

Електроника
Телекомуникације
Рачунарство
Аутоматика
Нуклеарна техника

ЗБОРНИК АПСТРАКТА И ПРОГРАМ

64. КОНФЕРЕНЦИЈЕ ЕТРАН

Бања Лука, Београд, Ниш, Нови Сад, Чачак
28. и 29. септембар 2020. године



**ЕТРАН - Друштво за електронику, телекомуникације, рачунарство, аутоматику
и нуклеарну технику**

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7th International Conference on Electrical, Electronic and Computing Engineering

IcETRAN 2020

Banja Luka, Belgrade, Čačak, Niš, Novi Sad
September 28 - 29, 2020



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09:00-11:00	Рачунарство	Акустика			Роботика и флексибилна аутоматизација
11:00-12:00			Микро-електроника, оптоелектроника и електроника	Метрологија (10:00-11:30)	
12:00-13:00		Нуклеарна техника		Електроенергетика (12:00:14:30)	
13:00-14:00					
14:00-16:00		Електрична кола, електрични системи и обрада сигнала		Метрологија 15:30-20:00	Омаж: Душан Петровачки Аутоматика
16:00-18:00					
18:00-20:00					

Уторак, 29.септембар 2020

	<i>On-line</i>	Кнеза Милоша 9/3 Зграда СИТС	Факултет техничких наука Чачак	Институт Михајло Пупин, Београд
09:00-11:30	Телекомуникације			Вештачка интелигенција
11:30-12:00		Антене и простирање и		
12:00-14:00		Микроталасна техника, технологије и системи	Нови материјали	Биомедицинска техника
14:00-18:00				

Monday, September 28th 2020.

	On-line	„SITS“ Kneza Miloša 9/3	University of Niš	University of novi Sad Ceremonial Hall	Institut Mihajlo PUPIN, Belgrade
09:00-11:00	Computers	Acoustics			Robotics and Flexible Automation
11:00-12:00			Microelectronics, optoelectronics & Electronics	Metrology (10:00-11:30)	
12:00-13:00		Nuclear Engineering		Power Engineering (12:00:14:30)	
13:00-14:00					
14:00-16:00		Electric Circuits and systems and signal processing		Metrology (15:30-20:00)	Tribute to Dušan Petrovački & Automatic Control
16:00-18:00					
18:00-20:00					

Tuesday, September 29th 2020

	<i>On-line</i>	„SITS“ Kneza Miloša 9/3	Faculty of Technical Sciences Čačak	Institut Mihajlo PUPIN, Belgrade
09:00-11:30	Telecommunications			Artificial Intelligence
11:30-12:00		Antennas and Propagation & Microwave and submillimeter technologies and systems		
12:00-14:00			Novel materials	Biomedical engineering
14:00-18:00				

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Tuesday, September 29th, 09:00 – 11:00, Institute “Mihajlo Pupin”, Belgrade

Chair: Milan Milosavljević, Singidunum University, Belgrade

AIII.1 PART OF SPEECH TAGGING FOR SERBIAN LANGUAGE USING NATURAL LANGUAGE TOOLKIT

Boro Milovanović and Ranka Stanković

Abstract: While complex algorithms for NLP (Natural language processing) are being developed, base tasks such as tagging remain very important and still challenging. NLTK (Natural Language Toolkit) is a powerful Python library for developing programs based on NLP. We try to leverage this library to create a PoS (Part of Speech) tagger for a contemporary Serbian language. Eleven different models were created by using NLTK tagging API. The best models are transformed with the Brill tagger to improve the accuracy. We trained the models on the tagged dataset counting 180,000 tokens. The best results on the test set of 20,000 tokens were demonstrated with the Perceptron tagger: 92,52 – 95,76% accuracy for the different tagsets.

AIII.2 HUMAN FACE RECOGNITION AND ALCOTESTING WITH CLOUD SERVER DATA PUBLISHING

Jovan Slavujević, Stefan Svenderman, Miloš Arbanas and Vladimir Rajs

Abstract: The theme of this project is to create an application which performs human detection and recognition of people of interest, their alcotesting, then publishing processed data to the Cloud server. As the resources the application has at its disposal a web camera of the computer and an MQ-2 sensor (sensor for flammable gas detection, in this case alcohol molecules) which is connected to the Raspberry Pi and delivers data using its GPIO pins.

AIII.3 VISUALIZATION OF MOVING OBJECTS IN THERMAL IMAGE

Milos Petrović, Miroslav Perić and Nataša Vlahović

Abstract: Motion detection in color or thermal imaging has become one of the major components of surveillance and monitoring systems. Since thermal images are usually presented as gray scale images, the need for smart assistance in surveillance for the operators has risen. A common way of emphasizing detected motion on an image is pseudo coloring. In this paper, an application for pseudo-coloring of thermal image areas with detected motion is provided in order to give an adequate visualization and draw attention of the operator to the moving objects. For motion detection SURF (Speeded Up Robust Features) detector key points are used along with Optical flow estimation (Lucas-Kanade method). Every detected region is presented by its center found by motion detection on two successive frames. Complete object motion detection and visualization is obtained using several more image processing techniques: morphological image processing, image segmentation and pseudo-coloring. Results are presented on the experimental dataset made for this purpose only.

AIII.4 AUTOMATIC SPEECH RECOGNITION SYSTEM FOR DICTATING MEDICAL FINDINGS

Branislav Popović, Edvin Pakoci and Darko Pekar

Abstract: The paper presents an automatic speech recognition (ASR) system for dictating medical findings, developed by AlfaNum – Speech Technologies Ltd for the Pension and Disability Insurance Fund of the Republic of Serbia. The system is developed in a form of a distributed client-server architecture. The training of acoustic models is performed using a “chain” sub-sampled deep time-delay neural network (TDNN), while language models training

is conducted using recurrent neural networks (RNNs), composed of “relu-renorm” layers followed by long short-term memory projection (LSTMP) components. The client application sends recorded user data to the server, where recognition of speech samples is performed in real time. The data is stored locally as well as in the central database, and can be exported in an appropriate form upon request. Recognition accuracy of 97% on a vocabulary of up to 50000 words is achieved.

AIII.5 PEOPLE MOVEMENT TRACKING BASED ON ESTIMATION OF AGES AND GENDERS

Nemanja Krajčinović, Nataša Avramović, Marko Adžić and Živko Bojović

Abstract: In this paper, a system for tracking people in a limited environment and creating a trajectory of their movement has been implemented. This includes detecting a person, estimating gender and age, and tracking location in the selected area. The system is able to instantly locate people based on their current position, estimate gender and age, monitor their movements and visually display it, but also to do statistics of their detention in certain parts of the building.

AIII.6 DIGITAL TRANSFORMATION AND TRANSPARENCY IN WINE SUPPLY CHAIN USING OCR AND DLT

Stevan Cakić, Aida Ismailisufi, Tomo Popović, Srdjan Krčo, Nenad Gligorić, Srdjan Kuprešanin and Vesna Maraš

Abstract: This paper describes an effort to utilize IoT, OCR, and blockchain technology to create a wine track and trace system evaluated in a real-life environment. The research is focused on digital transformation in the traditional wine supply chain, using computer vision to read the existing serial numbers labeled on bottles, so as to uniquely identifying individual bottles of wine and track the item life-cycle. The system provides a mobile app to allow end consumers to scan each wine bottle and learn more about that particular product instance, its origin, authenticity, rating, and potentially other characteristics. The status of each bottle is updated every time it has been scanned. To ensure the transparency of the recorded data and information immutability, blockchain technology is used to record all relevant information into the ledger, e.g. all status updates for each item. The developed service enables tracking of a bottle throughout the supply chain, from a producer to a consumer, where traceability story is still not finalized. The consumed serial numbers are kept in the ledger, to avoid counterfeit scenarios when one “bottle” (i.e. one serial number) is being sold multiple times. The life-cycle of the bottle and its status changes are recorded, and the authenticity ensured facilitating verifiable identity of the authorized handlers and cutting edge cryptography, thus providing additional trust in the solution and transparency to all stakeholders.

SESSION AII2 : DEEP NEURAL NETWORKS AND APPLICATION

Tuesday, September 29th, 11:00 – 12:30, Institute “Mihajlo Pupin”, Belgrade

Chair: Milan Milosavljević

AII2.1 CLASSIFICATION OF CHEST X-RAY IMAGES USING DEEP CONVOLUTIONAL NEURAL NETWORKS

Lara Laban, Radiša Jovanović, Mitra Vesović and Vladimir Zarić

Abstract: In this paper a method is proposed for the classification of a chest X-ray (normal, pneumonia-consisting of bacterial and viral) image data set. A deep convolutional neural network with an architecture resembling the VGGNet is presented using dropout, decay and data scaling. Since the dataset had a class imbalance, this was solved using a simple method called data scaling. The training of the neural network was done using small batches with a binary cross entropy loss function. The same neural network was then implemented adding batch normalization layers, and comparisons were made. Furthermore, the chest X-ray dataset was also trained using transfer learning with a pre-trained neural network VGG16 on the ImageNet dataset. Later on juxtapositions were made on using both techniques. Additionally, in applying these method we were able to achieve a satisfying classification for the training and validation datasets, save computational time and have a higher classification accuracy.

AII2.2 PNEUMONIA DETECTION AND CLASSIFICATION FROM X-RAY IMAGES – A DEEP LEARNING APPROACH

Jelena Božičković, Ivan Lazić and Tatjana Lončar-Turukalo

Abstract: Chest X-rays are one of the first medical imaging tools used for correctly assessing different causes of pneumonia. With the recent spread of the SARS-CoV-2 virus, fast diagnostics and differentiation of the COVID-19 disease from other causes (bacterial or viral) is important. In this study we evaluated four different neural network architectures and applied transfer learning in order to try to detect and classify pneumonia in patient images in a 4-class problem (normal, viral, bacterial and COVID-19). We applied data augmentation on the outnumbered COVID-19 class and compared the effects of single end-to-end network training to a two-stage variant. The best results were obtained using the ResNet50 model with an average cross-validation accuracy of 89.97%. Across all models the COVID-19 and normal X-ray images showed very high precision and sensitivity scores.

AII2.3 PNEUMONIA DETECTION USING DEEP LEARNING BASED ON CONVOLUTIONAL NEURAL NETWORK

Luka Račić, Tomo Popović, Stevan Čakić and Stevan Šandi

Abstract: Artificial intelligence has found its use in various fields during the course of their development, especially in recent years with the enormous increase in available data. Its main task is to assist making better, faster and more reliable decisions. Artificial intelligence and machine learning are increasingly finding their application in medicine. This is especially true for medical fields that utilize various types of biomedical images and where diagnostic procedures rely on collecting and processing large number of digital images. The application of machine learning in medical imaging has been found to improve accuracy and consistency, as well as efficiency in reporting. This paper describes the use of machine learning algorithms to process chest X-ray images in order to support decision making process in determining the correct diagnosis. Specifically, the research is focused on the use of deep learning algorithm based on convolutional neural network in order to build a processing model. This model has the task to help with a classification problem that is detecting whether a chest X-ray shows changes consistent with pneumonia or not, and classifying the X-ray images in two groups depending on the detection results.

AI2.4 IMPROVING THE AMLS SYSTEM WITH ANOMALY DETECTION MODULE IN FINANCIAL TRANSACTIONS USING ARTIFICIAL INTELLIGENCE METHODS

Dalibor Bogdanović and Elmir Babović

Abstract: The paper presents an overview of currently existing methods for detection of suspicious transactions in the financial set of transactions using machine search methods and comparatively presents the method of improving the detection of suspicious transactions with the proposed method of artificial intelligence. The paper presents an abstract solution for a given problem domain and proposes a decision tree that gives satisfactory results. Detection of suspicious transactions and its efficiency in recognizing them are essential for timely and efficient detection of the same in real time. This is crucial for an information system such as AMLS (Anti money laundering system). This way of realizing the detection of suspicious transactions that deviate from other common transactions is an improvement over the current situation. The results of such a proposed approach of artificial intelligence are presented in relation to the results of current solutions based on machine search of financial transactions in real time.

AI2.1 IDENTIFIKACIJA VRSTA ZA POTREBE BIOMONITORINGA KORIŠĆENJEM KONVOLUCIONIH NEURONSKIH MREŽA I DUBOKOG UČENJA

Aleksandar Milosavljević, Đurađ Milošević and Bratislav Predić

Apstrakt: Akvatični insekti i drugi bentonski makrobeskičmenjaci uglavnom se koriste kao bioindikatori ekološkog stanja slatkih voda. Međutim, skup i dugotrajan postupak identifikacije vrsta predstavlja jednu od ključnih prepreka za pouzdan biomonitoring akvatičnih ekosistema. U radu je predložen metod za identifikaciju vrsta zasnovan na dubokom učenju čija je evaluacija obavljena na nekoliko javno dostupnih skupova podatak (FIN-Benthic, STONEFLY9 i EPT29) kao i na sopstvenom CHIRO10 skupu podataka. Predloženi metod se zasniva na tri tehnike dubokog učenja koje se koriste za poboljšanje robusnosti kada se za obučavanje koristi relativno mali skup podataka: preneseno učenje (eng. transfer learning), proširivanje podataka (eng. data augmentation), kao i odbacivanje (eng. dropout). Evaluacija modela je vršena korišćenjem ulaznih slika dimenzija 256x256 piksela i usrednjavanjem 10 podela na trening (50%), validacioni (20%) i test (30%) skup. Dobijeni rezultati pokazuju značajno poboljšanje u odnosu na tradicionalne metode koje su originalno korišćenje i potvrđuju da postoji značajan dobitak kada postoji veći broj slika po uzorku.

SESSION / SESIJA AKI1 & AK1: ROOM ACOUSTICS, AUDIO SIGNAL PROCESSING (OBRADA AUDIO SIGNALA, ELEKTROAKUSTIKA, AKUSTIKA PROSTORIJA)

Tuesday, September 28th, 09:00 – 10:30, SITS, Kneza Miloša 9/III, Belgrade

Chair: Dragana Šumarac Pavlović, School of Electrical Engineering, University of Belgrade, Serbia and Iva Salom, Institute Mihajlo Pupin, Belgrade, Serbia

AKI1.1 SOUND FIELD DIFFUSIVITY IN A SMALL REVERBERATION ROOM

Dejan Ćirić, Kristian Jambrošić and Marko Janković

Abstract: Diffuse sound field is one of the most important prerequisites for various measurements in a reverberation room. Unfortunately, it is rather complex to have such a sound field in the whole frequency range of interest. This is especially valid at low frequencies, and for some rooms of inadequate characteristics like inadequate shape or small volume. Another topic is how to evaluate the diffusivity of the sound field. There is no direct measure to assess this property, instead various indirect descriptors are used for that purpose. This paper deals with assessment of sound field diffusivity of a small reverberation room. Focus is on energy decay curves and their deviation from the target ones. Two indirect descriptors – standard deviation of decay rate and linearity of energy decay curves are used here to investigate the sound field diffusivity. The effects of having diffusers in the room are also considered.

AKI1.2 USAGE OF DIFFERENT WAVELET FAMILIES IN DC MOTOR SOUNDS FEATURE ANALYSIS

Dorđe Damjanović, Dejan Ćirić, Miljan Miletić and Dejan Vujičić

Abstract: Widespread usage of wavelets in signal analysis places this method in a very high position in many researches, especially when audio signal classification is in focus. Wavelets have become an unavoidable segment in signal processing whose nature leads to more comprehensive results in comparison with standard methods, like Fourier transform. There are many wavelet families that have been developed in quite different forms for different purposes. In this paper, a selected set of wavelets is used in the decomposition of direct current (DC) motor sounds to detail and approximation coefficients for the purposes of finding the most suitable wavelets for audio feature analysis. Selection of wavelets is done according to the obtained results, taking into account all available wavelets in Matlab software package. DC motor sounds are recorded in two different conditions: laboratory condition and factory condition, although only those from the laboratory are presented here.

AK1.1 IZDVAJANJE ZNAČAJNIH AKUSTIČKIH KARAKTERISTIKA MOTORA SA UNUTRAŠNjim SAGOREVANJEM

Marko Milivojčević and Dejan Ćirić

Apstrakt: U ovom radu su izdvojena, a zatim i analizirana akustička obeležja motora sa unutrašnjim sagorevanjem putničkih vozila pokretanih najzastupljenijim fosilnim gorivima - benzinom i dizelom. Analiza je realizovana u softveru Matlab upotrebom predefinisanih funkcija za izdvajanje akustičkih (audio) obeležja signala. Analizom su obuhvaćena obeležja u vremenskom i u frekvencijskom domenu, odnosno, ukupno je analizirano po 35 akustičkih obeležja za svaki tip pogonskog goriva. Cilj ovako obimne analize je izdvajanje značajnih akustičkih karakteristika (obeležja) na osnovu kojih bi postojala mogućnost razlikovanja tipa pogonskog goriva kod motora sa unutrašnjim sagorevanjem korišćenih u putničkim vozilima.

AK1.2 ANALIZA RAZLIČITIH KLAVIRA NA OSNOVU ALGORITMA ZA PROCENU KOEFICIJENTA INHARMONIČNOSTI

Tatjana Miljković, Miloš Bjelić, Dragana Šumarac Pavlović and Jelena Čertić

Apstrakt: „Idealna“ žica koja je zategnuta na oba kraja, ali se ne odlikuje krutošću, pri okidanju osciluje stvarajući niz harmonika koji predstavljaju celobrojne umnoške osnovne frekvencije žice. U realnosti, kada se žica posmatra sa aspekta krutosti, pri njenom pobuđivanju nastali niz harmonika neće sadržati celobrojne umnoške osnovne frekvencije žice, već će harmonici imati frekvencijski pomeraj u odnosu na harmonike idealne žice. Fenomen frekvencijskog pomeraja harmonika je zastupljen kod svih žičanih instrumenata i naziva se inharmoničnost. U ovom radu predložen je algoritam za određivanje koeficijenta inharmoničnosti tonova klavira. Algoritam se zasniva na adaptivnom procesu koji izračunava frekvencijsko odstupanje harmonika tona od očekivanih frekvencija za dati ton. Testiranje predloženog algoritma izvršeno je na realnim tonovima različitih klavira. Sprovedena je analiza koeficijenata inharmoničnosti tonova klavira računata sa različitim brojem parcijala tonova. Ustanovljeno je da je na osnovu vrednosti koeficijenta inharmoničnosti za tonove klavira moguće izvršiti klasifikaciju klavira na osnovu njihovog tipa, starosti i učestalosti sviranja.

AK1.3 REALIZACIJA ZVUČNIČKOG SISTEMA SA SOFTVERSKOM KONTROLOM USMERENOSTI

Miloš Bjelić and Aleksandar Golubović

Apstrakt: Usmereni zvučni izvori predstavljaju nezaobilazan element u realizaciji audio sistema, bilo da se radi o otvorenom ili zatvorenom prostoru koji je potrebno ozvučiti. U ovom radu prikazan je jedan usmereni zvučni izvor, čiju je usmerenost moguće kontrolisati softverski, a ne hardverski, što je slučaj kod većine dostupnih rešenja na tržištu. Zvučnički sistem se sastoji od 12 zvučnika i procesora sa isto toliko izlaza, koji omogućava nezavisnu obradu signala za svaki zvučnik ponaosob. U radu je prikazan algoritam za prostorno-vremensku obradu signala koji omogućava upravljanje dijagramom usmerenosti u vertikalnoj ravni. Algoritam je implementiran na dva različita procesora i pokazano je da se oba procesora mogu koristiti za ovu namenu. Verifikacija rada celokupnog sistema izvršena je merenjem dijagrama usmerenosti zvučničkog niza u anechoičnim uslovima. U radu su prikazani i potencijalni problemi koji se mogu javiti prilikom korišćenja ovakvih sistema i načini da se ti problemi prevaziđu.

