TIMETABLE: SPLITECH2018
PRELIMINARY PROGRAM

IEEE ComSoc

FESB, University of Split, Tuesday, June 26

17:00*	REGISTRATION*

FESB, University of Split, Wednesday, June 27

TIME/HALL	A103	A104	A105
10:00 - 11:30	**S1:** Engineering Modelling – Electrical Engineering	**P1S:** Smart Cities	**P1E:** Energy Efficiency in Buildings
11:30 - 12:00	**Invited talk: Theodoros Theodosiou**, *"Smart and Adaptive Facades for Energy Efficient Buildings"* **(Great Hall)**		
12:00 - 13:00	Lunch		
13:00 - 13:30	**Invited talk: Čedomir Stefanović**, *"5G Use Cases for Vertical Industries"* **(Great Hall)**		
13:30 - 15:00	**S2:** Smart Cities – Networks	**IoT1:** Internet of Things – Hardware and Systems	**P2E:** Energy Modelling and Experiments
15:00 - 15:30	Coffee Break		
15:30 - 17:00	**S3:** Engineering Modelling – Simulations	**IoT: RFID**	**P3E:** Renewable Energy Technologies

FESB, University of Split, Thursday, June 28

TIME/HALL	Great Hall	A102		Small Hall	
09:00 - 10:30	**Round Table Discussion:** Smart and Energy Efficient buildings: Where we are?	**IoT: Presentations and Exhibition (08:30 – 11:00)**	**S4:** Smart Cities – Signal Processing **(Room: A103)**	**GPR Workshop (Room: A104)**	**S5:** E-Health
10:30 - 11:00	Coffee Break				
11:00 - 12:30	**OPENING CEREMONY** **Keynote speeches (A100):** **Hermann Hellwagner**, *"Multi-UAV Systems"* **Agis M. Papadopoulos**, *"Thermal Comfort in Zero Energy Buildings: State of the art and the prospects of personalized assessment"*				
12:30 - 13:30	Lunch				
13:30 - 14:00	**Invited talk: Gaetano Marrocco**, *"Recovery/Expanding Human Senses by Bio-integrated Epidermal RFID"* **(Great Hall)**				
14:00 - 15:30	**Workshop: Meet the Editor (14:00 – 15:00)**	**IoT2:** Internet of Things - Software		**Tutorial:** *Impact of Exposure to Electromagnetic Radiation* **(Room: A104)**	**Round Table Discussion:** RFID in Practice
15:30 - 16:00	Coffee Break				
16:00 - 17:30	**S6:** Energy – Innovations and Modelling	**IoT3:** Internet of Things - Applications		**S7:** Energy – Smart Grids	
18:30	Bus to the City Centre and Guided Tour of Split				
20:45	**Conference Dinner and Cocktails in "Diocletian palace - Cellar"**				

FESB, University of Split, Friday, June 29

TIME/HALL	Great Hall	A104
09:00 – 09:30	**Invited talk: Muslum Arici,** *"CFD Analysis of Melting Process in an Enclosure: Effect of Fin and Nanoparticle on the Melting Rate"* **(Great Hall)**	
09:30 - 11:00	**S8:** Smart Cities – Software	**S9:** Energy Efficiency and Energy Systems
11:00 - 11:30	Coffee Break	
11:30 - 13:00	**Smart City:** Round Table **(Great Hall)**	
13:00	**Lunch and Best Paper Award**	

*Registrations: Tuesday (17:00 – 19:00), Wednesday (09:00 – 17:00), Thursday (07:30 – 11:00, 13:00 – 17:30), Friday (08:30 – 13:00).

PRELIMINARY Program

Wednesday, June 27, 10:00 - 11:30

P1E: Energy Efficiency in Buildings

Co-generation systems and Micro-grids: An option for sustainable urban buildings in the Mediterranean?

Maria Symeonidou (Aristotle University Thessaloniki, Greece); Sandro Nizetic (University of Split, FESB, Croatia); Agis M. Papadopoulos (Aristotle University of Thessaloniki, Greece)

Co-generation has become quite cost-effective over the last years. At the same time, micro-grids enable its integration into urban energy systems in a much more flexible way than only a few years ago. It is therefore reasonable that it has become a popular solution in Northern and Central Europe. Still, it is a different issue to use this technology in the Mediterranean region, where the heating period and heating requirements are smaller. This problem is discussed in this paper, based on the example of residential buildings in Greece. The solutions needed have been considered, to provide not only heat and electricity but also the cooling for an apartment building, hence a tri-generation solution. A mathematical framework was developed to enable the determination of an optimal solution for such a system. Two main case studies have been solved scoping in approaching the energy production for the micro-grid system based either on a Micro-Combined Heat and Power system (Micro-CHP) or on a conventional gas-fired system. Moreover, the fuel of the conventional burners has been diered from natural gas to diesel oil. The results produced have been evaluated comparatively, in order to come up with the most efficient and cost-effective solution. As a result, the Pay-Back Period for a micro-grid co-generation system under varying conditions was elaborated, and the results also indicated the potential for future research and improvement, which will make such systems more appealing.

Experimental analysis of a vegetation wall influence on the building envelope thermal conductivity

Budimir Sudimac and Bratislav Ilic (University of Belgrade, Serbia); Vladimir Muncan and Aleksandar Andjelkovic (University of Novi Sad, Serbia)

The goal of this research is to show potentials of vegetation walls in order to decrease temperature of facade surfaces of buildings during summer. Decreasing these temperatures directly affects coefficient of thermal conductivity of façade elements. The use of vegetation walls in architecture has opened up new possibilities for reducing energy needed for cooling during summer months when the experiment was performed. The research shows the design of a concrete prefabricated, modular model of a vegetation wall which contains plants and its impact on the temperature balance in the building envelope. It is noticeable that vegetative walls covered by plants play an important role in the harmonization of the parameters of the microclimate in relation to the local environment. Methodology presented in this paper was based on analysis of climate characteristics of Belgrade climate zone, experimental measurements of the test model and comparative analysis with the reference wall. During the experiment, the data about external climate parameters and the coefficient of heat transfer through the wall were continuously measured. Also, in order to examine the effect of plant species on the temperature parameters of the green wall, temperature of the wall with different plant species was measured. Data analysis enabled the assessment of the efficiency of thermal insulation of the vegetation wall in the summer period. The distribution of temperature values seen on thermograms of the experimental model showed a fall in temperature in regard to the reference wall, which leads to a decrease in the total energy required for cooling inside the building. Methodology presented in this paper allows quantitative analysis of the effects of vertical greenery.

Thermal bridging problems on advanced cladding systems and smart building facades

Theodoros Theodosiou and Katerina Tsikaloudaki (Aristotle University of Thessaloniki, Greece); Stella Tsoka and Panagiotis Chastas (Aristotle University of Thessa, Greece)

On the way to achieve the demanding energy efficiency targets that adopt and even surpass the requirements of near Zero Energy Buildings, numerous techniques and systems have been proposed and constructed, aiming not only at improving the thermophysical characteristics of the building envelope, but even convert it to a smart, adaptive or energetic, efficient energy system. In many cases, such examples can transform the -until recently- passive building envelope to an energy producer with a variety of energy and environmental advantages. While technological advantages have led to such improved and innovative systems, there are still many factors to be considered before safely adopting such technologies. In this framework, a study on the thermal performance of the structure that supports such systems is performed. While designing an efficient thermal insulation protection can hardly considered as a challenging task following even national relevant regulations, the actual role of thermal bridges, when overcoming common regulation oversimplifications shows than these supporting structures encounter strong thermal insulation inefficiencies. These problems are mainly related to the neglection of point or 3D thermal bridges that might be negligible in most single skin façade buildings, but can have a dominant role in double skin structures, met often in many smart facades.

Indoor Environment Quality and its Impact on Health and Productivity - A Review

Igor Mujan (University of Novi Sad - Faculty of Technical Sciences, Serbia); Aleksandar Andjelkovic and Vladimir Muncan (University of Novi Sad, Serbia)

The purpose of this paper is to review the existing literature and to give the connection between indoor environment quality and its impact on occupant health and productivity in built environment. The study reviews data from books, standards, international SCI journals and conference articles that focus on the main physical factors of indoor environment quality. While the indoor environment quality can be separated in the eight main

factors, the emphasis will be put on the factors that can be influenced actively rather than proactively: thermal comfort, indoor air quality, lighting and noise and their impact on the occupants. The paper provides a concise starting point for future researchers interested in the area of indoor environmental quality, as it presents the comprehensive analysis of main indoor environment quality factors and their impact on building occupant health and productivity.

P1S: Smart Cities

A Study On Drone Forensics

Taiyu Teng (Central Police University, Taiwan)

Most of the concerns of drones revolve around the public and flight safety, but there lacks an interest in studying the forensic analysis of drones. The study found that manufacturers are the key role for the quality control tracking and to meet its legality requirements. Also the general design of the consumer grades the drone flight data recorder is to join its function, and easy to prompt censor when there's a crush or damage for the drone, or for the use of the drone debugging. Therefore the entry point for the drone forensics are the flight recorder that comes with the drone (Black Box) and has been proven a good facts. Because it records all the important information related to the accident that has been occurred and these useful evident may be revealed to the suspect by the police. Therefore, how to speed up the drone's forensics as quick as possible and provide one of the most direct way to access the drone-related recorder is the main thrust of my research. This study is to use forensics software to validate the drone system. Utilizing Android Debug Bridge (ADB) tools and to be popular mobile forensic software - XRY, we study the process of forensic analysis on Parrot Bebop II series' drone. From the PUD file and JSON file, we can get a hold of such data as location, battery, flight time, and more. By analyzing and cross-reference these messages and data, we are able to link the drone to an user's mobile device; thus proving the involvement of the suspect. This research bases its findings on attainable mobile data through XRY software, and we hope this offers a better support and a topic of a discussion for forensic lab technicians.

Human-robot interaction using colored LEDs and custom made hand-held device: a service robot design example

Ivan Madunić (Smart Technologies, Croatia); Josip Music (University of Split, Croatia); Višeslav Čelan (University of Split & Odabir, Croatia); Vladan Papic (University of Split, Croatia)

Robots are becoming ubiquitous, going out from production halls with well defined and structured spaces into unstructured spaces where they have to co-exist with humans. This brings into focus human-robot interaction (HRI), especially in the case of mobile service robots. Any misunderstanding of intents can potentially lead to injury since robots in many cases are large and heavy. Thus, in the paper, an HRI visualization interface for use with in-house built semi-autonomous floor scrubber service robot is presented. To that end, colored and animated LED strips are used. The LED strips can also help to visualize, in real-time, the performance of the algorithm for obstacle avoidance. Additionally, the design and the development of the custom-made hand-held wireless control unit is presented. The unit uses graphical user interface (GUI) for communication with the operator of the service robot. The software is based on Robot Operating System (ROS). The paper presents initial user and developer experiences and discusses obtained results with emphasis on possible improvements in the design.

A Vehicle Driving Adjustment Technique Based on Driving Schedule through the Tunnel in Cyber-physical Running Environment

Min-hwan Ok (Korea Railroad Research Institute, Korea)

Developing a control system for automatic driving vehicles which could drive on the tunnel-way constructed in the form of concatenated tunnels in the similar direction, in near future. A predetermined route is traversed within a bounded traversal time. For fluent and safe vehicle flow in the tunnel-way, the actual automatic driving should be adjusted to the driving schedule. In the driving experiment we adopted a control technique on which vehicle is presupposed as Cyber-Physical System, CPS, for the purpose of automatic driving control. The experiment is conducted along with the simulation. This simulation incorporating the experiment might be an evaluation tool for the central control of vehicles running on the tunnel-way.

