other forms of storage can be put forward, particularly in a distributed multi-energy system framework. The main objective of the talk is to present the challenges and opportunities related to thermal storage to facilitate the way towards low carbon energy systems. In particular, focus will be put on flexible distributed energy resources and end user technologies that can be dispatched as flexible demand to provide various market and networks services.

### **Biography:**

**Dr Pierluigi Mancarella** received the Ph.D. degree in Electrical Engineering from the Politecnico di Torino, Italy, in 2006. After working as a Research Associate at Imperial College London, UK, he is currently a Lecturer in Sustainable Energy Systems at the University of Manchester, UK, where he also teaches Power System Operation and Economics. His research interests include modelling and analysis of multi-energy systems, impact of electro-thermal technologies on distribution networks, system level integrated analysis of the electricity and heat sectors, sustainable development of energy systems, energy markets, and risk analysis of generation and network investment.

# The Storage Component in Active Distribution Grids

**Mihaela Albu**

“Politehnica” University of Bucharest

## **Abstract:**

Power systems evolve by including new types of generation units (some of them using renewable sources of primary energy), storage, power electronics based energy transfer units and loads with flexible demand. In this context, distribution networks change dramatically in order to accommodate local generation, opening in this way the concept of active distribution grids. A critical element of such distribution networks is the capability of controlling the energy transfer. Optimal solutions include demand side management, prosumers' controllability and energy storage.

Despite a high number of technological available storage applications, the selection of the storage technology is mainly based on availability and price, while the storage technical parameters and circuit design are usually afterwards derived. In order to customize the storage solution one needs an appropriate technical description of the power systems project – for example, system integration of fluctuant generation power of not aggregated DG units. Here, the intermittent nature of the generating capacity together with local grid connection requirements imposes specific operation of the electrical storage capacity, significantly different from that of automotive applications; consequently, the parameters relevant for such operation modes have to be determined. To this, the application case needs to be described by a set of variables derived from the classical power system case descriptors in such a way that this set can be directly related to the storage component. In addition, a comprehensive database including all the available data for storage technologies has to be continuously updated.

The presentation will focus on low power, low energy storage applications developed for distribution systems.

## **Biography:**

Mihaela Albu graduated in 1987 from the Power Engineering Department of the “Politehnica” University of Bucharest (U.P.B.). In 1998 she obtained the PhD from the same university with a thesis on "Electromagnetic Transients on HV Aerial Lines with Application to Digital Distance Protection Design". Since 2002 she is a Professor of Electrical Engineering. Her research interests include active distribution networks, DC grids, power quality, instrumentation, and remote experimentation embedded within on-line laboratories. She is IEEE senior member and volunteers for the IEEE Instrumentation and Measurement Society. Recent publications report work on synchronized measurement units, frequency estimation, algorithms for storage selection and virtual synchronous machines.

# Role of buildings and city quarters in the energy storage problem

**Antonello Monti, Marco Cupelli**

**E.ON Energy Research Center – RWTH Aachen University**

## **Abstract:**

In the light of the EU-2020 targets in reducing CO<sub>2</sub> emissions and after the events of Fukushima, which significantly reduced the role of nuclear power as a CO<sub>2</sub> free energy solution, a growth of renewable energy sources is expected. With the steady rise of these stochastic sources and the decommissioning of old concentrated plants, one of the major challenges is the achievement of the balancing between sources and loads at any time. Main option is energy storage.

While a variety of solutions are technically available such as battery systems, flying wheel storage, pumped hydro plants, CAES power plant, storage has not played traditionally a significant role in electrical systems.

Interesting solutions can also arise from a more holistic approach that combines the electrical grid with the heating and gas grids. In this respect buildings can play a major role. Buildings are already a major player, given that around 40% of the energy consumption is used for heating or cooling, but it could actually also be possible to leverage the existing building stock as thermal storage both through the thermal mass and the installed engineering systems. Main advantage is the decoupling of dynamics between electrical and thermal systems and the possibility to act with very limited economic impact. The presentation discusses a vision of future energy systems in which buildings play a key role in guiding the transformation towards a more decentralized energy management system.