AK1.4 MOGUĆNOST POBOLJŠANJA ZVUČNOG KOMFORA U OPEN PLAN PROSTORU SA SPECIFIČNIM OGRANIČENJIMA

Tatjana Miljković, Miloš Bjelić, Dragana Šumarac Pavlović and Miomir Mijić

Apstrakt: Problem obezbeđivanja zvučnog komfora u radnim prostorijama otvorenog tipa (Open Plan Office) u poslednjih 15 godina spada u važne inženjerske i projektantske teme. Zvučni komfor podrazumeva zadovoljavanje više aspekata, kao što su zaštita privatnosti i zaštita od uznemiravanja između ljudi koji rade u istom prostoru. Standardom ISO 3382-3 iz 2012. godine definisana je metodologija merenja i vrednovanja zvučnog komfora u prostorima ovakvog tipa. Željene karakteristike akustičkog kvaliteta u prostoriji se mogu postići sa nekoliko standardnih intervencija u, poput ugrađivanja apsorpcionih materijala na plafon i bočne zidove, postavljanje slobodno visećih apsorbera ili pravljenjem barijera između radnih mesta sa odgovarajućim izolacionim i apsorpcionim karakteristikama. U mnogim situacijama postoje određena arhitektonska rešenja koja onemogućavaju apliciranje svih potrebnih formi u enterijeru. U ovom radu su na primeru jednog prostora sa ograničenim mogućnostima za intervencije u enterijeru analizirani pojedinačnih dometi različitih intervencija. Prikazana analiza sprovedena je na bazi početnih merenja u objektu i simulacijama različitih mogućih intervencija u enterijeru.

SESIJA AK2: BUKA, GRAĐEVINSKA AKUSTIKA

Utorak, 28. septembar, 10:30 – 12:00, SITS, Kneza Miloša 9/III, Begrade

Chair: Miomir Mijić, Elektrotehnički fakultet, Univerzitet u Beogradu, Srbija

Dejan Ćirić, Elektronski fakultet u Nišu, Univerzitet u Nišu, Srbija

AK2.1 STUDIJA STANJA UGROŽENOSTI BEOGRADA BUKOM IZ UGOSTITELJSKIH OBJEKATA

Miomir Mijić, Aleksandar Milenković, Danica Boljević, Damir Savković, Tatjana Miljković, Miloš Bjelić and Dragana Šumarac Pavlović

Apstrakt: Masovno ugrožavanje bukom iz ugostiteljskih objekata dobro je poznat ekološki problem u Beogradu. Buka koju oni stvaraju najvećim delom potiče iz uređaja za reprodukciju muzike. Međutim, problem je kompleksniji jer činjenica da su takvi objekti mesto okupljanja većeg broja ljudi, i to dominantno u noćnom periodu, donosi ugrožavanje bukom zbog žamora i drugih zvučnih pojava koje to prate. U ovom radu prikazani su neki rezultati studije koja ima za cilj sagledavanje tog problema i predlaganje postupaka koji taj problem mogu da umanje. U radu je prikazana prostorna distribucija ugostiteljskih objekata koji su u protekle četiri godine bili predmet žalbi inspekcijskoj službi i analiza rezultata dobijenih kontrolnim merenjima buke koja su u istom periodu obavljana po nalogu inspektora.

AK2.2 ODREĐIVANJE OSTVARENE VREDNOSTI IZOLACIONE MOĆI FASADNIH PREGRADA NA BAZI IZDVOJENIH KARAKTERISTIČNIH DOGAĐAJA

Miloš Bjelić, Miodrag Stanojević, Dragana Šumarac Pavlović, Miomir Mijić and Tatjana Miljković

Apstrakt: Primenom mikrofonskog niza i algoritama za prostorno-vremensku obradu signala moguće je eksperimentalno utvrditi funkciju gustine verovatnoće ugaone raspodele incidentne energije u urbanim uslovima. Takav postupak je vremenski zahtevan jer je potrebno analizirati dugačke vremenske segmente saobraćajne buke snimljene mikrofonskim nizom. U ovom radu prikazana je metodologija za eksperimentalno određivanje ugaone raspodele na osnovu kratkih segmenata karakterističnih tipova zvučnih izvora u urbanim uslovima. Dobijene rezultate je potrebno težinovati jer njihov doprinos nije isti. U radu je prikazan postupak za određivanje optimalnih vrednosti težinskih koeficijenata za karakteristične događaje. Izvršeno je poređenje ostvarenih vrednosti izolacione moći izračunatih za pojedinačne događaje koristeći optimalne vrednosti težinskih koeficijenata sa vrednostima izolacione moći izračunate na osnovu dugačkih segmenata saobraćajne buke. Pokazano je da se vrednost ostvarene izolacione moći mogu proračunati na osnovu kratkih vremenskih segmenata i odgovarajućih težinskih koeficijenata. Na taj način postupak izračunavanja ugaone raspodele, a samim tim i ostavene vrednosti izolacione moći fasadne pregrade je ubrzan nekoliko desetina puta.

AK2.3 KOMPARATIVNA ANALIZA IZOLACIONIH SVOJSTAVA GRAĐEVINSKIH MATERIJALA

Dragana Šumarac Pavlović, Ljiljana Popović and Miloš Bjelić

Apstrakt: Zvučni komfor u zgradama obezbeđuje se postizanjem minimalno zahtevanih vrednosti izolacionih svojstava pregradnih elemenata. Sam izbor materijala i načina gradnje menja se u vremenu i uslovljen je različitim uticajima vezanim za tehnologiju gradnje, ekonomske faktore, kao i novim zahtevima koji se postavljaju u domenu drugih vrsta komfora u zgradama, pre svega toplotnog komfora. Iako su izolaciona svojstva klasičnih građevinskih materijala poznata i definisana fizičkim zakonima prostiranja zvuka, u građevinarstvu se neprekidno dešavaju promene koje iziskuju traženje optimalnih konfiguracija koje će moći da zadovolje različite i, ne retko, oprečne zahteve iz domena statike, ekonomske održivosti, estetike, zvučnog i toplotnog komfora. U ovom radu prikazana je detaljnija analiza izolacionih svojstava klasičnih građevinskih materijala, koji su u širokoj upotrebi, u funkciji njihovih

osnovnih karakteristika, gustine, brzine longitudinalnih talasa, faktora gubitaka i debljine. Cilj toga je da se u procesu projektovanja jasnije definišu karakteristike materijala koje će zadovoljiti postavljene kriterijume.

AK2.4 ANALIZA VARIJACIJA GRAĐEVINSKIH IZOLACIONIH SVOJSTAVA KONSTRUKCIJA BAZIRANA NA ARHIVSKIM MERENJIMA I PRORAČUNIMA

Ljiljana Popović, Dragana Šumarac Pavlović, Miomir Mijić, Aleksandar Milenković and Danica Boljević

Apstrakt: Zvučni komfor u zgradama jedan je od elemenata ukupnog komfora koji treba zadovoljiti. Zbog specifične prirode zvuka i njegove percepcije zvučni komfor je u subjektivnom smislu kvalitet koji čovek boravkom u zgradi najdirektnije percipira. S druge strane, povećanje izolacionih svojstava pregradnih konstrukcija uvodi ograničenja u izboru materijala i vodi ka promenama u ceni koštanja ili tehnologiji gradnje. Pod pritiskom takve realnosti u projektovanju se, po pravilu, ne uzima nikakva margina sigurnosti za izolacionu moć pregrada, već se usvajaju minimalne vrednosti da bi se pokazalo da je zvučni komfor obezbeđen. Posledica toga je da veliki broj zgrada izgrađenih u poslednjoj deceniji ima nedovoljnu zvučnu zaštitu. Da bi se ovaj problem sagledao sprovedena je analiza bazirana na poređenju rezultata merenja u realnim zgradama i na njihovim proračunima. Izmerene vrednosti preuzete su iz arhive Instituta za ispitivanje materijala u Beogradu i Laboratorije za akustiku Elektrotehničkog fakulteta u Beogradu. Rezultati koji su korišćeni u ovoj analizi odnose se na tavanice od armiranog betona debljine 14-16 cm u stambenim i poslovnim zgradama građenim u periodu 1979-1990. godine.

AK2.5 UTICAJ RAZLIČITIH TIPOVA PRAGOVA NA ZVUČNU IZOLACIJU VRATA

Aleksandar Milenković, Danica Boljević and Damir Savković

Apstrakt: U savremenoj građevinskoj praksi interesantno je da se poslednjih godina teži izbacivanju klasičnih fiksnih pragova i upotrebi tzv. padajućih pragova kod izvedbe vrata. Prilikom projektovanja arhitekta u poslednje vreme u većini slučajeva projektuju ulazna vrata u hotelske sobe bez fiksnog praga, iz estetskih prohteva, ali prvenstveno zbog činjenice da fiksni prag smeta pri svakodnevnoj upotrebi prtljaga sa točkovima pri ulasku i izlasku iz hotelske sobe. U radu su prikazani rezultati serije laboratorijskih merenja izolacije od vazdušnog zvuka jednog tipa ulaznih vrata sa varijacijama padajućih pragova i fiksnog praga. Ispitivanja su izvršena u skladu sa serijom standarda za laboratorijska ispitivanja izolacije od vazdušnog zvuka u građevinarstvu, SRPS EN ISO 10140.

SESSION API1: ANTENNAS AND PROPAGATION

Tuesday, September 29th, 11:30 – 13:30, SITS, Kneza Miloša 9/III, Belgrade

Chair: Branko Kolundžija, Faculty of Electrical Engineering, University of Belgrade

API1.1 SECOND INTEGRATION WITHIN POTENTIAL INTEGRALS IN CASE OF SINGULAR BASIS FUNCTIONS USING SINGULARITY CANCELLATION

Aleksandra Krneta and Branko Kolundžija

Abstract: Efficient and accurate evaluation of potential integrals represents one of the main problems when using singular basis functions in the MoM/EFIE analysis of structures with the edge effect. In this work singularity cancellation technique is considered for precise evaluation of the second integration of potential integrals with singular basis functions in case of axially symmetric structures. The efficiency of this technique is analyzed on several examples for various angles between edges and for different positions of the field point.

API1.2 PERFORMANCE OF MAX-ORTHO BASIS FUNCTIONS IN FEM SCATTERING ANALYSIS

Slobodan Savić, Milan Ilić and Branko Kolundžija

Abstract: Performance of previously developed maximally orthogonalized higher order basis functions implemented in the large-domain finite element method are additionally evaluated in two numerical examples. In order to expand their scope, the functions are combined with the first order absorbing boundary condition, and it is shown that this does not degrade their superiority regarding the condition number.

API1.3 METHOD FOR ESTIMATION OF ELECTRICAL DISTANCE BETWEEN ANTENNAS BASED ON MUSIC-TYPE ALGORITHM

Nikola Basta and Miljko Erić

Abstract: A method for estimation of electrical distance between two realistic antennas, based on a MUSIC-type algorithm, is proposed. A simple physical model of the antennas is assembled in a full-wave electromagnetic simulation tool. The synthesized signal accounts for the transfer function between antenna ports, which is extracted from the electromagnetic simulation. The method is verified through comparison with the actual distance within the electromagnetic model and with the computed normalized group-delay.

API1.4 TRADE-OFFS BETWEEN MAXIMAL FORWARD GAIN AND MINIMAL BACKWARD GAIN OF A YAGI ANTENNA

Ana Đurdjevic, Dragan Olćan and Branko Kolundžija

Abstract: Optimization of Yagi antenna for maximum forward gain and minimal backward gain is conducted. Possible trade-offs between objectives are presented in the form of a Pareto front. It is determined by weighting the cost functions with many different combinations of weighting factors. Antenna solutions are generated by genetic algorithm and evaluated in method of moments based numerical solver, in a frequency range of interest.

API1.5 THE INFLUENCE OF DIFFERENT REALIZATION OF GROUND PLANE ON A CHARACTERISTIC OF HFSWR TRANSMITTER MONOPOLE ARRAY

Nemanja Grbić, Pavle Petrović, Ana Čupurdija, Nikola Lekić and Slobodan Savić

Abstract: Mutual coupling of antennas in systems that use multiple antennas is a phenomenon that can be detrimental to a system's functionality. Mutual coupling of antennas in an existing High Frequency Surface Wave Radar (HFSWR) transmitter is analyzed in this paper. Earlier measurements of VSWR had indicated that significant coupling may be present. After various simulations, its presence was confirmed, and it was shown that the simulated radiation pattern

has differences compared to the theoretical. In this paper, simulations were performed to analyze the effects of different realization of ground planes on antenna coupling and its effect on radiation pattern while keeping the deployment area and antenna foundations intact. The nature of the coupling was analyzed along with different realizations of ground planes. Simulation results are presented and discussed in details, showing that coupling through the free space is dominant in nature of this effect.

API1.6 MODELING OF MATCHING LOAD FOR SLOTTED WAVEGUIDE ANTENNA

Bojan Milanović, Stefan Filipović, Vladimir Đorđević and Vladimir Petošević

Abstract: In this paper, simulation elapsed time for two models with different waveguide matching load are analyzed. Models are made in the WIPL-D PRO-16 software. One of the matching loads is modeled as pyramidal absorber with dimensions and characteristics from real component. In order to reduce surface to air area, the other model is made as rectangular dielectric layer with losses. Pyramidal model is made with the help of the WIPL-s technical support and it is used as the reference for the matching quality. Comparing the execution time it was shown that by modeling the load as dielectric layer with losses, pattern deviation less than 0.5dB is obtained, while simulation time is noticeable reduced.

API1.7 PHASED ARRAYS OF CAVITY-BACKED ANTENNAS FOR 5G SMARTPHONES WITH METALLIC CASING

Miodrag Tasic and Dragan Nikolic

Abstract: Cellular handset antennas for future 5G applications need to provide beam steering, so the antenna focus is on the phased arrays. For the metallic casing handsets, a cavity-backed antenna is a natural candidate for an element of the phased array. Cavity can be cut in the handset wall and filled with the dielectric, so potential waterproofing can be maintained. Radiation is through the cavity, so metallic casing is not an obstacle. In this paper we use electromagnetic models to investigate the problems and limitations of a phased array with cavity-backed antennas.

API1.8 (MTI) SIMULATION OF WIDEBAND BANDPASS FILTERS WITH ARBITRARY RELATIVE BANDWIDTH

Dušan Nešić, Branko Kolundžija and Tomislav Milošević

Abstract: Algorithm for the realization of the wide relative bandwidth (RBW) bandpass filters is introduced. Algorithm is based on periodic ideal waveguide cells each with short-ended stub. Design curve of the ratio between characteristic impedance of the short-ended stub and the characteristic impedances of the main lines is given for the broad range of values of RBW.

SESIJA AP1: ANTENE I PROSTIRANJE

Utorak, 29 septembar, 13:30 – 14:00, SITS, Kneza Miloša 9/III, Beograd

Chair: Branko Kolundžija, Elektrotehnički fakultet, Univerzitet u Beogradu, Srbija

AP1.1 NUMERIČKO RAČUNANJE KONAČNOG DELA ZOMERFELDOVIH INTEGRALA U BLIZINI RAZDVOJNE POVRŠI VAZDUHA I METAMATERIJALA NEGATIVNE PERMITIVNOSTI

Nikola Basta and Branko Kolundžija

Апстракт: Предложен је бројички приступ решавању коначног дела Зомерфелдовог интеграла који одговара расејаном потенцијалу вертикалног Херцовог дипола у околини споја две линеарне средине -- ваздуха и метаматеријала негативне пермитивности. Интеграл је рачунао дуж реалне путање интеграције применом Гаус-Лежандрове квадратурне формуле. У аналитичкој припреми интеграла, применом смене променљивих и екстракције сингуларитета, поништен је сингуларни утицај тачака грананја и пола подинтегралне функције, респективно. Предложен приступ верификован је бројичким примерима и поређењем са другом методом.

AP1.2 БИОСЕНЗОРИ РЕАЛИЗОВАНИ ПОМОЋУ ФРЕКВЕНЦИЈСКИ СЕЛЕКТИВНИХ ПОВРШИНА

Milka Potrebić, Dunja Lončarević and Nikola Basta

Апстракт: Вирусне инфекције које имају пандемијски потенцијал представљају претњу за цело човечанство. Да би се убрзала дијагностика и повећао капацитет тестирања заразе вирусом, отвара се могућност увођења алтернативних метода дијагностике као што је примена биосензора. Потрага за поузданом алтернативном методом, у последње време заузима све важније место у циљу брже дијагностике, веће осетљивости, неинвазивног и безконтактнoг мерења. У терахерцном опсегу учестаности, коришћењем сензора на бази фреквенцијски селективних површина - метаматеријала, омогућава се бржа дијагностика и осетљивост откривања нано супстанци. У циљу поузданије детекције инфлуензавирус А, анализирале су две различите ћелије метаматеријала. Биосензор је пројектован као апсорбер, а за детекцију као референтни параметар коришћен је коефицијент апсорпције. Анализирају се фреквенцијски помераји и промена вредности коефицијента апсорпције са и без постојања вируса. Добија се да јединични елемент са једном резонантном учестаношћу има већу осетљивост од елемента са више резонантних учестаности.

OMAŽ PROFESORU DUŠANU PETROVAČKOM

Ponedjeljak, 28. septembar, 14:00 – 14:30, Institut “Mihajlo Pupin”, Beograd

UČESNICI:

Zoran Jeličić (Novi Sad); Dejan Popović i Branko Kovačević (Beograd)

SESSION AU1: CONTROL SYSTEMS 1

Monday, September 28th, 14:30 – 16:00, Institute “Mihajlo Pupin”, Belgrade

Chair: Prof. Željko Đurović

AU1.1 PROJEKTOVANJE KLIZNE POVRŠI ZA KLIZNE REŽIME VIŠEG REDA U LINEARNIM SISTEMIMA SA VIŠE ULAZA

Boban Veselić, Cedomir Milosavljević, Branislava Draženović and Senad Huseinbegović

Apstrakt: Rad ispituje mogućnost projektovanje klizne površi za realizaciju kliznih režima višeg reda (KRVR) u linearnim sistemima upravljanja sa više ulaza. U posmatranom slučaju klizna površ mora ispuniti dva zahteva: da obezbedi željenu dinamiku sistema u KRVR i da ostvari odgovarajući relativni red klizne promenjive u zavisnosti od željenog reda KR. Pokazano je da takva klizna površ postoji samo u sistemima sa specifičnom strukturom, i ne dozvoljava proizvoljni izbor dinamike sistema. Teorijsko dobijeni rezultati su verifikovani na numeričkom primeru i ilustrovani simulacionim rezultatima.

