

З Д Р У Ж Е Н И Е З А
Е Л Е К Т Р О Н И К А
Т Е Л Е К О М У Н И К А Ц И И
А В Т О М А Т И К А И
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М А К Е Д О Н И Ј А



S O C I E T Y F O R
E L E C T R O N I C
T E L E C O M U N I C A T I O N S
A U T O M A T I C S A N D
I N F O R M A T I C S
O F T H E R E P U B L I C
O F M A C E D O N I A

ЗБОРНИК НА АПСТРАКТИ НА ТРУДОВИТЕ ОД XIV
МЕЃУНАРОДНА КОНФЕРЕНЦИЈА

Уредник: проф. д-р Мирослав Котевски

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ТЕЛЕКОМУНИКАЦИИ
АВТОМАТИКА И
ИНФОРМАТИКА
НА РЕПУБЛИКА
МАКЕДОНИЈА



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ELECTRONIC
TELECOMMUNICATIONS
AUTOMATICS AND
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OF THE REPUBLIC
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Сашо Цероски

ПОТПРЕТСЕДАТЕЛИ НА КОНФЕРЕНЦИЈАТА

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Драги учесници,

Во името на одборите на конференцијата ЕТАИ 2018 и во името на Здружението ЕТАИ, ви посакувам добредојде на 14-тата меѓународна конференција ЕТАИ 2018 која оваа година се одржува во Струга на брегот на Охридското Езеро, познато по својата природна убавина и културното наследство, заштитено од УНЕСКО.

Целта на конференцијата е да создаде форум што ќе овозможи, но и ќе поттикне, професионална размена на најновите научно-стручни сознанија од теориски и апликативен карактер, во подрачјата на електрониката, телекомуникациите, автоматиката и информатиката. Ова ќе биде реализирано преку презентации на научни и стручни трудови и дискусии на тркалезните маси како дел од програмата на конференцијата.

Конференцијата ќе ги продлабочи старите пријателства и ќе создаде нови, ќе развие деловна соработка и вмрежување на научните работници и деловните луѓе.

Сакам да ја изразам мојата голема благодарност кон нашите пленарни говорници: проф. д-р Јае Хонг Ли од Националниот универзитет во Сеул, Јужна Кореја, проф. д-р Брајан Барски од Универзитетот Беркли од Калифорнија, проф. д-р Сашо Џероски и проф. д-р Џани Јуричиќ кои доаѓаат од Институтот Јожеф Штефан од Словенија.

Конференцијата ЕТАИ традиционално е поддржана од повеќе организации и ентузијастички. Користам прилика да им заблагодарам на сите кои допринесоа за успешна реализација на ЕТАИ 2018. Исто така би сакал да им оддадам посебно признание на авторите на трудовите, рецензентите, членовите на Почесниот одбор, Програмскиот одбор и Организацискиот одбор, како и на сите волонтери за придонесот и несебичното залагање во организацијата и успехот на конференцијата.

Сигурен сум дека атмосферата во Струга ќе создаде услови за добра работа, и нови пријателства меѓу научните работници, инженерите и студентите. Со надеж дека ќе имаме успешен настан, ви пожелувам пријатен претстој на Охридското Крајбрежје.

Мирослав Котевски
Претседател на Здружението
ЕТАИ



FOREWORD AND WELCOME

Dear participants,

On behalf of the ETAI 2018 Conference committees and the ETAI Society I am delighted to welcome you at the 14th International Conference, ETAI 2018, hosted this year in Struga as part of our exceptional natural beauty and cultural heritage of Ohrid area, protected by the UNESCO.

The main goal of the conference is to bring together researchers and practitioners to present, discuss and further develop views on the state of the art in both, theoretical and applied aspects in the areas of Electronics, Telecommunications, Automatics and Informatics. This will be achieved through multi-disciplinary presentations and discussions of current issues and new technologies.

The conferences will also deepen old friendship and establish new ones, develop professional relationship and maintaining current networking.

I would like to express my gratitude to the plenary speakers: Prof. Jae Hong Lee from National University of Seoul, Prof. Brian Barskay from University of Berkeley, California and Prof. Saso Dzeroski and Prof. Dzani Juricic that are coming from Jozef Stefan Institute, Slovenia.

The ETAI conferences are traditionally supported by a number of enthusiasts and organizations. I would like to thank all who made contribution towards successful realization of ETAI 2018. Also I would like to give our sincere appreciation and special thanks to the paper authors, reviewers, Honorary Committee, Program Committee, Organizing Committee and volunteers for their work and contribution to the organization and success of the Conference.

I am sure that the atmosphere of Struga will provide stimulating conditions for good work and friendship among scientists, professional engineers and students. Hoping that we will have a successful meeting, I wish you all a pleasant stay at ETAI 2018.

Miroslav Kotevski
President of ETAI
Society

СПИСОК СО АПСТРАКТИ НА ТРУДОВИ – ЕТАИ 2018

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ПЛЕНАРНИ ПРЕДАВАЊА INVITED PLENARY LECTURES



COGNITIVE RADIO FOR WIRELESS COMMUNICATIONS: CONCEPTS AND APPLICATIONS

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Abstract: To meet rapidly growing traffic demands and accommodate large number of devices, more radio spectrum is needed for future wireless communications. Considering the scarcity of radio spectrum, it is needed to enhance the utilization of radio spectrum licensed exclusively to specific users. In cognitive radio, an unlicensed user, called a secondary user, is permitted to access the spectrum allocated to a licensed user, called a primary user. When the primary and secondary users transmit their signals simultaneously, interference occurs at both users which degrades their performance. Interference at the primary user can be avoided by spectrum sensing technique which prohibits a secondary user from transmitting its signal when it detects a primary user's signal. Also, interference level at the primary user can be limited below a certain threshold by spectrum sharing technique in which the secondary user adjusts its transmit power accordingly. Some recent results on cognitive radio are introduced, and its applications and future research subjects are shown.



PROGNOSTICS AND HEALTH MANAGEMENT OF MODERN SYSTEMS AND COMPONENTS: RECENT DEVELOPMENTS AND PERSPECTIVES

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Abstract: The ever-rising competitiveness on global markets is constantly pushing up the requirements for higher quality of the products and services as well as improved reliability and efficiency. Prognostics and Health Management (PHM) is an enabling technology that helps meet these goals by converting knowledge on failure mechanisms into decisions on system lifecycle management. Key to the PHM is in the ability to anticipate the time when the component will fail and to take timely and optimal mitigation actions. First major successes of PHM have been witnessed in the aerospace industry and transport. Substantial impact on the return of investment has been demonstrated thanks to the improved reliability and availability of the equipment, higher product quality and breaking the maintenance costs by replacing periodic maintenance with condition-based maintenance.

In this talk, we will first review the most recent advances in PHM. Its rising deployment into new areas is conditioned with rapidly evolving enabling technologies such as the Internet of Things, cloud computing, edge computing and Big data. Some promising results from our own case studies will be shared, in particular in the domain of critical industrial drives and the new generation of solid oxide fuel cell systems. The aim of the talk is not only to show the potentials of PHM but also to point out how fertile ground it is for problems and challenge attractive for the research community.

The final part of the talk will address the perspectives of PHM within the evolving concept of Industry 4.0, and future generation of machines and devices.



MINING BIG AND COMPLEX DATA

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Abstract: Increasingly often, data mining has to learn predictive models from big data, which may have many examples or many input/output dimensions and may be streaming at very high rates. Contemporary predictive modelling problems may also be complex in a number of other ways: they may involve (a) structured data, both as input and output of the prediction process, (b) incompletely/partially labelled data, and (c) data placed in a spatio-temporal or network context.

The talk will first give an introduction to the different tasks encountered when learning from big and complex data. It will then present some methods for solving such tasks, focusing on structured-output prediction, semi-supervised learning (from incompletely annotated data), and learning from data streams. Finally, some illustrative applications of these methods will be described, ranging from genomics and medicine to image annotation and space exploration.



FROM VISION-REALISTIC RENDERING TO VISION CORRECTING DISPLAYS

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Abstract: Present research on simulating human vision and on vision correcting displays that compensate for the optical aberrations in the viewer's eyes will be discussed. The simulation is not an abstract model but incorporates real measurements of a particular individual's entire optical system. In its simplest form, these measurements can be the individual's eyeglasses prescription; beyond that, more detailed measurements can be obtained using an instrument that captures the individual's wavefront aberrations. Using these measurements, synthetic images are generated. This process modifies input images to simulate the appearance of the scene for the individual. Examples will be shown of simulations using data measured from individuals with high myopia (near-sightedness), astigmatism, and keratoconus, as well as simulations based on measurements obtained before and after corneal refractive (LASIK) surgery.

Recent work on vision-correcting displays will also be discussed. Given the measurements of the optical aberrations of a user's eye, a vision correcting display will present a transformed image that when viewed by this individual will appear in sharp focus. This could impact computer monitors, laptops, tablets, and mobile phones. Vision correction could be provided in some cases where spectacles are ineffective. One of the potential applications of possible interest is a heads-up display that would enable a driver or pilot to read the instruments and gauges with his or her lens still focused for the far distance.



PERFORMANCE ANALYSIS OF WIRELESS INDUSTRIAL NETWORKS - CHALLENGES AND TRENDS

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http://etai.org.mk/wp-content/uploads/2018/06/CV_Neda_Petreska_ETAI.pdf

Abstract: The increased deployment of wireless networks in industrial settings enhances the need to provide performance guarantees while at the same time demands resource-efficient network operation. Especially for multi-hop wireless networks, characterized by fading channels and queueing effects, an appropriate analytical framework to compute an end-to-end statistical delay guarantee is needed. Moreover, a transmit-power-efficient packet transmission is especially important in energy-limited networks or industrial settings with high coexistence management requirements.

This talk discusses the research challenges for such scenarios and elaborates how the mentioned aspects can be combined in order to obtain analytical formulation of multi-hop network performance under delay constraints. It further presents a delay bound-based optimal power allocation for heterogeneous wireless multi-hop networks.

Typical industrial applications which would benefit of such performance analysis in the process of network design are discussed in addition. The obtained results are illustrated via numerical examples, mostly for TSCH-like networks, for which the resulting network lifetime duration is compared towards a system optimum gained via simulations.



ETAИ СЕСИИ ETAИ SESSIONS

ETA1 1: ARTIFICIAL INTELLIGENCE (1)

ETA1 1-1

DATA COLLECTION MODULE FOR HUMAN ACTIVITY RECOGNITION

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Abstract: Unobtrusive human activity monitoring using cheap and widely available sensors are the future for human activity recognition. It will support the extensive penetration of new applications in Ambient Assisted Living (AAL), Smart Homes (SH), Smart Cities (SC) and Health Monitoring (HM). The biggest challenges in these applications are the automatic processing and analyzing the large amounts of sensory data as well as building machine learning models for monitoring, detection, recognition and prediction of an activity, movement, state or an event. The aim of this research is to develop a data collection system that will enable detection and monitoring of human activity using very low-cost, unobtrusive passive infrared and microwave radar sensors. Our data collection module is composed of Arduino microcontroller, SD card module and real time clock module and enables connecting several sensors which measurements are to be logged. In our experiments we used a modified microwave radar sensor RCWL-0516 and a modified passive infrared sensor HC-SR501. Both are extremely low cost, easily accessible sensors usually used for general purpose applications like motion detection for light switching. Both sensors were modified in a way to make the raw analog output of the sensor available for logging by the microcontroller. The data collection module enables collecting measurements of up to 4 analog (10-bit precision), and up to 8 digital sensor inputs with sampling rates of up to 200 samples per second. The measurements are logged on a SD card including a precise timestamp that will enable the logs of several modules to be joined together keeping the time alignment of the readings. A separate setup for synchronized initialization of the RTC modules of the separate sensor modules is also presented. A series of experiments in a control environment with volunteers were conducted and the collected data from the sensors are pre-processed and labelled for further analysis and application of machine learning based approaches for automatic recognition and monitoring of human activity.