A Model of Parents' Technology Health-Awareness Towards a Better Management of a Chronic Diseases in Children and Adolescents

Walaa Barifah (Royal Melbourne Institute of Technology & Taif University, Australia)

Parents require comprehensive information once a child is diagnosed with a chronic disease. There are technologies available that can help parents to manage their children's conditions, but the parent must be aware of the technologies available and then be aware of how to use them. We call this required awareness "Technology Health-Awareness" (THA). THA is required if parents are to do the best for their children especially when the chronic disease has no cure. If the child is dependent on daily medications and/or treatment-technologies the THA is more complex. Information is produced by the ministries of health, allied professionals, medical devices company's producers, chronic diseases associations, profits and non-profits organizations associated in some way with the chronic disease. Parents might also be influenced by dubious sources such as friends, family and the general community. The results of poor THA are continued adverse events associated with all chronic diseases. This study is based on a desire to see the formation of THA from the viewpoint of parents as their child is first diagnosed with a chronic disease. The aim of the study was to produce an evidence-based model of the network of actors that influence the formation of THA in parents. This framework, based on an extensive study of parents of Type 1 Diabetic children, provides a conceptual framework that may apply to many chronic conditions in children. Objectives: To frame a Technology Health-Awareness model (THA model) of parents in managing chronic disease in children. The framework, based on empirical data, should provide a "checklist" of concepts to be considered by those seeking to influence parents and as a research framework for those seeking to understand the gap between information supplied and THA in parents. Methods: The case of Type 1 diabetes was chosen as the case since the technologies, in this case, are extensive, and the role of parents as primary care providers is crucial. Parents of type 1 diabetic children were interviewed. To provide a wide base the countries of Australia and the Kingdom of Saudi Arabia were chosen to broaden the range of types of parents. To provide a triangulation, several types of

professionals were also interviewed with a view to capturing their understanding of the problems of establishing THA from their viewpoint. Transcripts of the interviews were analyzed starting from the assumption that THA is created by interactions with all the actors surrounding them, both professional and personal. This Actor-Network Theory starting point also allowed us to consider interactions with socio-technical actors such as web sources, the equipment itself (is a child trusting of an insulin injecting needle) and the community in which the parent is embedded. Results: The primary human actors were identified (family members, medical system staff, the communities that have been created to support parents) and non-human actors were (diabetes treatment and mentoring devices, informatics source tools and, management information technology). The THA model allows those are attempting to help parents in improving THA to examine each of the actors and the issues of interaction in a systematic way. The study found several areas in which critical issues appeared due to poor uptake of information or the existence of actor interactions producing incorrect understandings.

S1: Engineering Modelling - Electrical Engineering

Influence of Environmental Stresses on High Voltage Polymer Rod Type Insulator Performances

Mirza Batalović (Faculty of Electrical Engineering, Bosnia and Herzegovina)

The main goal of this paper is to investigate the effects of environmental stresses on high voltage polymer insulators regarding electric field distribution. For that purpose simulations were carried out, using contemporary software tool COMSOL Mph, for polymer rod type insulator operating under polluted conditions and with presence of water droplets. Simulations were performed for clean insulator, with uniformly deposited contamination layer, with presence of dry band location and presence of water in the form of droplets on the hydrophobic surface of insulator. In order to simulate different types of pollution, the pollution layer is modeled as a conductive layer for different values of its conductivity. The results provided in this paper point out critical spots on the insulator due to the environmental stresses and as such they provide deeper understanding of polymer insulators performances under different polluted conditions from the surrounding ambient.

Analysis of Transformer Health Index Using Bayesian Statistical Models

Petar Sarajcev (University of Split, Croatia); Damir Jakus (University of Split & Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Croatia); Josip Vasilj and Matej Nikolic (University of Split, Croatia)

Health index (HI) is a very useful tool for representing the overall health of a complex asset, such as the power transformer, due to the fact that it quantifies equipment condition based on different criteria that are related to the long-term degradation factors that cumulatively lead to the asset's end-of-life. The main concern with HI computation is with the practical management of the numerous criteria that are combined in different ways (with proprietary information and associated weighting factors) to produce a HI value. Hence, several authors have proposed different approaches to the HI calculation, e.g., analytical expressions, logistic regression, fuzzy logic, support vector machines, and artificial neural networks. This paper proposes using Bayesian multinomial logistic regression for the HI calculation. This approach offers high flexibility with multiple metric and/or nominal predictors, including correlation and interaction between predictors, and acknowledges the fact that the transformer HI is described with three to five categories. It further offers high model interpretability and benefits from the Bayesian ability to quantize uncertainty in model parameters.

Real-Time Loss Calculation of a Hysteresis Controlled Power Converter

Mateo Bašić (University of Split, FESB, Croatia); Dinko Vukadinović (Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Croatia); Ivan Grgić (University of Split, Croatia)

This paper presents an algorithm for real-time calculation of losses of a hysteresis controlled power converter. The converter under consideration is a standard three-phase bridge converter, consisting of six insulated-gate bipolar transistors (IGBTs) and free-wheeling diodes. It is here utilized for vector control of a self-excited induction generator. The vector control algorithm requires measurement of two phase currents, rotor speed, and dc-link voltage. Application of the loss-calculation algorithm, on the other hand, requires knowledge of the dc-link voltage, one of the phase currents and IGBT switching signals. Hence, all three required inputs are already available, so no additional sensors need to be installed in order to implement the loss-calculation algorithm. The proposed algorithm allows the power converter losses to be determined both by type (switching/conduction losses) and device (IGBT/diode losses), thus enabling a more detailed loss analysis. In this paper, the power converter losses are determined over reasonably wide ranges of dc-link voltage and phase current values, and subsequently validated by comparison with the measured values.

Novel Dynamic Model of Photovoltaic Module

Ivan Grgić and Tihomir Betti (University of Split, Croatia); Ivan Marasović (University, Croatia); Dinko Vukadinović (Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Croatia); Mateo Bašić (University of Split, FESB, Croatia)

This paper presents a novel dynamic model of a photovoltaic (PV) module. The two-diode model of a PV module is upgraded with the diodes' parasitic diffusion and junction capacitances, which are, in turn, modeled as variable parameters. The experimental I-V static characteristics were measured for the monocrystalline PV module, at three different stages of a day. The measured characteristics were compared with the commonly used single-diode and two-diode models of the PV module. The simulation model of the proposed PV model was built in the MATLAB Simulink environment using basic Simulink blocks. Influence of the solar irradiation and the temperature on the parasitic capacitances is shown. Also, dynamic behavior of the PV module is analyzed in simulations.

Simulation of Human Body Exposure to High and Low Frequency Wireless Power Transfer Systems using Simplified Models

Maja Škiljo (University of Split, Croatia)

In this paper, human body exposure to high frequency (HF) electromagnetic field is analyzed. Antennas and wireless power transfer (WPT) systems are numerically modelled using commercial software FEKO, based on Method of Moments (MoM). The analysis is carried out for two simplified models of human body (parallelepiped and cylinder model) exposed to HF radiation in terms of power transfer efficiency (PTE) and specific absorption rate (SAR) at frequencies of 13.56 MHz, 6.78 MHz and 100 kHz. It is shown that the SAR in simplified human body model does not exceed the reference limit values prescribed by international guidelines, both for the general, and for the professional population. Used simplified models are validated by comparison with realistic human body model results at 13.56 MHz from literature.

Simplified Analysis of the Thin Wire Near Field

Dragan Poljak (University of Split, Croatia)

The paper deals with a simple analytical approach to determine the antenna parameters pertaining to near field zone, such as imaginary part of Poynting vector or the reactive power stored in the thin wire near field. The reactive power is obtained from the Poynting theorem in the complex phasor form. Simple closed form expressions for the electric and magnetic fields in the near field zone are used. An approximate sinusoidal form of the current distribution along the dipole is assumed.

Wednesday, June 27, 13:30 - 15:00

IoT1: Internet of Things - Hardware and Systems

Unobtrusive Detection of Home Appliance's Usage for Elderly Monitoring

Jochen Meis (GeoMObile, Germany); Luigi Patrono and Piercosimo Rametta (University of Salento, Italy)

Many elderly people spend a lot of time in their homes, doing simple or complex activities that often involve the usage with electrical devices and appliances. Therefore, detecting how elderly people interact with domestic electrical appliances, is an important parameter to assess potential Mild Cognitive Impairments and frailty issues. This paper proposes an innovative approach for monitoring elderly behavior by detecting home appliance's usage. It is based on an unobtrusive smart meter that constantly measures the global power consumption in the house, supported with some smart plugs for monitoring specific electrical devices. This infrastructure has been implemented and validated within the H2020 City4Age Project.

A Flexible IoT Energy Monitoring Solution

Danielly Avancini and Simion Martins (National Institute of Telecommunications (INATEL), Brazil); Ricardo Rabelo (Federal University of Piaui (UFPI), Brazil); Petar Šolić (University of Split & FESB, Croatia); Joel J. P. C. Rodrigues (National Institute of Telecommunications (Inatel), Brazil & Instituto de Telecomunicações, Portugal)

Energy management is a current major concern due to several reasons. Increasing energy consumption brought new challenges to energy networks, leading their development towards an intelligent direction with the advent of smart meters. Intelligence in energy systems provides results in many heterogeneous applications taking advantage from IoT, such as energy delivery efficiency, reliability, and fault recovery. Energy in smart environments is an important research topic of IoT since energy efficiency is vital for the environment and global sustainability. Smart meters create the basis for intelligent energy networks, providing real-time information regarding quality and usage of appliances, data consumption, and energy flow information. Besides, the use of an energy management system, capable for collecting data from distinct sensors, generate various reports using collected data, and perform alarm reports based on data analysis, is a need for both consumers and suppliers. The authors proposed, designed, and implemented a cost effective three phase smart energy meter, IoT enabled, multi-protocol and modular, capable to collect, process, and transmit several electric energy related information, mainly focused on consumer-side, to any smart energy control system. It is also proposed the use of a specific software platform to manage collected information, performing data analysis and post-processing. The proposed platform is client-server based, expandable, and future-proof, allowing further integration.

A multi-source energy harvesting sensory glove electronic architecture

Vincenzo Stornelli, Alfiero Leoni and Giuseppe Ferri (University of L'Aquila, Italy); Vito Errico (University of Rome "Tor Vergata", Italy); Mariachiara Ricci and Antonio Pallotti (University of Rome Tor Vergata, Italy); Giovanni Saggio (University of Tor Vergata, Rome, Italy)

We present a multi-source energy harvesting architecture, aimed to enhancing the battery last in powering the electronics of a sensory glove, capable to sense fingers movements. In particular, the proposed architecture is based on Radio Frequency, Piezoelectric and Thermoelectric harvesters. The glove is equipped with flex sensors and built-in electronics which includes a microcontroller and a transmitter. The overall harvesting system was built and tested as a prototype discrete element board, that is interfaced with an external microcontroller and a radiofrequency transmitter board. Measurement results demonstrated a meaningful improvement in battery operation life time up to 22%, considering different operating scenarios.

A Microservices-based IoT Monitoring System to improve the Safety in Public Buildings

Marina Mongiello (Politecnico di Bari, Italy); Francesco Nocera and Angelo Parchitelli (Politecnico of Bari, Italy); Luigi Patrono and Piercosimo Rametta (University of Salento, Italy); Luca Riccardi and Leonardo Avena (Politecnico of Bari, Italy)

Safety of public buildings' users is an important issue, especially in buildings frequented by a great number of people. In such places, in case of an emergency, like a fire, rescue workers must intervene in a timely manner, directing their efforts towards places where there are people to be saved. This work presents an Internet of Things (IoT)-based framework, aiming at monitoring environmental parameters in order to support rescuers during emergencies. The microservices paradigm allows a pattern-based specification of system components that are

refined and adapted on-the-fly depending on the specific execution context, based on the changing aspects such as, user's need and requirements, context variables, user's behavior, sensor data. First results related to the validation of the proposed system mainly concerning nonfunctional requirements of the implemented system through a proof-of-concept are reported and discussed.

Intelligent application for monitoring the pantograph-catenary contact in electric railway transportation

Stela Rusu-Anghel (Politehnica University of Timisoara, Romania); Manuela Panoiu and Cristian Abrudean (Polytechnic University of Timisoara, Romania)

This paper presents an intelligent software application implemented in order to easily diagnose the contact line characteristics in electric railway transportation. This application acquires data from a data acquisition system mounted on the upper part of the inspection locomotive. The software application offer information about the vertical distance between the upper part of the inspection car and the pantograph contact with the contact wire, zigzag movement, temperature and humidity according to the GPS coordinates of the moving train. The intelligent software application will be used to make decisions about urgent interventions as well as to predict the future evolution of contact line parameters. The time variation of the vertical distance between the upper part of the inspection locomotive and the pantograph contact is used to determine the contact force exerted by the pantograph on the LC. This distance offer information about the contact force between the pantograph and line contact using a high pass numerical filter with 2 Hz cutoff frequency

A New VCII Based Low-Power Low-Voltage Front-end for Silicon Photomultipliers

Leonardo Pantoli (University of Laquila, Italy); Gianluca Barile and Alfiero Leoni (University of L'Aquila, Italy); Leila Safari (Iran University Of Science and Tech (IUST), Iran); Vincenzo Stornelli (University of L'Aquila, Italy)

This work shows a new low-power and low-voltage solution for the processing of the electrical signal incoming from Silicon Photomultipliers, that are an emerging technology for physical applications. The electronic front end here proposed is based on a so-called voltage conveyor. It has been conceived to be completely integrated as a monolithic standard CMOS technology. The power consumption of the proposed solution is 700 µW being able to manage incoming pulses as short as 30 ns providing also a variable transimpedance gain up to 86 dB with an equivalent input noise of 7 nV/$\sqrt{}$Hz.