AUI1.1 CONCEPT OF SYSTEM FOR SURVEILLANCE AND MONITORING OF IOT HFSWR NETWORK

Nikola Stojković, Vladimir Orlić, Miroslav Perić, Dejan Drajić and Aleksandar Rakić

Abstract: The IoT (Internet of Things) concepts for maritime surveillance systems represent an interesting, but rather unexplored area. This paper presents the IoT architecture for the High Frequency Surface Wave Radar (HFSWR) network within the well-known Integrated Maritime Surveillance (IMS) concept. An overview of the topology of a typical HFSWR network is given, and IoT architecture layers and distributed middleware functionality are defined. The architecture is implemented and tested in the Gulf of Guinea, Africa, where an aggregated surveillance and monitoring Web application operates in the private cloud, supported by the Web REST services and SNMP. Effectiveness of the solution is demonstrated in both network monitoring and surveillance aspects by giving details of a SNMP agent testing and the system-level insight to the network operation from the application layer.

AUI1.2 IMPLEMENTATION OF THE MONITORING SYSTEM FOR HFSWR-BASED MARITIME SURVEILLANCE NETWORKS

Nikola Stojković, Dejan Nikolić, Vladimir Orlić, Bojan Džolić and Nikola Lekić

Abstract: Designing surveillance and monitoring applications for HFSWR (High Frequency Surface Wave Radar) networks faces with significant challenges, where it is mandatory to involve literally thousands of factors in order to create a comprehensive monitoring system, and respond to the needs of efficient maritime surveillance at the same time. All these factors make HFSWR network a complex system for distributed measurement and control. Described structure of sensor processing software and surveillance utility features allow system operators to make insight into specific surveillance situations, active protection of restricted naval areas and resolving missing vessel identifications, which represents huge problem in Exclusive Economic Zone (EEZ) monitoring of underdeveloped regions. Implemented solution for surveillance and monitoring system is presented through demonstration of its practical functionality, obtained from operational HFSWR network, installed in Gulf of Guinea, Africa.

AUI1.3 AUTOMATION A CONVEYOR BELT FURNACE FOR ANNEALING METALS IN A PROTECTIVE ATMOSPHERE

Pavle Stepanić, Aleksa Krošnjar, Aleksandar Rakić and Jelena Vidaković

Abstract: The paper presents the revitalization of a conveyor belt furnace for annealing metal, which included the design and implementation of a control system based on a programmable logic controller. The goal of the revitalization of the furnace is its modernization through the digital transformation of technological process variables as a new form of data availability in

the context of Industry 4.0. The application of a modern control system ensures optimal control of the technological process and thus significantly extends the useful life of the machine.

AUI1.4 VOWEL RECOGNITION USING FORMANT ANALYSIS AND NEURAL NETWORKS

Emilija Kisić, Goran Dikić and Vera Petrović

Abstract: In this paper, a system for vowel recognition using formant analysis and neural network is described. Complete procedure for vowel recognition which consists of historical dataset forming, dataset preprocessing, power spectral density estimation, formant extraction and neural network training and testing is given. Finally, gain results are discussed and it is shown that with first three formant frequencies and with appropriate neural network architecture vowels can be classified and recognized with big accuracy.

AUI1.5 MULTI-RESONANT OBSERVER PLL WITH ESTIMATION OF GRID UNBALANCES

Aleksandra Mitrović, Mirna Kapetina and Milan Rapać

Abstract: In this paper, phase locked loop or PLL algorithm for grid synchronization is investigated. Process of grid synchronization allows the device to be connected to the power system and certain conditions must be met for optimal functioning. One of the problems in the grid synchronization process, which occurs due to grid imperfections, are higher order harmonics which are treated as disturbances in electric power system. Because of that, the proposed PLL technique is implemented with reduced order observer of prostoperiodic disturbances and RST controller. Algorithm control loop is implemented in discrete time domain and two cases were considered. First case is with one higher order harmonic and second case is with two higher order harmonics in the system. The theoretical findings are substantiated by extensive simulation examples.

AUI1.6 DECISION SUPPORT SYSTEM FOR TRAFFIC JAMS BY USING ARTIFICIAL INTELLIGENCE

Luka Bjelica, Svetozar Vulin and Anja Buljević

Abstract: This paper presents one possible decision support system as partial solution of traffic jam problem using autonomous vehicles. Proposed solution is based on deep learning algorithms and artificial neural network (ANN) models which task is to make a decision whether to move the car to a side lane, or stay in the current lane. The optimality criteria is maximization of the elapsed distance in traffic by training ANN, using a supervised learning paradigm from labeled data, to control the car. Gradient descent algorithm is used for the network's parameters estimation. Verification, testing and simulation application is also presented in this paper.

SESSION AU2: CONTROL SYSTEMS 2

Monday, September 28th, 16:00 – 18:00, Institute “Mihajlo Pupin”, Belgrade

Chair: Prof. Milan Rapać

AUI2.1 AR SPEECH MODEL PARAMETER ESTIMATION USING A ROBUST NON-RECURSIVE ESTIMATOR

Ana Lazović, Mihailo Bjekić and Aleksandra Marjanović

Abstract: In this paper a robust block linear prediction (RBLP) method for autoregression (AR) model parameter estimation of speech signal is considered. The considered method consists of two separate iterative steps which are described in detail. The method is tested on both synthesized and natural human speech in the presence of outliers and additive measurement noise. A comparative analysis of the RBLP method and the conventional linear prediction method shows that the robust method gives results which are less biased and have a smaller variance.

AUI2.2 MODELLING AND CONTROL OF A SERIES DIRECT CURRENT (DC) MACHINES USING FEEDBACK LINEARIZATION APPROACH

Mitra Vesović, Radiša Jovanović, Lara Laban and Vladimir Zarić

Abstract: The nonlinear feedback control system applied to the direct current - DC motor is proposed in this research. Nonlinear mathematical model has been obtained using dead zone, Coulomb and viscous friction. The system stability has been analyzed using Lyapunov stability theory. The effectiveness and the comparison of the performance between linear and nonlinear control algorithm have been validated using Matlab/Simulink software. From the conclusions, based on the simulation and experimental results that have been provided, it is easy to see that nonlinear control systems are more suitable and have a better reach for controlling position. The validity of using feedback linearization in DC motors has been proven.

AUI2.3 MODELING AND CONTROL OF A LIQUID LEVEL SYSTEM BASED ON THE TAKAGI-SUGENO FUZZY MODEL USING THE WHALE OPTIMIZATION ALGORITHM

Radiša Jovanović, Vladimir Zarić, Mitra Vesović and Lara Laban

Abstract: The liquid level control remains an important task for research and is used by process control engineers. Firstly, the linear models for the tank system are obtained for the three different operating points. From these identified linear models a Takagi-Sugeno (TS) model is obtained using triangular membership functions in the premises of the rules. Furthermore, the whale optimization algorithm is implemented to fine tune parameters of Takagi-Sugeno fuzzy model, according to the chosen objective function. By using the parallel distributed compensation (PDC), a fuzzy controller is created by the fuzzy blending of three PI controllers designed for each of the operating points. In order to evaluate performance of the PDC based fuzzy controllers, the comparison is made between several local linear PI controllers and the PDC. Moreover, the PDC controllers from the optimized and original TS plant model are compared. The experimental results and the comparison results verificate efficiency of the proposed method.

AUI2.4 THE INTERACTING MULTIPLE MODEL GM PHD FOR SINGLE TARGET TRACKING

Branko Kovačević, Zvonko Radosavljević and Dejan Ivković

Abstract: The recursive algorithm based on non switching Interacting Multiple Model (IMM) with Gaussian Mixture Probability Hypothesis Density (GM PHD) filtering is proposed for estimating and tracking maneuvering target. The approach involves modeling the complex

movements with maneuver of target and measurements and applying the probability hypothesis density (PHD) recursion to propagate the posterior intensity, a first order statistics of target in time. We present there closed-form solution to the algorithm recursion. The proposed algorithm combines these recursions with a strategy for managing the number of Gaussian components to increase efficiency. At begin, a single target tracking is performed and tested. Proposed algorithm is shown better performance, in relation with standard GM PHD.

AUI2.5 RASPBERRY PI BASED SOUND ACQUISITION PLATFORM FOR MACHINE STATE ESTIMATION

Petar Jandrić, Uroš Rakonjac, Željko Đurović, Aleksandra Marjanović and Sanja Vujnović

Abstract: Scheduled maintenance in thermal plants is one of the essential tasks in efficient planning and could significantly decrease unwanted expenses due to unnecessary maintenance. Traditional systems currently in use in industry are composed of multiple different subsystems with highly specialized components which makes them unnecessarily expensive and complicated. The purpose of this paper is to propose a single, compact, cost efficient device to perform the acquisition of acoustic signals, which would then be used by a state detection algorithm. The algorithm uses a combination of wavelet transform and neural networks and is computationally inexpensive, so it can be implemented on a simple microcontroller. The testing has been done on real acoustic signals recorded in thermal power plant Kostolac in Serbia.

AUI2.6 DISTRIBUTED MULTI-AGENT REINFORCEMENT LEARNING ALGORITHM BASED ON GRADIENT CORRECTION

Milos Stanković, Marko Beko, Nemanja Ilić and Srđan Stanković

Abstract: In this paper we propose a decentralized gradient correction based temporal difference algorithm for multi-agent learning of linear approximation of the value function in Markov decision processes. The algorithm is composed of local parameter updates based on the single-agent off-policy temporal difference with gradient correction algorithm TDC(λ), and a linear dynamic consensus scheme. The overall scheme allows applications in which the agents may have different behavior policies, while evaluating a single target policy. Starting from the properties of the underlying Feller-Markov processes, we show that under nonrestrictive assumptions on the time-varying network topology and the individual state-visiting distributions of the agents the algorithm weakly converges to consensus. A discussion is given on the asymptotic parameter values at consensus, network design and variance reduction. The algorithm's properties are illustrated by simulation results.

AUI2.7 OPTIMIZING CONVERGENCE SPEED IN ADAPTIVE CONSENSUS ALGORITHMS

Nemanja Ilić, Miloš Stanković and Srđan Stanković

Abstract: In this paper multi-step adaptive consensus algorithms for distributed information processing via networks of intelligent sensors are considered. Network nodes are assumed to have limited resources in view of the limited connectivity range and the local availability of measurements (limited sensing range). Consensus schemes aimed at achieving the weighted average of node states (local information processing results) by utilizing the locally available communication channels are discussed. The setting where the adaptive asymptotic consensus weights reflect assertions about the individual node quality as well as the real-time measurement availability is adopted. Within this context, the paper proposes practically convenient procedure for designing the adaptive communication weights exhibiting the fastest convergence speed of the resulting consensus scheme, and proves the claimed optimality. This issue is of great importance for reducing sensor network communication requirements and increasing its energy efficiency. A number of numerical examples are given, illustrating the algorithm behind the proposed procedure and demonstrating its effectiveness.

SESSION BT11: BIOMEDICAL ENGINEERING

Tuesday, September 29th, 12:00 – 14:00, Institute “Mihajlo Pupin”, Belgrade

Chair: Dejan B. Popović, Serbian Academy of Sciences and Arts

BT11.1 A RULE-BASED CONTROL SYSTEM FOR ASSISTING THE GAIT BY MULTICHANNEL FUNCTIONAL ELECTRICAL STIMULATION: DESIGN AND PROOF OF CONCEPT

Eleonora Vendrame, Dejan B. Popović, Emilia Ambrosini and Lana Popović-Maneski

Abstract: A rule-based controller to assist stroke survivors' gait through multichannel functional electrical stimulation was developed. The controller was designed for the system comprising a wearable four-channel stimulator and insoles instrumented with pressure sensors and inertial measurement units. The gait segmentation algorithm processes Real-time signals from the sensorized insoles. The heuristically established rules split each gait cycle into five phases. These If-Then rules trigger stimulation channels to activate paralyzed thigh and shank muscles in an order that leads to the natural like stance and swing. The stimulator sends electrical pulses via surface electrodes positioned on a hemiplegic patient's paretic leg to activate the quadriceps, the hamstrings, the anterior tibialis, and the gastrocnemius muscles. A graphic user interface was developed to set the stimulation parameters and calibrate the system. The segmentation algorithm was validated on the recordings of 10 stroke patients, and the assistive gait training system was tested on one older adult to prove the concept.

BT11.2 SURFACE EMG FOR THE ASSESSMENT OF THE GAIT PERFORMANCE IN HEMIPLEGIC PATIENTS

Ivan Topalović, Suzana Dedijer Dujović, Ljubica Konstantinović and Dejan B. Popović

Abstract: We developed a method for assessment of the gait regularity in hemiplegic patients. We used a fully wearable system comprising ground reaction force sensors and inertial measurement units to record the dynamics and array electrodes and multichannel amplifiers for electromyography (EMG) mapping of activity of tibialis anterior m. during the gait. The fuzzy logic was applied to ground reaction force signals for estimating the gait symmetry. This paper introduces a new parameter for estimation of symmetry of muscle activities in the ipsilateral and contralateral legs based on the entropy of EMG maps. The presented method forms a set of gait parameters for quantifying the regularity of the patient's gait. The set of parameters are of interest for the assessment of the efficacy of the therapy.

BT11.3 CYCLOGRAMS BASED ON PRINCIPAL COMPONENTS FOR ASSESSING THE GAIT

Marija Gavrilović and Dejan B. Popović

Abstract: Objective measure of the gait quality is essential for evaluating the therapeutic protocol's effects on stroke patients' rehabilitation. We present a new proposal for assessing the gait, which uses the principal component analysis (PCA) of feet kinematics and ground reaction forces (GRF) data. The data have been acquired by the Gait Master comprising five GRF sensors and 6D inertial measurement units (IMU) per insole. The PCA reduces the 22-time series output from two insoles and generates cyclograms, allowing qualitative analysis of the pathologic and healthy gait differences. We suggest that cyclograms in the space with principal components on the axis provide useful information to the clinician about the gait performance. Five volunteers with no known motor impairment participated in the determination of the regular pattern. We tested the method in a small series of patients after stroke using the pattern of healthy as a standard. The results suggest that the PCA analysis provides a good measure of gait quality.

BT11.4 PARAMETER ESTIMATION OF A HUMAN CONTROLLER TRANSFER FUNCTION IN MAN-MACHINE SYSTEM USING THE PSO ALGORITHM

Jelena Bulatović, Filip Gašparić, Olivera Tomašević, Boris Knežević and Nikola Jorgovanović

Abstract: Quantification of human behavior has always been at the same time quite interesting and very challenging task for control engineers. What might seem as an automated action performed by human, in fact represents an expression of a complex underlying body and brain processes. Considering the man's ability to memorize, adapt and learn, this task sounds even more difficult. Regardless the non-linearity in human behavior which results from reasons listed above, some classical procedures have proved to be useful in practical application, and engineers have derived quasi-linear mathematical models which describe human controller in closed-loop man-machine systems. In this work, general form of these models was used and parameter estimation was performed. In the observed closed-loop system, a human controller was replaced with a corresponding system which contained estimated parameters. Performance of parameter estimation was measured using mean absolute error, when comparing output of an actual system, controlled by human, and a simulated one.

BT11.5 VALIDATION OF THE NEW WEARABLE INSTRUMENT FOR THE PENDULUM TEST BASED ON INERTIAL SENSORS

Marjan Miletić, Vladimir Atanasoski, Jelena Kršić, Aleksandar Lazović and Lana Popović-Maneski

Abstract: The important indicator of the impairment and the course of the recovery in humans with the central nervous system is the assessment of spasticity. The pendulum test was accepted as the quantification method of knee muscles' spasticity. We present a new, inexpensive, easy to use wireless pendulum test device for estimation of spasticity of knee muscles (quadriceps and hamstrings). The new system uses inertial, and electromyography (EMG) sensors positioned at the upper and lower leg segments. The measurement device was applied for the pendulum test on a population of thirteen healthy volunteers. We estimated seven parameters from the pendulum test, which form a single measure of spasticity in patients, termed the pendulum test (PT) score. Results show a small deviation for all parameters between subjects, and mean values of PT score are below 1, which is in the range for healthy persons from the literature. Hence, the seven parameters' values can be used as a reference for the PT score estimation in patients.

BT11.6 LACUNARITY ANALYSIS OF MICROVASCULAR MORPHOLOGY IN HUMAN RETINA

Ivana Konatar, Nataša Popović, Tomo Popović, Miroslav Radunović and Batrić Vukčević

Abstract: Fractal analysis provides means for the quantitative assessment of geometric patterns in one, two, and three dimensions. It is aimed at analysis of graphical shapes that belong to a class of fractal objects that are characterized by the self-similarity over different scales. Various structures in nature are fractals and fractal analysis techniques are widely used for analysis of biomedical images. One such example of application is analyzing blood vessel structure in the human retina that can be extracted from digital images captured by fundus camera. The most commonly used fractal analysis is estimation of fractal dimension using various box-counting methods for mono- and multi-fractals. Although two fractal images can have the same fractal dimension they can have very different appearance and structure. One can appear as a structure that fills most of the available space, while the other can have a lot of empty areas. These differences can be quantified by lacunarity parameter, which has greater value in images with less space-filling properties. This paper focuses on the estimation of the lacunarity parameter implemented in the Python programming language, which is aimed at lacunarity analysis of microvacular morphology in human retina. The implementation is validated by comparison with the results obtained by ImageJ, a commonly used software for analysis of biomedical

images. The value of the lacunarity analysis is demonstrated on a set of actual images of human retina associated with different medical conditions.

BT11.7 SEGMENTATION AND CLASSIFICATION OF LEUCOCYTE IMAGES FOR DETECTION OF ACUTE LYMPHOBLASTIC LEUKEMIA

Ivana Pešić

Abstract: Acute lymphoblastic leukemia (ALL) is the most common type of leukemia among children. It is characterized by excessive occurrence of immature lymphocytes – lymphoblasts, especially in bone marrow and lymphoid organs. Diagnosing ALL based on blood samples is routinely done by hematologists, often using cytogenetic analysis or immunophenotyping. However, these visual examinations are often slow and limited by subjective interpretation; therefore standardized inexpensive automated systems for detecting lymphoblasts in blood images are needed. Systems for ALL detection are still in the development stage; improving techniques of lymphocyte segmentation from blood images and classification techniques is a challenge. The aim of this paper is to perform a segmentation of lymphocytes on images from the publicly available ALL_IDB2 database and to compare different classification algorithms for ALL detection. Morphological, color and texture feature extraction from segmented lymphocyte images was performed as well as Principal Component Analysis (PCA) for dimensionality reduction. Classification into two groups (healthy lymphocytes and lymphoblasts) was performed using three different algorithms: k-Nearest Neighbours (kNN), Support Vector Machine (SVM) and feedforward neural network (NN).

BT11.8 BRAIN TUMOR SEGMENTATION IN MRI SCANS USING CONVOLUTIONAL NEURAL NETWORKS

Maja Pantić

Abstract: In this paper an algorithm for segmentation of brain tumor lesions in magnetic resonance images (MRI) using convolutional neural networks (CNN) is proposed. Precise determination of brain tumor regions is important for diagnosis, treatment choice and patient follow-up. The realized CNN model has the U-Net architecture, which is able to simultaneously extract structure characteristics and their precise locations in the input image. The U-Net is applied on the scans of high-grade glioma patients. The resulting segmentation is evaluated using Dice coefficient and the median Dice values achieved on the test images are 0.83, 0.58 and 0.74 on the whole tumor, active tumor and core tumor region respectively.