Key words: human activity recognition, passive infrared sensor, microwave radar sensor, Arduino, real time clock initialization



ETAI 1-2

DEEP REINFORCEMENT LEARNING FOR GOAL-DRIVEN ROBOT NAVIGATION

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Abstract: Mobile robots that operate in real-world environments need to be able to safely navigate their surroundings. Obstacle avoidance and/or path planning is a crucial capability for the autonomy of such systems. However, for new or fast changing environments, navigation methods that rely on an explicit map of the environment can be impractical or impossible to use. We present a new navigation method where a recurrent neural network is trained to navigate the robot without an explicit map of the environment. The navigation network is trained using a method based on the Advantage Actor-Critic (A2C) reinforcement learning method. We evaluate and compare our navigation method with a standard map-based approach on navigation scenarios in simulation and demonstrate that our methods work when the standard approach fails. We also show that our method works on a real robot.

Key words: Navigation, Mobile robotics, Deep reinforcement learning, POMDP

ETAI 1-3

MULTI-SENSOR HUMAN ENERGY EXPENDITURE ESTIMATION USING ENSEMBLE LEARNING

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Abstract: Measuring and monitoring energy expenditure is an important part of many medical and sports applications. Accurate estimation is a difficult task, primarily because it requires a lot of equipment, which makes it impractical for everyday use. However, the increasing accessibility of different sensors opens up the possibility of new methods for energy expenditure estimation. This paper presents two machine learning approaches, single-regression and ensemble-regression learning, for energy expenditure estimation of individuals wearing equipment consisting of two 3-axis accelerometers, a Zephyr sensor and a BodyMedia sensor. Since it is important to obtain proper multi-sensor measurements without great effort, the previously designed models were tested on data provided by the Zephyr and BodyMedia sensor in combination with accelerometers separately. The results showed that the ensemble methods outperformed the single regression methods, in terms of lower Root Mean Square Error and Mean Absolute Error. Additionally, the performance achieved by the Zephyr device is better than the BodyMedia device and is comparable with the performance

achieved by the model that uses the data from all the devices.

Key words: energy expenditure estimation, wearable sensors, machine learning

ETAI 1-4

MODELLING AND FORECASTING SEASONAL TIME SERIES IN TOURISM, CASE STUDY FOR REPUBLIC OF MACEDONIA

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Abstract: Time series analysis for basic tourism parameters in the Republic of Macedonia have accentuated seasonal component. Some of them have also accentuated trend in the last several years, but also rising variance during the time, or heteroscedasticity. All these characteristics of tourist demand time series make them real challenge for modeling. There are different types of models that can be used for modeling of time series with accentuated seasonal component. In this paper we'll use ARFIMA model for time series analysis, and we'll test several parameters of the series and their influence on the fit of the model and validity of the model. For accepted models we'll make forecast for one year in advance.

Key words: component, time series, modelling, parameters, forecasting.

ETAI 1-5

LARGE-SCALE SMARTPHONE-BASED TRANSPORTATION RECOGNITION USING MACHINE LEARNING

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Abstract: Activity and transportation recognition is a research field aiming at automatic recognition of user activities and transportation means. In the past this task has relied heavily on GPS sensor, but it's high power consumption and need for an unobstructed view of a satellite have made it a suboptimal solution. This paper aims to solve this classification problem using data from smartphone sensors (inertial and ambient sensors) as input to a multi-class classifier. We used the SHL dataset, which is the largest dataset for transportation recognition, collected by smartphones used on a daily basis in real life for a period of 4 months. The proposed solution is lightweight because the algorithm should be



processed on the smartphone itself. Therefore, we applied a pipeline that includes: feature extraction, reducing the features by two feature selection techniques, and finally applying a light classification method to recognize the activity and the transport of the user in real time. We performed a comparison of 6 classification methods, and hyperparameter analysis of the best performing one – Random Forest. The results showed that it achieves 83% F1-score, and that motor-vehicle activities (car, bus, train, subway) are more difficult to recognize than the ones that do not have motorized vehicle (being still, walking, running, cycling). Additionally, the train and the subway are mutually misclassified, as well as the car and the bus.

Key words: transportation recognition, activity recognition, sensors, smartphone, machine learning model, feature analysis

ETAI 1-6

FITTED RULE ENSEMBLES FOR MULTI-TARGET REGRESSION WITH RANDOM OUTPUT SELECTIONS

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Abstract: In this paper, we address the task of multi-target regression. We merge two existing algorithms in order to induce better-performing rule ensembles. We use random forests of predictive clustering trees with random output selections to learn an ensemble which is then decomposed and optimized by the fitted rule ensembles method in order to find a good subset of rules. We propose a new variant of aforementioned rule learning system, where we include rules that only give predictions for a subset of target attributes. We illustrate the proposed method on a benchmark dataset for community structure modelling of microorganisms in Slovenian rivers.

Key words: rule learning, ensemble learning, multi-target regression



ETAI 2: ELECTRONICS (1)

ETAI 2-1

ON THE CHOICE OF NUMBER OF TRAINING SIGNALS FOR OPTIMAL POWER QUALITY DISTURBANCES CLASSIFICATION

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Abstract: In this work we investigate the influence of the different number of input power quality (PQ) signals for training the support vector machine (SVM), decision tree (DT) and random forest (RF) classifiers, in order to obtain optimal classification model. The investigation is made in case of 7 and 11 classes of PQ disturbances, for pure PQ signals and PQ signals accompanied with 20dB, 30dB, 40dB and 50dB evenly distributed white Gaussian noise. Due to the fact that in measurements the level of noise is not fixed, there is a need of classification model that gives nearly highest accuracy for each level. The investigation has shown that the RF classifier, unlike other classifiers, does not exhibit significant changes in its accuracy, as the number of input signals is changed. It is also shown that RF gives high accuracy for both number of classes, whether the signal is pure or accompanied with noise. Hence, RF represents an optimal method for classification of PQ disturbances.

Key words: support vector machine, decision tree, random forest, power quality, classification

ETAI 2-2

AN ALGORITHM FOR QUALITY CONTROL OF AUTOMATED FIBER PLACEMENT

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Abstract: The paper presents an algorithm for detection of surface defects that appear in the process of automated fiber placement. The algorithm is designed to detect of six different defects. Defective regions appear in the form of vertical deviations on the surface; therefore, input data for the algorithm is provided using profilometer. The paper presents result from experimental testing of the algorithm, displaying also, situations in which algorithm fails to produce reliable results.

Key words: algorithm, defects, fitting, inspection



ETAI 2-3

IMPROVED TECHNIQUES OF COMPRESSED SENSING AND PARALLEL IMAGING FOR BRAIN MRI

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Abstract: This article explains way of improvement on compressed sensing and parallel imaging techniques for brain MRI. New sampling mask has been generated, which improves the initial results, combining it with translation invariant wavelet transform.

Key words: MRI, compressed sensing, parallel imaging, wavelet transform, POCS, zero-filled, GRAPPA

ETAI 2-4

FRONT VIEW VEHICLE RECOGNITION

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Abstract: This paper addresses the subject of vehicle recognition based on images or videos captured with a camera located in front of the approaching vehicle. Such camera setup is consistent with many real-world applications, such as paid parking lots, tolls, bridges, or any conditional access facilities. Here, we propose a recognition algorithm based on image processing and machine learning. The proposed algorithm obtains high accuracy vehicle recognition and classification, even without implementing any plate recognition.

Key words: Vehicle Recognition, Image Processing, Machine Learning.

ETAI 2-5

SEGMENTATION OF BOXES FROM A 3D POINT CLOUD FOR AUTOMATIC UNLOADING

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Abstract: This paper presents an algorithm for localizing, recognizing and

segmenting packaging boxes from a 3D point cloud representation of a scene, intended to be used for automatic trailer unloading. A typical packaging scenario contains piles of boxes of different sizes and shapes placed in arbitrary configurations, which results in a high degree of occlusion. The proposed algorithm relies on the structure of the packaging boxes which represent cuboid shapes comprised of orthogonal planes. Our work proposes the use of RANSAC (RANdom SAMple Consensus) for extracting planes from the input point cloud as the first step. A sequence of post-processing techniques is applied to the output of RANSAC to resolve the incorrectly assigned points, and the conditions for planes to form a box which are implied from the cuboid shape of packaging boxes – orthogonality and sharing a common edge, are exploited for combining the resulting planes into boxes. The algorithm is evaluated with simulated and real 3D point cloud data of different packaging scenarios.

Key words: segmentation of boxes, 3D point cloud, automatic unloading

ETAI 2-6

METHOD FOR OBJECT DETECTION USING ANALYSIS OF A SEQUENCE OF NEAR-INFRARED IMAGES PROCESSED BY BACKGROUND SUBTRACTION TECHNIQUES

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Abstract: This paper presents a method for robust detection and classification of moving objects, for instance, pedestrians and cyclists in dark street environments. The proposed method is based on computing geometric parameters of objects gathered by low-resolution cameras and is aimed at processing using low-power x86 cores that can be used in modern IIOT systems. The detection method uses results (mask) of applying background subtraction techniques on sequence of near-infrared images as input data. The suggested method compensates dynamic lighting sensitivity of background subtraction methods via analysis of objects' parameters. The given method is especially usable in a dark ambiance in presence of different weak light sources such as car lights and street lighting systems.

Key words: detection, algorithm, camera, near-infrared, OpenCV

ETAI 3: TELECOMMUNICATIONS

ETAI 3-1

RESOURCE ALLOCATION IN WIRELESS POWERED COMMUNICATION NETWORKS WITH IMPERFECT CSI

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Abstract: Assuming imperfect channel state information (CSI), we propose a resource allocation policy that maximizes the achievable sum rate in uplink. The proposed policy assumes that the energy harvesting units (EHUs) spend only a part of the available harvested energy in their batteries, and save the rest of it for future use. By simulation, we evaluate the influence of the number and the power of the pilot symbols, and the number of EHUs to the achievable sum rate. Additionally, we estimate the loss in the achievable sum rate compared to the system with perfect CSI.

Key words: energy harvesting, uplink TDMA WPCN, channel estimation, imperfect CSI

ETAI 3-2

SPECTRUM ASSIGNMENT IN ELASTIC OPTICAL NETWORKS

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Abstract: The emergence of new ICT applications has triggered a significant growth of traffic volume. As a result, novel flexible and adaptive concept for optical networks management emerged in order to meet the heterogeneous and variable traffic demands. The efficient spectrum usage has become one of the most important issues since the optical spectrum is not an infinite resource. This paper in particular provides a review on Routing and Spectrum Assignment (RSA) in Elastic Optical Networks (EONs). The main aim of the paper is to provide description of the spectrum assignment scheme as a keystone in the process of analyzing, designing, planning, and operating an EON. Hence, through MATLAB simulations a scheduling scheme for spectrum assignment in EONs is analyzed, evaluated and validated.

Key words: bulk data transfer (BDT), elastic optical networks (EONs), fix rate immediate transfer (FRI), routing and spectrum assignment (RSA)

ETAI 3-3

DESIGN OF TWO LEVEL TRANSMIT SIGNAL WAVEFORM FOR WIRELESS POWERED COMMUNICATION NETWORKS

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Abstract: Abstract—We analyze the influence of the transmit waveform on the average receive power in an energy harvesting (EH) receiver with single diode rectifier. We approach the problem from time domain perspective. To get insight into the influence of the waveform, we restrict the baseband waveform amplitude to a two level signal, with voltage values x_1 and x_2 , and respective occurrence probabilities, $a = P_r\{x_1\}$ and $b = P_r\{x_2\}$. Under these constraints we determine the optimal values of the two levels and the optimal probabilities that lead to highest average receive power. As a result of the analysis, the optimal Peak to Average Power Ratio is found for such system.

Key words: energy harvesting, wireless powered transfer, waveform design, two level baseband signal

ETAI 3-4

IMPLEMENTATION OF A COMPRESSIVE SAMPLING STEPPED FREQUENCY RADAR ON A USRP

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Abstract: We investigate an implementation of a compressive sampling (CS) stepped frequency radar using a USRP. Our approach uses a baseband stepped frequency signal, which is upconverted to RF, and, then, frequency hopping the RF carrier frequency to obtain several subbands to increase bandwidth and resolution. Due to the small number of targets, the response consists of a small number of delayed signals, i.e. the delays can be treated as a sparse signal, and therefore, CS approach is applicable. Here we apply CS in frequency domain since we use stepped frequency radar. The baseband stepped frequency signal uses a number of random frequencies from each subband. The reconstruction uses Basis Pursuit denoising (BPDN) algorithm. The resolution is significantly improved compared to the IDFT method, although the number of measurements is reduced. The CS approach to USRP implementation of stepped frequency radar significantly reduces the measurement time. Cross validation is used to estimate the parameter in the BPDN constraint, which reflects the trade-off between sparsity and reconstruction fidelity.