A beam steering transmitter prototype for IoT communications

Giulio D'Amato, Gianfranco Avitabile and Giuseppe Coviello (Politecnico di Bari, Italy); Claudio Talarico (Gonzaga University, USA)

This paper discusses the design, implementation and evaluation of a phased array transmitter for Internet of Things communications based on the LO phase shifting approach. The proposed architecture is made up of a four channel LO synthesizer, an RF frontend module and a linear array of patch antennas. The LO synthesizer is based on a revised DDS-PLL architecture, is centered at 2.453-GHz and implements mutual phase shifts among its output channels in the [0°; 360°] range with an 8-bit resolution. The RF frontend module performs the IF signal up-conversion (at 3.350-GHz) and all signal conditioning operations required to drive the antennas. Actual measurements are reported at block- and system- level.

P2E: Energy Modelling and Experiments

Evaluation of the water cycle determined with atmospheric energy balance for the purpose of surface fluxes monitoring

Monika Birylo (University of Warmia and Mazury in Olsztyn, Poland)

In the paper the author is presenting variability of the atmospheric energy balance and its impact on the surface fluxes observations. For this purpose, the following models were recomputed: the Global Land Assimilation System (GLDAS), The Modern-Era Retrospective analysis for Research and Applications version 2 (MERRA-2), Standardized Precipitation Evapotranspiration Index (SPEI). The atmospheric energy balance values are then compared to the total water storage using the Gravity Recovery and Climate Experiment (GRACE). The atmospheric energy balance and TWS (surface plus ground) changes were computed for the period 01.2006 to 12.2010. The time-series comparisons show a good agreement between the GLDAS, MERRA-2 and SPEI models

Laboratory investigation of the market available biomass pellet fuels for residential applications: A Croatian case

Sandro Nizetic (University of Split, FESB, Croatia); Gojmir Radica (University of Split, Croatia); Vlasta Zanki (HEP ESCO doo, Croatia); Branimir Lela (University of Split, Croatia)

This paper reports results related to the laboratory investigation of the different samples of the pellet fuels that can be found on the Croatian pellet market (primarily mix of beech and fir, and A2 quality class). Three different pellet samples were examined in laboratory conditions and analysis was conducted in the certified laboratory. General characteristics of the examined pellet fuels, as well as metal analysis of the pellet samples were reported and discussed. Gained laboratory results showed that examined pellet fuels were in accordance to the standards where net heat calorific value ranged from 17.15 MJ/kg to 17.78 MJ/kg with moisture content ranged from 3.4% to 8.2%. The ash content was elevated in the two samples in range from 16% to 25%, when compared to the maximal allowed amount by standards. One pellet sample had significantly increased amount of the aluminium when compared to the other samples for a factor 2.3 to 3.8 (increased amount was also found for iron, lead and silicon). In one sample the sulphur and ash content was found to be increased when compared with declared maximal values by pellet producer. Obtained results directed to the general importance of the more frequent quality control of the pellet fuels.

Measurement of Proton Concentration in PEM by Hall Effect

Ivan Poljak and Paško Županović (University of Split, Croatia); Frano Barbir (University of Split, FESB, Croatia)
A method based on Hall effect is applied to measure proton concentration in polymer electrolyte membrane. Although Hall effect is present in any kind of charge carriers, due to the fact that electrons are the charge carriers in any electronic device, only Hall voltage of electron systems can be measured. In this paper we show how Hall effect induces voltage on proton system in polymer electrolyte membrane of fuel cell of the same magnitude as in the electron system. In this way it is possible to determine essential microscopic properties of the proton system in the polymer electrolyte membrane, such as proton concentration and mobility.

Statistical Approach in Analyzing of Advanced Metering Data in Distribution Grid

Ivan Ramljak (JP Elektroprivreda HZHB dd Mostar, Bosnia and Herzegovina); Drago Bago (Elektroprivreda HZHB, Bosnia and Herzegovina)
In last period many distribution system operators (DSO) invest significant amount of money in smart metering system. Those investments are in part due to regulatory obligations and in part due to needs of DSO for knowledge about electric energy consumption. Term electric energy consumption refers not only on real consumption of electric energy but also on data about peak power, unbalance, voltage profiles, power losses etc. Data which DSO can have depends on type of smart metering system. Further, smart meters as source of data can be implemented in transformer stations (TS) MV/LV and in LV grid at consumer level. As amount of smart meters is greater, the possibility of data analysis is greater. In this paper will be presented a smart metering system of Electric power utility company, Mostar, Bosnia and Herzegovina. One statistical approach will be presented for analyzing of advanced metering data at TS MV/LV. Statistical approach presented here is powerful tool for analyzing great amount of data from distribution grid in simple way. Results obtained from statistical analysis can be implemented in distribution grid analyzing and in maintenance and investment planning.

An Energy Efficiency Tool For Steel Forging Industry

Ozlem Kara (University of Yalova, Turkey); Umit Unver (Yalova University, Turkey)
In this study, starting from energy audit of a steel forging company, the minimum energy consuming production route was determined. The method used in the study can be accepted as the continuation of the universal production process approach. This approach says that every facility manufacturing industry and even every facility in the service industry can be presented in the universal matrix of production processes. Thus, the developed algorithm represents a novel algorithm focusing on to the finding the best energy efficient production route. The result of the study showed that considering energy efficiency during production planning has vital importance.

S2: Smart Cities - Networks

Computational Modeling and Simulation of Dynamic Communication Network Resource Allocations in Excel

Edward Chandler (Milwaukee School of Engineering & ARP & Associates, Inc., USA); Andreas Pappas (ARP & Associates, Inc., USA)
A simulation tool has been developed to simulate the operation and performance of demand-assigned communication networks having time-varying data traffic patterns. Such networks use protocols to increase and decrease the bandwidth allocated to a user as the resource needs change. These bandwidth-allocation protocols are typically based on either queue sizes or data traffic generation rates when additional bandwidth is needed, and based on unused resources when excess bandwidth is available and can be released. The protocols have parameters such as numerical thresholds for requesting or releasing bandwidth. The determination of optimum values for such parameters is often assisted by simulations. Simulations would be possible using several commercially available simulation tools. However, the simulation tool presented here is a simple tool easily programmed into an Excel spreadsheet. The tool has three sections, one that generates network data messages having controllable random message-generation characteristics, a second section that processes the network-terminal data-transmission decisions using a queue that that emulates the queue processing done within the actual network-terminals, and a third section that executes the bandwidth-allocation protocol within the terminal. The simulator allows control of the bandwidth-allocation protocol parameter values for optimization. The overall design of the simulation tool is described, as is each of the three sections of the simulator. The simulator allows examination of how responsive the protocols are to changes in network traffic, and can track messages that are discarded due to being queued an excessively long time. Examples are included to illustrate the effects on performance metrics when parameter values for the bandwidth-allocation protocol are adjusted.

A Genetic Algorithm for Planning WAMS with a Heterogeneous Communication Network

Halil Alper Tokel, Gholamreza Alirezaei and Rudolf Mathar (RWTH Aachen University, Germany)
The optimal deployment of phasor measurement units(PMUs) and the required communication network topology remains still an open problem. The experiences in PMU deployments so far show that not only the hardware costs but also the cost of the communication network deployment and commissioning is a major driving cost factor. In this work, we, first, present an optimization model which enables the comprehensive integrated planning of a wide-area measurement system, including the optimal locations of measurement units, the optimal locations of phasor data concentrators, and the required optimal communication network topology with possibly multiple communication technologies in a joint optimization framework. Furthermore, a genetic algorithm is presented, which utilizes problem-specific genetic operators and have optimally solved problems with up to 5,000 binary optimization variables and up to 85,000 constraints. The proposed algorithm provides a basis for further development for finding near-optimal or optimal solutions for very large problem instances. The contribution in this work enables operators of distribution and transmission systems to analyze offers from several telecommunication providers for having a better understanding of possible deployment strategies.

Improving quality of multimedia transmissions via dropping functions

Andrzej Chydzinski (Silesian University of Technology, Poland)
Packet loss is one of the main reasons of deterioration of real-time multimedia transmissions in today's Internet.

This deterioration is especially severe, when several losses occur in a row, one after another. In this paper, it is shown how an application of the active queue management, based on the dropping function, may prevent losses from grouping together. A realistic model for the TCP traffic, incorporating the batch arrivals, is used, with several different shapes of dropping functions.

Impact of Shared LTE Network High Typical Traffic Loads on Smart Grid Demand Response Schemes

Juho Markkula (University of Oulu, Finland); Jussi P Haapola (Centre for Wireless Communications, University of Oulu, Finland)

The paper conducts an evaluation of traffic volumes, delivery ratios, and delays of various traffic types, including smart grid (SG) demand response (DR) communications, when an LTE macrocell network capacity is exceeded by an increased amount of typical traffic types (Skype video call, FTP, Yotube video stream, and HTTP). The communications performances are investigated also when quality of service (QoS) of some SG DR traffic components are kept below the QoS classes of typical traffics. DR programs and their management attain higher importance as distributed energy generation becomes more popular in households due to reducing prices of small-scale renewable energy generation equipment. The use of public telecommunications infrastructure is a good candidate for enabling DR communications over SGs, but the LTE network become excessively congested during peak hours and the SG DR traffic delivery can be degraded. The results show that the SG DR traffics can be delivered, maintaining satisfactory communications performances also in a highly loaded network conditions when the capacity of the network is clearly exceeded. The QoS class of SG DR traffics transmitted in downlink direction can even be considered to be lowered below the QoS of typical traffics.

How to build Controller Area Network Communication Test Environment using NVIDIA TX2 for Unmanned Aerial Vehicle

Jeong-Hwan Lee (ETRI, Korea)

In environments where there are many mission computers on the Unmanned Aerial Vehicle, there is a need for a network that ensures communication between mission computers and stable communication with the flight controller computer. In this paper, we describe how to build a Controller Area Network communications test environment for Unmanned Aerial Vehicle that uses NVIDIA TX2 board and AUVIDEA J90 carrier board to reduce wiring costs, hardware complexity, and weight.

S3: Engineering Modelling - Simulations

Dynamic analysis of elastic pendulum with slider

Damir Sedlar, Ivan Tomac and Petar Latinac (University of Split, Croatia)

The dynamic behaviour of constrained flexible multibody system was investigated. The Hamilton's principle is applied to obtain equation of motion. The equation of motion is augmented with penalty coefficient and Lagrange multiplier to put the problem in the equivalent unconstrained form. The dynamic response of the obtained system was gotten using Newmark integration method incorporated with Newton-Raphson iterative method.

Refined RBF-FD solution of linear elasticity problem

Jure Slak and Gregor Kosec (Jožef Stefan Institute, Slovenia)

Solving PDEs with Radial Basis Functions, especially using local approaches, has become a promising alternative to the Finite Element Method. This paper describes one such approach, a local RBF-FD method, analogous to Finite Difference Method, that can handle irregular geometries, varying discretization densities and is easy to implement. RBF-FD method is analysed by solving basic linear elasticity problems using uniform and refined discretizations. Finally, a linear elasticity problem arising from analysis of fretting fatigue is solved and RBF-FD solution is compared to existing solutions, obtained using commercial software.