## **Biography:**

Antonello Monti received his M.Sc degree (summa cum laude) and his PhD in Electrical Engineering from Politecnico di Milano, Italy in 1989 and 1994 respectively.

He started his career in Ansaldo Industria in Milano where he was responsible for the development of the digital control of large electrical drives. In 1995 he went back to academia to join Politecnico di Milano as Assistant Professor.

In 2000 he became Associate Professor at the Department of Electrical Engineering of the University of South Carolina (USA). During 2008 he was elevated to the position of Full Professor within the same department.

In the same year he accepted an offer from RWTH Aachen University (Germany) to start and direct the Institute for Automation of Complex Power System within the E.ON Energy Research Center.

Dr. Monti is author or co-author of more than 200 peer-reviewed papers published in international Journals and in the proceedings of International conferences. He is a Senior Member of IEEE and Associate Editor of the IEEE Transactions on Smart Grids and IEEE System Journal.

Marco Cupelli is a research associate in the Institute of Automation of Complex Power Systems at the E.ON Energy Research Center at RWTH Aachen University since 2009. He is received his Dipl. Wirt-Ing Diplom from Technische Universität Darmstadt in 2008 and worked then for a consultancy company. His current research interests include stability issues in distribution networks, microgrids and DC networks.

# Operation of Pumping Storage Facilities in Hydroelectric Plants for Increasing the Wind Penetration in Large and Isolated Power Systems

**Professor E. N. Dialynas**

**National Technical University of Athens**

## **Abstract:**

The integration of generating plants using Renewable Energy Sources (RES), such as wind parks and photovoltaic systems, into electric power systems presents certain technological challenges to system planners and operators. A continuously growing penetration level is being noticed worldwide and it will contribute to the low emission performance of future power systems. However, there are many issues that need to be considered in order to assure the reliable and secure operation of power systems while preserving the financial viability of the respective investment schemes. Additionally, the effective use of wind power generation in systems incorporating high penetration levels has serious limitations.

The purpose of this presentation is to describe computational probabilistic techniques that have been developed for assessing the reliability and operational performance of large and isolated power systems that incorporate increased penetration levels of RES generation as well as pumping storage facilities in hydroelectric power plants. These techniques are based on the Monte – Carlo sequential simulation approach and simulate realistically the stochastic nature of the RES plants and the effective operation of pumping storage facilities. An appropriate set of indices is calculated for quantifying the system performance. A number of alternative case studies are described representing various operational schemes of two typical power systems that are based on the Greek interconnected power system and a system of a Greek island. These schemes include different planning features and operating conditions, such as different criteria for spinning reserve requirements, various wind penetration levels and alternative features of pumping storage facilities. The obtained results of the indices are presented and compared in order to examine their impact on the power system operation.

## **Biography:**

**Evangelos N. Dialynas** received the Diploma in electrical engineering from the National Technical University of Athens (NTUA), Athens, Greece, in 1975 and the M.Sc. and Ph.D. degrees from the University of Manchester Institute of Science and Technology, Manchester, U.K., in 1977 and 1979 respectively. He is presently a Professor in electric power systems at the School of Electrical and Computer Engineering at NTUA, the Director of the Electric Energy Systems Laboratory and the Director of the Postgraduate Studies in “Energy Production and Management”. His research interests are reliability modelling and evaluation, power system probabilistic assessment, power system operation under the competitive electric energy market, impact of high penetration on the reliability and operational performance of interconnected and isolated power systems, power quality indices and computer applications of power systems. As a result of his research activities, he has written more than 70 papers published in international technical journals after review and more than 100 papers presented in various international conferences and published in their proceedings. He is a member of the Technical Chamber of Greece, a senior member of IEEE and a member of IET. He is also a distinguished member of CIGRE and a member of the Administrative Council of CIGRE.