Key words: Stepped frequency radar, Compressive sampling, USRP implementation, RF subbands, BPDN, Cross validation



ETAI 3-5

DRAFT CONCEPT FOR ENERGY EFFICIENCY IMPROVEMENT WITH SMART PHONES AND ARTIFICIAL NEURAL NETWORKS USAGE

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Abstract: Telecommunication and IT devices and tools are taking significant role in managing of daily activities of the consumers, which is opening a possibility for their usage in energy efficiency improvement. One possibility is to use them to change the consumer behavior in energy consumption. In this paper, the proposed model is using smart phones and artificial neural networks as tools for consumer data collection and processing, as well as prediction and instruction of consumer activities for reduction of energy consumption. The proposed model should identify the consumer status, the dependence and link with the energy provider, and to predict and to influence their energy consumption.

Key words: smart phones, artificial neural networks, energy efficiency, concept and proposed model, consumer behaviour

ETAI 3-6

PERFORMANCE OF ERROR CORRECTING CODES IN WAKE- UP-RADIO WIRELESS SENSOR NETWORKS

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Abstract: The wireless sensor networks (WSNs) are crucial point to the emerging Internet of Things (IoT) technology. Since their presence will become ubiquitous in IoT, the data they collect and send will be more or less sensitive, depending on the application. Hence, the importance of safe and reliable communication via the wireless communication channel is immense. In this paper, we present a model of WUR (Wake-up radio) WSN in which the main receiver is off when it doesn't communicate with the other nodes, but an auxiliary low-power receiver, called WUR, is employed. If the received bit-sequence is matching the address of the sensor itself, then the main radio is activated. The wireless communication channel is prone to errors, and for that reason in this paper we will present the different error correcting codes that we used and compare them in terms of BER (bit-error rate) and number of false-positive alarms. Also, the performance without using such a code will be evaluated. Because of the frequent occurring errors, the number of re-sent sequences in the WSN will be



significant. The energy efficiency of the implemented codes will be also discussed.

Key words: wireless sensor network (WSN), wake-up radio, error correcting code, bit-error rate (BER), energy efficiency

ETAI 4: AUTOMATICS (1)

ETAI 4-1

FROM RECURRENT NEURAL NETWORKS TO HUMAN NEURONAL NETWORKS AND BACK: A COMPUTATIONAL BIO-CYBERNETICS (INVITED PAPER)

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Abstract: An unprecedented rapid development of software for various technological applications is taking place, largely based on cognition science and pattern recognition, during the last few years. And even more so many claims have been put forward by various software applications all designated as being Artificial Intelligence (AI) developments, quite many based on Science of Neural Networks. Though, since the artificial neuron of McCullock and Pitts (1943) via Hopfield's neurons (1984) to Hagen and co-authors (Oklahoma State University, 2012) neural designs and to Kasabov spiking-neurons 'neucube' (2014) and evolving connectionist systems (2003), Science of Neural Networks has undergone developments beyond any predictions that have been put forward in due course. Rightly so Hagen and Co-authors begin their book with this very first sentence: "As you read these words you are using a complex biological neural network. You have a highly interconnected set of some 1011 neurons to facilitate reading, breathing, motion and thinking. Each of your biological neurons, a rich assembly of tissue and chemistry, has the complexity, if not the speed of microprocessor. Some of your neural structure was with you at birth. Other parts have been established by experience." – the quotation ends. There is no step further indicated into the other side of the complexity of neuronal and neural networks spectrum. Yet, on the other side of this spectrum Science of Neurophysiology (Gayton and Hall; 2006) yielded insights [2], [12], [39] converging closer and closer to Science of Systems Biology [9] based approach to brain's living complex neuronal network. Those appear to be rather involved concepts and ideas on the crossroad with Kolmogorov's representation superposition and Hilbert's Thirteen Problem, which appeared to yield emergence of certain delicate subtle issues (Sprecher; 2017). This paper gives one perception of these issues and a revised insight into the foundations of past developments, possibly by re-thinking the realm of recurrent artificial neural networks which possess time-varying delays within the setting of recent new stability results (Yan et al., 2015; 2016) to which the authors have been involved. Furthermore, it attempts to combine those two spectrum-ends in a cybernetic convolution thus giving new prospect for innovative findings with novel AI potential for applications.

Key words:

ETAI 4-2

PERFORMANCE ANALYSIS OF DUPID CONTROL OVER CSTR SYSTEM WITH VARYING PARAMETERS

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Abstract: In this paper the dynamically updated PID (DUPID) controller has been discussed in detail. This paper provides a detailed case study in which the DUPID and the PID controller are compared when both are used for control of CSTR system with time varying parameters, including the heat transfer coefficient and the feed fluid temperature. For the sake of comparison of both controllers ability to deal with plant's changing parameters, simulations were conducted under different operating conditions of the plant. The results from the simulations have shown that the DUPID beats the control performance of the PID by average of 47%.

Key words: dynamically updated PID, PID controller, continuous stirred tank reactor (CSTR) system

ETAI 4-3

STABILITY OF NONLINEAR DESCRIPTOR SYSTEMS AND APPLICATION TO STABILIZATION OF QUADCOPTERS

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Abstract: In this paper, new sufficient Lyapunov-like stability conditions and new sufficient Lyapunov-like stabilizability conditions for nonlinear descriptor systems with control are presented along with their applications to quadcopter's flight stabilization. Most of these results are rather practical because they do not need solving nonlinear differential equations and nonlinear algebraic equations. Thus the usage of these new results requires only differentiation of functions.

Key words: nonlinear descriptor system, Lyapunov-like stability, nonlinear hybrid control, quadcopter stabilization

ETAI 4-4

NOVEL CHARACTERIZATIONS FOR SWITCHED NONLINEAR SYSTEMS WITH AVERAGE DWELL TIME: FURTHER FINDINGS

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Abstract: It is well known, present day theory of switched systems is largely based on assuming certain small but finite time interval termed average dwell time. Thus it appears dominantly characterized by some slow switching condition with average dwell time satisfying a certain lower bound, which implies a constraint nonetheless. In cases of nonlinear systems there may well appear non-expected complexity phenomena of particularly different nature when switching becomes no longer. A fast switching condition with average dwell time satisfying an upper bound is explored and established. A comparison analysis of these innovated characterizations via slightly different overview yielded new results on the transient behaviour of switched nonlinear systems, while preserving the system stability. The multiple-Lyapunov functions approach is used in the analysis and switched systems framework is extended shading new light on the underlying, switching caused system complexities.

Key words: arbitrary switching, average dwell time, lower bound condition, multiple Lyapunov functions, switched nonlinear systems, stability, upper bound condition

ETAI 4-5

DYNAMIC MODELING AND CASCADE CONTROL DESIGN FOR QUADROTORS

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Abstract: This paper presents the systematic dynamic modeling of the multicopter –



quadcopter, including the dynamics of the motor and propellers. Consequently, a stabilizing cascade control for a quadcopter is designed, which ensures robust trajectory tracking performance. The comparison of using a linear cascade PID-PD and combination of PID-MPC is performed on 3D tracking referent trajectories. The results are obtained from the MATLAB simulation model.

Key words: quadcopter dynamics, control system design, linear control, trajectory tracking

ETAI 4-6

COMPARISON OF A STANDARD PID AND ENHANCED PID CONTROLLING STRUCTURES WHEN APPLIED TO A SISO WATER TANK SYSTEM

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Abstract: In this paper a comparison of the ability of two control structures to maintain a given water level in a nonlinear water tank is assessed. The control structures in question are a standard PID controller and a controller comprised of a standard PID and a supervisory mechanism based on a quadratic polynomial model. The reason for this comparison to be made is the questionable ability of the standard predesigned PID controlling structure to adapt to an unforeseen change in the model of the controlled system, and our desire to counter that. This is achieved with a recently developed supervisory mechanism in the latter structure, which as an additive term to the standard PID tries to counter the change in the parameters of the system. The system on which this comparison is made is a singleinput single-output (SISO) water tank. From the results it is evident that the PID controller with the supervisory mechanism is superior to the stand-alone PID controller in certain settings.

Key words: PID controller, supervisory mechanism, SISO, SIMO, water tank



ETAI 5: INFORMATICS

ETAI 5-1

COMPARISON OF SD NEAR- AND OFFSHORING PROJECTS REGARDING ASSETS AND DRAWBACKS RESULTING FROM CULTURAL AND GEOGRAPHIC DISTANCE

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Abstract: Research comparing near- and offshoring projects regarding assets and drawbacks is hardly available. The study results showed that software development (SD) projects offshored to India were more influenced by cultural and geographic distance than those nearshored to Russia regarding the researched areas management complexity, communication difficulties, project and task complexity, output quality and impact of misunderstandings. The application of informal control, the possibility of face-to-face contacts and the development of trustful relationships are essential to mitigate the negative impact of culture and distance.

Key words: SD offshoring, SD nearshoring, culture, globe study, geographic distance, control

ETAI 5-2

BLOCKCHAIN BASED TRANSFORMATION IN GOVERNMENT: REVIEW OF CASE STUDIES

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Abstract: Blockchains are immutable digital ledger systems implemented in a distributed way and usually without a central authority. Each transaction in the public ledger is verified by consensus of a majority of the participants in the system. Once entered, information can never be erased. The blockchain contains a certain and verifiable record of every single transaction ever made. It operates in a decentralized peer-to-peer network using cryptographic algorithms to verify, validate and distribute transactions across millions of nodes, enabling the secure, auditable, transmission of assets without intervention by a central authority.

The economic, political, humanitarian, and legal system started realizing the benefits of Bitcoin and blockchain technology and the fact that this is potentially an extremely powerful technology that could have the capacity to modify many aspects of society and its operations.



This document provides a short, high-level technical overview of the blockchain technology. It provides a review of application beyond crypto-currencies and financial applications through use cases in government and public services.

Key words: Blockchain, distributed systems, eGovernment, digital transformation

ETAI 5-3

MANAGE VARIABILITY IN OBJECT-ORIENTED APPLICATIONS WITH FEATURE MODELS

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Abstract: This method helps developing configurable object oriented applications in a practical way by using feature models. It has several steps to develop an application. Firstly, a feature model should be designed with respect to the variability points in the domain. By using this feature model, our code generator produces automatically the source code templates including interfaces, configurator classes and entity classes with attributes designed specially as data structures to be used to manage variability. Then, software developers develop application by using the generated source code and data structures considering the commonality and variability of the domain, so the final application can work for various feature combinations. That is, the application developed with our method takes just a configuration file including user selections in a pre-defined domain by using the feature model as an input and then automatically configure and manage itself with respect to these selections during run-time.

Key words: Feature Model, Feature Oriented Software Development, Object Oriented Programing, Variability in Feature Models

ETAI 5-4

PERFORMANCE MEASUREMENTS OF IN-MEMORY AND HARD DISK DATABASES USING TPC-C SCHEMA WORKLOAD

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Abstract: Nowadays optimization of databases using in-memory architecture is considered a real option. This paper will address performance measurements including advantages of using in-memory optimized tables instead of hard disk database tables. In particular, two different scenarios of performance measurements for OLTP databases will be



performed, and the same TPC-C schema workload will be applied on both database architectures, which will be run on the same hardware machine. Comparative analysis approach will be used in order to evaluate the performance of in-memory optimized databases. The derived results will be based on the selected number of virtual users and the number of warehouses used. Moreover, TPM and NOPM metrics will be used for performance measurement calculations.

Key words: workload, test, memory, tpc-c, measurement, oltp, optimization, performance

ETAI 5-5

ANALYSIS OF THE DISTRIBUTED LEDGER TECHNOLOGIES: A SURVEY OF THE MOST POPULAR BLOCKCHAINS

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Abstract: By offering trust, transparency, and relieving the middleman from its centralized authority through giving the decisive power to the entire community, the Distributed Ledger Technology (DLT) is successfully disrupting multi-billion dollar industries, such as finance, medicine, transport and many more. A wide range of companies are nowadays putting their efforts into building their specialized solutions by leveraging the power of programmable DLT, which has significantly increased the risk of fraud since people are pouring their money into almost everything that has the word blockchain in it.