CFD Simulation for the Knock Analysis in the Internal Combustion Engine

Gojmir Radica (University of Split, Croatia); Dino Dodig (Engineer, Croatia); Toni Šantić and Nikola Matulic (University of Split FESB, Croatia)

The novel approach to the IC engine modelling are established and performed while modelling a motorcycle spark ignited gasoline engine for knocking prediction. Model is developed and simulated within multi-disciplinary software solution and the most important engine parameters were optimized: compression ratio, intake valve closing angle, combustion beginning angle and inlet pressure. The boundary conditions were determined for advanced combustion and gas exchange analysis within the 3D CFD. The combustion chamber geometry has been obtained by 3D optical scanning method of the mentioned engine and then further processed via 3D CAD software. Simulation domain and mesh generations are executed through AVL FIRE ESE Engine module. Knock prediction capable combustion models were used within 3D CFD simulations. Results of 0D and 3D CFD simulations have been elaborated and compared respectively.

Wednesday, June 27, 15:30 - 17:00

IoTRFID: IoT: RFID

RFID Tag localization with UGV in retail applications

Andrea Motroni, Alice Buffi and Paolo Nepa (University of Pisa, Italy); Paolo Tripicchio and Matteo Unetti (Scuola Superiore Sant'Anna, Italy)

This paper presents the application of the phase-based SARFID technique to locate static tags through an

Unmanned Grounded Vehicle (UGV) equipped with a UHF-RFID reader. The UGV is remote-controlled to move inside a complex indoor environment and the knowledge of its trajectory is achieved through a Simultaneous Localization and Mapping (SLAM) procedure. The bi-dimensional tag position can be estimated with a location error up to centimeter order if the phase samples are collected in a proper spatial interval. Differently from other localization techniques, neither reference tags (anchor tags), nor large phased array antennas are required.

Reduction of Power-Discretization Effects in UHF RFID Tag Performance Estimation Systems based on Off-the-Shelf Programmable Readers

Riccardo Colella and Luca Catarinucci (University of Salento, Italy)

The rigorous electromagnetic characterization of passive UHF radio-frequency identification (RFID) tags is a challenging task. Among various solutions, in a previous work an automatic tool for the over-the-air evaluation of significant RFID tags metrics has been presented. Once fixed the distance, the system, based on the estimation of the minimum power emitted by the interrogating reader capable to energize the tag under test, has an accuracy that, although adequate, is limited by the minimum power step at the reader side. In this work, a new platform implementing a smart method to overcome this limit while preserving flexibility and cost-effectiveness, is presented, implemented and tested. The platform can automatically vary with continuity the interrogating distance —which becomes hence a new degree of freedom— and it is able to estimate for each frequency the couple power-distance which annuls the estimation error due to the discrete variability of the reader emitted power.

Sensing-oriented RFID tag Response in High Temperature Conditions

Cecilia Occhiuzzi (RADIO6ENSE srl & University of Roma "Tor Vergata", Italy); Sara Amendola (RADIO6ENSE S.r.l.); Simone Nappi (RADIO6ENSE S.r.l. and University of Roma "Tor Vergata"); Nicola D'Uva (RADIO6ENSE srl, Italy); Gaetano Marrocco (RADIO6ENSE S.r.l. and University of Roma "Tor Vergata")

Sensing and communication performances of RFID tags subjected to high temperature stress are here experimentally investigated with the aim of assessing the effective operability of conventional RFID technology in Industry 4.0 scenarios. Three popular microchips embedded into dipole tags have been tested. Results suggest that while the maximum communication ranges sensibly reduce as the temperature increases, the temperature measurements returned by the RFID on-chip sensors look rather robust up to 110°C and even up to 130°C provided that a linear calibration is applied. However, in case of external sensors connected to the IC, the response curve becomes non-linear thus lowering the maximum operative temperature and a more complex correction is required.

Compact In-metal UHF RFID Tag for Manufactured Metallic Components

Vittorio Franchina, Andrea Michel and Paolo Nepa (University of Pisa, Italy); Alfredo Salvatore (Sensor ID, Italy)

In this paper, a low-profile in-metal UHF RFID tag for identification of metallic objects is described. The radiating element is printed on a 23×23×1 mm3 copper-clad Alumina (Al2O3) substrate and consists of two rectangular Planar Inverted-F Antennas (PIFAs). Several vias have been introduced to reduce the effect of the lateral metal walls when the tag is embedded in cavities created in a metallic pieces. The entire structure has been optimized by taking into account the presence of a thin sheet of commercial epoxy resin used to keep the tag embedded into metallic cavities. Numerical results are here presented and discussed. Also, preliminary experimental results are shown in terms of reading range.

Application of the Pseudo-BAP mode to a 3D-Printed Wearable UHF RFID Tag with Sensing Capabilities

Riccardo Colella and Luca Catarinucci (University of Salento, Italy)

In body-centric RFID-based applications the possibility to retrieve sensor data from RFID tags in a passive and standard way is crucial. In this work, a new fully Gen2-compliant design strategy to get the sensor data from a specific RFID chip, called "Pseudo-BAP mode", has been implemented. Based on the use of a well-defined reader commands and on a specific circuit optimizing the energy management on board the RFID chip the Pseudo-BAP mode has been applied on a wearable sensor tag realized in 3D printing technology on Poly-lactic Acid (PLA) substrates. The electromagnetic performance of the 3D-printed structure joint to the flexibility of the proposed "Pseudo-BAP mode" in retrieving the sensed data demonstrate the effectiveness of the proposed approach in realizing battery-less RFID-based wearable devices.

Breath-monitoring by means of Epidermal Temperature RFID Sensors

Cecilia Occhiuzzi (RADIO6ENSE srl & University of Roma "Tor Vergata", Italy); Maria Cristina Caccami (University of Rome "Tor Vergata", Italy); Sara Amendola (RADIO6ENSE S.r.l.); Gaetano Marrocco (RADIO6ENSE S.r.l. and University of Roma "Tor Vergata")

Human breathing reveals many information about the health status and its monitoring is a recognized powerful tool to support diagnosis of respiration deficits and even of cardiovascular pathologies. This paper proposes a wireless tech- nology based on sensor-oriented Radiofrequency Identification skin antennas that is promising for a seamless and comfortable monitoring of the breath. Three different epidermal sensors in the form of shaped dipoles/loops suitable for placement onto the nose, the upper lips as well as on the chin are experimented. The measured physical parameter is the temperature of the air flux that is correlated to the inhalation and exhalation rhythm and depth. Twenty volunteers enrolled into a small experimental campaign were asked to produce both normal and anomalous breathing profiles. Results clearly demonstrate that the proposed RFID system is able to identify the occurrence of apnea events.

P3E: Renewable Energy Technologies

A comparison among hybrid PV/T, PV and ST plants in a residential building facility

Antonio Gagliano (University of Catania & Italy, Italy); Giuseppe Marco Tina and Stefano Aneli (University of Catania, Italy); Sandro Nizetic (University of Split, FESB, Croatia)

The energy needs of buildings consists of both thermal energy and electricity that may be satisfied by renewable energy sources. In buildings with ambitious energy targets or limited available areas for local energy generation, solar thermal and photovoltaic plants could eventually compete among them to find necessary surfaces. A technology able to simultaneously satisfy the electric and thermal production is given by PV/T modules, which allow a higher conversion rate of the absorbed solar radiation than standard PV modules. In this paper, a comparison between separate photovoltaic and solar thermal systems (PV-ST) and hybrid photovoltaic thermal system (PV/T) is showed. The study is carried out having as target a residential unit located in the city of Catania, just in the center of the Mediterranean area. The performance analysis show that when there is a scarceness of available surface the PV/T system produces about 34.0% more energy than the separate systems which take up the same surface. Moreover, it was observed that to split the surface take up by ST or PV modules, when the percentage allocated to the ST module between 20 to 60%, does not give important differences in terms of global energy produced

Effect of nanoparticle-enhanced phase change material on efficiency of photovoltaic system: A numerical investigation

Muslum Arici and Feyza Bilgin (Kocaeli University, Turkey); Sandro Nizetic (University of Split, FESB, Croatia); Agis M. Papadopoulos (Aristotle University of Thessaloniki, Greece)

The nanoparticle-enhanced phase change material (NEPCM) has a good potential for improving the energy conversion efficiency of photovoltaic (PV) system by increasing the thermal conductivity of phase change material. In this paper, a photovoltaic panel coupled with nanoparticle-enhanced phase change material (PV-NEPCM) was numerically investigated considering different PCM melting temperatures (ranging from 5 to 50°C with 1°C intervals), PCM layer thicknesses the range of 1-50 mm with 1 mm intervals) and nanoparticle volume fractions (1%, 3% and 5%). Measured monthly-averaged climatic data for Ankara was used to analyze the effect of investigated parameters on the conversion efficiency, cell temperature and electricity output of PV-NEPCM system. The results showed that the combination which provides the highest improvement (1.72%) is NEPCM with PCM melting temperature of 20oC, PCM thickness of 50 mm and nanoparticle volume fraction of 5%. The total annual electricity output of PV panel, 9585 Wh/m2year, can be increased to 9750 Wh/m2year by incorporating NEPCM with optimized parameter.

Efficiency improvement of the photovoltaic energy conversion by application of the fins: An overview

Hrvoje Dedić-Jandrek (University of Split & Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Croatia); Sandro Nizetic (University of Split, FESB, Croatia)

One of the main issues related to the commercial available siliceous based photovoltaic technologies is efficiency degradation due to elevated operating temperatures. Improvement of the photovoltaic (PV) energy conversion can be obtained with application of the passive or active cooling techniques. This paper contains and overview and current status of the efficiency improvement in the case of the passive cooled PV panels. Considered passive cooling technique assumes aluminium fins that are positioned on the back side surface of the PV panel and that can enhance heat transfer from the backside surface to surroundings. Through this research it was concluded that passive cooling, using the aluminium fins, can ensure increase in the PV panel performance, as well as reasonable decrease of the PV panel operating temperature. Basically, an average difference in the electrical efficiency between the passive cooled and non-called PV panel is about 2%. In any case a fins based passive cooling has better performance then stand-alone PV panel, but further improvement of the proposed cooling techniques is needed to become more effective as well as more economically viable.

Pros and Cons of Policies for Residential On-grid Solar PV Installation in the Philippines

Ana Paula Farias Rocha, Griselda Adilene Sanchez Cubedo, Jesselyn Rochelle Malimata and Karim Hassan (IMT Atlantique Nantes, France); Luis Rojas-Solórzano (School of Engineering, Nazarbayev University, Kazakhstan)

The Philippines' growing economy is supported by new sources of energy. In particular, feed-in-tariff (FIT) and net metering policies were enacted to catalyze solar photovoltaic (PV) investments. This paper deals with the technical and financial viability of implementing on-grid PV in a housing facility in the Philippines. Impact of FIT and net-metering policies is explored. Both policies were found to be economically sound in two examined cases for a 100 kW on-grid PV installation under: (a)FIT policy resulted in a Net Present Value (NPV) of 4,721,696 PhP, with a benefit-cost ratio of 4.17 and a simple payback period of 4.1 years; and (b) Net-metering policy resulted in a positive NPV of 27,306 PhP, with an equity payback of 7.8 years, and modest benefit-cost ratio of 1.50. Sensitivity analysis shows that initial cost is the most important factor for FIT, whilst currently high electricity cost is the major driver for net-metering. Viability of projects under both policies can be further improved through additional grants. Finally, the hypothetical lower limit of the FIT rate for an eventual expansion of the current capacity allocation, known as FIT Phase 3, was calculated based on an NPV of 0, and was found to be 4,195.2 PhP/MWh.

Thursday, June 28

Thursday, June 28, 08:30 - 10:30

GPR: GPR Workshop

Frequency Domain and Time Domain Analysis of the Transient Field Radiated by GPR Antenna

Dragan Poljak, Silvestar Sesnic and Anna Susnjara (University of Split, Croatia); Darko Paric

(Croatian Academic and Research Network, Croatia); Vicko Doric (University of Split, FESB, Croatia); Sinisa Antonijevic (University of Split, Croatia)

The paper reviews the frequency domain and time domain analysis of transient electric field generated by the ground penetrating radar (GPR) dipole antenna radiating above a lossy ground. The frequency domain model is based on the space-frequency Pocklington's integro-differential equation and related field formulas, while the related transient response is obtained by means of the Inverse Fast Fourier Transform (IFFT). The direct time domain approach deals with the space-time Hallen integral equation and related field formulas. The numerical solution of Pocklington and Hallen equation, respectively, is carried out via the Galerkin-Bubnov Indirect Boundary Element Method (GB-IBEM). The effects of the two-media interface are taken into account via the corresponding space-frequency and space-time reflection/transmission coefficients. Some illustrative computational examples for the transient electric field reflected from interface and the transient field transmitted through the ground are presented. The numerical results obtained by different approaches are in a satisfactory agreement.

