



XV INTERNATIONAL CONFERENCE ETAI 2021 ETAИ

23-24 SEPTEMBER, ONLINE CONFERENCE

ЗБОРНИК НА АПСТРАКТИ НА ТРУДОВИ
PROCEEDINGS OF ABSTRACTS

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



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

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XV МЕЃУНАРОДНА КОНФЕРЕНЦИЈА

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ЕТАИ 2021 – ЕТАИ 2021

PROCEEDINGS OF ABSTRACTS
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Драги учесници,

Во името на одборите на конференцијата ЕТАИ 2021 и во името на Здружението ЕТАИ, ви посакувам добредојде на 15-тата меѓународна конференција ЕТАИ 2021 која оваа година за прв пат се одржува на нов начин во нашето ново виртуелно секојдневие. Со секоја конференција организирана досега се гордееме што на нашите учесници сме успевале да им ја доловиме уникатната атмосфера на нашиот бисер - Охридското Езеро, познато по својата природна убавина и културното наследство и заштитено од УНЕСКО. За жал оваа година и тоа искуство ќе се обидеме да го доловиме виртуелно, со надеж дека следниот пат традицијата ќе продолжи.

Оваа година одбележуваме 40 години постоење на Здружението ЕТАИ. Целокупното искуство собрано низ годините се пренесува на секоја следна генерација ентузијастички вклучени во работата на Здружението, секогаш со безрезервна поддршка од поистакнатите наши членови. Токму затоа сакам да изразам огромна благодарност на дел од членовите на Здружението кои се тука со нас од почетокот па се до ден денес и секогаш со несмален ентузијазам успеваат да го задржат и подигнат квалитетот на работата на Здружението и конференциите ЕТАИ низ годините.

Секако, целта на оваа конференција со долгогодишна традиција е да не поврзе преку заедничките интереси и да создаде место каде ќе се поттикне професионална размена на најновите научно-стручни искуства од теориски и апликативен карактер во подрачјата на електрониката, телекомуникациите, автоматиката и информатиката и секако мулти-дисциплинарните достигнувања кои се денешната наша реалност. Оваа година конференцијата ќе се реализира преку повеќе разновидни и интересни сесии каде ќе се презентираат научни и стручни трудови од актуелни теми. Очекуваме дискусиите на тркалезните маси на тема "Next generation wireless communications - Opportunities and challenges for IoT" и "e-Health and Pervasive Technologies: Challenges and Opportunities", кои се дел од овојгодишната програмата на конференцијата да предизвикаат љубопитност кај учесниците и публиката и да отворат широка палета на прашања кои во иднина ќе бидат разгледувани од научната и стручната заедница. Исто така, се надеваме дека конференцијата ќе ги продлабочи старите пријателства и ќе создаде нови, ќе развие соработка и вмрежување на научните работници и деловните луѓе и дека за тоа нема да биде пречка начинот на кој сме принудени да ја изведеме.

Сакам да ја изразам мојата голема благодарност кон нашите пленарни говорници: проф. д-р Пенг Ши од Универзитетот од Аделаида, Австралија, академик проф. д-р Јануш Кацпшик од Институтот за истражување системи при Полската академија на науки и проф. д-р Матјаж Гамс кој доаѓа од Институтот Јожеф Штефан од Словенија. Исто така сакам да го поздравам и истакнатиот млад научник д-р Томе Ефтимов исто така од Институтот Јожеф Штефан од Словенија.

Конференцијата ЕТАИ традиционално е поддржана од повеќе организации и ентузијастички. Најпрво, како нераскинлив дел од ЕТАИ, сакам да му се заблагодарам на Факултетот за електротехника и информациски технологии при УКИМ кој е постојан поддржувач на Здружението и конференциите низ годините. Оваа година конференцијата ќе биде поддржана и од неколку здруженија од македонскиот оддел на меѓународна организација IEEE со кои заеднички се организираат неколку сесии. Исто така, оваа година имаме поддршка и од Меѓународниот проект WideHealth од

делот на Tweening програмата на ЕУ, преку заедничка организација на тркалезната маса "e-Health and Pervasive Technologies: Challenges and Opportunities". На крајот, користам прилика да им заблагодарам на сите кои придонесоа за успешна реализација на овогодишната конференција ЕТАИ 2021 и да им оддадам посебно признание на авторите на трудовите, рецензентите, членовите на Почесниот одбор, Програмскиот одбор и Организацискиот одбор, како и на сите вклучени за придонесот и несебичното залагање во организацијата и успехот на конференцијата.

Сигурна сум дека програмата на овогодишната конференција е доволно актуелна и интересна и за академската и за стручната заедница и дека ќе овозможи услови за унапредување и стекнување со нови пријателства меѓу научните работници, инженерите и студентите. Со надеж дека ќе имаме успешен настан, ви пожелувам пријатна работа.

Марија Календар
Претседател на Здружението
ЕТАИ

FOREWORD AND WELCOME

Dear participants,

On behalf of the of the ETAI 2021 Conference committees and the ETAI Society, I welcome you to the 15th International Conference ETAI 2021 this year, for the first time, hosted in a new way to reflect our new virtual everyday life. With every conference organized so far, we have always been very proud to capture the unique atmosphere of our pearl - Lake Ohrid, known for its natural beauty and cultural heritage and protected by UNESCO as well. Unfortunately, this year, we will have to try and capture that experience virtually, hoping that on our next meeting the tradition will continue.