# Degradation Intelligent Monitoring of Hybrid Systems – Flywheel Energy Storage

**Claudia Maria García**

**Universitat Politècnica de Catalunya, UPC Spain**

## **Abstract:**

From older steam engines to the revolutionary hybrid vehicles flywheels has been and is extensive used on automotive, energy recovery systems and other branch of engineering. Flywheel Energy Storage (FES) is composed by a flywheel attached to induction machine (IM); this physical contact to transmit power creates a friction between the rotating parts, under degradation, this friction become more present with the corresponding energy loss, reducing on that way the system performance. Furthermore, friction is the most common incipient fault cause of IM degradation, flowing into the actuator breakdown.

At this presentation an IM test-bed, hardware and software, is explain; some thermo-mechanical accelerated aging test results are shown and a degradation trend is observed. At the aging accelerated test the friction is increase with a resulting increment of the load torque,  $T_L$ .

The system degradation life is modeled as a hybrid automaton, from fully functional to no functionality, based on a Grey-Health Index. The methodology then is, design a simplified adaptive model, for the electric and mechanic part of the IM, to use it for diagnosis and prognosis purpose. To deal with the unknown terms an Error Filtering On-line Learning (EFOL) scheme is used, where  $T_L$  is on-line approximated via a Radial Basis Funtion Neural Network (RBFNN). The principal idea behind this approach is to monitor the plant for any off-nominal system behavior due a wear or degradation.

## **Biography:**

Claudia Maria García was born in Terrassa, Barcelona, Spain in 1984. She holds a Technical Engineering degree specialized in Industrial Electronics (2006), at EUETIT, Universitat Politècnica de Catalunya (UPC), Barcelona, Spain. Degree's Final Project developed in Karel de Grote-Hogeschool (KdG), Antwerp, Belgium. She did An Automatic Control and Industrial Electronics Master Engineering, at ETSEIAT, UPC (2008), graduated with honors for finalizing as first of the promotion. An Automotive Electronic Technology Bachelor degree was developed as European Program (2007-2008) at Glyndwr Univeristy, Whales, UK, with a First award. As Ph.D student she finishes a Master in Automatic Control & Robotics in January 2010, cursing Diagnosis and Fault Tolerant Control lectures and Hybrid System between others. She was chosen to participate on the Doctoral Consortium PHM 2010 with Prognosis and Health Management Society Grant. She also participated on a Short Term Scientific Mission STSM at the KIOS Research Center for Intelligent Systems and Networks at the University of Cyprus (UCY), Nicosia, Cyprus (2010-2011), with COST IC0806 funding. Ph.D student on the theme of PHM applied to maintenance mainly using artificial intelligence techniques. She is a full time researcher at Sistemes Avançats de Control (SAC) research group at UPC in Terrassa, Spain. She is IEEE and CEA Student member.

# I2Sim DR-NEP Simulation Platform for Worldwide Access to Disaster Preparation, Response, and Recovery

**Dr. José R. Martí**  
University of British Columbia

## Abstract:

During large disasters critical infrastructures will suffer structural and lifeline damage that will impede the capability of the system to produce and deliver essential resources (e.g., electricity, water, transportation, hospitals). The availability of these resources and their optimal allocation will have a large impact on lives lost and business recovery. The i2Sim interdependencies simulator, working together in real-time with domain-specific simulators (power system, water network, etc.), is capable of running multiple what-if simulation scenarios and optimize the allocation of available resources to maximize lives saving and optimize business recovery. The Disaster Response Network Enabled Platform (DR-NEP) project, sponsored by Industry Canada through the high-bandwidth CANARIE network, seamlessly binds together multiple centres of simulation and expertise in Canada and abroad to create a Cloud Computing platform that can be accessed by local emergency response communities across the world using a simple web browser interface. The local responders will be able to perform simulation scenarios for disaster preparation, training, real-time response, and system recovery using the sophisticated DR-NEP cloud computing simulation resources and databases of historical disaster simulations and best-practice response strategies.