Comparison of Electric Field Transmitted into a Lossy Medium Radiated by a GPR Antenna

Silvestar Sesnic (University of Split, Croatia)

The paper deals with the calculation and comparison of an electric field radiated by a GPR antenna and transmitted into a lossy medium. Realistic bow-tie GPR antenna is modeled using gprMax software (FTDT method) as well as equivalent dipole antenna with current distribution governed by Hallen integral equation. The value of electric field transmitted into a lossy medium at different depths is compared.

Electric Field Radiated By a Dipole Antenna and Transmitted Into a Two-Layered Lossy Half Space

Anna Susnjara (University of Split, Croatia); Vicko Doric (University of Split, FESB, Croatia); Dragan Poljak (University of Split, Croatia)

The paper deals with the calculation of electric field radiated by a dipole antenna and transmitted into a lossy half space modelled as a two layered medium. The frequency domain formulation to determine the unknown current along the wire is based on Pocklington's integro-differential equation which is solved numerically by using the Galerkin Bubnov scheme of Indirect Boundary Element Method (GB-IBEM). The calculated current is then inserted into field formulas and the field transmitted into the ground is obtained. The presence of the three medium configuration, air-layer1-layer2, is taken into account by two approaches. The first approach, Fresnel transmission coefficient approximation, beside the electric properties of the media, accounts for the incidence angles at the interfaces air-layer1 and layer1-layer2. On the other hand, the Modified Image Theory (MIT) based approach assumes the normal incidence and simplifies the calculation which is particularly important for a direct time domain analysis. Computational examples present several scenarios for the different sublayer types. Comparison of the two approaches in frequency domain undertaken in this work serves as a benchmark for the future time domain modelling of multilayered subspaces which is more cumbersome and MIT based approach may seem as a plausible approach.

Antenna Design for Low-Cost Laptop-based Ground Penetrating Radar

Maja Škiljo, Toni Konsa, Zoran Blažević and Dragan Poljak (University of Split, Croatia)

Ground penetrating radar (GPR) is non-destructive device used for monitoring underground structures. COST Action TU1208 promoted its use outside the civil engineering applications and provided a lot of free resources to the GPR community. In this paper, we built a low-cost GPR prototype for educational purposes according to the given resources and continued the work with focus on GPR antenna design. According to the required radiation characteristics, some antenna types are thoroughly discussed, fabricated and measured.

Thursday, June 28, 09:00 - 10:30

S4: Smart Cities - Signal Processing

Outdoor People Detection in Low Resolution Thermal Images

Gianmarco Cerutti (Bruno Kessler Foundation & University of Bologna, Italy); Bojan Milosevic and Elisabetta Farella (Fondazione Bruno Kessler, Italy)

Presence detection is a main functionality to make our living spaces smarter and is implemented through several kinds of sensors and smart devices. Recent advancements in embedded systems market and technology enable the design of sophisticated solutions in a low-cost and scalable fashion. However, applications of presence detection, such as surveillance or occupancy detection, home automation or smart lighting are built for indoor scenarios. Therefore, many systems weaken their performance when applied outdoor, where ambient conditions have higher variability. In this work, we describe our exploratory study on people detection in outdoor scenarios by use of an 8x8 pixels resolution thermal sensor. We tested different techniques to extract the presence of a person crossing the detection area. We observed that signal to noise ratio depends on the difference between background and human body temperature. To address this, we collected a dataset spanning a wide range of background conditions and different user clothing and we used it to tune and evaluate the proposed detection techniques. As a possible solution, we propose to adapt the threshold with temperature, providing a regression curve to select it and demonstrate benefits against the use of a fixed threshold with all explored techniques.

Metadata-oriented concept-based image retrieval for forest fire video surveillance system

Ljiljana Šerić (University of Split - Faculty of El. Eng., Mech. Eng. and Naval Arch., Croatia); Maja Braović, Toni Beović and Gordan Viđak (University of Split - FESB, Croatia)

In this paper we analyse and discuss various approaches for archival image metadata storage and retrieval in forest fire video surveillance system. Video surveillance is an effective approach for the protection of valuable assets, such as buildings, work facilities and open areas. Forest fire video surveillance systems are used for forest monitoring since they allow rapid reaction in the case of forest fires. Video surveillance systems provide their users

with real time images, but there is also a demand for storage of those images for event reconstruction processes. Each image in an archive has metadata associated with it. In this paper we compare two standard approaches for metadata storage: encoding metadata in images, and storing metadata in a separate database. We discuss advantages and disadvantages of these approaches from the aspect of user experience, and in terms of ease of image retrieval, portability, and search speed.

Region Proposal Approach for Human Body Detection on Aerial Imagery

Zeljko Marusic (University of Mostar & Faculty of Science and Education, Bosnia and Herzegovina); Dunja Božić Štulić (University of Split, Croatia); Sven Gotovac (University of Split & FESB, Croatia); Tonćo Marušić (University of Mostar, Bosnia and Herzegovina)

In this paper we evaluated region proposal based CNN approach in human body detection from aerial perspective. Particular emphasis is on the automation of the detection for the purpose of search and rescue missions. This challenging task is characterized by two critical requirements. The first requirement for proposed algorithm is real-time speed of execution and the other is exceptional detection quality on complex natural environment images. Evaluation is performed on high spatial resolution images with high level of details that were collected by UAV platforms. Our proposed and evaluated method based on FasterRCNN detection model shown great preliminary performance, as well as fast processing of high resolution images. Overall detection model achieved 88.3\% recall with precision of 61.7\%.

Gas Emission Prediction for Environmental Sustainability via Heterogeneous Data Sources Correlation with Support Vector Regression

Sieh Kiong Tiong and Phing Chen Chai (UNITEN, Malaysia); Johnny Koh and Albert Fong (Universiti Tenaga Nasional, Malaysia); Md Fauzan Kamal Mohd Yapandi (TNB Research, Malaysia)

With the emerging of industrial revolution 4.0, artificial intelligence (AI) together with big data analytics will be playing an important role in environmental sustainability by improving system efficiency and intelligent environment monitoring. Increase of electricity demand and urbanization process has caused more power plants to be built to meet the demand of electricity. However, development of power plants will cause environmental issue for its surrounding. Hence, necessary measures need to be taken to ensure environmental sustainability. This paper is to investigate the ability of a regression based artificial intelligent algorithm, namely Support Vector Regression (SVR), correlating with multiple sources of big data sets to predict the Sulfur Dioxide (SO2) emission level at atmosphere surrounding a Combined Cycle Gas Turbine (CCGT) power plant. The heterogeneous data sources that have been used to train and establish the knowledge of SVR are meteorological data, terrain and land use data, historical emission data and power plant parameters particularly related to the point source emitter. Although there are a number of gasses emitted from power plant, SO2 is selected as the key emission in this paper due to inhaling of sulfur dioxide will cause respiratory symptoms and disease for living things, and study has reviewed that preterm birth can be associated to exposure to sulfur dioxide. The historical emission data samples used for gas prediction modeling were acquired using the Continuous Emission Monitoring System (CEMS) installed with necessary gas sensors. Meanwhile, meteorological data, terrain and land use data were purchased from authority. Power plant parameters particularly related to the point source emitter was obtained from power utility company. With the correlation of multiple big data sources, SVR is then trained for the prediction of emission rate at the chimney and certain targeted areas such as residential area, which are classified as air sensitive receptors (ASR) surrounding the power plant. The developed predictive model is incorporated into an online monitoring tool namely Integrated Support Vector Regression Emission Monitoring System (i-SuVEMS). The predicted SO2 gas emission result by i-SuVEMS was compared with the actual emissions results from the CEMS. The predicted values from the i-SuVEMS implementation at power plant show an average of 90% accuracy compared to the actual measured emission values. This prediction performance result indicates that i-SuVEMS is able to meet the requirement of US EPA 40 CFR Part 60 in predicting the quantity of SO2 gas emission into the atmosphere and consequently can be considered to be a tool for environmental sustainability monitoring.

Influence of Data Collection Parameters on Performance of Neural Network-based Obstacle Avoidance

Stanko Kruzic, Josip Music, Ivo Stancic and Vladan Papic (University of Split, Croatia)

Neural networks are becoming wide-spread, including applications in mobile robotics and related fields. Most state-of-the-art approaches to training neural networks use video cameras for generating training datasets. However, these data are hard and time-consuming to collect resulting in a bottleneck of neural network training procedure. Thus, the paper briefly presents simulation-based LiDAR data collection for the training of neural networks for obstacle avoidance. The influence of two data collection parameters in simulation (distance to obstacles and number of LiDAR points) on the performance of the real-world mobile robot is analysed in more depth. Experimental testing was performed in a narrow corridor (augmented with additional obstacles) in order to fully test the neural networks and detect possible limitations. For a better understanding of proposed algorithms and analysis of their performance in real-life scenarios, a simple test-bed was devised with Turtbebot 2 as a test vehicle although it can be applied on similar mobile robot platforms. Based on obtained results, and with safety in mind, conclusions are drawn and possible future improvements proposed.

S5: e-Health

Wandering Behaviors Detection for Dementia Patients: a Survey

Abbass Hammoud, Michel Deriaz and Dimitri Konstantas (University of Geneva, Switzerland)

Dementia is an age-associated impairment that could affect about 135 million people worldwide by the year 2050. People with dementia suffer from memory and orientation problems, which cause them to wander and get lost. Advances in technologies and connectivity can be leveraged to reduce the risk of unsafe wandering. In this paper, we present a survey of state-of-the-art technologies and methodologies, which are used for tracking and detection of wandering behaviors. The survey provides a compilation of the most related works in the literature and commercial fields, discusses their aspects and limitations, with the aim to benefit future efforts in this domain. We

found that several approaches exist to tackle the problem of wandering, where most of the reviewed works tend to focus on the technical side, rather than adopting a user-centric design. We also observe that the commercial systems are lagging behind the research efforts, which can have a great impact if wisely applied in real world applications. Finally, we review the related sides of security, privacy and ethical concerns around the development of tracking systems, and present general recommendations for developing systems that respect these sides.

Automatic segmentation of relevant sections of the conjunctiva for non-invasive anemia detection

Giovanni Dimauro (Universita' di Bari & Dipartimento di Informatica, Italy); Francesco Girardi (UVARP ASL Bari, Italy); Danilo Caivano (Università di Bari, Italy); Luigi Baldari and Giuseppe Colucci (Università degli Studi di Bari, Italy)

Anemia is diagnosed by measuring the blood concentration of hemoglobin (Hb). In the literature, many studies have aimed to diagnose anemia with non-invasive methods, for example, estimating the pallor of the conjunctiva by means of digital images. In this way, this article aims to identify a procedure for the automatic segmentation and optimization of conjunctiva sections. Therefore, image analysis algorithms have been studied and applied to optimize the area of interest in terms of correlation with the estimated Hb value by blood sampling. Optimization was also possible through the study of the influence of image brightness on the correct Hb estimation by means of digital images of the conjunctiva. In conclusion, interesting experimental results were reported.

Design and Implementation of Nursing Record Assist System based on Hospital Falls and Pressure Ulcer Monitoring Method

Yongsu Jeon, Jinwoo Lee, Taegu Kim and Yunju Baek (Pusan National University, Korea)

Electronic medical record systems have been developed for efficient financial management of hospitals, personnel, and medical services. However, they require a large amount of information input and medical staff to perform various related tasks in addition to medical tasks. In this paper, we propose a system that can recognize a patient's walking behavior, falls, and pressure ulcers and store them in the system server together with photographs to support nursing records. We also propose a method of recognizing falls and pressure ulcers using the proposed system. Experiments in an actual hospital environment confirm that the proposed system is effective. In addition, the recognition accuracy of falls and pressure ulcers was measured, and it was confirmed that the fall recognition accuracy was 83% and the pressure ulcer recognition accuracy was 97%

A Review of Image Processing and Deep Learning Based Methods for Automated Analysis of Digital Retinal Fundus Images

Maja Braović (University of Split - FESB, Croatia); Dunja Božić-Štulić (University of Split, Croatia); Darko Stipaničev (University of Split - Faculty of Electr. Eng., Mech. Eng. and Naval Arch., Croatia)

Retinal fundus imaging is a medical procedure used by medical professionals in the discovery and tracking of various retinal abnormalities. Sometimes the analysis of retinal fundus images can be slow and difficult when performed by medical staff, and in response to this many automated, image-processing based methods for the analysis of these images exist. In recent years, deep learning methods have become increasingly popular in machine learning applications, so it is no surprise that they are also being used in the image processing based analysis of retinal fundus images. In this paper we discuss recently proposed methods that use deep learning techniques in the image processing based analysis of digital retinal fundus images. Special attention is given to the analysis of retinal fundus image datasets and various techniques employed to the images from these datasets in order to make them suitable for deep learning based applications.