Building solutions on top of programmable blockchain technologies require simple programming knowledge, but choosing the right distributed technology for the right purpose requires broader knowledge and research since new technology with a unique set of features emerges every day.

In this paper, we compare the most popular blockchain technologies focusing on development, scalability, and consensus. We also analyze popular startups beyond financial operations and cryptocurrency, which have raised millions into disrupting every aspect of our lives.

Key words: Blockchain, DLT, use cases



VARK LEARNING STYLES AND ONLINE EDUCATION: CASE STUDY

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Abstract: In this paper we seek to understand the outcomes of online education by observing the role of learning styles. Under the assumption that the behaviors that maximize learning are dependent on the delivery method, we compared learning outcomes of students participating in two classes set up on an interactive e-learning platform. Our results show that learning styles are variables worthy of consideration in online settings, even though the correlation among learning styles and test results does not indicate a significant association. Specifically, we argue that online education demands a particular set of behavioral patterns (i.e., low companionship, achievement orientation) necessary to navigate the eccentricity of online education (e.g., social isolation, schedule flexibility). We discuss the theoretical implications of our results in the context of online education and offer practical suggestions for online teaching design.

Key words: quality of experience, VARK, online education.



ETAI 6: ELECTRONCS (2)

ETAI 6-1

INFLUENCE OF SEGMENTATION ON THE PRECISION OF CIRCUIT BASED METHODS

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Abstract: All numerical methods are based on segmenting the domain of calculations. In this paper the influence of wire segmentation on the precision of calculations of approximate numerical models for analysis of grounding systems is investigated. It is well known that increasing the number of segments leads to increased precision in the calculations. However, the maximum number of segments is limited by the conditions from the thin wire approximation that is implemented by these methods. As a result convergence of the numerical technique may not always be reached. In this paper convergence of the relative error obtained by each numerical method as a function of relative segment length is parametrically investigated.

Key words: segmentation, numerical models, convergence

ETAI 6-2

COMPARISON OF APPROXIMATE MODELS FOR HIGH- FREQUENCY ANALYSIS OF GROUNDING SYSTEMS IN UNIFORM EARTH

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Abstract: Electromagnetic model for grounding analysis and its approximations are traditionally based on the Sommerfeld's resolution for Hertz vector potentials. However, another resolution based on transverse Hertz vector potentials is also valid. This paper shows that approximate model based on this resolution provides best results among existing alternatives. Accuracy of proposed approximation is validated for different arrangements of grounding electrodes, different excitations and for wide range of parameters in the domain of interest for grounding analysis.

Key words: electromagnetic, full-wave, grounding, transverse potentials, Sommerfeld



ETAI 6-3

DEVELOPMENT OF MODULAR INSTRUMENTATION CALIBRATION PROCEDURE AND UNCERTAINTY ESTIMATION

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Abstract: Modular instrumentation offers significant configuration flexibility, as well as interchangeability, speed, and size advantages when it comes to deploying measurement or automation systems. However, the architecture that enables these advantages also introduces certain challenges when calibrating modular instruments. The calibration is often conducted outside of the instrument's usage environment. For modular instrumentation, this may mean performing calibration on a module with a different chassis and its related electronics. Additionally, the module's ambient environmental conditions depend upon chassis fan speed, the use of slot blockers and the presence of other modules. The operating software and CPU for modular instruments are contained outside the module in an external computer, which often does not travel with the module to be calibrated. Modular instrumentation may require multiple modules configured together to provide measurement capability, which may require calibration on the entire set of modules as a system or, a method to relate system level performance to the calibrated performance of individual modules. These issues affect both the calibration and the calibration report. This paper provides an overview of the concept of modular instrumentation and explores issues concerning modular instrument calibration in detail and addresses the requirements for assuring the ability to make traceable measurements using calibrated modular instrumentation. A case study of a modular PXI instrument calibration is also presented in the paper.

Key words: modular instrumentation, calibration, PXI, measurement uncertainty

ETAI 6-4

IMPROVEMENT OF THE FEIT LABORATORY OF ELECTRICAL MEASUREMENTS BEST CMC THROUGH INTERNATIONALLY TRACEABLE CALIBRATIONS AND INTER-LABORATORY COMPARISONS

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Abstract: The paper presents the process of maintaining and improving calibration



and measurement capabilities of calibration laboratory for electrical quantities. The improvement in the calibration and measurement capabilities in FEIT calibration laboratory is performed by periodical examination of its primary reference standards with standards traceable to BIPM quantities. The traceability in the laboratory itself is further accomplished with an intra- and inter-laboratory comparisons of instruments and standards with different levels of accuracy.

Key words: calibration, traceability, reference standards, uncertainty

ETAI 6-5

PROPOSAL OF SMALL WIND TURBINES APPLICATION IN A MICROGRID AT THE UNIVERSITY CAMPUS

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Abstract: This paper describes the potential of different types of renewable energy sources in the Republic of Serbia, with a special focus on wind energy, contrasting the very same with resources in Europe and the world, the possibilities and justification for their usage with respect to the key parameters that are used for design and the use of generators of electricity obtained by conversion of the energy of solar radiation at a specific micro-location. In addition, the paper analyses and describes the construction of small wind turbines planned on the roof of the Faculty of Technical Sciences in Novi Sad, which is a type of renewable energy source that produces a symbolic amount of electricity and acts as a practical polygon for students. The paper presents a techno-economic and environmental analysis of the application of the small wind turbines within the idea concept of a microgrid in the university campus, with a special focus on the annual energy production, investment costs and avoided CO₂ emissions realized through the use of proposed distributed energy sources.

Key words: microgrid, distributed energy resources, power electronics, small wind turbine, wind energy



CALCULATION MODEL CONFIGURATION FOR SMALL FIELDS IN RADIOTHERAPY

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Abstract: To be able to achieve high precision and accuracy in treatment delivery, small fields characteristic should be analyzed very carefully. For this purpose, the most important aspects are the dosimetry measurements for small field parameters and the dose distribution calculation in Treatment Planning System (TPS). The goal of this paper is to analyze the output factors and their impact into calculation model configuration.

Using 6 MV photon beam produced by Varian iX accelerator and two PTW detectors, output factors are measured in the same conditions; on certain depth into the water phantom. A small photon field is generally defined as the one having dimensions smaller than the lateral range of the charged particles that contribute to the dose deposited at a point along the central axis of the beam [8,9]. According to this criterion, field sizes of less than 4 x 4cm² are considered to be small for 6 MV photon beam [10]. On the other hand, if one dimension is smaller than 4 cm, the small field characteristics are also present. These rectangular fields are taken into account as small fields

These two series are inserted into TPS (analytical anisotropic algorithm – AAA) to configure the calculation models. Both calculation models, the reference one from microDiamond detector measurements and the additional one from diode P detector measurements, are compared.

Point dose comparisons for the same square fields show a difference in dose at a point greater than 1 % for only the smallest measured field. At repeated measurements the difference is consistent. According to the results analysis, the diode detectors were found suitable for output factor measurements.

Key words: small field, output factors, photon beam, configuration



ETAI 7: AUTOMATICS (2)

ETAI 7-1

COMPUTER-BASED SIMULATION AND VALIDATION OF ROBOT ACCURACY IMPROVEMENT METHOD AND ITS VERIFICATION IN ROBOT CALIBRATION PROCEDURE

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Abstract: Algorithm for improving accuracy of six-axes robot is developed and validation method based on computer simulation is implemented. Optimization is used to minimize the distances between nominal and actual positions of the tool. That way, the parameters of the robot are calibrated and using such calibrated parameters, accuracy of the robot is significantly enhanced.

Measurement is done using API Radian laser tracker and experimental data is collected on KUKA 480 R3330. For the set of 75 points used for calibration, simulation predicted reduction of the mean of the total displacement error from 1.619 mm to 0.174 mm. After that, the same points were used for verification procedure. Another measurement is performed, using the calibrated parameters and numerically calculated compensation of the machine coordinates of the robot. The mean of total displacement error was 0.293 mm and that way the correctness of described method is verified.

Key words: robot calibration, robot accuracy, robot precision, parametric calibration, optimization

ETAI 7-2

RELIABLE ROBUST TRACKING CONTROLLERS DESIGN REVISITED: AN IMPROVED LMI BASED SYNTHESIS

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Abstract: The synthesis design problem of reliable tracking controllers against

actuator faults is a continuing research challenge. Linear uncertain plant systems with a more general model of actuator faults are considered and sufficient conditions for the existence of a reliable tracking controller derived. Based on these findings a state feedback reliable controller design using LMI based methodology is elaborated on. Furthermore, a comparison analysis is carried out of control system employing this novel reliable tracking controller and the system without one, which demonstrated the necessity of reliable tracking control. The obtained results for a case-study example illustrate the effectiveness of the proposed synthesis.

Key words: linear uncertain plants, reliable control, synthesis design, tracking control, quality performance

ETAI 7-3

RELIABLE ROBUST ADAPTIVE CONTROL FOR UNCERTAIN SWITCHED FUZZY SYSTEMS: DESIGN SYNTHESIS REVISITED

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Abstract: The robust stabilization problem for a newly model of uncertain switched fuzzy systems, in which each subsystem of the switched system is an uncertain fuzzy system, is investigated and solved. A robust fuzzy adaptive reliable controller is constructed to ensure the relevant closed-loop system is uniformly ultimately bounded despite a seriously faulting actuator hence the residual actuator part cannot enforce stable operation of the original system. This controller is designed using the concept of switching control along with multiple Lyapunov function method. The switching strategy enforcing the uniformly ultimately bounded stable operation of the uncertain switched fuzzy system is given. An illustrative example and its computer simulation results demonstrate the effective feasibility of the proposed reliable control synthesis.

Key words: linear uncertain plants, reliable control, synthesis design, tracking control, quality performance



ETAI 7-4

DESIGN OF AUTONOMOUS MOBILE ROBOT FOR PRECISE AGRICULTURE APPLICATIONS

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Abstract: Robots are finding their way into the agricultural fields. Robots which are light, neat in movement and are able to operate in unstructured environments will play a considerable role in the development of sustainable and efficient farming systems. Integration of many sensors, systems and algorithms into a working, operating autonomous mobile robot is presented. Four wheel drive designs are requested. This paper discusses in details the challenges that we have encountered during the design and development of the robot. Mobility test was performed. Experimental results pointed out the ways to improve maximum traverse range.

Key words: flying wing, UAV, 6DOF model, guidance and control, PID control, simulation

ETAI 7-5

DESIGN, MODELING AND PROTOTYPING OF BIO-INSPIRED MOBILE ROBOT ACTUATED BY PIEZOELECTRIC TRANSDUCERS

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Abstract: This paper focuses on the design and development of a bio-inspired mobile robot using piezoelectric transducers as drives. The design of the device aimed to imitate the trajectory movement of a crawl-like animal. Design constraints as producing controlled movement with piezoelectric transducer, as well as the combination of multiple piezoelectric patches into one mobile robot are presented in their practical aspects. The robot uses 2 piezoelectric transducers as main drives, but also as main structural components of the device. The patches are connected with a thin light rod, and the kinematic of movement is achieved with 4 tiny wooden legs connected on each of the patches.

The project investigates the possibility and effectiveness of the piezoelectric transducers for movement of the bio-inspired mobile robot. From conceptual development, to the mechanical and numerical design and control, the mobile robot is used to test different trajectories of movement. Ni RIO Evaluation kit has been incorporated as a real-time and FPGA control platform for the mobile robot while using LabView programming environment.



To accomplish complex trajectories of movement the velocity of the robot was measured for straight line and rotation of the robot. Mathematical model is built and analyzed through SimMechanics module in Matlab.