## Biography:

Dr. José Martí is a Professor in the Department of Electrical and Computer Engineering of the University of British Columbia. He has over 25 years of experience in real time computer simulation of large electrical networks using parallel processing techniques. He received a Masters degree in Electric Power Engineering from Rensselaer Polytechnic Institute in New York and a Ph.D. degree in Electric and Computer Engineering from the University of British Columbia in Vancouver, Canada. He is a registered Professional Engineer in British Columbia, a Fellow of the Institute of Electrical and Electronic Engineers, and a Fellow of the Canadian Academy of Engineering. He is the leader of UBC's Complex Interdependent Systems Simulation Laboratory developing real time simulation tools for optimization and decision support in complex physical and human environments. Current work includes the development of a system of systems simulator that integrates the interdependencies and flow of resources among multiple critical infrastructures (e.g., power system, water system, transportation system, ICT system, etc.). This tool is currently being applied to the development of the DR-NEP platform for world access to effective disaster preparation and real-time response to minimize loss of human lives, and to maximize human and economic systems' recovery.

# Power systems with high wind penetration: A reserve scheduling problem

**Kostas Margellos**

ETH Zurich

## **Abstract:**

In this talk we consider the case of power networks with a significant amount of wind power. A hierarchical structure is proposed, by applying different control techniques at each layer of the hierarchy, starting at the level of single wind turbines and building up to the integration of entire wind farms into the power network. We concentrate on the problem of optimal reserve scheduling from the point of view of the operator of the system. The problem is formulated as a linear program with chance constraints, and a Markov chain-based model is employed for generating realistic wind scenarios. Preliminary results are provided, and the advantages and limitations of the method are highlighted.

## **Biography:**

Kostas Margellos obtained his diploma in electrical and computer engineering from the University of Patras, Greece, in 2008. He then joined the Automatic Control Laboratory at ETH Zurich, Switzerland, where he is currently pursuing the Ph.D degree under the supervision of Prof. John Lygeros.

# **SEE HYDROPOWER, targeted to improve water resource management for a growing renewable energy production**

**Bogdan Popa**

**University Politehnica of Bucharest**

## **Abstract:**

The present work is an outcome of the project “SEE HYDROPOWER, targeted to improve water resource management for a growing renewable energy production”, in the frame of the South-East-Europe Transnational Cooperation Programme, co-funded by the European Regional Development Fund ([www.seehydropower.eu](http://www.seehydropower.eu)).

The project is based on the European Directive on the promotion of Electricity from Renewable Energy Sources in respect to the Kyoto protocol targets, that aims to establish an overall binding target of 20% share of renewable energy sources in energy consumption to be achieved by each Member State, as well as binding national targets by 2020 in line with the overall EU target of 20%. Objectives of the SEE HYDROPOWER deal with the promotion of hydro energy production in SEE countries, by the optimization of water resource exploitation, in a compatible way with other water users following environmental friendly approaches. Therefore, it gives a strong contribution to the integration between the Water Frame and the RES-e Directives.

Main activities of the project concerns the definition of policies, methodologies and tools for a better water & hydropower planning and management; the establishment of common criteria for preserving water bodies; to assess strategies to improve hydropower implementation, such as small hydropower; testing studies in pilot catchments of partner countries; promotion and dissemination of project outcomes among target groups all over the SEE Region countries.

In particular, here is presented the activity *Innovative technologies and informatic tools to assess SHP potential*, in particular the Romanian contribution.

## **Biography:**

1990 - Graduate of University POLITEHNICA of Bucharest (UPB), Faculty of Power Engineering, Hydro Power Engineering Specialization.

2002 - PhD in Power Engineering

Since 2007 - Associate Professor, University POLITEHNICA of Bucharest for: The Department of Hydraulic and Hydraulics Machineries, within Power Engineering Faculty.

## Summary Experience and Skills

Teaching in the field of Hydropower engineering, Water resources management, Renewable Energy Sources - Small Hydropower Plants,

Experience in managing and implementing of projects in the energy sector, Hydropower Plants.