Sensitivity and Noise Evaluation of an Optoelectronic Sensor for Mosquitoes Monitoring

Diego Santos and Luiz Teixeira (National Institute of Telecommunications (INATEL), Brazil); Antonio M Alberti (National Institute of Telecommunications, Brazil); Vasco Furtado (University of Fortaleza, Brazil); Joel J. P. C. Rodrigues (National Institute of Telecommunications (Inatel), Brazil & Instituto de Telecomunicações, Portugal)

Mosquitoes play a biological role of significant impact on public health, being vectors of several diseases transmission. In particular, the Aedes aegypti mosquito is a vector of potentially fatal diseases such as Dengue, Zika, Chikungunya, and Yellow Fever. The studies progress on these insects biological properties is fundamental for the improvement of more accurate mosquitoes detection sensors. Therefore, the optoelectronic sensors for flying insects detection and classification taking into account the fundamental wingbeat frequency of several insects species database available in the literature. Also, the optoelectronic approach is capable to perform insect sensing without needing uninterrupted data recording. This functionality is essential to reduce the sensor's power consumption and enable the construction of a low-power device ready for an Internet of Things (IoT) scenario. In this regard, this paper aims to design and deploy an optoelectronic sensor module to validate the optoelectronic sensor operating principle and evaluate the main optical interference sources. Thus, it is possible to determine the best sensor's operating bandwidths for an optimal signal-to-noise ratio and efficiency.

A Critical Analysis of Healthcare Applications Over Fog Computing Infrastructures

Pedro Vilela (National Institute of Telecommunications (INATEL), Brazil); Joel J. P. C. Rodrigues (National Institute of Telecommunications (Inatel), Brazil & Instituto de Telecomunicações, Portugal); Luciano Vilela (National Institute of Telecommunications (INATEL), Brazil); Mukhtar M. E. Mahmoud (University of Kassala, Sudan); Petar Šolić (University of Split & FESB, Croatia)

Over the past decade, the number of Internet of Things (IoT) smart devices has grown exponentially. In order to support the computational demand of real-time latency-sensitive applications in healthcare, a new paradigm named Fog Computing has emerged. Fog Computing is located closer to the IoT devices/sensors and is considered to be an extension of the Cloud Computing. In this paper, a hospital ward room is used as a case study, where the scenario is simulated using the iFogSim simulator, in order to evaluate and analyse its behaviour in terms of latency, network usage, cost of transmission, and power consumption. The results point out the possibility to enhance Quality of Service for patients and care givers by adding the Fog Computing layer to the current Cloud

Thursday, June 28, 14:00 - 15:30

IoT2: Internet of Things - Software

Context-aware IOT middleware for home care - "R2V adaptive"

Andrei Vasilateanu (Politehnica University of Bucharest, Romania)

This paper presents "R2V adaptive" a middleware that enables the use of commercial smart devices in executing care plans, enabling continuity of care in an efficient way for home care, and avoiding digital ecosystem lock-down. We propose a two sided approach - to reuse existing smart devices and to assign dynamically tasks to them based on the care process for the patient and their capabilities. The system achieves this by executing a customized care plan with activities annotated with corresponding devices. Such a system is context-aware as it adapts to the context of the device and to the medical context of the user. The system is in the prototype phase, implementing sensing and notification tasks on two smart devices.

TACTUS: an intuitive and tangible framework for composing IoT Services

Stefano Pino (Engineering Ingegneria Informatica Spa, Italy); Davide Storelli, Enza Giangreco, Marco Alessi, Alessio Camillò and Marco Pinnella (Engineering Ingegneria Informatica S.p.A., Italy)

Smart objects are around us, more than in the past, and their services are available for being used. Large scale consolidation and easy availability of the IoT paradigm, pervasive services, Cloud computing, lead us to face the challenge of effective interaction with emerging clusters of novel devices, capable of collaborating together in order to meet always changing users' needs. The problem that must be solved is how to meet the immense number of possible services offered by device collaboration, with the everyday users' needs, who could be untrained and lacking proper skills. Actual solutions are scattered, often solving vertical problems, and requiring some deal of training for properly usage. The absence of technical skill for end users is crucial, if we want to take advantage of their creativity and innate knowledge, so that new services may emerge, without any developers' limitation. It becomes fundamental to investigate how to communicate the new pervasive and powerful opportunities that those smart objects offer, and how to leverage fruition through device collaboration. In this paper we present our theoretical approach to empower common users with an interaction model for IoT services composition, capable to intuitively manage the complexity of smart devices deployed all around us. Then we propose a technological tool, based on the novel interaction paradigm, able to scale the fruition of self made solutions, so that the users can autonomously solve their special needs by simply adding functionalities to the services they receive. Following this evolutionary paradigm, self customization of IoT service composition, empowers users in creating always different services, fit for their unique contexts.

Accounting for User Diversity in the Design for Sustainable Behaviour in Smart Offices

Ane Irizar-Arrieta, Diego Casado-Mansilla and Aiur Retegi (University of Deusto, Spain)

Human factors are essential in the promotion and success of energy efficiency initiatives in the workplace. The existing literature on the field has demonstrated that 'one-size-fits-all' solutions tend to fail because they overlook addressing user diversity and the different motivations to behave pro-environmentally. Thus, accounting for user heterogeneity appears to be a successful approach to improve the accuracy selecting and developing behaviour change strategies for different user profiles and work-contexts. This paper addresses the ideation and design process of an Internet of Things (IoT)-based physical object, a coaster, to foster energy awareness in an office-based workplace. Putting the diversity of users in the centre of the process, the Iot-design proposal links persuasive principles with user profiles in order to give personalised eco-feedback for each different user type. Insights on the inclusion of user diversity on the Design for Sustainable Behaviour (DfSB) theories are provided after conducting qualitative research to evaluate the relationship between users and the designed interactive coaster.

Make users own their data: a decentralized personal data store prototype based on Ethereum and IPFS

Stefano Pino (Engineering Ingegneria Informatica Spa, Italy); Davide Storelli, Alessio Camillò, Enza Giangreco, Marco Alessi and Marco Matera (Engineering Ingegneria Informatica S.p.A., Italy)

In the times we are living, data protection infringements, at local, national or international level, are a daily occurrence, highlighting how important is the problem of users' awareness and "consent" about what data should or not be shared. A vast number of service providers strives to have access to users' personal data. While users may be aware of being sharing data with direct services they receive, they may be still unaware if their data is passing in others' hands and unknown third parties. But the sharing of personal data remains unavoidable, in this always connected digital era, contextualized services are not only fancy desires, they could save money, time, and even lives. The problem becomes even more complicate if we try to consider the devices around us: how to share devices we own, so that we can receive pervasive services, based on our contexts and device functionalities. The European Authority has provided regulations about personal data protection, but there are still significant differences in the ways each EU member state would implement the protection of privacy and personal data in national laws, policies, and practices. The tool that should empower users with the personal data protection has to face two problems: data privacy and control. Due to the lack of central authorities, blockchain technologies would seem fit for the challenge, but solutions based on distributed technologies are not fully exploited. One possible reason is that distributed architectures alone do not achieve privacy of data. In this paper we tackle the challenge of a novel Personal Data Store, by making use of a distributed architecture, based on the Ethereum framework, extended with an ontology to model user profile and data sharing towards services. Such solution, The Decentralized Identity Manager, solves personal data protection by offering a unique endpoint, without any central authority, where users can manage their data, their privacy levels, and grant or deny sharing consent, every time

services ask for personal data.

A Performance Analysis of an IoT-aware Elderly Monitoring System

Aitor Almeida (DeustoTech - Deusto Institute of Technology, Spain); Marina Andrić (BELIT, Serbia); Ruben Mulero (Deusto Tech, Spain); Luigi Patrono and Piercosimo Rametta (University of Salento, Italy); Vladimir D. Urošević (Belgrade University Faculty of Organizatinal Sciences & Belit Ltd. Belgrade, Serbia)

The growing average age of the urban population, with an increasing number of 65+ years old citizens, is calling for the cities to provide global services specifically geared to elderly people. In this context, collecting data from the elderly's environment and his/her habits and making them available in a structured way to third parties for analysis, is the first step towards the realization of innovative user-centric services. This paper is focused on a performance analysis of three main blocks of a IoT-aware monitoring system: (i) data capturing in home and in the city, (ii) data store and management in the Cloud and, (iii) data analytics. Critical points in the system architecture have been highlighted trying also to define potential solutions able to overcome them. The system architecture analyzed is used by the H2020 City4Age project to help geriatricians in identifying the onset of Mild Cognitive Impairment (MCI) disease.

A Proposal for Bridging the Message Queuing Telemetry Transport Protocol to HTTP on IoT Solutions

Mauro Cruz (Instituto Nacional de Telecomunicações, Brazil); Joel J. P. C. Rodrigues (National Institute of Telecommunications (Inatel), Brazil & Instituto de Telecomunicações, Portugal); Ellen Paradello (National Institute of Telecommunications (INATEL), Brazil); Pascal Lorenz (University of Haute Alsace, France); Petar Šolić (University of Split & FESB, Croatia); Victor Albuquerque (Universidade de Fortaleza-Unifor, Brazil)

Internet of Things (IoT) is a promising market and data gathered by IoT devices is highly valuable. The software that handles and stores these data is known as IoT middleware. The devices transfer data to middleware through an application protocol, which can be different from those supported by middleware. This paper proposes an application layer gateway that converts Message Queuing Telemetry Transport Protocol (MQTT) messages into HTTP. This solution can be deployed on a computer or Raspberry Pi, allowing devices to seamlessly send data to any REST endpoint. Instead of sending data directly to a middleware, IoT devices can send a smaller message to this bridge, which reconstructs it and forwards to a middleware, reducing the stress on the IoT device. The graphical user interface allows users to configure aspects related to messages conversion and forwarding in runtime. The paper demonstrates the efficiency of this approach by evaluating three scenarios where data is sent to Orion context broker (a Fiware project), which reveals that packet size that is sent by an IoT device through this proposed approach is 10 times smaller than other bridges and 17 times smaller than sending an HTTP request straight to the server.

Thursday, June 28, 16:00 - 17:30

IoT3: Internet of Things - Applications

Timing analysis for IoT-based vehicle-pedestrian collision avoidance for NLOS conditions

Nadezda Yakusheva (University of Udine & Bauman Moscow State University, Italy); Andrey Proletarsky (BMSTU, Russia); Mikhail Basarab (Bauman Moscow State Technical University, Russia)

development of a system for VRU safety based on V2X communication is considered an important issue. Different approaches are used today to improve safety. A number of systems using V2I and V2X communications with Cloud computing technology, Big data analysis were proposed. Nowadays, the Internet-of-Things paradigm is not only an unavoidable process but also the basis of cyber-physical systems. It can be beneficial for real-time road and pedestrian safety applications. But the most important issue of using IoT for time critical emergency application is the latency. This paper contains the case study of using flexible IoT Framework for pedestrian safety service in "non in-Line-of-Sight" conditions. In this paper we we consider a common collision scenario and focus on the timing analysis for pedestrian collision avoidance system using IoT.

Intelligent Street Light System Based on NB-IoT and Energy-saving Algorithm

Langcheng Zhao (Beijing University of Posts and Telecommunications, P.R. China); Qihong Gao (Beijing University Of Posts And Telecommunications, P.R. China); Ran Wang, Nan Fang, Zhuqi Jin, Neng Wan and Lianming Xu (Beijing University of Posts and Telecommunications, P.R. China)

Aiming at saving energy and reducing the maintenance cost and difficulty of the urban street lighting system, this paper proposes a design scheme for an intelligent LED Street light control system based on NB-IoT network. The solution consists of a cloud server, a remote monitoring interface, and street light control terminals. Combined with NB-IoT network and Power Line Carrier (PLC) communication, this solution realizes local intelligent control and remote supervision of LED street lights. During daytime when lights are normally off, if the light intensity sensor detects that the natural brightness is insufficient, lights will be turned on at a required level. During nighttime when lights are normally on, the on-demand lighting is achieved by the energy-saving algorithm described in this paper. Meanwhile, environmental monitoring can be realized as well as fault alarm and abnormal protection.