Key words: bio-inspired robots, piezoelectric transducers, NI Rio Evaluation Kit, Matlab Simulink

ETAI 7-6

MODELING OF MULTI LOCOMOTION OF SOFT ROBOT

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Abstract: Inspired by nature, engineers have explored the design of soft bio-inspired robots. Soft-bodied robots have potential to exploit morphological computation to adapt and interact. Modeling of the movement of a worm, a caterpillar and an octopus will be presented and analysed in this work. The models rely on segmented approach and variations of external loadings to achieve the desired kinematics of movement using Matlab/Simulink. The parametric results from the simulation lead to a conclusion of optimal number of segments and performance. The actuation of the robot is foreseen to be achieved by shape memory alloys in linear and torsional configuration. Multi locomotion of these bio-inspired soft robots will be analysed.

Key words: soft robots, bio-inspired engineering, modelling, SMA materials, octopus arm, worm-like robots, caterpillar-like robots, MatLab/Simulink



ETAI 8: STANDARDISATION AND REGULATION IN ELECTRONIC COMMUNICATIONS

ETAI 8-1

NET NEUTRALITY: CONSUMER PROTECTION PRINCIPLE

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Abstract: This paper considers net neutrality –the principle that all electronic communication passing through a network is treated equally –in the context of an environment where traffic management, in varying forms and in varying degrees, is ubiquitous. It sets out an overview of these traffic management measures and the factors driving their use. That not all of these measures –despite each contravening a pure concept of “neutrality” –are considered problematic suggests that concerns over the particularly controversial measures may instead stem from a broader issue, such as non-discrimination or the appropriate use of market power. To the extent that some traffic management practices do raise potential concerns, the regulatory response should be –as it is with all issues –proportionate and evidence-based. In practice, this is likely to mean that reliance on existing regulatory frameworks and market-based mechanisms is an appropriate initial response in many instances. If harmful traffic management continues, refinements may be necessary, particularly to improve transparency and reduce switching costs for consumers and, potentially, introduce powers to restrict specific behavior such as blocking and unreasonable discrimination.

Key words: net neutrality, open Internet, ISP, CAP, blocking, throttling

ETAI 8-2

THE NEED OF REGULATION FOR THE OTT SERVICES IN THE WORLD, EUROPE AND MACEDONIA

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Abstract: The dynamic technological development has led to the emergence of new Internet based services, and thus to new business models. The emergence of Internet-based services called OTT (over-the-top) services is important in the development of the information and communication technologies, which are of great importance to users and business. The growth of OTT market has brought the need for a discussion about which regulatory approach is the best and most appropriate and should be established. This paper presents the need for regulation of OTT services and presents their definition and



classification according to BEREC. This paper also presents the interaction between OTT services and electronic communications services, as well as the different regulatory treatment that applies to them.

Key words: telecom industry, OTT services, OTT providers, electronic communication service, regulation

ETAI 8-3

5G STANDARDS (APPLICATION PAPER)

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Abstract: We present the current and future 5G standardization activities going on in ITU and 3GPP. We first discuss the timeline for IMT-2020 development, the three different usage scenarios (eMBB, URLLC and mMTC) and the requirements based on capabilities defined in ITU-R M.2083, and how they relate to the different usage scenarios. We then describe the current 3GPP 5G standardization activities on Release 15 (Phase 1), where most of the work is focused on the New Radio (NR) air interface. We explain both the Non-standalone 5G (with LTE-NR dual connectivity and LTE Core Network) and the Standalone 5G (with 5G NR and 5G Core Network). We also describe the future activities in 3GPP Release 16 (Phase 2) which should be completed by December 2019 and will meet the IMT-2020 requirements and timeline. We then elaborate on 5G NR, where we focus on the Scalable OFDM and Flexible frame structure, but also discuss the Massive MIMO, the mmWaves and the new channel coding techniques. We briefly cover the 5G Spectrum Types (Licensed, Shared Licensed and Unlicensed Spectrum) and Bands (below 1 GHz, 1-6 GHz and above 6 GHz). We then describe the 5G Core network and explain the important concept of network slicing. Finally, we present the activities within the Technical Committee for Electronic Communications of the Standardization Institute of Republic of Macedonia, where most of the work is focused on adopting ETSI EN standards as national standards and withdrawing old and conflicting standards.

Key words: IMT-2020 usage scenarios and requirements, 3GPP Release 15 and Release 16, 5G New Radio (NR) air interface, Non-standalone 5G and Standalone 5G, 5G Spectrum, 5G Core Network, Standardization Institute of Republic of Macedonia



ETA1 8-4

ПРИМЕНЕТ СИСТЕМ ЗА МЕРЕЊЕ НА БРЗИНА НА ИНТЕРНЕТ ВО ФИКСНИ МРЕЖИ

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Abstract: Согласно европската регулатива REGULATION (EU) 2015/2120, АЕК има обврска да обезбеди систем со кој ќе се мери квалитетот на услугата за пристап на интернет која се нуди на македонскиот интернет пазар. Овде е претставено како практично АЕК одговори на тоабарање.

Key words: регулатива, минимална, максимална и нормално расположива и рекламирана брзина за примање и праќање, доцнење, варијација на доцнење, ширина на канал, тестна сонда

ETA1 8-5

ISO STANDARDS AND THE CHALLENGE OF THEIR IMPLEMENTATION IN TELECOM SECTOR

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Abstract: The survival of the companies in era of the market globalization in all segments is highly dependent of their agile and adaptive ability. One of the major factors for their adaptability is to comply with several layers of standardization requirements (technology standards required by international committees and bodies; standards requested by the government as a form of regulatory frame, as well as the standards demanded by the market).

The telecommunication sector is faced with rapid technology changes, which is impacting the implementation of the new technology standards. Considering the sensitivity of the information in the telecommunication services, telecom operators are faced with additional standardization requirements imposed by governmental bodies, and market itself reflecting the requirements and expectation of the end users.

Information security of the converged telecom/ IT services is an imperative that should be completely accomplished by telecom operators in all phases of the information treatment (processing, transmission and storage) in order to obtain the customer confidence.

Telecom operators should provide the agility in their internal processes ensuring the synergy of the standards requirements in any aspect. They are challenged with the implementation of ISO standards imposed by the standardization bodies, regulatory and customer requirements with focus on ISO 27001 Information Security management System, ISO 20000-1 IT Service Management System and CSA Cloud requirements. The integrated implementation of those standards is an opportunity for telecom operators to become more



agile in their operation and to increase the control over their services. This control becomes even more demanding and more complex considering the latest trend for outsourced and managed telco services. At the same time it is an obligation for timely and complete response on customer's requirements which expectations overcome the standardized telecommunication/ IT services and highly impose non standardized, tailor made services adjusted to their special needs.

Key words: ISO, Telco, standardization

ETAI 8-6

WEB GIS SYSTEM FOR ELECTRONIC DATA DELIVERY FOR NEWLY CONSTRUCTED ELECTRONIC COMMUNICATIONS NETWORKS

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Abstract: According to article 8 of the Law for electronic communications (The Public Enterprise the Official Gazete of Republic of Macedonia, No.39/14 and changes and additions of the same Law, The Public Enterprise the Official Gazete of Republic of Macedonia, No.188/14, 44/15, 193/15), for realization of the regulatory obligations, Agency for electronic communications (AEC) has authority through web page to ensure Single Point of Information (SPI) so interested parties can find minimal information, toward planned construction of public electronic communication network and resources and existing structure of subject that manage with infrastructure objects like: type, technical characteristic and horizontal and vertical position of under and over ground infrastructure objects and following installation , as data for the subjects that manage those objects. This paper is consists of practical solution of these issue presented by the Agency for electronic communications.

Key words: regulative, Law for electronic communications, WEB GIS application, Single information point, electronic communication network, operators, TK networks, TK services, TK infrastructure, electronic data



ETAI 9: ELECTRONICS, TELECOMMUNICATIONS, AUTOMATIC AND INFORMATICS

ETAI 9-1

PERFORMANCE EVALUATION OF MOBILE APPLICATIONS

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Abstract: In this paper we investigate the performance metrics of mobile applications and their impact on user experience. Mobile devices are limited by their processing capabilities and power consumption that confronts the mobile user's expectations for better performance and longer battery life. To overcome these obstacles the calculations can be offloaded to a remote server.

By running tasks with different computational complexity, we examine the performance of local and offloaded mobile calculations. The result of this analysis suggests which tasks should execute locally on the device and which need to be offloaded in order to obtain better performance, and with that a better user experience.

Key words: mobile performance metrics, computational complexity, computational offloading, mobile computing, mobile cloud computing, mobile edge computing

ETAI 9-2

HARDWARE/SOFTWARE CO-VERIFICATION PLATFORM FOR EMBEDDED MULTIPROCESSORS

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Abstract: A strategy and a platform for design and verification of embedded multiprocessor systems is presented. The hardware/software co-verification strategy significantly increases the confidence in the design of both hardware and software. Software verification can start very early in the design phase of the system, even when minimum functionality is achieved at the RTL (Register-Transfer Level), which besides significant reduction of the time-to-market of the final product, reduces efforts and costs since the platform enables early detection of bugs, bottlenecks and problems both in hardware and software, before any silicon is produced. Furthermore, the platform automatically indicates design errors and compliance to specifications of the multiprocessor. It also generates various types of reports such as the number of cache hits or misses, number of taken or correctly predicted branches, interrupts and other statistic data. Thus, system properties, performance, bottlenecks, stalls due to interconnection or data/instruction interdependencies, or unavailable



parallelism could be analyzed. A case study of the design and co-verification processes of an 8-core multiprocessor is presented. It shows a time-to-market improvement of 30% when the co-verification approach is used vs. the traditional approach.

Key words: hardware/software co-verification, embedded multiprocessors, assertion-based verification, instruction set simulator

ETAI 9-3

SUPERVISOR AND GRAPHICAL USER INTERFACE AIMED FOR 3D PRINTERS AND CNC MACHINES

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Abstract: A simple parallel microcontroller error detection system for 3D printers and computer numerical controlled machines is presented. Main components of the supervisory system for temperatures, voltages, currents and mechanical position monitoring are discussed. Various approaches for reliability improvement in commercial printers are analyzed. The main emphasis is put on increasing the reliability of open loop motor drive control systems. Endpoint sensors as parallel part of the standard system and the supervisory system are presented. A graphical user interface for machine parameters displaying is explained in context of user-machine interaction. A practical implementation of the system is evaluated. Possible directions for further research in this area are pointed out.

Key words: CNC machine, CNC machining, 3D printer, 3D printing, microcontroller parallel monitor, supervisor, error detection system, graphical user interface

ETAI 9-4

ON THE EFFECTIVENESS OF THREE BATTERY CONTROL STRATEGY FORMULATIONS FOR RESIDENTIAL PHOTOVOLTAIC SYSTEMS

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Abstract: Batteries solve many technical problems that arise from the widespread adoption of intermittent photovoltaic (PV) generators. However, when a PV-storage system is



considered, it is most often to reduce the consumer's reliance on the grid and not for the benefit of the distribution system operator. In this paper we compare some technical aspects of using three battery control strategies for residential PV application. Two strategies, Target Zero and Minimize Power have been adopted from the literature, while the third, Minimize Energy strategy has defined for the purposes of this study. The results indicate that despite the fact that Minimize Energy has been formulated as an optimization problem aiming to reduce energy consumption from the grid, it does not increase the self-sufficiency rate by more than 2% when compared to the other strategies. At the same time it yields an inconsistent net load profile with high reverse power flows, making it undesirable from the distribution system operator's point of view.

Key words: storage, optimization, self-sufficiency, battery scheduling

ETAI 9-5

TECHNIQUES AND TOOLS FOR RELIABILITY ASSESSMENT OF POWER SYSTEMS

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Abstract: The power system is a complex system consisting of more subsystems that are complex. Each of these subsystems has an impact on the reliability and security of the system as a whole. The functioning of the elements of this system, such as busbars, lines, switches, can affect the quality of delivered electricity as well as the reliability of the system. This paper initially defines the types of defects that can occur in the transmission and distribution grid. Then, the application of Mark's processes is considered for determining the frequency of failures and repairing of some of the electrical equipment. In the second part a model of the power system developed in the program package Neplan is given. An analysis of the system in normal operation and in the event of a fault has been made, and also, the estimates of defects of individual elements of the power system. In addition, criteria is established on which one can make a list for replacement, rehabilitation and reconstruction of the elements of the power system in order to reduce its operating costs for operating and maintaining the reliability and security of the power system as a whole.