Author and co-author of over 60 scientific papers, 3 books on hydroelectric power plants basics and operation and environment engineering, over 50 contract-based research and design works.

Currently, participation to 2 European projects and responsible for a national project.

## Electricity demand characterisation and flexibilisation

**Gianfranco Chicco**

**Politecnico di Torino, Italy**

### **Abstract:**

The research in progress at Politecnico di Torino (Polito), Italy, is consistent with the IntelliCIS WG2 objective “Refine and apply tools and methodologies from computational intelligence”. In particular, the National Project “Demand flexibilisation” (PRIN 2008ML9KPC\_005, 2010-2012) considers that the introduction of greater flexibility in the electrical system allows several benefits, both in normal operation and in emergency conditions. This flexibility can be achieved by widening control of loads, made technically and economically more attractive by the recent developments of devices developed for building automation and based on power line technology, which require minimal changes to user installations. Enhanced knowledge of the shape of electrical demand patterns is a further key asset to study the potential of demand flexibility. The presentation highlights some aspects concerning the current research at Polito on computational intelligence applied to electricity demand characterisation, as well as electricity demand flexibilisation through load control.

### **Biography:**

GIANFRANCO CHICCO graduated in Electrotechnics Engineering (honors) in 1987 at Politecnico di Torino (PdT), Italy, and obtained the Ph.D. in Electrotechnics Engineering in 1992. His academic career has been developed in the Electric Energy Systems research group at PdT, as Assistant Professor (1995-2002), Associate Professor (2002-2010), and Professor (since 2011). He is the President of the University Academic Planning Council (UACP) in Electrical Engineering at PdT (since 2007). In April-May 1999 he was a Visiting Assistant Professor at the University of Illinois at Urbana-Champaign, Electrical and Computer Engineering Department, Urbana, IL. In 2001-2010 he visited Politehnica University of Bucharest, Valahia University of Targoviste, and Technical University of Iasi (Romania) under the Erasmus/Socrates Staff Exchange Programme.

He has been the scientific responsible and coordinator of projects on energy resource deployment and sustainability, as the National project PRIN 2004094435\_007 "Experimental tests and analysis of the energy production of photovoltaic and wind systems" (PdT research unit, 2004-2006), the project "Territorial sustainability of distributed energy generation and interactions with electroenergetic systems" (funded by the Piemonte Region, 2006-2010), and the scientific co-responsible of the project "Technical, economic and environmental assessment of the scenarios for the diffusion of the distributed generation in the regional territory" (funded by the Fondazione CRT, 2005-2007). He participated in the EU FP6 Project DIGENAS (Distributed Generation in the Associated States - Research Priorities and Challenges on the Open Electricity Market).

He has been the Conference Chairman and Editor of the Proceedings of the Sixth World Energy System Conference (WESC), Torino, Italy, 10-12 July 2006, and a Conference co-Chairman of the next two editions of WESC in Iași, Romania (2008), and Targoviste, Romania (2010). He has been a Technical Committee Member and Conference Session Chairman in many international Conferences.

Since 2011 he is an Associate Editor of the Energy journal (ISSN 0360-0442). He has been the co-Guest Editor of two Special Issues for the journals Energy and Electric Power Systems Research. He is a peer-Reviewer of various international journals published by IEEE, IET, and Elsevier.

His International scientific production includes one books, three book chapters, over 40 journal publications, and over 120 publications in conference proceedings.

He is a Senior Member of the IEEE Power and Energy Society, a Member of the Italian Federation of Electrotechnics, Electronics, Automation, Informatics and Telecommunications (AEIT), and a registered professional Engineer in the Province of Torino, Italy.

## **Hybrid and Wireless monitoring technologies: the PoliMi experience**

**Dr. Antonio Marullo**

**Politecnico di Milano – Dipartimento di Elettronica ed Informazione, Italy**

### **Abstract:**

Hybrid and wireless sensor networks represent the natural technology to be considered for monitoring a large class of critical infrastructures.