Rapid Prototyping of a Star Topology Network based on Bluetooth Low Energy Technology

Lorenzo Invidia (University of Salento, Italy); Silvio Lucio Oliva and Andrea Palmieri (STMicroelectronics, Italy); Luigi Patrono and Piercosimo Rametta (University of Salento, Italy)

The ever-growing number of smart devices enabling the Internet of Things (IoT) in several contexts, demands for the availability of a set of tools, both hardware and software, allowing end-users to fast prototype applications for different scenarios. This work presents an implementation of a star topology network based on the Bluetooth Low Energy (BLE) protocol, exploiting the ST's STM32 Open Development Environment (ODE). It setups a simple sensor network whose central node collects data from several peripheral nodes and forwards them to a iOS smartphone application, where data are visualized.

Real Time System for Measuring the Pantograph Vertically Position Correlated with Temperature and Air Humidity

Caius Panoiu, Raluca Rob and Stela Rusu-Anghel (Politehnica University of Timisoara, Romania)

This paper presents a system used for measuring the pantograph vertically position correlated with temperature and air humidity, system which nowadays is used in railway transportation infrastructure. The real time measurement technology is ensured by a system which contains NI (National Instruments) MyRIO controller equipped with FPGA (Field Programmable Gate Array) system, connected to a Laser distance sensor and also to a humidity and temperature measurement sensor. Data can be monitored and saved into .txt file documents.

A Comparative Study of Cycling Mobile Applications

Miguel A. Wister, Pablo Pancardo and Pablo Payro Campos (Juarez Autonomous University of Tabasco, Mexico)

This article analyzes some available bike mobile applications for smartphones as an alternative to bike computers (Cycle Computers or speedometer or speed sensors). We have records of a large number of MTB (Mountain Bike) datasets, 219 datasets were recorded on 4 different routes. These applications create maps and profiles from geographic data. Inputs can be in GPS data (tracks and waypoints), driving routes, street addresses, or simple coordinates. Most applications estimate fields such as speed, heading, slope, distance, VMG (velocity made good) and pace (cadence). However, it is necessary to calculate the relationship between cadence and power in pedaling so that cyclists know the appropriate moment to apply power to their legs to improve the torque. This paper shows tables, comparative graphs, and performance evaluation of biking routes in four different cycling mobile applications. Author: Miguel A. Wister

S6: Energy - Innovations and Modelling

A concept of the novel regenerative hydraulic suspension: The prototype description

Vjekoslav Tvrdić, Srdjan Podrug, Damir Jelaska and Milan Perkušić (University of Split, Croatia)

This paper deals with the issue of increasing the efficiency and reduction of harmful gas emissions in the automotive sector. The main idea of this research is the ability to save and reuse the vibrating energy of the vehicle through the regenerative hydraulic suspensions. In the introductory section, a brief review of articles which are recently published from the research area of regenerative suspensions for hybrid vehicles has been made. The article also explains in detail the principle of the regenerative hydraulic suspension system, which is planned to be produced in the future for the purpose of experimental and numerical tests. Finally, the new unique regenerative hydraulic suspension prototype design solution is proposed and described along with all of the details of this construction. It is estimated that by using this regenerative device it is possible to achieve up to 3% reduction in fuel consumption in vehicles.

Influence of guide vane topology on the shape and stability of gravitational vortex

Sandro Nizetic (University of Split, FESB, Croatia); Željko Penga (University of Split, Faculty of FESB, Croatia); Muslum Arici (Kocaeli University, Turkey)

This paper represents a continuation of the research work related to the further development of the alternative renewable energy concept of the solar plant with short diffuser (SPD). The main idea of the alternative energy concept is to produce and maintain vortex system in the controlled conditions from available renewable energy source. Finally, produced pressure difference by the vortex system will ensure usefully shaft work to drive the turbines. Already developed numerical model of the SPD concept was further upgraded taking into account the effect of the guide vane geometry on the vortex stability and shape. Different blade shapes were examined (variation of the geometry) as well as different configurations of the attack angles. Finally, it was found that novel enrolled and proposed geometry modifications have a significant effect on the minimal required delta pressure for establishing and maintaining the vortex, while at the same time keeping the maximal velocities in reasonable range with respect to the present technical limitations in the case of the turbines.

Numerical and analytical research of a perforated plate thermal and fluid flow process

Mladen Tomić (University of Novi Sad, Faculty of Technical Sciences, Serbia); Aleksandar Andjelkovic (University of Novi Sad, Serbia); Predrag Živković (University of Niš, Faculty of Mechanical Engineering, Serbia); Miroslav Kljajić (University of Novi Sad, Faculty of Technical Sciences, Serbia); Mića Vukić (University of Niš, Faculty of Mechanical Engineering, Serbia)

The need for compact heat exchangers has led to the development of many types of surfaces that enhance the rate of heat transfer, among them and perforated plate heat exchangers. The perforated plate heat exchangers consist of a series of perforated plates that are separated by a series of spacers. In this paper, numerical simulations were done in order to define heat transfer coefficient of a perforated plate with square arranged cylindrical perforations. Three parameters were varied in the study: plate porosity, hole-based Reynolds number, and the working fluid. Plate porosity was varied in the range from 10 to 50%, while perforation diameter and plate thickness were kept constant. The Nusselt number was correlated as the function of Reynolds number, Prandtl number, and geometric parameters. A comparison was done with other authors correlations and the difference was found to be acceptable. In the second part of the paper, a pressure drop was analyzed on the basis of well know analytical relations. The analysis showed that friction coefficient depends strongly on geometry parameters.

Development of The Passive Air Mixing Chamber for an Air Handling Unit

Hyunjae Chang and Seokyoung Lim (Hongik University, Korea)

Air mixing chamber in an air handling unit (AHU) is an important part to affect heat exchange efficiency and the controllability of AHU. In this study, the novel definition of air mixing ratio (AMR) is proposed, and several ideas to improve AMR has been investigated by computational fluid dynamics (CFD) simulation and experiment. In conventional air mixing chamber, airflow characteristics show that outdoor air flowing into the air mixing chamber is suppressed by a large volume of return air, and OA and RA are not mixed well. AMR of the conventional air chamber is quite low as 20 ~ 50%. Among the cases investigated in this study, the case "Double inducing chamber / three slits on each side walls" shows the best mixing state. AMR of this case shows about 80%, and pressure loss about 20 Pa. These performances has been validated by an experiment.

A review on the application and usefulness of metal nanosized particles in solid rocket propellants

Ilyes Ghedjatti, Shiwei Yuan and Haixing Wang (Aerospace Propulsion Laboratory, School of Astronautics, Beihang University, P.R. China)

In order to make the next leap forward from the current generation of technology, energy applications of nanotechnology have been developed. Nanotechnology is any technology that contains components smaller than 100 nm. Nanomaterials research takes a materials science-based approach to nanotechnology, leveraging advances in materials metrology and synthesis which have been developed in support of microfabrication research. Materials with structure at the nanoscale often have unique optical, electronic, mechanical, thermal, magnetic or catalytic properties. This research work aims to review the most relevant, recent investigations that have been made in order to clarify the importance of the application of these energetic nanomaterials, particularly for aerospace propulsion, for solid rocket propellants characteristics and performance enhancement, and this by exploring the different factors and characteristics of these materials that influence the burning rates, burning times, ignition delays and temperatures. First, we explored the addition of metals to solid propellants for different applications and the advantages that it can bring. Then, we investigated the benefits of substituting metals micron-sized particles by their nanosized counterparts. Finally, the enhancement of composite solid propellants decomposition by using nanosized particles as catalysts. the benefits of utilizing nanoparticles consist of the potential to eliminate agglomeration encountered for larger particles, earlier ignition, higher total heat release rate, and further extension of the burning rate for functionalized/catalytic particles.

S7: Energy - Smart Grids

A Two-layer Strategy for Reactive Power and Voltage Control for Improving the Static Voltage Stability of PV Power Cluster

Haixiao Li, Lin Zhou and Qianjin Zhang (Chongqing University, P.R. China)

Benefiting from the significant technical advances in solar cells and power electronics, the photovoltaic(PV) grid-connected capacity has continued to grow rapidly [1] bringing with it the occurrence of some voltage problems in the PV grid integration area. In China, solar energy-rich regions are concentrated in the northwest and far away from the load center. PV power cluster(PVPC) have centralized access to weak grid lacking conventional water and thermal power plants, which has strong voltage sensitivity. Random fluctuation of the PV power output induces the fluctuation of voltage amplitude at point of common coupling(PCC). PV inverters have capability of reactive power output, and can be used in conjunction with reactive power compensation devices, such as Static Var Generator(SVG) to participate in PCC voltage regulation. Verband der Elektrotechnik(VDE) proposed four independent inverter control solutions[2], and related application have been studied[3]-[5]. But under the background of large-scale and cluster of PV power system, this kind of distributed method based on single inverter is difficult to achieve coordination between inverters and SVG. Compared with it, centralized method is more effective to be applied in the PVPC. Centralized method determines the control strategy according to global information. The central controller computes the set-points based on an optimization technique, and sends them back to the control devices for implementation. The computation of the control actions can be regarded as the solution of optimal power flow(OPF). Under the control framework, different control strategy are proposed. [6] uses the nine-area diagram to regulate PCC voltage and power factors. [7] proposes a three-level reactive power control strategy for photovoltaic power plant aim to mitigate voltage fluctuation at PCC. In [8], an OPF formulation with the objective to minimize the market value of the curtailed energy of embedded wind generation is proposed. Other control objectives contains minimizing the network loss [9], change times of transformer tap [10] , and voltage profile deviation [11]. From the aspect of voltage amplitude control, the above reference provides a wealth of ideas, but few works have studied the static voltage stability of power generation system. In recent years, wind power chain off-grid accident have occurred frequently in China. According to related reports, during year 2013, a total of 193 off-grid accidents occurred, among them, 54 accidents have lost power to 100~500MW, and 12 accidents have lost more than 500MW. Although similar reports in the PV industry are rare, the voltage stability problem should attract enough attention. This paper attempts to adjust PCC voltage amplitude and improve the static voltage stability margin of the PVPC simultaneously. Firstly, the static voltage stability index(SVSI) applicable to the PVPC, i.e. L-index is studied. And then, based on Centralized method, a two-layer reactive power and voltage control strategy is proposed. The upper layer preliminarily computes the amount of total reactive power needed to be injected into PCC roughly considering the voltage amplitude deviation. After this, the lower layer makes further adjustments to the amount of total reactive power, and determines the specific reactive power allocation for improving static voltage stability of the PVPC. For involved OPF problem, swarm intelligence algorithm is taken considering complex nonlinear constraints of the optimization model. Moreover, for reducing the optimization computation time, radial basis neural network(RBFNN) is brought in to predict L-index. The rest of this paper is organized as follows. In Section II, the voltage limit and instability mechanism of the PVPC is presented. In Section III, L-index applied to evaluate the static voltage stability for the PVPC and RBF model used for L-index prediction is introduced. In Section IV, the optimization formulation of the two-layer reactive power and voltage control strategy is detailed. The test system and the simulation results are reported in Section V. Finally, the conclusion is presented in Section VI.

Acquisition of Low-Voltage Grid States in Real-Time

Michael Schallenburger (University of Applied Sciences Düsseldorf, Germany); Leschek Kopczynski and Philipp Huppertz (University of Applied Sciences Duesseldorf, Germany); Roland Zeise (FH Duesseldorf & University of Applied Sciences, Germany)

Partial results of a research project, which aimed at the systematic processing of real-time data from 20 low-voltage networks are presented. After a brief overview of current problems regarding the German distribution grids in the course of the Energiewende, the defined goals and challenges of the project are presented. Therefore, we present the way of real-time data from measurement over the transport to the systematic processing and visualization using an office computer. This report shows that new methodical skills are needed to generate real added value to operational and planning processes from future mass data.