Key words: electrical equipment; reliability, defect



THE FUSION BETWEEN BLOCKCHAIN AND IoT FOR HEALTHCARE SYSTEMS

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Abstract: Blockchain technology is new technology for digital asset tracking and management. Initially Blockchain was implemented as a financial solution, through the Bitcoin and its digital cryptocurrency. This was changed with the development of Ethereum new approach for management of digital assets. The existence of Smart contracts in the Ethereum Virtual Machine (EMV), introduced new ways for dealing the problems with third-parties. This opens opportunities for plethora of new Blockchain implementations for smart homes, smart objects, healthcare, finance management, insurance, supply chain management and many others. This survey paper addresses the state-of-the-art and highlights the possibilities for integration of Blockchain technology and IoT, with main focus to healthcare systems. Due to the Blockchain specifics, there are many unsolved issues and open challenges for the researchers in this area.

Key words: Blockchain, smart contract, Bitcoin, Ethereum, IoT, healthcare, smart home, smart objects



ETA1 10: ARTIFICIAL INTELLIGENCE (2)

ETA1 10-1

COMPARATIVE ANALYSIS FOR THE INFLUENCE OF THE TUNING PARAMETERS IN THE ALGORITHM FOR DETECTION OF EPILEPSY BASED ON FUZZY NEURAL NETWORKS

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Abstract: This study presents a comparative analysis for the influence of the tuning parameters in our previously published algorithm for detection of epilepsy [2]. As the algorithm in [2] is generated using wavelet transform (WT) for feature extraction, and Adaptive Neuro-Fuzzy Inference System (ANFIS) for classification, the comparison in this paper is based on the different data splitting methods, the different input space partitioning methods in the ANFIS model, the usage of the different wavelet functions in the WT, the effects of normalization, as well as the effects of using different membership functions. The model was evaluated in terms of training performance and classification accuracies, and it was concluded that different combinations of input parameters differently classify the EEG signals.

Key words: Adaptive Neuro-Fuzzy Inference System (ANFIS), wavelet transform, fuzzy logic, Finite Impulse Response (FIR) filter, electroencephalogram (EEG), comparative analysis; normalization, input space partitioning

ETA1 10-2

FINANCIAL MODELING BY STOCHASTIC DIFFERENTIAL EQUATIONS

Nikola Veljanovski and Katerina Hadzi-Velkova Saneva

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Abstract: Stochastic calculus is a powerful mathematical tool for describing many processes in finance. In this paper, we analyze and describe the application of some stochastic differential equations in financial modeling. We study some historically wrong ideas in



economics and model them with practical empirical models based on stochastic calculus.

Key words: martingales, Wiener stochastic process, liquid finance markets, stationary increments, statistically independent increments, exact market clearing, average market clearing, equilibrium price.

ETAI 10-3

COMBINING LEXICON-BASED AND MACHINE LEARNING APPROACH FOR TWITTER SENTIMENT ANALYSIS

Anastaisija Nikolovska, Natasha Mladenovska, Hristijan Gjoreski

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Abstract: Twitter platform is one of the leading social networks that made an Internet revolution by transferring human social life into a digital form. Because of the short and simple way of expression, people most often choose Twitter to share their attitudes and feelings, prompted by the current events in the world, their immediate proximity or personal life. Having an automatic system that will recognize the sentiment of the tweet (positively, negatively, neutral) would be very useful and will allow a lot of potential applications on top of it. However, the complexity of human thought and the ability to express using signs, abbreviations and slangs allow for deeper research into the subject matter. In this paper we propose an approach that combines the lexicon-based and machine learning approach to correctly label the sentiment in a tweet. The approach first uses a dictionary to evaluate each word from the tweet as positive, negative or neutral, and this way it forms a polarity vector. Then the feature vector is formed by extracting features from the polarity vector, and also by extracting additional domain features from the words which are not in the dictionary, such as emoticons, exclamation marks, hashtags, etc. Finally, a classification model is learned to classify the tweet into positive, negative or neutral. We compared the multiple classification algorithms and discussed the results obtained. The results show that the tweets can be classified as positive, negative or neutral with 89% accuracy and 91% F1-score, and that the largest error occurs in classifying the tweet as neutral, probably because it is sometimes difficult to define what is a neutral tweet.

Key words: Twitter, Sentiment Analysis, Machine Learning, Feature Extraction



ETAI 10-4

COMPUTER-AIDED DETECTION OF MELANOMA, A CASE STUDY

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Abstract: Melanoma is the most dangerous form of skin cancer, and its detection at an early stage can allow timely treatment and prevention of fatal consequences. In this paper we present a case study of computer-aided diagnostics of melanoma using images of patients moles. The initial study was performed on two datasets: a benchmark dataset which is publicly available and a second one, containing images that were taken in hospitals in Macedonia. We present the obtained results and a short discussion of further directions for research. The results on the initial dataset were promising and showed 83% accuracy in the detection of the melanoma on the benchmark dataset. However, the same approach applied on the Macedonian dataset, the results could not be reproduced due to the low number of positive examples. The results showed that the performance of the classifiers did not benefit from under-sampling or oversampling techniques, nor did from feature selection. We can conclude that to build a reliable system for melanoma detection, a datasets of hundreds of images is not enough to train a machine-learning based model.

Key words: melanoma, tumor detection, pattern recognition, machine learning, classification

ETAI 10-5

FEATURE RANKING FOR HIERARCHICAL MULTI-LABEL CLASSIFICATION WITH TREE ENSEMBLE METHODS

Matej Petković, Sašo Džeroski and Dragi Kocev

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Abstract: In this work, we address the task of feature ranking for hierarchical multi-label classification (HMLC). The task of HMLC concerns problems with multiple binary variables organized into a hierarchy as target attributes. The goal is to learn a model for predicting all of them simultaneously. This task is receiving an increasing attention from the



research community, due to its wide application potential in text document classification and functional genomics. Here, we propose a feature ranking method based on bagging of predictive clustering trees. Bagging is an established ensemble learning method, while predictive clustering trees are a generalization of decision trees towards predicting structured outputs. Furthermore, we propose to use symbolic scoring function for calculating the feature importances. We illustrate the proposed method on two benchmark HMLC datasets (Reuters and Yeast) and show that it yields relevant rankings.

Key words: ensemble methods, feature ranking, hierarchical multi-label classification, symbolic scoring

ETAI 10-6

OPTION PREDICTIVE CLUSTERING TREES FOR MULTI-LABEL CLASSIFICATION

Tomaž Stepišnik Perdih, Dragi Kocev and Sašo Džeroski

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Abstract: In this work, we focus on the task of multi-label classification (MLC), where every example is associated with a set of labels. We propose an algorithm for learning option predictive clustering trees (OPCTs) for MLC, based on the predictive clustering framework. The algorithm addresses the myopia of the standard tree induction algorithm by considering alternative splits in the internal nodes of the tree and introducing option nodes where appropriate. An option tree can be viewed as a compact representation of an ensemble. It broadens the space of trees that is searched and reduces the myopia, compared to the standard tree induction. We evaluate the proposed OPCTs on 4 benchmark MLC datasets from different domains. Results show that OPCTs achieve performance similar to bagging ensembles of PCTs. We also performed parameter sensitivity analysis and provided avenues for future work.

Key words: option trees, predictive clustering trees, multi-label classification, ensemble methods

ETAI 11: NETWORKS, IoT AND REGULATIO

ETAI 11-1

LOW-COST, HIGH-AVAILABLE AND SECURE LMS CLUSTER PLATFORM – LOAD AND STRESS TESTING

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Abstract: In this paper a model of high-available and secure LMS cluster based platform is presented. The proposed three tier architecture model consists of load balancing cluster (two redundant pfSense firewalls), LMS cluster (two redundant SAKAI Apache/Tomcat web servers) and storage cluster (two redundant OpenFile IP storages). For extended security purposes the model has been configured and with IDS/IPS package (Snort/Suricata). The load and stress testing of the LMS cluster have been also conducted. The LMS integrated into a university/faculty campus LAN is low-cost, reliable, high-available, secure and affordable.

Key words: LMS cluster platform, university/faculty LAN, high-availability, load balancing, clustering, network security, load testing, stress testing

ETAI 11-2

CLOUD-BASED ORCHESTRATED SERVICES WITH QOS SUPPORT FOR MOBILE BROADBAND TERMINALS AND NETWORKS

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Abstract: This paper presents a novel framework for QoS Mobile Cloud computing and fog computing for future fifth generation (5G) of mobile terminals with radio network aggregation capability. It provides enhanced QoS provisioning in mobile and wireless networks using specific algorithm for heterogeneous environment of Cloud orchestrated-services. The proposed mobile cloud and fog computing framework for mobile broadband terminals and services is leading to high performance utility networks with high QoS provisioning for any given multimedia service, higher bandwidth utilization, traffic load sharing and multi-RAT usage. This is because in this framework the cloud is extended and distributed to the edge of access network, i.e. diffused among the mobile terminals. Like that the cloud becomes fog and it offers superior performances compared to the conventional cloud computing models and frameworks, for any multimedia traffic. The performance of our proposed framework for mobile terminal is evaluated using simulations and analysis with



multimedia traffic in heterogeneous mobile and wireless environments.

Key words: aggregation, cloud, fog computing, quality of service, vertical multi-homing

ETAI 11-3

LEGAL ASPECTS OF INTERNET OF THINGS AND THE REGULATION OF DATA PROTECTION IN EU

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Abstract: Internet of Things (IoT) is the actual stage in the path of digital transformation of the society. The power and the value of businesses and companies are beginning to depend on the processing of different types of real-time data to enable the execution of a variety of actions. The huge number of devices connected through a wireless connection that process huge data volumes, allowing communication between people and things and between the things, in addition to the enormous benefits for everyday life, also pose serious risks in terms of privacy, personal data and security. Such an environment has led to a new regulatory approach for the protection of personal data aimed at extending existing regulations and improving data management practices that will dramatically affect the Internet of things and how data is collected, stored and protected in devices. So, when planning the future of the businesses and companies in the spirit of the Internet of things, legal aspects must be taken in to consideration in the light of the regulations related to the protection of the data at their disposal.

This paper presents the legal aspects and the concept of the Internet of things, the essence, the meaning and the great speed with which it is involved in society and in everyday life, the importance of "dealing with" it, especially with regard to the preservation of the guaranteed fundamental human rights - the right of privacy and protection of personal data whose processing is essential part of the overall IoT idea and the implementation of the reform on GDPR profiling in IoT as one of the key risks to privacy and data protection in the concept.

Key words: the Internet of Things, data protection, general data protection regulation, profiling, industry 4.0



ETAI 11-4

MANAGING REAL TIME IoT DATA WITH CLOUD COMPUTING SERVICES

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Abstract: The popularity of the IoT paradigm, as well as the growth of the IoT market, has emerged new and innovative ways of incorporating IoT devices and models in different kinds of applications. The goal in this paper is to present a very modular architecture design of a full hardware-software solution for connecting a complete set of IoT devices, IoT and other modules in the Cloud, and testing the performance for real-time applications. The solution enables continuous synchronization of the sensors and real-time data processing through the different layers of the system architecture up to web presentation layer. The system outlines the benefits and the drawbacks when using real-time data in a cloud computing system.

Key words: internet of things, AWS, Raspberry Pi, cloud computing, serverless architecture, real-time cloud computing system, Docker

ETAI 11-5

EVOLUTION TO 5G AND COMPLIANCE TO EMF EXPOSURE STANDARDS

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Abstract: The 5th Generation Wireless Systems (abbreviated 5G) are based on the classical spectrum of legacy frequencies below 6 GHz, used in existing 2G, 3G and 4G technologies, and a new radio access in mmWave, known as 5G NR (New Radio). The key 5G technology concepts have already been broadly implemented as advancements in LTE networks. Extension of the spectrum to mmWave creates new possibilities, but also brings challenges in the wireless technology. In this work, we are considering the metrics, limitations and some aspects of compliance of 5G technology with standards for exposure to electromagnetic fields. It also briefly reviews findings in recent scientific investigation studies related to



specifics of exposure metrics and safety limitations that could be challenge for planning, designing and deployment of 5G network and equipment.