In this direction, Politecnico di Milano has developed two monitoring infrastructures (a fully wireless and a hybrid wireless/wired one) to protect critical infrastructures exposed to a rock face collapse. In particular, we introduce and discuss an integrated monitoring system for the Torrioni di Rialba, a rock tower-like limestone complex overlooking an area of strategic importance connecting the Lecco and Como provinces, north Italy. The area covered by the hazard encompasses the presence of a freeway, a railway line and the gas and power distribution pipelines.

### **Biography:**

Dr. Antonio Marullo is a research assistant at the Dipartimento di Elettronica e Informazione at the Politecnico di Milano. He received a laurea degree in computer engineering from the Università di Pisa and a Ph.D. in applied geophysics from the Università di Messina. His main interests are embedded systems, soft computing, automated controls and their application in the geophysics area.

# The problem issues of intelligent monitoring and control of CIS in Latvia

**Anatolijs Zabašta**

Riga Technical University

## **Abstract:**

The field of critical infrastructure interdependency is a new, but rapidly growing area of study with contributions from multiple researchers in various engineering, mathematical and social science disciplines, which is indicated by growing number of research and publications during last year's.

Review of researches and projects implemented in Latvia devoted to monitoring and control of critical infrastructures demonstrates growing interest to this area of research, however pointed out the number of problem issues:

1. The methods of monitoring and control reviewed above are relevant only to particular critical infrastructure thus the impact of critical events occurred in one of CI to the operation of other critical infrastructures is not yet a priority of research.

2. Critical infrastructures of one domain, for example, district heating or water distribution networks are considered as a set of independent autonomous systems, however in reality adjustments in one of the system could cause unexpected deviations in another ones evoking imbalance and even damage.

3. The lack of actual data about the state of CIS, for instance about water flow, pressure, temperature or faulty equipment prevents effective monitoring and control of Latvian CIS.

4. Application of wireless sensor networks for monitoring and control of CIS could notably improve its efficiency by improvement quality of services, minimizing peaks of demand, alerting in case of malfunctioning equipment and providing actual data for load balancing between interdependence systems.

In the view of the growing importance and sophistication of critical infrastructures the further studies on the models and methods for CIS monitoring and control, which are aware dynamic and interdependence of CIS, should be in an agenda for the future research.

## **Biography:**

During 2004-2009 A.Zabašta managed E-Government department at the Secretariat of E-government Affairs of Latvia, which was responsible for coordination of ICT implementation in public governance institutions of Latvia. A.Zabašta was responsible for elaboration of Latvia eGovernment Development Plan 2005-09. He lead a team in 2005-2009 that implemented several projects that resulted in creation he first national public e-services portal [www.latvia.lv](http://www.latvia.lv) and state information systems integrator, which enables to develop first cross institution e-services for business and consumers. Several research studies aiming to identify threats and provide recommendation to secure information systems of public governance institutions was initiated by A.Zabašta. In 2004-09 he was a member of eGovernment working group leading by DG INFSO of European Commission resolving the issues of security of IS, cross border e-services and future technologies for e-government. In 2009 he joined Micro Dators, which provides research and piloting in the field of monitoring and operational management of water distribution systems using ICT tools. In 2009-10 in cooperation with Ventspils High Technology Park he managed a project aiming to make a study of water distribution networks and to recommend a model for monitoring and control of water distribution systems using ICT tools. In 2010-11 together with Ventspils University he participates in the piloting of the model for monitoring and control of water distribution systems in several Latvian regions. A.Zabašta holds MSc degrees in Management Information Systems (in 2000), Business Administration (in 2004) and a primary degree in Telecommunication Engineering. Since 2010 he studies Computerised control of electrical technologies at Riga Technical University, Faculty of Power and Electrical Engineering, Institute of Industrial Electronics and Electrical Engineering with the purpose to obtain PhD degree.