BT11.9 REAL-TIME NAVIGATION SYSTEM FOR CENTRAL VENOUS CATHETERS USING ULTRASOUND TECHNOLOGY

Dejana Vuković, Jens Wildhagen and Korbinian Köhler

Abstract: In this paper the development and testing of a system prototype for a novel real-time navigation using 100 kHz ultrasound technology intended for the precise positioning of a CVC (Central Venous Catheter) inside the central venous system is presented. For the prototype realization a DSP (Digital Signal Processor) based hardware, including data converters, an ultrasonic transducer and a hydrophone, has been used. The processing algorithms implemented in C programming language included amplitude modulation/demodulation, matched filtering, and polyphase interpolation of chirp signals. For testing purposes, a measurement setup with a model of the upper part of the human torso based on water, agar-agar, pork ribs and pork lung was established. This paper shows the results of testing the developed prototype in terms of robustness, accuracy, and the possibility of ultrasound transmission through tissue, lungs, and ribs. The presented results indicate that even though the developed system shows a high level of accuracy (> 98 %) with a distance estimation update rate of 3.2 s and a usability for distances up to 20 cm in case of transmission through tissue and ribs, the overall applicability of the introduced ultrasound based navigation system is limited by the presence of the lungs. Additionally, the results confirm the existence of a statistically significant difference between ultrasound transmission through tissue and ribs.

SESSION EE1: POWER ENGINEERING/ ELEKTROENERGETIKA

Monday, September 28th, 12:00 – 14:30, University of Novi Sad, Ceremonial Hall

Chair: Marko Rosić, Faculty of Technical Sciences Čačak, University of Kragujevac

EEI1.1 VOLTAGE ORIENTED CONTROL DESIGN FOR BRUSHLESS DOUBLY-FED RELUCTANCE MACHINES

Taufik Taluo, Lepasava Ristić and Milutin Jovanović

Abstract: The paper considers voltage vector oriented control (VOC) of a promising brushless doubly-fed reluctance machine (BDFRM) for large-scale wind turbines or pump drives. The BDFRM has been receiving increasing attention due to its low operation and maintenance costs achieved by using partially-rated power electronics and a highly reliable brushless construction. Furthermore, the BDFRM may provide competitive performance to its traditional slip-ring counterpart, the doubly-fed induction machine (DFIM). The BDFRM has been modeled in MATLAB/Simulink with the VOC being implemented to both the machine and grid side converter bridge to provide a bi-directional power flow. Aspects concerning proportional integral (PI) controllers optimal tuning have been considered and comprehensive simulation results presented to demonstrate the obtained VOC response under the unity power factor and maximum torque per inverter ampere conditions.

EEI1.2 EDUCATIONAL LABORATORY PUMP SYSTEM SETUP – PQ OPEN LOOP CONTROL

Mihailo Bjekić, Vojislav Vujičić, Marko Šućurović, Marko Rosić and Miroslav Bjekić

Abstract: In this paper, an educational laboratory pump system setup, realized in the Process Engineering Laboratory of the Faculty of Technical Sciences in Čačak, is described. The system is controlled in an open loop by calculating the desired frequency of the variable speed drive and the angle position of the throttle valve based on the desired pressure and flow. Starting from the acquired pump system characteristics $p=f(Q)$ and the characteristic of the throttle valve, mathematical equations were derived.

EE1.1 PODRŠKA NASTAVI ELEKTRIČNIH MAŠINA KORIŠĆENJEM INTERAKTIVNE MREŽNE APLIKACIJE GEOGEBRA

Miroslav Bjekić

Apstrakt: Na Fakultetu tehničkih nauka u Čačku se više od 25 godina razvijaju i u nastavi koriste obrazovni računarski softveri iz oblasti Električnih mašina. U poslednjih godinu dana razvijeni su novi programi kreirani u programskom paketu GEOGEBRA. U ovom radu biće dat kratak prikaz svih tih do sada kreiranih programa sa osnovnim informacijama o nameni, načinu korišćenja i očekivanim nastavnim efektima za studente.

EE1.2 PRIMJENA HAOTIČNOG OPTIMIZACIONOG ALGORITMA U ESTIMACIJA PARAMETERA ZAMJENSKE ŠEME DVOKAVEZNE ASINHRONE MAŠINE

Željko Fuštić, Martin Čalasan, Tatijana Dlabac and Branko Koprivica

Apstrakt: U ovom radu je predstavljena upotreba haotičnog optimizacionog algoritma - Chaotic Optimization Algorithm (COA) u estimaciji parametara zamjenske šeme dvokavezne asinhronne mašine. Parametri zamjenske šeme dvokavezne asinhronne mašine su određeni pomoću podataka naznačenih na natpisnoj pločici mašine (polazni moment, nominalni moment, maksimalni moment i nominalna vrijednost faktora snage). Poređenjem rezultata COA algoritma sa rezultatima dobijenim primjenom Modifield Shuffled Frog - Leaping Algorithm – MSFLA i modifikovanog Njutnovog metoda uključenog u SimPowerSystem Toolbox u MATLAB (Power Asynchronous Machine Params - PAMP) pokazano je da se COA algoritam može veoma efikasno primijeniti u estimaciji parametara zamjenske šeme dvokavezne asinhronne mašine.

EE1.3 ANALIZA UTICAJA REAKTIVNE SNAGE STANICA ZA EV NA LOKACIJU STANICA I GUBITKE ENERGIJE U DISTRIBUTIVNOJ MREŽI

Ana Pavličević and Vladan Durković

Apstrakt: U radu je analiziran uticaj reaktivne snage stanica za električna vozila (EV) na lokaciju i gubitke energije u distributivnoj mreži. Sprovedena analiza za tri karakteristična način punjenja EV pokazuje značaj dispečinga reaktivnih snaga samih stanica za punjenje vozila. Prikazani rezultati obuhvataju uticaj dnevnog dijagrama stanica za punjenje EV i dnevnog dijagrama potrošača. Gubici u slučaju iskorišćenja reaktivne snage stanica za punjenje EV su upoređeni sa dosadašnjim načinom punjenja koji podrazumjeva da stanice za električna vozila troše samo aktivnu snagu.

EE1.4 ARHITEKTURA SISTEMA ZA DALJINSKO UPRAVLJANJE STANICE ZA PUNJENJE ELEKTRIČNIH VOZILA KOJA SE NAPAJA IZ OBNOVLJIVIH IZVORA ENERGIJE

Jovan Vujasinović, Goran Savić and Željko Đurišić

Apstrakt: U ovom radu je opisana arhitektura sistema za daljinsko upravljanje stanice za punjenje električnih vozila, koja se napaja iz obnovljivih izvora energije. Sistem omogućava objedinjavanje većeg broja funkcionalnosti koje doprinose efikasnijem korišćenju zasebnih podsistema, kao što su: podsistem za daljinsko upravljanje punjačima električnih vozila, podsistem za daljinsko upravljanje pametnim baterijama, podsistem za daljinsko upravljanje pametnim brojilima i podsistem za daljinsko upravljanje fiskalnim kasama. Na ovaj način se stanice za punjenje električnih vozila, koje se napajaju iz obnovljivih izvora energije, čine dostupnijim korisnicima električnih vozila. Time se daje i doprinos podsticajima za povećanje obima korišćenja električnih vozila za koje se energija obezbeđuje iz obnovljivih izvora, čime se smanjuju i stepen zagađenja vazduha i efekti klimatskih promena u vidu globalnog zagrevanja.

EE1.5 OPTIMAL LOCATION AND SIZE OF CAPACITOR BANKS IN DISTRIBUTION NETWORK WITH HARMONIC DISTORTION

Nikola Krstić

Abstract: Growing presence of nonlinear loads in distribution networks leads to deterioration in the quality of operation of these networks due to injection of higher harmonics. In this paper, optimal location and size of capacitor banks (CB) in distribution network with the presence of higher harmonics, for different priority factors, are determined, in order to see the efficiency and suitability of this, often used solution for reactive power compensation, in the presence of harmonic distortion. Metaheuristic particle swarm optimization (PSO) method was used to find optimal solution to the optimization problem. IEEE18 distribution network was used as a test network, and computer simulations, for results generation and verification, were done in the Matlab software.

EE1.6 NOVI ALGORITAM ZA ESTIMACIJU PARAMETARA SIGNALA U EES-U BAZIRAN NA PRONIJEVOJ METODI

Dimitrije Rozgić and Predrag Petrović

Apstrakt: U radu je prikazan novi algoritam za estimaciju parametara osnovnog harmonika napona ili struje (amplitude, kružne frekvencije i faze) u elektroenergetskom sistemu, baziran na Pronijevoj metodi. Poboljšanje performansi predloženog algoritma ostvareno je primenom posebno dizajniranog DFT filtra i ZC metode. DFT filtrom se izdvajaju odbirci osnovnog harmonika procesiranog ulaznog signala, dok se ZC metodom poboljšava selektivnost DFT filtra.

EE1.7 GUBICI SNAGE U TORUSNOM JEZGRU OD FEROMAGNETSKOG LIMA ZA SLUČAJ MAGNETSKE INDUKCIJE OBLIKA SEGMENTISANE SINUSOIDE

Srđan Divac, Branko Koprivica, Alenka Milovanović and Milan Plazinić

Apstrakt: Cilj ovog rada je prikaz vremenskog oblika snage magnećenja uzorka od feromagnetskog lima pri kontrolisanom obliku magnetske indukcije oblika segmentisane sinusoide, sačinjene od linearnih delova. U radu su prikazana poređenja vremenskih oblika magnetskog polja, magnetske indukcije i snage magnećenja. Analizirana je promena snage u vremenu sa brzinom promene magnetske indukcije. Takođe, analizirana je promena vrednosti snage gubitaka sa promenom broja segmenata razmatrane sinusoide. U radu je data odgovarajuća diskusija rezultata.

SESSION EKI AND EK: ELECTRIC CIRCUITS AND SYSTEMS, AND SIGNAL PROCESSING/ ELEKTRIČNA KOLA, ELEKTRIČNI SISTEMI I OBRADA SIGNALA (EK)

September, 28th, 14:00-16:00, SITS, Kneza Miloša 9/3, Belgrade

Chair: Ana Gavrovska, Faculty of Electrical Engineering, University of Belgrade

EKI1.1 BINARY MASK BASED CROWD COUNTING ANALYSIS USING MULTI-COLUMN CONVOLUTIONAL NEURAL NETWORK

Lara Kašca and Ana Gavrovska

Abstract: Crowd counting has attracted significant attention recent years since it is valuable to estimate the number of people in a crowd in numerous applications, especially the ones related to video surveillance. Artificial intelligence, especially convolutional neural networks, became a part of such applications. In this paper, multi-column convolution neural network implementation has been analyzed, where the output is density map. The number of people is estimated as a sum of the map. In this paper experimental analysis using binary mask based postprocessing and ShanghaiTech dataset is performed. The obtained results seem promising in dealing with unwanted texture details related to irrelevant regions as in the case of greenery.

EKI1.2 DISTANCE METRIC COMPARISON FOR PEOPLE MONITORING ACROSS MULTI-CAMERA VIEWS USING TERNARY ENCODING

Katarina Popović and Ana Gavrovska

Abstract: Person monitoring is based on re-identification process, where it is important to establish correspondence between the person representations in different frames. The feature vectors may use ternary encoding like in local maxima occurrence representation, where color and texture features are implemented. In this paper three different distance metrics are compared after ternary encoded feature computation for people's pattern recognition. Moreover, since a person is usually a moving object, two different resizing approaches are distinguished. The color, the texture and the combined (color-texture) feature vectors are analyzed for the purpose of differentiation between image sets corresponding to different persons obtained across six camera views. The results show how the differentiation in multi-camera network can be affected by the choice of resize technique and distance metric.

EKI1.3 CONSTANT QUALITY MODE 4K VIDEO COMPARISON USING AV1 REFERENCE TOOL

Milan Milivojevic, Dragi Dujkovic and Ana Gavrovska

Abstract: A variety of new coding tools has been developed and are expected to be developed in the near future in order to achieve high-quality video transmission. One of the next-generation video encoding formats is AV1, as the first compression format developed by the Alliance for Open Media, where AV1 is recognized as VP9 successor. In this paper 4k low frame rate video sequences are compared for different constant quality (CQ) values using reference tool libaom. The obtained results are also compared to VP9 and HEVC codecs. Slow AV1 coding is performed using libaom, in order to analyze differences between different CQ settings. The results show compression performance using 2-norm evaluation and time needed for coding.

EKI1.4 REAL-TIME MOVING OBJECT OF INTEREST DETECTION IN MULTI-SENSOR IMAGING SYSTEM

Miloš Pavlović, Nikola Stojiljković, Ivan Gluvačević, Miljan Vučetić and Miroslav Perić

Abstract: The video surveillance systems usually require a constant user's observation of the scene in order to respond on time to situations that could be risky. In order to allow the system

to understand and react to the environment and in that way to reduce user's need for manual intervention, objects of interest detection algorithms need to be integrated into the video systems. This paper proposes a real-time algorithm for moving object of interest detection, applicable to the multi-sensor imaging system. Algorithm introduces a combination of the method for motion detection in images - Optical flow and deep learning method for detecting objects of interest - YOLO algorithm. The objects of interest for detection in this paper are pedestrians and cars.

EKI1.5 INFRARED FOCAL PLANE ARRAYS PERFORMANCE ACHIEVEMENTS AND FUTURE TRENDS

Dragana Perić and Branko Livada

Abstract: This paper gives a review of current infrared focal plane arrays from the point of view of the practical application capabilities in the long range surveillance systems. We have tried to point out the vital components of the IR detector and gave the current trend of development that will be useful for a system architect whose task is to select components from the most competitive technologies available on the market now and to have in mind what is expected to be available in the near future.

EKI1.6 HUMIDITY SENSOR CIRCUITS BASED ON THE CURRENT PROCESSING

Predrag Petrović, Marija-Vesna Nikolić and Mihajlo Tatović

Abstract: A novel electronic conditioning circuits based on the current-processing technique for accurate and reliable humidity measurement, without post-processing requirements, are presented. The pseudobrookite nanocrystalline (Fe₂TiO₅) thick film was used as capacitive humidity transducer in proposed design. The interface circuitry was realized in TSMC 0.18μm CMOS technology. The sensing principle of the sensor was obtained by converting the information on environment humidity into a frequency variable square-wave current signal. The proposed solution features high linearity, insensitivity to temperature, as well as low power consumption. The sensor has a linear function with relative humidity in the range of Relative Humidity (RH) 30-90%, error below 1.5% and sensitivity 8.3 x10¹⁴Hz/F evaluated over the full range of change. A fast recovery without the need of any refreshing methods was observed with a change in RH. The total power dissipation of readout circuitry was 1mW.

EKI1.1 PRIMJENA TEORIJE GRAFOVA U OBLASTI ELEKTROTEHNIKE - ODABRANI PRIMJERI

Jovana Forcan and Miodrag Forcan

Apstrat: Teorija grafova ima široku primjenu u oblasti elektrotehnike, a ključni razlog je pogodnost modelovanja elektrotehničkih elemenata i procesa usmjerenim grafovima. Cilj ovog naučnog rada je da se kroz odabrane primjere ukaže na opšti značaj teorije grafova u različitim oblastima elektrotehnike. U radu su analizirani odabrani primjeri iz oblasti analize električnih kola, elektroenergetike i teorije automatskog upravljanja. Kombinovana primjena teorije grafova i teorije kola ilustrovana je na primjeru analize paralelnog RLC kola.

SEKCIJA ML1: ETALONIRANJE

Ponedjeljak, 28. september, 10:00-11:30, Univerzitet u Novom Sadu, Svečana sala

Chair: Dragan Denić, Elektronski fakultet, Univerzitet u Nišu

ML1.1 ODREĐIVANJE FAKTORA ETALONIRANJA SENZORA SNAGE NA FREKVENCIJAMA DO 10 MHZ

Neda Spasojević, Ivica Milanović and Miša Markuš

Apstrakt: U radu je opisana metoda određivanja faktora etaloniranja senzora snage primenom AC/DC termopretvarača i DC kalibratora kao referentnog etalona. Predstavljena metoda se u laboratoriji za etaloniranje Tehničkog opitnog centra (TOC) primenjuje za frekvencije niže od 10 MHz, dok se na višim frekvencijama koristi metoda direktnog poređenja sa transfer etalonom, odnosno referentnim etalonom za mikrotalasnu snagu. U radu je dat i proračun merne nesigurnosti za opisanu metodu.

ML1.2 UTICAJ IZBORA PERIODE NA PROCENU RMS VREDNOSTI SIGNALA

Marina Subotin, Dragan Pejić, Stefan Mirković, Nemanja Gazivoda, Marjan Urekar and Bojan Vujicic

Apstrakt: U ovom radu je istražen kvalitet izračunavanja procene efektivne vrednosti napona (RMS) primenom pravougaonog, trapeznog, prvog i drugog modifikovanog Simpsonovog pravila u zavisnosti od izbora periode. Uvođenjem modifikacija kod Simpsonovih pravila je prevaziđen zahtev u pogledu broja tačaka nad kojima se vrši numerička analiza. U istraživanju je obuhvaćen sažet teorijski pristup izračunavanju procene efektivne vrednosti napona pomoću ovih metoda i sprovedena je simulaciona analiza. Pokazano je da procena RMS vrednosti napona i njena merna nesigurnost zavise od izbora periode. Za svaku od metoda je ustanovljen najpogodniji izbor periode u cilju poboljšanja mernih performansi.

ML1.3 POSTUPAK ETALONIRANJA MERNIH PRETVARAČA AC STRUJE I NAPONA I ELEKTRIČNE OTPORNOSTI

Stefan Mirković, Nemanja Gazivoda, Bojan Vujicic, Marina Subotin, Marjan Urekar and Platon Sovilj

Apstrakt: Ovaj rad opisuje postupak etaloniranja mernih pretvarača električne otpornosti, struje i napona u električnu struju u uslovima unutar metrološke laboratorije. Prikazane su najbolje mogućnosti merenja, opisana je priprema za merenje, navedena je merna oprema koja se koristi, opisani su postupci merenja koje treba sprovesti i prikazana je obrada dobijenih rezultata.

ML1.4 POSTUPAK ETALONIRANJA MERNIH PRETVARAČA AKTIVNE I REAKTIVNE ELEKTRIČNE SNAGE

Stefan Mirković, Nemanja Gazivoda, Bojan Vujicic, Marina Subotin, Marjan Urekar and Platon Sovilj

Apstrakt: Laboratorija za metrologiju (FTN) vrši etaloniranje mernih pretvarača aktivne i reaktivne električne snage. Snaga koja se izmeri mernim pretvaračem poredi se sa ulaznom referentnom snagom, i na osnovu toga se određuje greška pretvarača. U radu su prikazane mogućnosti etaloniranja, postupak pripreme za etaloniranje, dokumentovana je merna oprema kao i postupci merenja. Prikazani su specifični rezultati etaloniranja propraćeni odgovarajućim mernim nesigurnostima.