Autarkic State Control in Electrical Distribution Grids

Kamil Korotkiewicz, Marcel Ludwig and Felix Dorsemagen (University of Wuppertal, Germany); Markus Zdrallek (Bergische Universität Wuppertal, Germany)

Smart grid systems have been established as an economic and efficient opportunity to avoid or delay cost intensive grid enhancement in order to cope with the transformation process in electrical distribution networks. This paper presents the conceptual results of an automation system for medium voltage grids with the ability of coordinated operation across the voltage levels in a distribution grid. Aspects of the algorithmic solution that is currently in an intensive field testing phase are depicted.

Challenges in Modeling Wind Power Generation Based on Available Weather Data

Oleg Yakimenko and William Anderson, Jr. (Naval Postgraduate School, USA)

This paper presents the results on an initial effort to model the wind turbine power output based on available weather data. For small isolated locations, like Isle of Eigg, Scotland, considered in this study data gathering might not be a trivial issue, especially weather data. Weather stations at airports are usually the most reliable source of data, however they may not be available at isolated locations. In this case, mesoscale numerical weather modeling becomes the only source of weather data. These models require a heavy computational process and are only capable of utilizing about 50km grid. Obviously, modeled data may not be accurate and definitely does not account for a local terrain. This paper utilizes the modeled data in attempt to model an output of a 6kW wind turbine with an unknown power curve using a curve fitting method and neural networks. It discussed all the challenges, shows advantages and disadvantages of each approach and ends with recommendations on how to improve model accuracy to account for a local terrain.

Comparison of Regression Tool for Regional Electric Load Forecasting

Nils Jakob Johannesen, Mohan Kolhe and Morten Goodwin (University of Agder, Norway)

Machine Learning algorithms is going to contribute to predict the electricity consumption used to manage energy systems. The most commonly used algorithm for load prediction is Artificial Neural Network (ANN), which is a complex predictor that utilizes a big amount of training data. k-Nearest Neighbour (kNN) has proven to be efficient by the introduction of binary dummy variables for categorisation and it can be used for short term and long term load forecasting. This paper explores the use of regression tool for regional electric load forecasting by combining binary dummy variables (seasonal load patterns with time) and weather parameters. Different analytical components facilitates the improvement of the model, yet can also be deceiving. Data correlation over seasonal changes have been argued by means of improving Mean Absolute Percentage Error(MAPE). By examining the structure of the kNN-regressor other regressors are compared for the lowest MAPE. For short term (30min) prediction Random Forest Regressor scores best at 0.78 %, for long term prediction (24hrs) the kNN is preferred at 5.9 %.

Exploring Willingness to Pay for Electric Vehicle Charging with Gamified Survey

Lara Dorcec (University of Zagreb, Croatia); Dario Pevec and Hrvoje Vdović (University of Zagreb, Faculty of Electrical Engineering and Computing, Croatia); Jurica Babic (University of Zagreb & Faculty of Electrical Engineering and Computing, Croatia); Vedran Podobnik (University of Zagreb, Faculty of Electrical Engineering and Computing, Croatia)

The on-going trends of promoting electric vehicles (EVs) via free charging resulted in the acceptance of this new transportation technology by early adopters. However, as EVs are more and more becoming a mass-market technology, the era of free charging will finish and EV owners' willingness to pay for the charging service will become a critical parameter for both transportation and energy industries. That being said, this work explores how do people value the EV charging service. Since the relevant datasets are extremely scarce due to the low EV market penetration levels, this work uses the gamified survey for eliciting willingness to pay for EV charging. The experimental setup includes both the classic (text-only) questionnaire, as well as the game-based questionnaire. Interesting insights on the willingness to pay for EV charging were identified and validated against the relevant study from the literature. Finally, evidence from user experience analysis of the questionnaires suggests that use of gamification is the beneficial approach to perform a survey as it has superior hedonic quality in comparison to the classic methods (i.e., text-only questionnaire).

Friday, June 29

Friday, June 29, 09:30 - 11:00

S8: Smart Cities - Software

Using Arabic Social Media Feeds for Incident and Emergency Management in Smart Cities

Manar Alkhatib (British University in Dubai, United Arab Emirates); May El Barachi (University of

Wollongong Dubai, United Arab Emirates); Khaled F. Shaalan (The British University in Dubai & Cairo University, United Arab Emirates)

Research on Smart Cities tackles the challenges related to the rapid urban population growth combined with resources' scar-city. A key function of any Smart City initiative is to be able to continuously monitor and track a city's environment and re-sources so as to convert the data into intelligence for streamlining the city's operations. Social media has become one of the most popular means to allow users to communicate and share information, opinions, and sentiments about events and incidents occurring in a city. With the rapid growth and proliferation of social media platforms, there is a vast amount of user-generated content that can be used as source of information about cities. In this work, we propose the use of text mining and classification techniques to extract the intelligence needed from Arabic social media feeds, for effective incident and emergency management in smart cities. In our system, the information collected from social media feeds is processed to generate incident intelligence reports, including information such as: the event type; the event stage, the impact level, the environmental conditions on the incident scene; and the number of people impacted. Such real-time generated reports can be used by rescue teams for fast assessment and effective response to incidents and emergencies occurring in the city. The proposed algorithm was implemented and tested using datasets collected from Arabic Twitter feeds, and the obtained results are very promising.

Analyzing the transformational Effects of Emerging Technologies on Smart Cities: Blockchain and IoT

Soumaya Ben Dhaou (UNU-EGOV & Operating Unit on Policy-Driven Electronic Governance, Portugal); Nuno Lopes (UNU-EGOV, Portugal)

This paper discusses how to transform urban centers into smarter and sustainable cities by leveraging emerging and disruptive technologies. Blockchain and Internet of Things (IoT) are presented in this paper as some of the most promising technologies for enhancing the cities modus operandi. The fundamental components for achieving a transformational process towards the citizens' needs have been identified based on a systematic literature review and by analyzing a recent practical case. As a result, a conceptual framework for understanding the dynamics of the emerging technologies in a smart city context, and for predicting the potential benefits of those technologies, is proposed.

Next Generation data flow and storage solution in ALICE experiment

Zeljko Seremet (Assistant, Bosnia and Herzegovina & University of Split, Croatia); Eugen Mudnic (FESB, Croatia); Stipe Celar (University of Split & FESB, Croatia)

LHC Run3 and Run4 represent an unprecedented challenge for HEP computing in terms of both data flow and data volume. New approaches are needed for how data is collected and filtered, processed, moved, stored and analyzed if these challenges are to be met with a realistic budget. This paper gives the innovative technologies that are currently being explored by CERN and discusses the long-term strategies that are pursued by the LHC communities with the help of industry in closing the technological gap in networking and storage needs expected in Run3 and Run4. The EOS storage system with the bandwidth of the external network (LHCOPN, LHCONE) is promising solution for these requirements.

A Hybrid Artificial Bee Colony Algorithm using Multiple Linear Regression on Time Series Datasets

M. Fatih Adak (Sakarya University, Turkey); Mustafa Akpinar (University of Sakarya & Agdas Adapazari Natural Gas Distribution Company, Turkey)

Heuristic algorithms are successfully being applied to solution of time series datasets. The algorithms can be improved further for an elevated level of success. In this study, a hybrid application of the successful artificial bee colony (ABC) algorithm with the statistical multiple linear regression (MLR) method is presented. The proposed algorithm is applied to 3 benchmark time series datasets commonly used in the literature, and favorable results are obtained compared to other similar studies. Pure multiple linear regression, on the other hand, is shown to be unable to reach the same level of success. The results demonstrate that the hybrid application of ABC and multiple linear regression produces satisfactory results in time series datasets.

S9: Energy Efficiency and Energy Systems

A Heat Pump System Design for the Green Campus of University of Yalova

Melis Yurtcu, Ozlem Kara and Elif Kucukkaya (University of Yalova, Turkey); Alper Kelesoglu and Umit Unver (Yalova University, Turkey)

The progress in the green building studies are relatively slow in developing countries. Thus, the best way to lead the society to concern green and sustainable building concept is to show the way and application methods for the public buildings. The most appropriate public buildings are the university campuses. In this study, a ground source heat pump was designed to support the existing heating system for the building of Energy Systems Engineering Department of Yalova University. With this application, authors want to open a path for green campus approach. The results showed that, 90 kW powered heat pump system will be sufficient to support the existing heating system. For the designed system, 2032 m of pipe is required for vertical installation.

The current state of research on thermal comfort prediction models

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This paper provides an overview of the relevant published literature data on the thermal comfort models in general. The focus of the paper was to provide a better understanding of the current state related to the research and development of, heat-balance models, adaptive models and personal comfort models enabled by the use of wearable devices. Gained results revealed an importance of the individual approach to the thermal comfort issue, i.e. development of the personal thermal comfort models and which is a challenge. Finally, application of the wearable sensory devices should be further investigated as it could be a helpful tool for the introduction of the

individual approach (that can have a potential effect on the energy savings in the buildings).

Application of mechanistically inspired model on biogas production at the biogas plant

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Biogas is a product of activity of degrading microorganisms on biodegradable organic matter in anaerobic atmosphere. In this paper the application of Anaerobic Digestion Model No. 1 (ADM1) on anaerobic co-digestion process on biogas plant has been examined. The feedstock in biogas plant is composed from maize silage, animal manure and slurry. Anaerobic digestion process has been conducted under mesophilic conditions in digesters. Model predicts the following components in generated biogas: methane, carbon dioxide and hydrogen. By the correlation of experimental data and model results on the gas phase, the acceptability of model on continuous process has been considered. Estimation of model parameters has been conducted considering experimental data.

A new approach for evaluating biochar quality from biomass thermal processing

Stanislaw Szwaja, Anna Poskart and Monika Zajemska (Czestochowa University of Technology, Poland)

This paper presents results from investigation on a new method for both evaluating char quality and control biomass thermal processing at range temperature between 250 and 375°C. Thermal processing of biomass in this temperature range is torrefaction and pyrolysis. Investigation was focused on processing Virginia Mallow energetic crops. Several strong correlations were observed as follows: carbon and hydrogen content in char, ash and volatile matter from char, calorific value and temperature of the process, and finally, acetic acid in condensate and carbon content in char. The correlation between acetic acid and carbon content was used to introduce a new method which can be considered as a diagnostic tool for determining char quality during biomass thermal processing. Hence, carbon content in char as well as its calorific value can be determined by measuring percentage of acetic acid in the condensate. This method provides relatively fast evaluation of the torrefaction/pyrolysis process, what makes it possible to continuously optimize process parameters (temperature, retention time) while the process is ongoing.

Viability of Energy-Saving Illumination in a Commercial Building in Coimbatore, India

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India is one of the highest GHG emitters in the world. Building energy efficiency measures can go a long way in contributing to reducing this emission. With lighting being a major contributor to commercial building energy consumption, improvements in this sector can be an effective way to bring energy savings and reduce GHG emissions. This paper studies the technical and economic feasibility of lighting improvements in a commercial building in Coimbatore, India using life cycle cost analysis. The study proposes use of LED bulbs to replace the 399 existing fluorescent and incandescent lamps of varying wattages (16x18W incandescent bulbs, 8x18W-CFL, 4x36W-CFL, 281x36W linear fluorescent tubes, 60x54W linear fluorescent tubes, 12x50W-CFL, and 18x60W-CFL) covering a total floor area of 3454m². The project was found to be feasible with an NPV of INR 2,373,077, benefit-cost ratio of 14.44, and a simple payback of 0.6 years. It was also estimated to have 19.3 tCO2e avoided emissions annually.

Standardization and Life Cycle Cost Assessment Approach in Circular Economy for Photovoltaic Waste

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Growing photovoltaic (PV) panel waste causes a new environmental challenge, but on the other hand it gives opportunities to create value and new economic paths. An implementation of a circular economy for photovoltaic waste will help the companies within its value chain to improve its synergies and collaboration. This paper presents a route for implementation of a circular economy based on recycled, reused and recovered silicon, as well as indium and silver, from PV waste, developed within European H2020 project CABRISS. Here the authors present the principles of standardization and relevant standard documents for successful adoption of circular economy for photovoltaic waste. The application is mainly for photovoltaic, but also for electronic and glass industry. The integration of latest scientific findings and technological developments into new standards can provide a foundation for subsequent developments and new research efforts. Additionally, life cycle cost assessment (LCC) approach of the circular economy system and its main findings are presented.