Key words: 5G, millimeter-wave, EMF exposure limits, specific absorption rate, power density (PD)

ETAI 11-6

CRITICAL DATA COMMUNICATIONS IN HETEROGENEOUS NETWORKS

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Abstract: Digitalization of today's society is closely related to the recent development of IoT and next generation 5G networks, as well the applicable use cases in everyday life. The IoT ecosystem presents the environment of connected devices communicating with each other and remotely with applications hosted on the cloud datacenter. Remote communication presents a great challenge for today's systems that need to enable reliable transmission for critical data communications. To cope with this challenge, a novel approach of using heterogeneous devices and networks is a necessity, with the next generation 5G networks being the center of the heterogeneous network environments. User-centric approach, network interoperability, as well as the symbiosis with emergency communications systems, complements the IoT systems and the heterogeneous networks, enabling reliable transfer of critical data communication.

Key words: IoT, 5G, cloud systems, heterogeneous networks, critical data communications



ETAI 12: PRESENTATION OF SELECTED PAPERS PUBLISHED IN SELECTED JOURNALS

ETAI 12-1

H. Gjoreski, M. Ciliberto, L. Wang, F. J. O. Morales, S. Mekki, S. Valentin, D. Roggen, "The University of Sussex-Huawei Locomotion and Transportation Dataset for Multimodal Analytics With Mobile Devices," *IEEE Access*, vol. 6, pp. 42592-42604, 2018.

ETAI 12-2

T. Shuminoski, T. Janevski, "5G Terminals with Multi-Streaming Features for Real-Time Mobile Broadband Applications," *Radioengineering*, vol. 26, no. 2, pp. 470-478, 2017.

ETAI 12-3

D. Zivanovic, M. Simic, Z. Kokolanski, D. Denic, V. Dimcev, "Generation of Long-time Complex Signals for Testing the Instruments for Detection of Voltage Quality Disturbances," *Measurement Science Review*, vol. 18, no. 2, pp. 41-51, 2018.

ETAI 12-4

G. Nadzinski, M. Dobrevski, C. Anderson, P. V. E. McClintock, A. Stefanovska, M. Stankovski, T. Stankovski, "Experimental Realization of the Coupling Function Secure Communications Protocol and Analysis of Its Noise Robustness," *IEEE Transactions on Information Forensics and Security*, vol. 13, iss. 10, pp. 2591-2601, 2018.

ETAI 12-5

M. Simic, Z. Kokolanski, D. Denic, V. Dimcev, D. Zivanovic, D. Taskovski, "Design and Evaluation of Computer-based Electrical Power Quality Signal Generator," *Measurement*, vol. 107, pp. 77-88, 2017.



ETAI 2018 TECHNICAL PROGRAMME SCHEDULE

THURSDAY, 20. IX. 2018

SESSION ETAI - 1: ARTIFICIAL INTELLIGENCE (1)

14:15 – 15:45

Co-Chairs: Dejan Gjorgjevikj and Cvetko Andreeski

ETAI 1-1	DATA COLLECTION MODULE FOR HUMAN ACTIVITY RECOGNITION
	Dejan Gjorgjevikj and Gjorgji Madjarov
ETAI 1-2	DEEP REINFORCEMENT LEARNING FOR GOAL-DRIVEN ROBOT NAVIGATION
	Matej Dobrevski and Danijel Skočaj
ETAI 1-3	MULTI-SENSOR HUMAN ENERGY EXPENDITURE ESTIMATION USING ENSEMBLE LEARNING
	Ivana Kiprijanovska, Simon Stankoski and Hristijan Gjoreski
ETAI 1-4	MODELLING AND FORECASTING SEASONAL TIME SERIES IN TOURISM, CASE STUDY FOR REPUBLIC OF MACEDONIA
	Cvetko Andreeski and Daniela Meckaroska
ETAI 1-5	LARGE-SCALE SMARTPHONE-BASED TRANSPORTATION RECOGNITION USING MACHINE LEARNING
	Elena Merdzanovska, Stefan Kalabakov, Ivona Milanova and Hristijan Gjoreski
ETAI 1-6	FITTED RULE ENSEMBLES FOR MULTI-TARGET REGRESSION WITH RANDOM OUTPUT SELECTIONS
	Martin Breskvar, Dragi Kocev and Sašo Džeroski

SESSION ETAI - 2: ELECTRONICS (1)

14:15 – 15:45

Co-Chairs: Zoran Ivanovski and Tomislav Kartalov

ETAI 2-1	ON THE CHOICE OF NUMBER OF TRAINING SIGNALS FOR OPTIMAL POWER QUALITY DISTURBANCES CLASSIFICATION
	Marija Markovska and Dimitar Taskovski
ETAI 2-2	AN ALGORITHM FOR QUALITY CONTROL OF AUTOMATED FIBER PLACEMENT
	Ljupcho Milosheski and Zoran Ivanovski
ETAI 2-3	IMPROVED TECHNIQUES OF COMPRESSED SENSING AND PARALLEL IMAGING FOR BRAIN MRI
	Aleksandar Kamilovski and Zoran Ivanovski
ETAI 2-4	FRONT VIEW VEHICLE RECOGNITION
	Maria Bjelickj, Zoran Ivanovski and Tomislav Kartalov
ETAI 2-5	SEGMENTATION OF BOXES FROM A 3D POINT CLOUD FOR AUTOMATIC UNLOADING
	Elena Vasileva and Zoran Ivanovski
ETAI 2-6	METHOD FOR OBJECT DETECTION USING ANALYSIS OF A SEQUENCE OF NEAR-INFRARED IMAGES PROCESSED BY BACKGROUND SUBTRACTION TECHNIQUES
	Ivan Matveev, Ingo Chmielewski, Eduard Siemens and Aleksey Yurchenko



SESSION ETAI – 3: TELECOMMUNICATIONS

14:15 – 15:45

Co-Chairs: Aleksandar Risteski and Peco Nedelkovski

ETAI 3-1	RESOURCE ALLOCATION IN WIRELESS POWERED COMMUNICATION NETWORKS WITH IMPERFECT CSI
	Slavche Pejovski and Zoran Hadzi-Velkov
ETAI 3-2	SPECTRUM ASSIGNMENT IN ELASTIC OPTICAL NETWORKS
	Teodora Kocevaska, Pero Latkoski, Marko Porjazoski and Borislav Popovski
ETAI 3-3	DESIGN OF TWO LEVEL TRANSMIT SIGNAL WAVEFORM FOR WIRELESS POWERED COMMUNICATION NETWORKS
	Slavche Pejovski, Zoran Hadzi-Velkov and Marija Poposka
ETAI 3-4	IMPLEMENTATION OF A COMPRESSIVE SAMPLING STEPPED FREQUENCY RADAR ON A USRP
	Venceslav Kafedziski
ETAI 3-5	DRAFT CONCEPT FOR ENERGY EFFICIENCY IMPROVEMENT WITH SMART PHONES AND ARTIFICIAL NEURAL NETWORKS USAGE
	Igor Bimbiloski and Aleksandar Risteski
ETAI 3-6	PERFORMANCE OF ERROR CORRECTING CODES IN WAKE-UP-RADIO WIRELESS SENSOR NETWORKS
	Robert Adamovski, Marko Poposki, Valentin Rakovic, Liljana Gavrilovska and Aleksandar Risteski

SESSION ETAI – 4: AUTOMATICS (1)

16:00 – 17:30

Co-Chairs: Mile Stankovski and Jovan Stefanovski

ETAI 4-1	FROM RECURRENT NEURAL NETWORKS TO HUMAN NEURONAL NETWORKS AND BACK: A COMPUTATIONAL BIO-CYBERNETICS (INVITED PAPER)
	Georgi Dimirovski and Kevin Warwick
ETAI 4-2	PERFORMANCE ANALYSIS OF DUPID CONTROL OVER CSTR SYSTEM WITH VARYING PARAMETERS
	Dusko Stavrov, Goran Stojanovski, Gorjan Nadzinski and Stojce Deskovski
ETAI 4-3	STABILITY OF NONLINEAR DESCRIPTOR SYSTEMS AND APPLICATION TO STABILIZATION OF QUADCOPTERS
	Drilon Bunjaku, Jovan Stefanovski and Georgi M. Dimirovski
ETAI 4-4	NOVEL CHARACTERIZATIONS FOR SWITCHED NONLINEAR SYSTEMS WITH AVERAGE DWELL TIME: FURTHER FINDINGS
	Georgi Dimirovski, Jiqiang Wang, Hong Yue and Jovan Stefanovski
ETAI 4-5	DYNAMIC MODELING AND CASCADE CONTROL DESIGN FOR QUADROTORS
	Drilon Bunjaku, Gorjan Nadzinski, Mile Stankovski and Jovan Stefanovski
ETAI 4-6	COMPARISON OF A STANDARD PID AND ENHANCED PID CONTROLLING STRUCTURES WHEN APPLIED TO A SISO WATER TANK SYSTEM
	Georgi Vitanov, Dushko Stavrov, Goran Stojanovski and Vesna Andova



SESSION ETAI – 5: INFORMATICS

16:00 – 17:30

Co-Chairs: Vladimir Trajkovik and Hristijan Gjoreski

ETAI 5-1	COMPARISON OF SD NEAR- AND OFFSHORING PROJECTS REGARDING ASSETS AND DRAWBACKS RESULTING FROM CULTURAL AND GEOGRAPHIC DISTANCE
	Oliver Sebelin
ETAI 5-2	BLOCKCHAIN BASED TRANSFORMATION IN GOVERNMENT: REVIEW OF CASE STUDIES
	Julija Basheska and Vladimir Trajkovik
ETAI 5-3	MANAGE VARIABILITY IN OBJECT-ORIENTED APPLICATIONS WITH FEATURE MODELS
	Ender Bulut and Cevat Şener
ETAI 5-4	PERFORMANCE MEASUREMENTS OF IN-MEMORY AND HARD DISK DATABASES USING TPC-C SCHEMA WORKLOAD
	Vigan Raca, Anastas Mishev and Goran Velinov
ETAI 5-5	ANALYSIS OF THE DISTRIBUTED LEDGER TECHNOLOGIES: A SURVEY OF THE MOST POPULAR BLOCKCHAINS
	Nasi Jofce, Riste Stojanov and Dimitar Trajanov
ETAI 5-6	VARX LEARNING STYLES AND ONLINE EDUCATION: CASE STUDY
	Ermira Idrizi, Sonja Filiposka and Vladimir Trajkovik

SESSION ETAI – 6: ELECTRONICS (2)

16:00 – 17:30

Co-Chairs: Mare Srbinovska and Andrijana Kuhar

ETAI 6-1	INFLUENCE OF SEGMENTATION ON THE PRECISION OF CIRCUIT BASED METHODS
	Andrijana Kuhar, Vesna Arnautovski-Toseva, Lidija Ololoska-Gagoska, Leonid Grcev and Blagoja Markovski
ETAI 6-2	COMPARISON OF APPROXIMATE MODELS FOR HIGH-FREQUENCY ANALYSIS OF GROUNDING SYSTEMS IN UNIFORM EARTH
	Blagoja Markovski, Leonid Grcev, Vesna Arnautovski-Toseva and Andrijana Kuhar
ETAI 6-3	DEVELOPMENT OF MODULAR INSTRUMENTATION CALIBRATION PROCEDURE AND UNCERTAINTY ESTIMATION
	Bodan Velkovski, Marija Cundeva-Blajer and Mare Srbinovska
ETAI 6-4	IMPROVEMENT OF THE FEIT LABORATORY OF ELECTRICAL MEASUREMENTS BEST CMC THROUGH INTERNATIONALLY TRACEABLE CALIBRATIONS AND INTER-LABORATORY COMPARISONS
	Kiril Demerdziev, Marija Cundeva-Blajer, Vladimir Dimcev, Mare Srbinovska and Zivko Kokolanski
ETAI 6-5	PROPOSAL OF SMALL WIND TURBINES APPLICATION IN A MICROGRID AT THE UNIVERSITY CAMPUS
	Nemanja Savić, Vladimir Katić and Nenad Katić
ETAI 6-6	CALCULATION MODEL CONFIGURATION FOR SMALL FIELDS IN RADIOTHERAPY
	Sonja Petkovska, Yasin Acarbas, Margarita Ginovska, Hristina Spasevska and Dragana Manasova