ML1.5 POUZDANA DETEKCIJA GREŠAKA OČITAVANJA KODA U PSEUDOSLUČAJNOM APSOLUTNOM ENKODERU

Goran Miljković, Dragan Denić, Milan Simić and Aleksandar Jocić

Apstrakt: Pseudoslučajni apsolutni enkodori se najčešće koriste u modernim servo sistemima radi pouzdanog određivanja pozicije i ugaone brzine. Enkoder u ovom radu ima na kodnom disku dve fazno pomerene pseudoslučajne binarne sekvence koje se serijski očitavaju. Različite nesavršenosti i zaprljanja kodne trake dovode do grešaka u procesu očitavanja koda, što onda uzrokuje pogrešne informacije o poziciji. U radu je predstavljena pouzdana metoda detekcije grešaka bazirana na formiranju glavne i kontrolne kodne reči na osnovu očitanih bitova sa dve različite pseudoslučajne kodne trake. Predstavljen je enkoder koji nakon pogrešno očitano bita ne daje pogrešnu informaciju o poziciji

SEKCIJA ML2: METROLOGIJA I INDUSTRIJA 4.0

Ponedjeljak, 28. septembar, 15:00-16:30, Univerzitet u Novom Sadu, Svečana sala

Chair: Marjan Urekar, Fakultet tehničkih nauka, Univerzitet u Novom Sadu

ML2.1 ULOGA METROLOGIJE U TRANZICIJI INDUSTRIJSKE PROIZVODNJE NA KONCEPT INDUSTRIJE 4.0 U SRBIJI

Marjan Urekar, Jelena Đorđević Kozarov, Ivan Gutai, Stefan Mirković, Marina Subotin and Đorđe Novaković

Apstrakt: Globalni koncept Industrije 4.0 predstavlja jedan od ključnih aspekata digitalizacije i unapređenja industrijske proizvodnje, pri čemu je pojam industrije shvaćen u najširem smislu. Rad predstavlja razmatranje uloge i zadataka metrologije (nauke o merenju) u ovom novom okruženju. Predložen je jasan i koncizan, ali i detaljan plan u deset tačaka koji definiše najvažnije aktivnosti metrologije koje će dovesti do uspešne tranzicije industrijske proizvodnje u koncept Industrije 4.0, na nivou Srbije. Predloženi plan takođe može biti upotrebljen kao skica za strategiju razvoja metrologije u konceptu Industrije 4.0 na globalnom nivou.

ML2.2 ALGORITAM ZA SKLADIŠTENJE INFORMACIJA U SISTEMU ZA MERENJE PARAMETARA ŽIVOTNE SREDINE U KONCEPTU INDUSTRIJE 4.0

Ivan Gutai, Aleksandra Gutai, Platon Sovilj, Marjan Urekar, Đorđe Novaković and Marina Subotin

Apstrakt: U Industriji 4.0 se često dešava da se korisnici uređaja zasipaju nepotrebnim podacima i može se desiti da im promakne nešto što je bitno ili da im se prosledi pogrešan podatak. U merno akvizicionom sistemu u kom se merenje vrši preko DHT22 senzora, tačnosti $\pm 0.5^{\circ}\text{C}$, nema smisla prikazivati trenutnu temperaturu u obliku 23.46°C iz dva razloga, koja će biti detaljno opisana u ovom radu. Prvi razlog je što nije metrološki korektno prikazivati korisniku nešto što je suprotno sa specifikacijom proizvođača. Drugi razlog je nepotrebno trošenje prostora u EEPROM-u (Electrically erasable programmable read-only memory, npr. skladištenje celog broja zauzima jedan bajt, dok upotreba broja sa pokretnim zarezom (eng. floating point) zauzima bar četiri bajta. Takođe će biti opisan algoritam koji omogućava zapis podataka 24/7, na svakih 20 minuta u 4 KB EEPROM-a, sa akcentom na robusnosti i metrološkoj ispravnosti skladištenih podataka. Sistem test je vrlo važna disciplina i u ovom radu je odnos pisanja koda i testiranja sistema u srazmeri 1:3.

ML2.3 PAMETAN ULOŽAK ZA CIPELE U KONCEPTU INDUSTRIJE 4.0

Aleksandar Kostovski, Igor Popadić, Đorđe Polovina, Igor Milijašević and Marjan Urekar

Apstrakt: U ovome radu je predstavljena ideja razvoja pametnog uložka za cipele koji bi pomogao deci da u najranijem dobu svog života nauče da hodaju pravilno. Pametni uložak se sastoji iz tri FSR senzora koji mere sile kojom dete deluje na njega. Podaci o silama se šalju na mobilni telefon koji mora biti uz dete i ukoliko dođe do nepravilnog hodanja, tada bi se ispustio zvuk roditelja kako opominje dete da hoda pravilno.

ML2.4 PAMETNI KOŠARKAŠKI RUKAV ZA ŠUTIRANJE

Igor Popadić, Aleksandar Kostovski, Đorđe Polovina, Igor Milijašević and Marjan Urekar

Apstrakt: U ovome radu je predstavljena ideja razvoja pametnog košarkaškog šuterskog rukava koji bi pomogao košarkašima prilikom treniranja i trenerima da pomoću aplikacije bolje isprate napredak igrača koje treniraju. Pametni šuterski rukav bi se sastojao iz tri povezana dijela, senzora na rukavu, senzora na košu i web aplikacije.

ML2.5 KONCEPT INDUSTRIJE 4.0 U OBLASTI POLJOPRIVREDE - POLJOPRIVREDA 4.0

Dorđe Polovina, Igor Popadić, Aleksandar Kostovski, Igor Milijašević and Marjan Urekar

Apstrakt: U ovom radu predstavljene su neke od ideja koje bi mogle doprineti razvoju proizvodnje hrane. Poljoprivreda 4.0 predstavlja prekretnicu u načinu uzgajanja biljaka i održivosti poljoprivrednih sistema i farmi. Ovakvi sistemi omogućavaju potpunu automatizaciju procesa uzgajanja biljaka, uz mogućnost nadzora u realnom vremenu pomoću određene aplikacije, kao i velike uštede resursa. Sistem poput ovoga bi se sastojao iz četiri funkcionalna bloka: blok sa biljkama, blok za upravljanje, blok za kontrolu i blok računarskog oblaka.

ML2.6 MERENJE UV ZRAČENJA I PRIMENA ZA BIOMEDICINU, U KONCEPTU INDUSTRIJE 4.0

Igor Milijasevic, Aleksandar Kostovski, Dorđe Polovina and Igor Popadić

Apstrakt: U ovom radu su predstavljena, analizirana i opisana rešenja za primenu UV senzora u oblasti biomedicine sa usmerenjem na Industriju 4.0. Upoređena su postojeća rešenja sa novim idejama i primenama.

SEKCIJA ML3: PROJEKTOVANJE I RAZVOJ MERNO-INFORMACIONIH SISTEMA

Ponedeljak, 28. septembar, 16:30-18:30, Univerzitet u Novom Sadu, Svečana sala

Chair: Dragan Pejić, Fakultet tehničkih nauka, Univerzitet u Novom Sadu

ML3.1 SISTEM ZA NADZOR I KONTROLU USLOVA U PLASTENIKU ZASNOVAN NA MIKROPROCESORSKIM MERNIM MODULIMA

Milan Šaš and Đorđe Novaković

Apstrakt: Ovaj rad prikazuje sistem za nadzor i upravljanje uslovima u plasteniku ili stakleniku. Osnovni delovi ovog sistema su Raspberry Pi 3 i Easy PIC Pro V7 razvojni sistem sa mikrokontrolerom PIC18F8K22. Kao senzore sistem koristi click pločice Illuminance, DHT22 i Air Quality 2. Kao protokoli koriste se I2C, One-Wire i UART za komunikaciju. Na RPi3 se nalazi GUI aplikacija, realizovana u Python programskom jeziku, koja komunicira sa mikrokontrolerom, prikuplja merene vrednosti, obrađuje i prikazuje te vrednosti i smešta ih u MongoDB bazu podataka. Dodatno, aplikacija omogućava upravljanje vodenom pompom, ventilima, svetlom i regulacijom CO2. Pored aplikacije na RPi3 nalazi se i Flask server koji omogućava online pristup merenim podacima.

ML3.2 CAN PLATFORMA ZA LOGOVANJE I NADZOR PARAMETARA U VOZILIMA

Duško Gajinović

Apstrakt: U ovom radu prikazan je primer platforme za komunikaciju preko CAN mreže u vozilima. Osnovu projekta čini Arduino Uno ploča, na kojoj se nalazi ATmega328 mikrokontroler, koji preko SPI protokola komunicira sa CAN Bus dodatnom pločom. Na istoj ploči se nalazi MCP2515 CAN kontroler, koji preko MCP2551 uspostavlja komunikaciju sa samom CAN mrežom. Sastavni deo ove platforme je i GUI program, koji je realizovan u Python programskom jeziku, pomoću kojeg se mogu pratiti, filtrirati i slati poruke na CAN mrežu. Uređaj poseduje i funkcije koje su specifične za OBD2 protokol, koji se nalazi u većini modernih automobila, tako da se mogu pratiti razni parametri koji inače nisu dostupni vozaču.

ML3.3 RAZVOJ MERNO INFORMACIONOG SISTEMA ZASNOVANOG NA GSM/GNSS MODULU

Žarko Dubajić, Radovan Karan and Đorđe Novaković

Apstrakt: Ovaj rad prikazuje komunikaciju GPS modula sa računarom pomoću mikrokontrolera, koristeći razvojni sistem EasyPIC Pro v7, sa mikrokontrolerom PIC18F87K22. Koristeći Pajton biblioteku "folium" i "PyQt5" na računaru iscrtavamo mapu i prikazujemo poziciju prijemnika u realnom vremenu. Za dobijanje pozicije koristi se GSM/GNSS click.

ML3.4 PROJEKTOVANJE MERNOG PRETVARAČA SA SENZOROM TEMPERATURE PT1000

Andrea Josipovic, Djordje Novakovic and Platon Sovilj

Apstrakt: U ovom radu je predstavljen postupak projektovanja mernog pretvarača sa senzorom temperature Pt1000. Urađena je projektantska analiza u programu LTSpice, a potom i projektovanje električne šeme i štampane ploče u programu KiCad.

ML3.5 RAZVOJ MODULARNOG UREĐAJA ZA AKVIZICIJU PARAMETARA ŽIVOTNE SREDINE UPOTREBOM OTVORENOG HARDVERA U KONCEPTU INDUSTRIJE 4.0

Ivan Gutai, Janoš Gutai, Platon Sovilj, Marjan Urekar, Đorđe Novaković and Marina Subotin

Apstrakt: Upotreba otvorenog hardvera već dugi niz godina olakšava izradu prototipova raznih uređaja. U ovom radu će detaljno biti opisan hardver koji je korišćen za izradu prototipa modularnog uređaja za akviziciju parametara životne sredine. Pored opisa hardvera i firmvera, u radu je opisan i jedan od softverskih alata koji omogućava dizajniranje spoljašnjosti uređaja. Uređaj prikazuje trenutne vrednosti temperature, vlažnosti vazduha i tačno vreme. Akvizicija podataka se vrši 24 sata, 7 dana u nedelji, na svakih 20 minuta i čuva se u 4 KB EEPROM-a (Electrically Erasable Programmable Read-Only Memory). U Industriji 4.0 se ne sme zaboravljati da je informacija koje se šalje, zapravo osnova celog sistema i u ovom radu je dat akcenat na smanjivanju količine informacija koje se skladište, vodeći računa o vremenskom žigu (eng. timestamp) i korektnom prikazu izmerenih vrednosti. Od hardvera je korišćen: Arduino Nano, RTC (Real Time Clock) DS3231, DHT22 senzor, OLED ekran, 7 segmentni displej sa 4 digita i eksterno napajanje od 5 V.

ML3.6 RAZVOJ MERNE STANICE SA WEB INTERFEJSOM, UPOTREBOM OTVORENOG HARDVERA U KONCEPTU INDUSTRIJE 4.0

Ivan Gutai, Platon Sovilj, Marina Subotin, Nemanja Gazivoda, Bojan Vujičić and Đorđe Novaković

Apstrakt: Upotreba otvorenog hardvera pored toga što ubrzava razvoj prototipova uređaja, omogućava i kreiranje korisničkog interfejsa koji je prilagođen prenosnim uređajima kao što su tableti i mobilni telefoni. Upotrebom Espressif ESP32 razvojnog sistema je omogućeno merenje različitim senzorima, kreiranje bežične pristupne tačke (eng. Access Point-a), kreiranje web korisničkog interfejsa a zatim i pristup mernom sistemu sa prenosnog uređaja koji poseduje Wi-Fi. U radu je opisan edukativan primer kreiranja merne stanice, kao i konfigurisanja razvojnog okruženja za ESP32 razvojne sisteme. Pored razvojnog sistema, od hardvera je korišćen senzor BME 280 i 3.7 V litijumske baterije dimenzija 18650.

ML3.7 STOHAISTIČKO MERENJE SLABIH PROSTOPERIODIČNIH SIGNALA I DETEKCIJA NULE (TEORIJSKI ASPEKAT)

Bojan Vujičić, Dragan Pejić and Vladimir Vujicic

Apstrakt: U radu je postavljen i rešen problem merenja slabih AC signala i detekcije AC nule primenom dvobitne stohastičke digitalne merene metode. Pokazano je kako se sa detekcijom nule na opisani način može zaći u subnanovoltno područje.

SESSION MLI1: METROLOGY

Monday, September, 28th, 18:30-20:00, University of Novi Sad, Ceremonial Hall

Chair: Platon Sovilj, Faculty of Technical Sciences, University of Novi Sad

MLI1.1 DC VOLTAGE AND CURRENT CALIBRATION IN CONCEPT OF INDUSTRY 4.0

Zdravko Gotovac and Marjan Urekar

Abstract: This paper represents short historical and technical overview of calibration of direct current and voltage, and in light of new scientific and technological inventions, discussion of potential improvements which can be made. Development of different standard technologies will be discussed, differences between them, as well as their adoption and usage by higher international organizations, who are responsible for their appointment and maintenance

MLI1.2 DEVELOPMENT OF VIRTUAL MEASURE INSTRUMENTATION IN ERP SOFTWARE APPLICATION

Natalija Vukosavljević and Stefan Mirković

Abstract: This paper presents the extraction of ERP components from EEG signals using the averaging method. The phenomenon of ERP components is described, as well as the recording method and the necessary instrumentation for recording of EEG signal during stimulation. Software application for analyzing results was implemented in the LabVIEW programming environment.

MLI1.3 FALL DETECTION SYSTEM BASED ON GPS TRACKING AND ACCELEROMETER MODULE

Sanja Mandić and Đorđe Novaković

Abstract: This paper gives an insight into a fall detection system, whose main purpose is assistance to the elderly. Hardware components used in the design of this system are described, as well as adequate firmware. The first section provides a description of the EasyPIC PRO v7 development board, the GSM/GNSS click module, and the MPU-6050 sensor, whereas the remaining section describes code implementation.

MLI1.4 MICROPROCESSOR BASED MEASUREMENT IN SERVO SYSTEM

Mario Volaš, Jovana Jović and Đorđe Novaković

Abstract: The goal of this paper was to find a practical use for electromyography signals that can be detected on a muscle. This was achieved using an EasyPIC PRO v7 with a PIC18F87K22 microcontroller, an EMG click (MIKROE-2621), which is based on a MCP609 operational amplifier and MAX6106 micropower voltage reference, and a servo motor. The signal from the arm is processed by the microcontroller, which also controls the servo motor.

MLI1.5 WEB BASED MEASUREMENT SYSTEM FOR BODY MONITORING

Zdravko Gotovac, Milica Mitrović, Platon Sovilj, Đorđe Novaković and Ivan Gutai

Abstract: In this paper is shown development of a compact web based sensory system, which is being used for purposes of monitoring body temperature, breathing rate and heart rate of user.. Development of this complete system is based upon usage of existing, free or relatively inexpensive hardware and software solutions.

MLI1.6 POSTURE MONITORING BY PIC MEASUREMENT SYSTEM BASED ON FSR SENSOR

Aleksandra Lojaničić, Tijana Đurkić and Đorđe Novaković

Abstract: The aim of this project is to provide a system that detects benching of the back during sitting, the way of connecting and using hardware components needed for building it. First part of this paper includes description of a development board, a sensor and an actuator. The other part gives detailed explanation of a practical work, code implementation, as well as suggestions for further development of this system.

SESSION MOI & MO: MICROELECTRONICS AND OPTOELECTRONICS, NANOSCIENCES AND NANOTECHNOLOGIES

Monday, September, 28th, 11:00-13:00, University of Niš. Niš

Chair: Ninoslav Stojadinović, Serbian Academy of Sciences and Arts

MOI1.1 RESPONSE SURFACE METHODOLOGY AND ARTIFICIAL NEURAL NETWORK-BASED MODELS FOR PREDICTING ROUGHNESS OF CU COATINGS

Ivana Mladenović, Jelena Lamovec, Nebojša D. Nikolić, Stevan Andrić, Marko Obradov, Vesna Radojević and Dana Vasiljiveć-Radović

Abstract: Abstract— Copper coatings are produced on silicon wafer by electrodeposition (ED) in pulsating current (PC) regime. Electrodeposition was performed at various current density amplitudes in the range of 80-140 mA cm⁻², frequency in the range of 30-100 Hz and coating thickness in the range of 10-60 μm. The resulting composite systems consist of monolayered copper films electrodeposited from sulfate bath on Si wafers with sputtered layers of Cr/Au. Roughness measurements were performed to evaluate properties of the copper coating surface. The coating roughness (R) was measured using Atomic Force Microscope in contact mode. The software Gwyddion was used for determination an average roughness parameter (Ra). After that (Artificial Neural Network-ANN) model was used to study the relationship between the parameters of electrodeposition process and roughness of copper coatings. The influence of experimental values: amplitude current density, frequency and thickness of coating on the surface roughness will be highlighted. Response surface methodology (RSM) was utilized to improve the correction between Ra and input parameters. Finally, the results of the average roughness (experimental and predicted) were used to estimate the new value of (Ra) of copper for each variation of the input parameters and compared capability of ANN and regression analysis for surface roughness generated under different electrochemical conditions. The coefficient of determination was found 95% for ANN and 93% for regression analysis.

MOI1.2 INFLUENCE OF SINTERING TEMPERATURE ON THE PERFORMANCE OF TITANIUM DIOXIDE ANODE IN DYE SENSITIZED SOLAR CELLS WITH NATURAL PIGMENT HYPERICIN

Katarina Cvetanović Zobenica, Nenad Tadić, Uroš Lačnjevac, Evgenija Milinković, Milena Rašljić Rafajilović, Milče M. Smiljanić, Dana Vasiljević-Radović and Dragomir Stanisavljev

Abstract: Dye Sensitized Solar cells (DSSC) are very attractive due to their low cost fabricating methods and used materials. One of the most important parts of the cells is the photoanode. Many semiconducting materials are used for this purpose, but most common one is titanium dioxide (TiO₂). Optimal sintering temperature of anode plays important role in performance of TiO₂ layer in DSSC, since it provides good electrical contact between particles, which consequently leads to better electron transfer through the cell, but still restricts unfavorable phase transformation. In this paper two identical cells with natural pigment hypericin as sensitizer were assembled with anodes sintered on two different temperatures (500 °C and 600 °C), so their performance parameters could be compared. The ratios between the maximal power densities (P_{max}) and solar to electrical energy conversion efficiencies (η) for the two measured cells are 5 times in favor for the cell sintered at 600 °C, which shows the importance of temperature treatment of TiO₂ electrodes for better performance of solar cells.

MOI1.3 AN OVERVIEW OF APPLICATIONS AND INTEGRATED CIRCUIT DESIGN TECHNIQUES FOR SEMICONDUCTOR GAS SENSORS

Vladimir Milovanović

Abstract: A gas sensor as the device that detects the presence and quantitatively measures the concentration of the certain gas analyte is in pervasive use even nowadays. Nevertheless, with further technological advancement which will imply smaller form factors, lower power consumption and reduced unit prices, this sensor type is expected to become ubiquitous in the Internet of Things era. Semiconducting metal oxides are currently considered as the most promising sensing material to fulfill the foreseen agenda of gas sensor omnipresence. One of the major factors is the processing compatibility with CMOS fabrication technology which allows sensor conditioning and interface circuitry to be cointegrated onto the same chip. This paper gives a brief snippet of some semiconductor gas sensor applications which range from industrial safety and security, over use in health care and medical, all the way up to air quality and environmental monitoring, and automotive. An overview of the MOx gas sensor support circuits with an accent on integrated implementations is also scratched.

MOI1.4 INFLUENCE OF VACUUM DEGASSING ON MICROCHANNEL PLATE PERFORMANCE

Aleksandra Stanković, Ivan Zlatković, Rade Nikolov and Dragan Pantić

Abstract: This article discusses the influence of vacuum degassing on the microchannel plate (MCP) performance. Vacuum baking is a process of degassing by heating components to make them release molecules attached to their surfaces (mainly H₂O). Experiments were done with the MCPs with a channel diameter of 6µm, that were backed for 12h at the temperature of 430°C under a high vacuum. The results showed a change in electrical parameters of MCP- the resistance and the gain changed up to 30% and 50%, respectively.

MOI1.5 DIFFERENT WAYS TO CHARGING SUPERCAPACITOR IN WSN USING SOLAR CELLS

Milan Stojanović, Jana Vračar and Ljubomir Vračar

Abstract: The supercapacitors are widely used as a primary or secondary energy source in WSN. In this paper, different ways to charge the supercapacitor using solar cells are presented. The charging time for different connection of solar cells at different levels of light intensity is shown. Also, the advantages and disadvantages of using voltage booster are discussed and explained with appropriate results.

MO1.2 MODELOVANJE PROMENA NAPONA PRAGA P-KANALNIH VDMOS TRANZISTORA SNAGE TOKOM NBT NAPREZANJA

Nikola Mitrović, Danijel Danković, Zoran Prijić and Ninoslav Stojadinović

Apstrakt: U ovom radu prikazana je analiza eksperimentalnih rezultata nestabilnosti napona praga p-kanalnih VDMOS tranzistora snage IRF9520 podvrgnutih temperaturnom naprezanju sa negativnom polarizacijom gejta, dok je glavni deo istraživanja modelovanje promene napona praga prema dobijenim eksperimentalnim rezultatima. Osmišljeno je i prikazano elementarno kolo za modelovanje i statičkog i impulsnog naprezanja tranzistora, kao i proračun vrednosti ključnih elemenata kola. Na kraju je data uporedna analiza eksperimentalnih i modelovanih rezultata.

ELI1.1 DEVELOPMENT OF TESTING ENVIRONMENT FOR A DISCRETE D/A CONVERTER USING NI HIGH-SPEED M SERIES ACQUISITION DEVICE

Anđela Jovanovic, Miljana Milić and Marko Dimitrijević

Abstract: A testing environment for the D/A converter board is suggested in this paper. The system required hardware-software co-design. It is intended for the demonstration purposes at the Course of Electronic circuit testing and diagnostics and enables students to study effects of different types of defects that could appear in one mixed-signal circuit. Necessary testing signals are applied from the computer, via the acquisition device to the inputs of the converter, and obtained voltage levels at the output of the D/A converter are measured and recorded for further analyses. The software part is realized using LabVIEW programming tool.

ELI1.2 COMPUTER VISION AIDED 2D MOTION SEQUENCE TEST SUPERVISION

Zoran Milosavljević, Marko Barjaktarović and Darja Zafirović

Abstract: This study presents an object trajectory tracking system that would increase the reliability and accuracy of motion sequence testing for devices such as accelerometers. By attaching an ArUco marker to the device, we are able to perform pose estimation for the device and calculate the coordinates of the device in a coordinate system of our choosing. By tracking the coordinates in consecutive frames, the trajectory is noted. While testing, speed corrections are displayed. We are able to compare the test trajectory to a reference trajectory and determine whether the test device is malfunctioning, or the motion was performed incorrectly. In case of an incorrect trajectory, the exact section that was incorrectly performed is determined, and rectified in subsequent testing. This eliminates uncertainty between the test device malfunction and incorrect device motion performed during the test, thus providing more accurate test results.

SESSION NMI &NM: NEW MATERIALS IN ELECTRICAL AND ELECTRONIC ENGINEERING/ NOVI MATERIJALI

Tuesday, September, 29th, 12:00-14:00, Faculty of Technical Sciences, Čačak

Chair: Nebojša Mitrović, University of Kragujevac, Faculty of Technical Sciences, Čačak

NMI1.1 RAMAN SPECTRA OF THE MATERIALS BASED ON MECHANICALLY ACTIVATED ALKALINE EARTH METAL TITANATES

Vera Pavlović, Ani Tshantshapanyan, Branislav Vlahović, Jelena Živojinović, Darko Kosanović and Vladimir Pavlović

Abstract: The changes in the Raman spectra of electronic materials obtained from mechanically activated BaTiO₃ and SrTiO₃ powders, with or without additives, are presented in this paper. Mechanical activation, performed in a high-energy planetary ball mill, was chosen as the method for the production of fine-grained nanocrystalline powders with an increased surface activity and an altered micro and/or crystal structure. Having in mind the growing relevance of the development of multiferroic materials, the analysis of Raman spectra was used not only for the structural investigations of the mechanically activated undoped titanate powder, but also for the examination of the mechanically activated Fe/BaTiO₃ system and the subsequent hexaferrite formation during the sintering process. Additionally, Raman spectroscopy was applied in the study of the emergence of electroactive crystalline phases in nanocomposites based on semi-crystalline fluoropolymers, such as PVDF (polyvinylidene fluoride), in the case when mechanically activated BaTiO₃ powder was used as a filler in the polymer matrix. Furthermore, the effects of the mechanical activation of SrTiO₃ powder on the occurrence of polar nano and micro-regions at room temperature, as well as the simultaneous influence of activation and MnO₂ addition on structural changes in ceramic SrTiO₃ samples, have also been analysed using Raman spectroscopy.

NMI1.2 STRUCTURAL AND MAGNETIC FEATURES OF A FECO-2V ALLOY PROCESSED BY METAL INJECTION MOLDING

Borivoje Nedeljkovic, Nebojsa Mitrovic and Vladimir Pavlovic

Abstract: In this study the characterization of FeCo-2V alloys toroidal samples produced by MIM technology was presented. The feedstock for metal injection molding (MIM) was prepared by mixing starting FeCoV powder with a low viscosity binder. Sintering of brown samples was performed during 3.5 hours from 1370°C to 1460°C in hydrogen atmosphere in order to attain the appropriate functional properties. Microstructure and magnetic hysteresis B(H) of toroidal samples were investigated as a function of sintering temperature. An optimum magnetic property were observed after sintering at temperature of 1370°C. Magnetic properties were analyzed as frequency dependent in operating frequency range from 5 Hz to 60 Hz.

NM1.1 MAGNETOIMPEDANSNI EFEKAT CoFeSiB AMORFNE ŽICE

Jelena Orelj, Nebojsa Mitrovic and Vladimir Pavlovic

Apstrakt: U radu su prikazana ispitivanja magnetoimpedansnog (MI) efekta žice legure CoFeSiB. XRD rendgenogram pokazuje da legura poseduje potpuno amorfnu strukturu. DTA analizom je uočeno da je legura temperaturski stabilna do oko 540°C gde je registrovan egzotermni pik procesa kristalizacije. Pojava MI-efekta kod ispitivane žice je uočena na frekvencijama od 5 kHz do 7 kHz. U opsegu frekvencija 700 kHz ÷ 900 kHz ÷ 1 MHz (@ Hmax » 4.63 kA/m) registrovan je maksimalni MI-odnos od oko 330 % i skoro identičan oblik krive $\Delta Z(H)/Z$. Najveći MI-odnos od oko 334 % je dobijen pri frekvenciji od 950 kHz i maksimalnom spoljašnjem magnetnom polju od 7.72 kA/m.

NM1.2 UTICAJ SINTEZE POČETNIH PRAHOVA NA MIKROSTRUKTURNA I ELEKTRIČNA SVOJSTVA BaTiO₃ KERAMIKE

Sandra Veljković, Miloš Đorđević, Vesna Paunović, Zoran Prijić and Vojislav Mitić

Apstrakt: U ovom radu ispitivana su mikrostrukturalna i dielektrična svojstva čistog i La/Mn dopiranog BaTiO₃ čiji su početni prahovi dobijeni različitim metodama. Metode dobijanja početnih prahova bile su konvencionalna metoda pripreme polazeći od čistih oksida i Pechini metoda koja polazi od organsko-metalnog kompleksa kao prekursora. Sistemi su sinterovani na 1310°C dva sata. Analiza mikrostrukture nedopirane BaTiO₃ keramike pokazala je da je za keramiku dobijenu konvencionalnom metodom karakterističan diskontinualni rast zrna i veličina zrna od 3 do 15 μm, dok je za uzorke dobijene Pechini metodom karakteristična uniformna mikrostruktura i zrna od 1 do 10 μm. Za La/Mn dopiranu keramiku dobijenu Pechini metodom karakteristična je bimodalna mikrostruktura i homogena raspodela aditiva. Dielektrična konstanta ispitivana je u frekventnom opsegu od 100 Hz do 20 kHz. Najveću vrednost i promenu dielektrične konstante sa temperaturom pokazivala je La/Mn dopirana BaTiO₃ keramika dobijena Pechini metodom. Dielektrična konstanta ove keramike na Kirijevoj temperaturi bila je 7837. Kiri-Vajsov zakon i modifikovani Kiri-Vajsov zakon korišćeni su za proračun parametara kao što su Kirijeva konstanta, Kirijeva temperatura i parametar g koji opisuje difuzivnost i stepen nelinearnosti promene ϵ_r od temperature iznad Kirijeve temperature.

NM1.3 KARAKTERIZACIJA DOPIRANE BaTiO₃ KERAMIKE PRIMENOM NOVE METODE ZA MERENJE ELEKTRIČNIH KARAKTERISTIKA

Miloš Đorđević, Miloš Marjanović, Vesna Paunović and Danijel Danković

Apstrakt: U ovom radu je opisano poređenje rezultata dobijenih manuelnim putem i primenom nove metode za merenje i karakterizaciju dopirane BaTiO₃ keramike na različitim temperaturama i frekvencijama. Za merenje i karakterizaciju parametara materijala u funkciji temperature korišćeni su LCR metar i programabilna peć za testiranje. Rezultati dobijeni manuelnom kontrolom LCR metra su mereni ručnim zadavanjem parametara. Dobijeni rezultati su poređeni sa rezultatima dobijenih primenom nove metode za automatsku kontrolu LCR metra, za koju je razvijena aplikacija. Na osnovu toga pokazano je da se merenje karakteristika može obaviti i bez potrebe za ljudskim faktorom. Rezultati koji su poređeni su dobijeni merenjem uzoraka dopirane Nb/BaTiO₃ keramike. Na osnovu analize izmerenih rezultata primećeno je da je nova metoda preciznija i sa rezultatima je lakše manipulirati u daljem radu.

SESSION NTI & NT: NUCLEAR ENGINEERING AND TECHNOLOGY/ NUKLEARNA TEHNIKA (NT)

Monday, September, 28th, 12:00-14:00, Kneza Miloša 9/3, Beograd

Chair: Koviljka Stanković, University of Belgrade, Faculty of Electrical Engineering

NT1.1 UTICAJ GAMA ZRAČENJA NA MERNU NESIGURNOST BRZOG, KOMPENZOVANOG KAPACITIVNOG DELILA

Nenad Kartalović, Koviljka Stanković, Dusan Nikezić, Tomislav Stojić, Uzahir Ramadani and Uroš Kovačević

Apstrakt: U radu se razmatra uticaj gama zračenja na pouzdano merenje jednokratnih naponskih impulsa snopova elektrona za injektovanje u plazmu tokom fuzionih eksperimenata. U tu svrhu je konstruisano brzo, 10 GHz, delilo napona. Visokonaponski kondenzator je bio gasni kondenzator, a niskonaponski kondenzator je bila paralelna veza 10 liskunskih kondenzatora. Pokazalo se da primljena doza zračenja ispravlja prenosni odnos pošto poravnjava frekventnu karakteristiku liskuna u oblasti prostornog naelektrisanja. Ova pojava je objašnjena i sa pozitivnog i sa negativnog aspekta sa efektom na konkretnu primenu. Takođe je ukazano na potrebu daljeg rada na ovom problemu u cilju ustanovljavanja saturacione doze za dobijanje konstantne frekventne karakteristike liskuna. Istaknut je i interes za ponašanje brzog delila u neutronsom polju.

NTI1.1 UTILIZATION OF WASTE-BASED GEOPOLYMERS FOR RADIONUCLIDE IMMOBILIZATION – A REVIEW

Slavko Dimović, Ivana Jelić and Marija Šljivić-Ivanović

Abstract: The aim of this article is to review the utilization of waste components for radionuclides immobilization by geopolymerization. The geopolymers represent a wide range of alkaline-activated aluminosilicates. Synthesis of geopolymers from waste provides less raw material consumption and addresses issues regarding the disposal of waste. Fly ash, red mud, construction and demolition waste, or slags are the most utilized waste types. The advantage of these waste materials represents the possibility of utilization of any aluminosilicate-containing waste that could be dissolved in an alkaline solution to produce a matrix for radionuclide immobilization. Despite many publications and investigations concerning the usage of waste components in geopolymerization, the utilization of waste-based geopolymers in the disposal of radionuclides has not yet been developed enough.

NTI1.2 ESTABLISHING THE RQR RADIATION QUALITIES IN THE SECONDARY STANDARD DOSIMETRY LABORATORY

Nikola Kržanović, Miloš Živanović, Olivera Ciraj-Bjelac, Predrag Božović and Andrea Kojić

Abstract: Quality assurance in the area of diagnostic radiology is performed by examining X-ray output parameters under medical exposure irradiation conditions using calibrated dosimetry equipment. The diagnostic radiology dosimeters are calibrated in reference radiation fields established according to IEC 61267 international standard. In practice, radiation qualities are defined by the X-ray tube voltage and the half-value layer and homogeneity coefficient. Comparison of these parameters with the recommendations of the standard can be used for incident photon spectrum characterization and modification by improving the added filtration for each radiation quality, thus acquiring the desired half-value layer for the given X-ray tube voltage. For most of the diagnostic radiology radiation qualities available at the Secondary Standard Dosimetry Laboratory a deviation of the first half-value layer less than $\pm 3\%$ was achieved, with an exception of one radiation quality where a correction would be required.

NTI1.3 UPOREDNA ANALIZA UTICAJA γ I X ZRAČENJA NA KARAKTERISTIKE KOMERCIJALNIH GASNIH ODVODNIKA PRENAPONA U IMPULSNOM REŽIMU RADA

Luka Rubinjoni, Srboljub Stanković, Tomislav Stojić and Boris Loncar

Apstrakt: Gasni odvodnici prenapona su izdržljive i pouzdane komponente za bezbedno odvođenje prenapona, koje rade na principu jonizacije izolacionog medijuma – gasa. Jonizujuće zračenje utiče na karakteristike odvodnika. U ovom radu prikazana je uporedna analiza uticaja γ i X zračenja na osobine komercijalnih gasnih odvodnika prenapona u impulsnom režimu rada, primenom poluempirijske metode merenja impulsnog probojnog napona i određivanja impulsne (volt-sekundne) karakteristike.

NTI1.4 ANALYSIS OF RADIATION OUTPUT MATHEMATICAL MODEL PARAMETERS FOR X RAY DEVICES USED IN DIAGNOSTIC RADIOLOGY

Andrea Kojić, Predrag Božović, Nikola Kržanović, Jelena Stanković Petrović and Olivera Ciraj-Bjelac

Abstract: Application of ionizing radiation in medicine is inseparable part of modern medical diagnostics. With increasing number of medical exposures in the world the need for optimization of doses delivered to patients arises. Doses delivered to the patient in diagnostic radiology can be estimated with Entrance Surface Air Kerma, where one of the methods for obtaining ESAK is the calculation based on radiation output. Furthermore, radiation output can be measured or calculated using mathematical formulas or Monte Carlo simulations. In this work we measured radiation output for 15 different x-ray devices and calculated parameters for mathematical formula to obtain generalized model for radiation output. These results were compared with the results of Monte Carlo simulations and the results obtained in similar studies.

NTI1.5 UNCERTAINTY BUDGET FOR AMBIENT DOSE EQUIVALENT RATE MEASUREMENTS

Jelena Krneta Nikolic, Ivana Vukanac, Miloš Živanović, Milica Rajačić, Dragana Todorović, Gordana Pantelić and Marija Janković

Abstract: Dosimetric measurements are readily used to assess the exposure of public and working force to ionizing radiation via monitoring various spaces and goods that are imported or in transit through the country. This is done by measuring the ambient dose equivalent rate on the surface of the goods, in the transportation vehicle, or inside of the object of interest. The instruments that are often used in this monitoring type of measurement are compensated Geiger-Muller tube counters. The indication of these instruments is often count per second (cps) and therefore it has to be multiplied by calibration coefficient to obtain result in Sv/h. Due to this and due to the nature of the measurement itself, the greatest challenge is to define the uncertainty budget and calculate the measurement uncertainty accordingly. In this paper we will present the analysis of the uncertainty budget for 4 types of dosimeters used in Radiation and Environmental Protection Department, their calculated measurement uncertainty and the comparison conducted between our instruments and other calibrated instruments that are in the quality management system.

SESSION RTI1: COMPUTER ENGINEERING, COMPUTER NETWORKS AND EDUCATION – CECN & EDU

Monday, September, 28th, 09:00-10:00, On-line

Chair: Ivan Milentijević, Univerzitet u Nišu, Elektronski fakultet, Niš

RTI1.1 ESXI, MICROSOFT HYPER-V, XENSERVER: FILESYSTEM PERFORMANCE COMPARISON FOR TYPE-1 HYPERVISORS

Borislav Đorđević, Valentina Timčenko and Stefan Kovačević

Abstract: This paper is dedicated to the performance comparison of three representatives of type-1 hypervisors: ESXi, Microsoft Hyper-V and XenServer. Hypervisor performance is measured based on a file system performance test. We apply ATTO Disk Benchmark as a benchmark tool and we have tried to provide equivalent testing conditions for all hypervisors. For all tested hypervisors, we measured performance with one, two, and three virtual machines running simultaneously, with Windows Server 2012 R2 as the guest operating system. We set up a mathematical model, gave the expected hypothesis, and validated the benchmark results based on the model and hypothesis.

RTI1.2 EXAMPLE OF GOOGLE CLOUD SPEECH API USAGE AND INTERPRETATION OF RECOGNIZED CONTENT ON THE E-INK DISPLAY

Igor Medenica, Nikola Radulović, Vladimir Milovanović, Jelena Vasiljević and Miloš Jovanović

Abstract: Accelerated lifestyle and increasing technological development requires an ever faster way to establish communication between two people. Virtual communication has become a common and frequent way of contact between people in the 21st century. It is performed via the Internet, voice or SMS messages. This paper presents one of the custom types of accelerated communication. Using the Cloud Speech API, speech recognition and conversion to text format is performed. The recognized content from the Android device is transmitted via Bluetooth communication to the Arduino UNO to which the E-ink display is connected, on which the received content is displayed. The use of this system speeds up communication with people who are unable to communicate in any other way, while maintaining privacy. The advantages of use are portability and small dimensions, which enable easy viewing of content without the use of a mobile device.