FRIDAY, 21. IX. 2018

SESSION ETAI – 7: AUTOMATICS (2)

11:30 – 13:00

Co-Chairs: Georgi Dimirovski and Stojce Deskovski

ETAI 7-1	COMPUTER-BASED SIMULATION AND VALIDATION OF ROBOT ACCURACY IMPROVEMENT METHOD AND ITS VERIFICATION IN ROBOT CALIBRATION PROCEDURE
	Samoil Samak, Igor Dimovski, Mirjana Trompeska, Vladimir Dukovski, Martin Hristoski and Filip Kochoski
ETAI 7-2	RELIABLE ROBUST TRACKING CONTROLLERS DESIGN REVISITED: AN IMPROVED LMI BASED SYNTHESIS
	Yuan-Wei Jing, Fu-Zhong Wang, Jovan Stefanovski and Georgi Dimirovski
ETAI 7-3	RELIABLE ROBUST ADAPTIVE CONTROL FOR UNCERTAIN SWITCHED FUZZY SYSTEMS: DESIGN SYNTHESIS REVISITED
	Yuan-Wei Jing, Le Zhang, Imre Rudas and Georgi Dimirovski
ETAI 7-4	DESIGN OF AUTONOMOUS MOBILE ROBOT FOR PRECISE AGRICULTURE APPLICATIONS
	Vasko Sazdovski and Stojce Deskovski
ETAI 7-5	DESIGN, MODELING AND PROTOTYPING OF BIO-INSPIRED MOBILE ROBOT ACTUATED BY PIEZOELECTRIC TRANSDUCERS
	Maja Anachkova, Jovana Jovanova and Simona Domazetovska
ETAI 7-6	MODELING OF MULTI LOCOMOTION OF SOFT ROBOT
	Simona Domazetovska, Vasko Changoski, Jovana Jovanova and Maja Anachkova

SESSION ETAI – 8: STANDARDISATION AND REGULATION IN ELECTRONIC COMMUNICATIONS

11:30 – 13:00

Co-Chairs: Venceslav Kafedziski and Slavica Nasteska

ETAI 8-1	NET NEUTRALITY: CONSUMER PROTECTION PRINCIPLE
	Slavica Nasteska
ETAI 8-2	THE NEED OF REGULATION FOR THE OTT SERVICES IN THE WORLD, EUROPE AND MACEDONIA
	Jovan Miloshevski, Iskra Ivanovska, Valentina Angjelkoska and Aleksandar Risteski
ETAI 8-3	5G STANDARDS (APPLICATION PAPER)
	Venceslav Kafedziski
ETAI 8-4	APPLIED INTERNET SPEED MEASUREMENT SYSTEM FOR FIXED NETWORKS
	Zoran Aleksov and Boris Arsov
ETAI 8-5	ISO STANDARDS AND THE CHALLENGE OF THEIR IMPLEMENTATION IN TELECOM SECTOR (APPLICATION PAPER)
	Frosina Geceva Kocova
ETAI 8-6	WEB GIS SYSTEM FOR ELECTRONIC DATA DELIVERY FOR NEWLY CONSTRUCTED ELECTRONIC COMMUNICATIONS NETWORKS
	Boris Arsov and Zoran Aleksov

SESSION ETAI – 9: ELECTRONICS, TELECOMMUNICATIONS, AUTOMATICS AND INFORMATICS

11:30 – 13:00

Co-Chairs: Aleksandar Simevski and Dimitar Dimitrov

ETAI 9-1	PERFORMANCE EVALUATION OF MOBILE APPLICATIONS
	Anita Andonoska and Kire Jakimoski
ETAI 9-2	HARDWARE/SOFTWARE CO-VERIFICATION PLATFORM FOR EMBEDDED MULTIPROCESSORS
	Aleksandar Simevski
ETAI 9-3	SUPERVISOR AND GRAPHICAL USER INTERFACE AIMED FOR 3D PRINTERS AND CNC MACHINES
	Nikola Jovanovski and Josif Kjosev
ETAI 9-4	ON THE EFFECTIVENESS OF THREE BATTERY CONTROL STRATEGY FORMULATIONS FOR RESIDENTIAL PHOTOVOLTAIC SYSTEMS
	Vladimir Gjorgievski, Dimitar Dimitrov and Marija Kacarska
ETAI 9-5	TECHNIQUES AND TOOLS FOR RELIABILITY ASSESSMENT OF POWER SYSTEMS
	Natalija Petrova, Nevenka Kiteva Rogleva and Vangel Fustic
ETAI 9-6	THE FUSION BETWEEN BLOCKCHAIN AND IOT FOR HEALTHCARE SYSTEMS
	Jovan Karamachoski, Liljana Gavrilovska and Anis Sefidanoski

SESSION ETAI – 10: ARTIFICIAL INTELLIGENCE (2)

14:30 – 16:00

Co-Chairs: Vesna Ojleska Latkoska and Elena Hadzieva

ETAI 10-1	COMPARATIVE ANALYSIS FOR THE INFLUENCE OF THE TUNING PARAMETERS IN THE ALGORITHM FOR DETECTION OF EPILEPSY BASED ON FUZZY NEURAL NETWORKS
	Marjan Stoimchev and Vesna Ojleska Latkoska
ETAI 10-2	FINANCIAL MODELING BY STOCHASTIC DIFFERENTIAL EQUATIONS
	Nikola Veljanovski and Katerina Hadzi-Velkova Saneva
ETAI 10-3	COMBINING LEXICON-BASED AND MACHINE LEARNING APPROACH FOR TWITTER SENTIMENT ANALYSIS
	Anastaisija Nikolovska, Natasha Mladenovska and Hristijan Gjoreski
ETAI 10-4	COMPUTER-AIDED DETECTION OF MELANOMA, A CASE STUDY
	Petre Lameski, Eftim Zdravevski, Slobodan Kalajdziski, Vesna Trajkova and Elena Hadzieva
ETAI 10-5	FEATURE RANKING FOR HIERARCHICAL MULTI-LABEL CLASSIFICATION WITH TREE ENSEMBLE METHODS
	Matej Petković, Sašo Džeroski and Dragi Kocev
ETAI 10-6	OPTION PREDICTIVE CLUSTERING TREES FOR MULTI-LABEL CLASSIFICATION
	Tomaž Stepišnik Perdih, Dragi Kocev and Sašo Džeroski



SESSION ETAI – 11: NETWORKS, IoT AND REGULATION

14:30 – 16:00

Co-Chairs: Miroslav Kotevski and Marija Kalendar

ETAI 11-1	LOW-COST, HIGH-AVAILABLE AND SECURE LMS CLUSTER PLATFORM – LOAD AND STRESS TESTING
	Dejan Cabukovski and Toni Janevski
ETAI 11-2	CLOUD-BASED ORCHESTRATED SERVICES WITH QOS SUPPORT FOR MOBILE BROADBAND TERMINALS AND NETWORKS
	Tomislav Shuminoski, Stojan Kitanov and Toni Janevski
ETAI 11-3	LEGAL ASPECTS OF INTERNET OF THINGS AND THE REGULATION OF DATA PROTECTION IN EU
	Iskra Ivanovska, Jovan Miloshevski, Valentina Angjelkoska and Aleksandar Risteski
ETAI 11-4	MANAGING REAL TIME IOT DATA WITH CLOUD COMPUTING SERVICES
	Dejan Vasilevski, Ana Cholakoska, Marija Kalendar and Danijela Efnusheva
ETAI 11-5	EVOLUTION TO 5G AND COMPLIANCE TO EMF EXPOSURE STANDARDS
	Konstantin Martinov, Miroslav Kotevski and Jovan Karamacoski
ETAI 11-6	CRITICAL DATA COMMUNICATIONS IN HETEROGENEOUS NETWORKS
	Simon Bojadjevski, Natasha Anastasova Bojadjevaska, Marija Kalendar and Aristotel Tentov

SESSION ETAI – 12: PRESENTATION OF SELECTED PAPERS PUBLISHED IN SELECTED JOURNALS

14:30 – 16:00

Co-Chairs: Tomislav Shuminoski and Gorjan Nadzinski

ETAI 12-1	THE UNIVERSITY OF SUSSEX-HUAWEI LOCOMOTION AND TRANSPORTATION DATASET FOR MULTIMODAL ANALYTICS WITH MOBILE DEVICES
	Hristijan Gjoreski, Mathias Ciliberto, Lin Wang, Francisco J. O. Morales, Sami Mekki, Stefan Valentin and Daniel Roggen
ETAI 12-2	5G TERMINALS WITH MULTI-STREAMING FEATURES FOR REAL-TIME MOBILE BROADBAND APPLICATIONS
	Tomislav Shuminoski and Toni Janevski
ETAI 12-3	GENERATION OF LONG-TIME COMPLEX SIGNALS FOR TESTING THE INSTRUMENTS FOR DETECTION OF VOLTAGE QUALITY DISTURBANCES
	Dragan Živanović, Milan Simić, Zivko Kokolanski, Dragan Denić and Vladimir Dimcev
ETAI 12-4	EXPERIMENTAL REALIZATION OF THE COUPLING FUNCTION SECURE COMMUNICATIONS PROTOCOL AND ANALYSIS OF ITS NOISE ROBUSTNESS
	Gorjan Nadzinski, Matej Dobrevski, Christopher Anderson, Peter V. E. McClintock, Aneta Stefanovska, Mile Stankovski, and Tomislav Stankovski
ETAI 12-5	DESIGN AND EVALUATION OF COMPUTER-BASED ELECTRICAL POWER QUALITY SIGNAL GENERATOR
	Milan Simić, Zivko Kokolanski, Dragan Denić, Vladimir Dimcev, Dragan Živanović and Dimitar Taskovski



PROGRAM

Day	Time	Congress Hall	Hall 1	Hall 2	Hall 3
THURSDAY, 20. IX 2018	11:00-11:30	Conference Opening			
	11:30-12:15	Plenary Lecture 1: Prof. Dr. Jae Hong Lee (Cognitive Radio for Wireless Communications: Concepts and Applications)			
	12:15-13:00	Plenary Lecture 2: Prof. Dr. Đani Juričić (Prognostics and Health Management of Modern Systems and Components: Recent Developments and Perspectives)			
	13:00-14:00	Lunch break			
	14:15-15:45		ARTIFICIAL INTELLIGENCE (1)	ELECTRONICS (1)	TELECOMMUNICATIONS
	15:45-16:00	Coffee break			
	16:00-17:30		AUTOMATICS (1)	INFORMATICS	ELECTRONICS (2)
	17:30-18:30	Round Table 1: Innovative Strategies for Promoting Positive Youth Development Among High School Students (moderator Mrs. Nancy Schiff)			
	19:00-20:00	Welcome drink			
FRIDAY, 21. IX 2018	09:30-10:15	Plenary Lecture 3: Prof. Dr. Sašo Džeroski (Mining Big and Complex Data)			
	10:15-11:00	Plenary Lecture 4: Prof. Dr. Brian A. Barsky (From Vision-Realistic Rendering to Vision Correcting Displays)			
	11:00-11:30	Coffee break			
	11:30-13:00		AUTOMATICS (2)	STANDARDISATION AND REGULATION IN ELECTRONIC COMMUNICATIONS	ELECTRONICS, TELECOMMUNICATIONS, AUTOMATIC AND INFORMATICS
	13:00-14:00	Lunch break			
	14:30-16:00		ARTIFICIAL INTELLIGENCE (2)	NETWORKS, IoT AND REGULATION	PRESENTATION OF SELECTED PAPERS PUBLISHED IN SELECTED JOURNALS
	16:00-16:30	Young researcher presentation: M. Sc. Neda Petreska (Performance Analysis of Wireless Industrial Networks - Challenges and Trends)			
	16:30-17:00	Coffee break			
	17:00-17:15	Address by the Director of the Fund for Innovations and Technology Development, Jovan Despotovski			
	17:15-19:00	Round Table 2: Smart ECO Technology			
20:00	Gala dinner				
SATURDAY, 22. IX 2018	10:00-10:30	Closing Ceremony			
	11:00-15:00	Trip to Vevcani (TBA)			