RTI1.3 THE RISING THREAT OF HARDWARE ATTACKS: USB KEYBOARD ATTACK CASE STUDY

Petar Bojovic, Ilija Basicevic, Milos Pilipovic, Zivko Bojovic and Milena Bojovic

Abstract: The software aspect of computer security has been investigated more thoroughly in the research literature than the hardware aspect. Consequently, one of the aims of this paper is to raise public awareness regarding hardware-based attacks. During this project hardware that intercepts keyboard USB communication with a PC computer was developed. The hardware is based on Arduino modules and it can be used to execute several known attacks: keyboard logging, man-in-the-middle and scheduled BadUSB attacks. The research presented in this paper proves that by using commercial off-the-shelf hardware and rather simple software modules, efficient attacks that gain access to sensitive information and achieve control of the computer system can be realized.

RTI1.4 SEO IN SERBIAN WEBSITES

Jana Knezevic, Jovana Panovic, Nikola Savanovic and Miodrag Zivkovic

Abstract: Search Engine Optimization, well known as SEO, strives to improve sites' visibility on search engines. It is some sort of guidance on how to become the first result in search results. In its practice is to improve/make the most of quality and quantity of website traffic. It is important to emphasize that SEO is all about understanding what people are interested in, and what they search to find. Because Global network and optimization techniques keep changing dynamically and the new ones are appearing, it is very important to keep up with the latest SEO news. We found some of the most important factors that might help improving the position in organic search results. With this in mind, we have aimed to discover the most common mistakes when it comes to our (Serbian) sites. This study will be beneficial to website developers, webmasters and any other person who participate in creating our websites. While doing this research, not to mention that we were testing and validating all results. The last part of our article concludes the whole story of our SEO research and gives further recommendations.

SESSION RTI2: SOFTWARE ENGINEERING AND SOFTWARE APPLICATIONS – SESA

Monday, September, 28th, 10:00-1:00, On-line

Chair: Dražen Drašković, University of Belgrade, Faculty of electrical engineering

RTI2.1 SOURCE CODE QUALITY EVALUATION USING NETWORK SCIENCE

Ivan Blažić, Marko Mišić and Zaharije Radivojević

Abstract: Structural quality of the source code has a great impact on the efficiency of software development processes. The cost and the complexity of adding functionalities or fixing a bug depend on how well-structured the code is. A standard way of measuring the structural quality of software is the calculation of code quality metrics, which are statistical data obtained by static source code analysis. This paper presents a software system for calculating code quality metrics by analyzing the network of dependencies between source code elements. Adaptations of well-known metrics can be calculated using this method, but with a more advanced application of network science new metrics can be introduced. Description of the applied method, the implemented system, as well as the results of a use case analysis are presented.

RTI2.2 ANDROID APPLICATION FOR PROMOTING THE CULTURAL INSTITUTIONS THROUGH WI-FI ACCESS

Vladislav Tokovic, Luka Gajic, Dusan Cvetnic, Miodrag Vidacic, Nikola Savanovic and Miodrag Zivkovic

Abstract: Tourists frequently use available wireless connections, to keep their roaming costs as low as possible. Such wireless connections exist in hotels, bars, restaurants, and similar places tourists frequently visit. Work presented within this paper proposes another approach for providing wireless internet connection, both for tourists from abroad and the citizens of the country. We have aimed to develop a mobile app that combines enjoyable experience - good internet connection and informative experience – providing cultural and historical information about countries' landmarks interactively and entertainingly. In this way, it is possible to achieve the promotion and marketing of cultural institutions, such as museums, libraries, churches, monasteries, art galleries.

RTI2.3 DIFFERENT APPROACHES IN SERBIAN LANGUAGE PARSING USING CONTEXT-FREE GRAMMARS

Teodora Đorđević and Suzana Stojković

Abstract: Syntax analysis is an extremely significant phase of natural language processing. This paper presents a comparison of two methods for syntax analysis of the Serbian languages based on context-free grammars. First, it describes building a POS tagger with corpora. Secondly, it defines a context-free grammar for the Serbian language. After that, it explains how the syntax parser is created and compares its performance with a parser implemented using NLTK. Finally, it explains the post-processing layer which is added in order to reduce the number of syntax trees generated due to grammar ambiguity. The experiments showed that the implemented parser is on average 6115 times faster than the NLTK parser and that the post-processing reduced the number of syntax trees by 54% on average.

RTI2.4 MEME APP GENERATOR

Vladislav Tokovic, Luka Gajic, Dusan Cvetnic, Miodrag Vidacic, Nikola Savanovic and Miodrag Zivkovic

Abstract: Memes are today part of cultural evolution, as a way of passing the information in form of a combination of image and text. Memes are all around us, being shared millions of times via social networks, different media sites or chat applications. In the work presented in

this paper, we have aimed to develop application/service which would allow users to quickly access available meme templates, option to select any of them, add original top and bottom text (which is somewhat classic meme format) and quickly get their meme in the image format.

RTI2.5 DETECTION OF LINUX MALWARE USING SYSTEM TRACERS - AN OVERVIEW OF SOLUTIONS

Igor Vurdelja, Ivan Blazic, Drazen Draskovic and Bosko Nikolic

Abstract: The increasing number of smart devices and intensified process of digitalization creates a high demand for computer security. This area requires continuous improvements, as the new malicious software is being created and attack methods evolve. Linux is widely used for servers and embedded systems which require a high level of security and reliability. Although Linux is secure in general, traditional defense methods, such as signature-based detection, fail to detect new malicious programs. A more advanced approach is based on prediction of malicious behavior with dynamic analysis of the executed process. One method of observing the process execution on a Linux system is the use of system tracers such as ftrace and strace. This paper presents an overview of existing solutions for malware detection by using system tracers on Linux.

SESSION RTI3: COMPUTER SYSTEMS AND APPLICATIONS – CSA

Monday, September, 28th, 11:00-12:30, On-line

Chair: Vladimir Ćirić, University of Niš. Faculty of electronics, Niš

RTI3.1 IOT-BASED SYSTEM FOR COVID-19 INDOOR SAFETY MONITORING

Nenad Petrović and Đorđe Kocić

Abstract: In this paper, we introduce an affordable IoT-based solution aiming to increase COVID-19 indoor safety, covering several relevant aspects: 1) contactless temperature sensing 2) mask detection 3) social distancing check. Contactless temperature sensing subsystem relies on Arduino Uno using infrared sensor or thermal camera, while mask detection and social distancing check are performed by leveraging computer vision techniques on camera-equipped Raspberry Pi.

RTI3.2 DATA-DRIVEN MOBILE APPLICATIONS BASED ON APPSHEET AS SUPPORT IN COVID-19 CRISIS

Nenad Petrović, Maša Radenković and Valentina Nejković

Abstract: In this paper, it is explored how data-driven mobile applications can contribute to battle against the COVID-19 pandemic. As proof of concept, two novel case studies are presented: indoor safety monitoring and resource planning during pandemic crisis. AppSheet platform for automated development based on Google Sheets as data source was used for implementation of corresponding multiplatform mobile applications.

RTI3.3 METEOROLOGICAL DATA AGGREGATION SYSTEM FOR APPLICATION IN AGRICULTURE 2.0

Balša Lazarević and Tomo Popović

Abstract: Digital transformation has given numerous new possibilities for improvement of all industries through creation of new business processes or changes to existing ones. Agriculture, specifically, has experienced a “rebirth” through the use of digital technologies such as sensor networks, drones, satellites and similar, which has received a name Agriculture 2.0. Meteorological data management systems found their use in agriculture decision supporting solutions, as well. However, there are some challenges, these solutions are only as good as the data made available to them and implementing a system for acquiring quality data may be very expensive. The research described in this paper aims to solve these issues by using multiple publicly available free weather data sources and analyzing it to get the best possible results. The proposed system builds on acquired and analyzed data to provide users with features such as reliable notifications and machine/equipment automation.

RTI3.4 ONE SOLUTION OF SAFETY CORE IN AUTONOMOUS DRIVING SYSTEMS

Maksim Egelja, Marko Dragojević, Nikola Teslić and Nemanja Lukić

Abstract: Automotive industry now days needs one of the most sophisticated software, as that it brings in any new challenges to the world of engineering. Recently, autonomous driving became one of the biggest challenges of this field and it imposes high safety procedures. Work presented in this paper defines modern autonomous driving safety core which is responsible for detecting and controlling the autonomous system when safety critical event occurs either outside or inside the vehicle.

RTI3.5 ONE SOLUTION OF KEEP LANE FUNCTION AND CURVATURE CALCULATION WITH SD MAP DATA USING ROS

Maksim Egelja, Stevan Stević, Nikola Teslić and Nemanja Lukić

Abstract: Software in automotive industry today is a very popular branch and brings many new challenges to the world of engineering. Recently, autonomous driving became one of the biggest challenges of this field. Goal is to develop a system capable of controlling vehicle almost completely independently. Work presented in this paper defines modern autonomous driving algorithm, which includes functionality of keeping autonomous vehicle in appropriate lane using SD (Standard Definition) map data instead of HD (High Definition). This algorithm is based on data fusion from camera sensor and map data.

SESSION RTI4: COMPUTER GRAPHICS AND COMPUTER VISION – CGCV

Monday, September, 28th, 13:00-14:30, on-line

Chair: Dejan Rančić. University of Niš. Faculty of electronics, Niš

RTI4.1 MODERN JAVASCRIPT 3D VISUALIZATION FRAMEWORKS: A COMPARATIVE STUDY

Vladislav Tokovic, Miodrag Zivkovic and Nikola Savanovic

Abstract: Web applications are the most popular type of modern applications. The trigger, which increased the popularity of the web applications, was the interactivity, provided with the introduction of the JavaScript language. Using JavaScript web sites became dynamic, with the possibility to communicate with site users. JavaScript today is not only limited to the client side, but can also be used as the server side language. On the other side, modern browsers have also improved in the recent time. Amongst others, one exiting capability, which can be visually appealing to the end users, is the possibility to render interactive 3D graphics within the browser itself. The focus of this research is to give an overview of the popular 3D graphics JavaScript frameworks: Babylon.js, ClayGL and Three.js. Within this paper, we have compared the frameworks, and presented the advantages and disadvantages of each framework.

RTI4.2 SERBOCR - OPTICAL CHARACTER RECOGNIZER OF THE SERBIAN CYRILLIC ALPHABET BASED ON CONVOLUTIONAL NEURAL NETWORKS

Jovan Vjestica, Teodora Djordjevic and Suzana Stojkovic

Abstract: This paper presents a technique for optical character recognition of machine-written Serbian Cyrillic text based on deep Convolutional Neural Networks. The described OCR system makes use of distinct preprocessing, character segmentation and character classification modules. For preprocessing, an adaptive gaussian threshold was used, while character segmentation used horizontal and vertical projection as well as connected component analysis. The classifier itself is a deep convolutional neural network. The entire system gave good results, with scanned documents yielding strings with a Levenshtein distance of less than 1% of the string length to the actual value present on the image.

RTI4.3 RESOLUTION DEPENDENT SPATIAL DETECTION OF MOVING OBJECTS

Vladan Borović, Dejan Rančić, Olivera Pronić-Rančić and Igor Dumančić

Abstract: Modern technologies include video camera systems used in the process of detecting the position of moving objects and tracking their movement. These systems are very important for detecting the moving objects in different areas, especially in sports like football and tennis, along with police, military and surveillance purposes. This paper describes the dependence of objects' detection in space regarding the video camera resolution. Examples of the real world designed system in practical usage are stated.

RTI4.4 OPENGL SPECULAR REFLECTIONS CAUSED BY LIGHT SOURCE PLACED BELOW SHADOWED OBJECT

Dzenan Avdic, Dejan Rancic, Aldina Avdic and Petar Spalevic

Abstract: Reflections and shadows are crucial for enhancing scene realism and providing important visual cues. In recent years, many important contributions have been made in modeling both for shadows and for reflections which are consequences of presence of object made of special material, with the mirror effect. Shadows are created by light source which is placed above shadowed object. Those shadows are placed on surface where shadowed object is

placed. But, if a point light source is placed below shadowed object made of material which reflects light, phenomenon that is created on that surface is not shadow. This specular reflection is topic that will be described in this paper, on the example of circle and sphere object.

RTI4.5 SINGULAR VALUE DECOMPOSITION (SVD) AS AN APPROACH IN PROCESSING OF AGRICULTURAL IMAGES

Miloš Ilić, Petar Spalević, Dragana Stojnev, Nebojša Stojanović and Aleksandra Stojnev Ilić

Abstract: The problem that we tried to solve is processing of digital images that were created over agriculture filed. In other words we observe digital image processing from the domain of collecting a large amount of metadata, that can be used in different future researches. Collecting data on the condition of crops on production areas by processing images obtained using anemone aircraft equipped with high-resolution cameras enables a completely new approach within smart agriculture. The accuracy of the data obtained depends on the quality of the images. High-resolution photos usually require a large storage space, so we must work on their compression, which must not affect the quality of the photos themselves. In addition, another problem that occurs is the correction of angles in the process of mapping the terrain in cases of shooting at an angle or uneven terrain. Singular Value Decomposition has taken a significant place in the implementation of image processing applications in recent years. In this paper, we propose a survey for the SVD as an efficient transform method in preprocessing of agriculture images.

SEKCIJA RT1: RAČUNARSTVO (*COMPUTING* – C)

Ponedjeljak, 28.septembar, 14:30-16:00, on-line

Chair: Igor Tartalja, Univerzitet u Beogradu – Elektrotehnički fakultet

RT1.1 INKREMENTALNI RAZVOJ 3D VIDEO IGRE ARENA KROZ PRAKTIČAN RAD STUDENATA

Vojislav Bogosavljević and Igor Tartalja

Abstract: U radu je opisano iskustvo inkrementalnog razvoja 3D video igre kroz njenu evoluciju od skeleta koda prikazanog studentima na pokaznoj laboratorijskoj vežbi na predmetu Računarska grafika, preko kontrolne laboratorijske vežbe i kasnijeg domaćeg zadatka (projekta), sve do diplomskog rada studenta. Cilj razvijene igre je da se za ograničeno vreme sakupi što veći broj poena i preživi u areni sa nekoliko prostorija, izbegavanjem prepreka, uz sakupljanje različitih bonusa. Softver je modelovan na standardnom jeziku UML (Unified Modeling Language), a implementiran na programskom jeziku Java, uz korišćenje biblioteke JavaFX.

RT1.2 JEDNA REALIZACIJA SIGNALIZACIJE NISKOG I SERVISNOG NIVO A U PROGRAMSKOJ PODRŠCI ATSC 3.0 SREDNJEG SLOJA

Lazar Švonja, Mladen Ilić and Ilija Bašičević

Abstract: U ovom radu su opisane osnovne karakteristike i principi ATSC (eng. Advanced Television System Comitee) standarda, kao i implementacija programske podrške za ATSC 3.0. ATSC 3.0 je dominantan TV standard u Severnoj Americi. Poseban akcenat biće na signalizaciji niskog i servisnog nivo a u okviru modula za upravljanje servisima. Ideja ovog rada je pored ostalog da ukaže na specifičnosti ATSC standarda, gde se kao glavni problem javlja rukovanje ROUTE i MMTP paketima. Dato je jedno rešenje obrade signalnih paketa, koje kao rezultat daje podatke u obliku pogodnom za dalju obradu i reprodukciju. Rešenje je verifikovano korišćenjem namenske Java aplikacije za Android operativni sistem.

RT1.3 APPLICATION OF TWO-LEVEL ALGORITHM FOR EDGE DETECTION MODELED IN UPGRADED PETRI-NETS

Perica Štrbac, Vukman Korać and Miloš Pejanović

Apstrakt: This work presents a two-level algorithm for edge detection. The first level includes a color image transformation into a gray image, stretching of contrast, application of Gaussian blur, and application of a double threshold. The second level refers to parts of the Canny algorithm: gradient calculation, non-maximum suppression, retention of strong-edge pixels, and weak-edge pixels associated with strong edges. The model of the proposed algorithm was modeled in Upgraded Petri nets (UPN) and then transformed into a specific computer program. The experimental results refer to the application of the proposed algorithm over the selected set of images with comparisons with the Canny algorithm are presented.

RT1.4 JEDNO RJEŠENJE PROŠIRENJA PVR MODULA PODRŠKOM ZA VIŠE SKLADIŠNIH UREĐAJA

Radenko Banović and Ilija Bašičević

Apstrakt: PVR (eng. Personal Video Recorder) je jedan od najvažnijih modula DTV (eng. Digital Television) prijemnika te je postao sastavni dio skoro svakog STB (eng. Set-top box) uređaja. U nekim državama poput Japana je zakonski zabranjeno vraćanje televizijskog sadržaja u nazad (eng. Timeshifting) pa je PVR iz tog razloga još značajniji. Na modernim STB uređajima je povećan broj USB otvora (eng. Ports), te svaki uređaj ima najmanje dva USB otvora čime se stvara mogućnost spajanja STB uređaja sa više skladišnih uređaja. Takođe, povećan je i lokalni skladišni prostor STB uređaja, te se pojavljuje mogućnost skladištenja DTV toka podataka i na lokalni skladišni prostor. U ovom radu je predstavljeno jedno rješenje

proširenja PVR modula koji je sastavni dio DTV srednjeg sloja. Srednji sloj implementira standarde vezane za digitalnu televiziju i služi za obradu podataka na prijemnoj strani, kao i za apstrakciju kompleksnijih modula koji se nalaze ispod srednjeg sloja.

RT1.5 JEDNO RJEŠENJE POSLUŽIOCA TELEVIZIJSKOG SADRŽAJA SA PODRŠKOM ZA IPV4 I IPV6 PROTOKOLE

Radenko Banović and Ilija Bašičević

Apstrat: U ovom radu je prikazano jedno rješenje poslužioca televizijskog sadržaja sa podrškom za IPv6 (Internet Protokol verzije 6) kao i IPv4 (Internet Protokol verzije 4) prenosom podataka višeznačnim i jednoznačnim upućivanjem i korištenjem RTP (eng. Real-Time Transport Protocol) / RTSP (eng. Real-Time Streaming Protocol) protokola. Zbog masovnog prelaska na IPv6 protokol pojavili su se prijemnici multimedijalnog toka podataka u kojima je implementiran isključivo IPv6 protokol iako je IPv4 (internet protokol verzije 4) i dalje najdominantniji internet protokol na svijetu. Krajnji cilj je da IPv6 protokol (čije se učešće u svjetskom internetu svakodnevno povećava) u konačnici u potpunosti zamijeni IPv4 protokol. Stoga, pojavila se potreba za poslužiocem koji podržava oba navedena protokola. Rješenje je testirano korištenjem nekoliko klijenata.

SESSION ROI1 & RO: ROBOTICS AND FLEXIBLE AUTOMATION/ ROBOTIKA I FLEKSIBILNA AUTOMATIZACIJA

September, 28th, 09:00-10:30, Institute “Mihajlo Pupin”. Belgrade

Chair: Aleksandar Rodić / Zoran Miljković, Institute Mihajlo Pupin, Belgrade

ROI1.1 ROBOTIZED ACQUISITION OF DATA FOR CHARACTERISATION AND CALIBRATION OF SOFT FINGERTIP SENSOR

Mirko Raković, Faculty of Technical Sciences, University of Novi Sad

Srdan Savić, Faculty of Technical Sciences, University of Novi Sad

Darko Todorović, Faculty of Technical Sciences, University of Novi Sad

Andrej Čilag, Faculty of Technical Sciences, University of Novi Sad

Vladimir Sibinović, Faculty of Technical Sciences, University of Novi Sad

Branislav Borovac, Faculty of Technical Sciences, University of Novi Sad

Miroslav Božić, High Tech Engineering Center, Novi Sad

Abstract: The tactile sensory system is of high importance for robotic grasping and manipulation and provides the robot with information about properties of physical interaction with the object. Out of many properties that can be measured, contact forces are of the greatest importance. This information can be used to determine the quality of the grasp and it can be used as a force feedback for the control of the robot's hand and arm. As a part of the development of robotic hand we are designing a fingertip sensor that can sense a contact force vector and the location of the contact point. The sensor is distributed, with a matrix of magnets and magnetic sensors, and covered with silicone layer. In order to characterise and calibrate each sensor a procedure for acquiring the data is extensive and requires a large amount of variations of contacts between external object and sensor. This paper presents a systematic way to conduct the repeatable process of data acquisition with industrial robot that covers variations in position, orientation and intensity of the force vector at the contact point.

ROI1.2 FOUR-BAR LINKAGE MECHANISM OPTIMIZATION FOR LINKAGE DRIVEN UNDERACTUATED ROBOTIC FINGER

Lazar Matijašević, Faculty of Mechanical Engineering, Belgrade University

Petar Petrović, Faculty of Mechanical Engineering, Belgrade University

Abstract: When designing linkage driven underactuated robotic finger, many parameters need to be satisfied in order to produce robust robotic hand capable of withstanding industrial environment and capable of fulfilling all needs of robotic assembly in terms of precision and dexterity. For this study, four-bar linkage mechanisms are used to drive underactuated robotic finger and design parameter that will be addressed is transmission performance. Optimization method used for obtaining length of links of four-bar mechanism, based on transmission performance is shown. Freudenstein's analytic method for four-bar linkage function generation, is chosen, and calculated link lengths are to be used for acquiring parameter called transmission defect, parameter that is objective function to be minimized in this optimization process. Maximizing transmission performance, leads to increase of the transmitted torque from the actuated joints to the underactuated joints through transmission mechanism. This paper presents design and kinematic analysis of three degrees of freedom (3-DoF) underactuated robotic finger with linkage driven mechanism for CMSysLab robotic hand.

ROI1.3 CALCULATION OF ACHIEVABLE ROBOT JOINT ACCELERATIONS BASED ON A NEW ROBOT FORWARD DYNAMICS ALGORITHM

Vladimir Kvrgić, Institute Mihajlo Pupin, University of Belgrade
Jelena Vidaković, Lola Institute, Belgrade

Abstract: An algorithm that calculates the feasible robot joints' accelerations based on a new forward dynamics algorithm while considering the actuators' force/torque saturations and achieves a realistic simulation of robot movements is given in this paper. While the most used Walker and Orin's method 1 calculates robot forward dynamics solving Recursive Newton-Euler Algorithm (RNEA) $n + 1$ times, where n is the number of degrees-of-freedom (DoFs), algorithm used here solves forward dynamics using the modified RNEA (mRNEA) only once. Owing to that, this algorithm is very efficient. It is significantly more beneficial when used for robot simulations as it does not require calculating joint torques as inputs for forward dynamics unlike other methods. The suggested method is the ease of development and implementation for a specific robot. The proposed mRNEA and its application in the forward dynamics algorithm are demonstrated using a serial 4-DoF spatial disorientation trainer as an example.

ROI1.4 IDENTIFYING UNMODELLED DYNAMICS IN CONTACT TASKS IN INDUSTRIAL ROBOTICS

Zaviša Gordić, University of Belgrade, School of Electrical Engineering, ETF Robotics Laboratory
Kosta Jovanović, University of Belgrade, School of Electrical Engineering, ETF Robotics Laboratory

Abstract: The intention of this paper is to propose and discuss different approaches to identifying unmodelled dynamics found in tasks performed by industrial robots. Unmodelled dynamics, forces and torques found in contact tasks cause deviations of joint currents and/or torque measurements from their expected values. Correct classification of these deviations and their distinction from collision-induced disturbances is of outmost importance for a reliable collision detection algorithm. Prospects and concerns of different approaches which can help make this distinction are discussed in terms of their reliability, applicability, and versatility. All approaches rely on information which is possible to obtain from industrial robots with closed architecture using standard commands and without any alteration to their control structure.

ROI1.5 IMPEDANCE CONTROL OF AN INDUSTRIAL MANIPULATOR

Jovan Šumarac, Robotics Laboratory, Institute "Mihailo Pupin", University of Belgrade
Aleksandar Rodić, Robotics Laboratory, Institute "Mihailo Pupin", University of Belgrade
Kosta Jovanović, Robotics Laboratory, Institute "Mihailo Pupin", University of Belgrade

Abstract: This paper presents an algorithm for implementation and simulation of impedance control for industrial robots. Force control has increasingly found its uses in industry as well as been a focus of academic research. Since its proposal in 1984 impedance control has become one of the most studied and applied fields of force control. The goal of this paper was to implement an impedance controller and use it for task space control of an industrial robot with six degrees of freedom. The controller model was realized and simulation was done in Matlab/Simulink with the industrial UR5 robot as a case study. The robot was given tool position and forces as control inputs. Position and force responses are presented using computer simulation; positions were calculated and forces were estimated based on the impedance control law.

RO1.1 SISTEM ZA AUTOMATSKU KALIBRACIJU SENZORA SILE I MOMENTA KOD INDUSTRIJSKIH ROBOTA

Nikola Vidaković, School of Electrical Engineering, University of Belgrade

Nikola Knežević, School of Electrical Engineering, University of Belgrade

Apstrakt: Ogroman je značaj merenja kontaktne sile u zadacima industrijske robotike. Ova merenja se mogu koristiti prilikom kontrole sile, zaštite od prekomernih sila, kao i u oblasti kolaboracije između čoveka i robota. Prilikom korišćenja senzora sile i momenta susrećemo se sa nekoliko problema koje ćemo u ovom radu pokušati da rešimo. Cilj nam je da razvijemo sistem za automatsku kalibraciju senzora sile i momenta, koja će podrazumevati estimaciju pomeraja senzora, gravitacionu kompenzaciju, kao i transformaciju sile u koordinatni sistem od interesa. Rezultat ove procedure je dobijanje preciznijih merenja kontaktnih sila koje su nam od značaja za dalju primenu.

SESSION ROI2 & RO2: ROBOTICS AND FLEXIBLE AUTOMATION/ ROBOTIKA I FLEKSIBILNA AUTOMATIZACIJA

September, 28th, 10:30-12:00, Institute “Mihajlo Pupin”, Belgrade

Chair: Veljko Pokonjak, Metropolitan University; Petar Petrović, University of Belgrade, Faculty of Mechanical Engineering

ROI2.1 EYE GAZE AND BODY MOTION SYNCHRONIZATION IN DYADIC INTERACTION

Danilo Nikić, Faculty of Technical Sciences, University of Novi Sad

Nikola Ilić, Faculty of Technical Sciences, University of Novi Sad

Darko Todorović, Faculty of Electronic Engineering, University of Niš

Nuno Duarte, Instituto de Sistemas e Robótica / Instituto Superior Técnico, Portugal

José Santor-Victor, Universidade de Lisboa, Portugal

Branislav Borovac, Faculty of Technical Sciences, University of Novi Sad

Mirko Raković, Faculty of Technical Sciences, University of Novi Sad

Abstract: Understanding the behavior alignment in dyadic human-human interaction and human-in-the-loop control in human-robot interaction relies on reliable tracking of the human motion. The gaze tracking and motion capture are common techniques that are used nowadays, but they are usually used separately. In this work we combined two Pupil-labs gaze tracker with a Vicon optical motion capture system. To synchronize the recordings of all devices we developed the solution that utilized Lab Streaming Layer for unified collection of measurement time series in research experiments that handles both the networking, time-synchronization and (near-) real-time access of the data. The aim of the experimental setup is to study the interaction of two humans while performing a joint task that requires interpersonal motion coupling.

ROI2.2 BIOLOGICALLY INSPIRED OPTIMIZATION METHODS FOR IMAGE REGISTRATION IN VISUAL SERVOING OF A MOBILE ROBOT

Lazar Đokić, University of Belgrade - Faculty of Mechanical Engineering

Aleksandar Jokić, University of Belgrade - Faculty of Mechanical Engineering

Milica Petrović, University of Belgrade - Faculty of Mechanical Engineering

Zoran Miljković, University of Belgrade - Faculty of Mechanical Engineering

Abstract: Image registration (IR) represents image processing technique that is suitable for use in Visual Servoing (VS). This paper proposes the use of Biologically Inspired Optimization (BIO) methods for IR in VS of nonholonomic mobile robot. The comparison study of three different BIO methods is conducted, namely Genetic Algorithm (GA), Particle Swarm Optimization (PSO), and Grey Wolf Optimizer (GWO). The aforementioned optimization algorithms utilized for IR are tested on 24 images of manufacturing entities acquired by mobile robot stereo vision system. The considered algorithms are implemented in the MATLAB environment. The experimental results suggest satisfactory geometrical alignment after IR, whilst GA and PSO outperform GWO.

ROI2.3 EXPERIMENTAL TESTBED SYSTEM FOR BUILDING AND EVALUATION OF ARTIFICIAL MIND WITH INTELLIGENT ROBOTS – CONCEPT AND METHODOLOGY

Aleksandar Rodić, Institute Mihajlo Pupin, Robotics Laboratory

Miloš Jovanović, Faculty of Computing, University Union

Draško Furundžić, IMP Automatika

Abstract: Intelligent beings possess a mind that allows them to be aware of the environment, experience, to think, learn, feel and conclude that they are aware of their emotions, understand

others and control own feelings. An increasing interest in emotion can be seen in the behavioral, biological and social sciences but also in AI and intelligent systems. Research over the last two decades suggests that many phenomena, ranging from individual cognitive processing to social and collective behavior, cannot be understood without taking into account affective determinants such as motives, attitudes, moods, and emotions. The emerging field of affective science seeks to bring together the disciplines which study the biological, psychological and social dimensions of affect. The fact that emotions are considered to be essential to human reasoning suggests that they might play an important role in intelligent robots as well. The research objectives of the paper are focused on developing of an experimental testbed system for studying, modeling and practical implementation of AI algorithms with robots, which are related to scenario-driven and emotion-driven behavior (EDB). Aiming to this goal, the project requires a comprehensive data acquisition from humans, using an experimental AI-platform. Based on experimentally acquired data it will be accomplished a knowledge generalization and developed a knowledge-based model of human EDB using machine learning and fuzzy inference models. The developed models will be implemented in robot controller to enable facial gestures and speech reproduction. The project expects significant theoretical impacts on studying and modeling of human EDB, strongly modulated by personality traits. The project has a major impact on further development of AI algorithms with intelligent systems, for building smart personal devices characterized by a higher level of mind embodiment in IT industry and potential applications in medicine for therapy of children with developmental disorders.

ROI2.4 CYBER-ATTACK DETECTION METHOD BASED ON RNN

Dušan Nedeljković, University of Belgrade, Faculty of Mechanical Engineering

Živana Jakovljević, University of Belgrade, Faculty of Mechanical Engineering

Abstract: Current and forthcoming market requirements bring huge challenges to today manufacturing. Answer to the changing demands and high product variety is found in the integration of the Internet of Things (IoT) and Cyber-Physical Systems (CPS) into industrial plants. CPS as smart devices capable of data processing and information exchange enable fast adaptation of manufacturing resources to production of diversified products. Nevertheless, fully implemented internet communication at factory shop floor opens up a whole new area for potential cyber-attacks. The consequences of attacks can have a negative influence on the system or even endanger human lives. Therefore, defence techniques must be developed to ensure a high level of protection. Early detection of cyber-attacks is crucial to minimize or completely avoid the negative effects of the attack and keep the system safe and reliable. In this work, we propose an attack detection method based on deep learning approach. We explore the application of several deep learning architectures based on Simple Recurrent Neural Networks (Simple RNN) and Long Short-Term Memory (LSTM) based RNN for generation of the detection mechanisms tailored to the concrete process. Our method was experimentally verified using real world data and it proved to be effective, as it detected all considered attacks without false positives.

SESSION TEI & TE: TELECOMMUNICATIONS

Monday, September, 28th, 09:00-12:00, *on-line*

Chair: Goran T. Đorđević, Faculty of Electronic Engineering, University of Niš, Serbia

TEI1.1 POWER CONSUMPTION OF 100GE PACKET PROCESSOR DEPENDING ON A LOOKUP TABLE SIZE

Teodora Komazec, Aleksandra Smiljanić, Milan Bjelica and Mihailo Vesović

Abstract: Power consumption has become a critical performance measure in the design of modern routers. In this paper, we examine power consumption of packet processor implemented on advanced Xilinx UltraScale+ chip, depending on a size of lookup table. We used SDNet to implement IPv4 lookup tables and Vivado power analysis feature to analyze the power consumption of the high-speed router ports.

TEI1.2 PERFORMANCES OF RCIED ACTIVATION SIGNAL MULTISWEEP JAMMING

Aleksandar Lebl, Vladimir Kosjer, Jovan Radivojević and Mladen Mileusnić

Abstract: In this paper we present the characteristics of RCIED activation message signal multisweep jamming. Mathematical analysis is developed for MPSK modulated signals jamming. The first contribution of the paper is that analytical expressions for BER calculation are developed for the whole set of amplitude ratios of RCIED activation signal to the jamming signal. The characteristics of multisweep jamming are compared to the characteristics of pure sweep jamming. The second important paper contribution is the proof that multisweep jamming implementation increases jamming reliability while in the same time decreases necessary jamming power comparing to pure sweep jamming.

TEI1.3 APPLICATION OF 5G CHANNEL CODING TECHNIQUES IN SMART GRID: LDPC VS. POLAR CODING FOR COMMAND MESSAGING

Mirjana Maksimovic and Miodrag Forcan

Abstract: A reliable, scalable, secure, and cost-effective telecommunication and information exchange system is of immense importance in a Smart Grid (SG) vision. 5G, as a novel technology, promises to bring numerous benefits in the energy sector, mostly in increasing overall energy efficiency, reliability, quality of service and accelerating the SG development. Channel coding, as a fundamental building block in any communications system, plays a substantial role in the realization of fast communication with minimum errors during data transfer in an imperfect channel environment. In this paper command messaging in SG has been considered and the performance of 5G channel coding techniques, Low-Density Parity-Check (LDPC), and Polar codes, in terms of the Bit Error Ratio (BER) for different code rates, have been investigated. The simulation results confirm the superiority of Polar coding in the case of transmitting a typical command message from the base station to the Phasor Measurement Unit (PMU) device.

TEI1.4 GPU-ACCELERATED SIMULATION ENVIRONMENT FOR PERFORMANCE OF RELAY SIGNAL ADOPTING DF TECHNIQUE INFLUENCED BY H-μ FADING

Selena Vasić, Nenad Petrović, Stefan Panić, Dejan Milić and Suad Suljović

Abstract: In this paper, the performance of cellular communication system operating over η - μ fading channel, is considered. Using a Decode-and-Forward (DF) multi-hop relay system transmission performances can be enhanced. The closed-form expression for the outage probability (Pout) of the system has been derived. In the proposed system, the transmission time has been divided into two phases to be used by the decode and forward protocol. In the

first phase, the source transmits its data whereas the relays and destination nodes are in receiving mode. In the second phase relay communicates to destination point by sending the recoded information. Moreover, we introduce a GPU-enabled simulation tool to illustrate how the derived expression within scenarios related to smart city mobile networks. According to the achieved results, leveraging GPU significantly accelerates fading calculation for this kind of analysis.

TE1.1 POZICIONIRANJE U NLOS USLOVIMA PRIMJENOM GRAVITACIONOG PRETRAŽIVAČKOG ALGORITMA

Stevo Lukić and Mirjana Simić

Apstrakt: Najveći problem u realizaciji lokacijskih usluga predstavlja pozicioniranje u uslovima blokade direktne putanje između mobilne stanice MS (Mobile Station) i bazne stanice BS (Base Station), odnosno pozicioniranje u tzv. NLOS (Non-Line of Sight) propagacionom okruženju. U ovom radu prikazan je postupak poboljšanja tačnosti lociranja MS u ćelijskim radio mrežama u NLOS uslovima, zasnovan na TOA (Time of Arrival) orjentisanom ML (Maximum Likelihood) estimatoru uz primjenu odabranog metaheurističkog metoda optimizacije.

TE1.2 VREMENSKA VARIJABILNOST INTENZITETA ELEKTRIČNOG POLJA KOJE POTIČE OD MIKRO LTE BAZNE STANICE

Ivana Stojanović, Mladen Koprivica, Nenad Stojanović and Aleksandar Nešković

Apstrakt: U radu je izvršena analiza promene intenziteta električnog polja koje potiče od mikro LTE (Long Term Evolution) bazne stanice, čije je merenje vršeno tokom sedam dana. Merenje je vršeno u downlink smeru komunikacije na centralnoj učestanosti od 1835 MHz. Realizacija intenzivnih merenja je izvršena u realnim uslovima rada mreže u indoor okruženju. Promene u intenzitetu električnog polja mogu se podeliti na dva perioda u toku jednog dana i to na period sa višim nivoima i češćom promenom intenziteta električnog polja (od 08:00 do 22:00 časova) i na period sa nižim nivoima i ređim promenama u intenzitetu električnog polja (od 22:00 do 08:00 časova narednog dana). Razlike u intenzitetu električnog polja uočene su i između radnih dana (ponedeljak-petak) i neradnih dana (subota i nedelja). Izračunavanjem merne nesigurnosti određena je vremenska varijabilnost intenziteta električnog polja. Izračunata merna nesigurnost koja je u opsegu od 1.71% do 11.26% pokazuje relativno malo odstupanje izmerenih vrednosti.

TE1.3 VEROVATNOĆA PREKIDA KOMUNIKACIJE U HIBRIDNOM RF - PLC/VLC SISTEMU

Jelena Anastasov, Dejan Milić, Daniela Milović and Nenad Milošević

Apstrakt: U ovom radu razmatra se hibridni sistem za prenos informacija do krajnjeg korisnika u zatvorenom prostoru. Prenos se obavlja preko kooperativnog linka sa DF (decode-and-forward) relejem koji povezuje PLC (power line communication) i VLC (visible light communication) deonice. Kao back-up link koristi se bežični RF kanal. Korisnik, primenom SC kombinovanja (selection combining) bira link koji mu omogućava bolji kvalitet signala. U radu je analizirana verovatnoća prekida i uticaj parametra PLC, VLC i RF deonica na performanse ovakvog sistema. Detaljnije, razmatran je uticaj pozicije LED lampe (visina, ugao zračenja), uticaj odnosa srednjih snaga signala i šuma sa svih deonica, dubine fedinga radio kanala i vrednosti praga prekida na verovatnoću prekida komunikacije u posmatranom sistemu.