This year we celebrate the 40th anniversary of the ETAI Society. The entire experience gathered over the years is passed onto every next generation of enthusiasts involved in the work of the Society, always with the unreserved support of our more experienced members. That is why I want to express my gratitude to some of the members of the Society who are here with us from the beginning until today and always with undiminished enthusiasm manage to maintain and raise the quality of the work of the Society and the ETAI conferences over the years.

Of course, the purpose of this conference with a long tradition, is to connect us through common interests and to create a place for professional exchange of the latest scientific and practical experiences of theoretical and applied nature, in the fields of electronics, telecommunications, automation and informatics and of course the multi-disciplinary achievements that are our reality today.

This year the conference will be realized through several diverse and interesting sessions where scientific and professional papers on current topics will be presented. We expect that the roundtable discussions tackling the topics of "Next generation wireless communications - Opportunities and challenges for IoT" and "e-Health and Pervasive Technologies: Challenges and Opportunities" that are part of this year's conference program, will arouse curiosity among participants and audiences with intention to open a wide range of issues that will be addressed in the future by the scientific and professional community. We also hope that the conference will deepen old friendships and create new ones, develop business collaboration and networking of scientists and business people, and that the format we are forced to organize it by, will not present an obstacle to these goals.

I would like to express my great gratitude to our plenary speakers: prof. Dr. Peng Shi from the University of Adelaide, Australia, academician prof. Dr. Janusz Kacprzyk from the Systems Research Institute at the Polish Academy of Sciences and prof. Dr. Matjaz Gams from the Jozef Stefan Institute from Slovenia. I would also like to greet the prominent young scientist Dr. Tome Eftimov also from the Jozef Stefan Institute in Slovenia.

The ETAI conference has traditionally been supported by many organizations and enthusiasts. First, I would like to thank as an inseparable part of ETAI, the Faculty of Electrical Engineering and Information Technologies (FEEIT), that is a constant supporter of the Society and our conferences throughout the years. This year, the conference will be also supported by several Chapters of the Macedonian branch of the international IEEE organization, by joint organization of several sessions. Additionally, we have support from the EU funded WideHealth Project from the Tweening track by jointly organizing the round table "e-Health and Pervasive Technologies: Challenges and Opportunities".

Finally, I take this opportunity to thank all those who contributed to the successful implementation of this year's ETAI 2021 conference and to pay special tribute to the authors



of the papers, reviewers, members of the Honorary Committee, Program Committee, Organizing Committee and volunteers as well as all involved for their contribution. and selfless commitment to the organization and success of the conference.

I am confident that the program of this year's conference is contemporary and interesting enough for both the academic and professional community, and it will provide conditions for promotion and making new friendships between scientists, engineers and students. With the hope that we will have a successful event, I wish you all pleasant work.

Marija Kalendar
President of ETAI Society

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ПЛЕНАРНИ ПРЕДАВАЊА INVITED PLENARY LECTURES

FORMATION CONTROL DESIGN FOR MULTI-AGENT SYSTEMS

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Abstract: Multi-agent Systems (MAS) are systems with characteristics of cooperation and decentralization. As the agents often work under complex circumstances, limitations of the hardware that include limited passive sensing and active communication capabilities are likely to be present. As a result of the localization conditions above, the agents need to cooperate in a distributed manner to achieve a common goal. Formation control, which is one of the most popular topics within the realm of multi-agent systems, generally aims to drive multiple agents to achieve a desired scalable formation or time-varying formation changing. In this talk, depending on the agents' sensing and interaction capabilities, the analysis and design of a variety of distributed formation control and some applications are introduced. Under complex circumstances, issues on collision avoidance and system robustness for MAS are also addressed. Simulation and Lab experimental results are given to demonstrate the effectiveness of some design schemes proposed in our group.



IS WEB TRANSFORMING OUR MINDS AND WHERE IS OUR CIVILISATION GOING TO?

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Abstract: This paper analyses civilization dangers that Bill Gates and Elon Musk warn about: pandemics, demographic and AI. In addition, the undesired societal changes especially in relation to the mind tampering and the Web are observed. The analysis about longevity of human civilization seems to indicate that we humans on our own are not smart enough to find a solution. Luckily, there is a possible solution: to create and cooperate with superintelligence.

HUMAN-IN-THE-LOOP AI IN DECISION AND CONTROL SYSTEMS: THE ROLE OF LINGUISTIC DATA SUMMARIES

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Abstract: We consider the problem of how to develop an Artificial Intelligence based – or AI based, for short – system for solving complex decision making and control problems, in both engineering and socioeconomic systems. We consider problems in which, in addition to aspects which are subject to an „objective” evaluation by sensors, there are many relevant aspects which are subject to human judgment, intentions, preferences, etc. which are difficult to quantify, subjective, changeable over time, and subject to many cognitive biases, notably the status quo bias. As the presumably most promising architecture for solving such problems we assume the „human-in-the-loop” paradigm, called also the „human-in-the-loop AI” in which it is postulated and implemented a synergistic cooperation between the human being and the „machine”, that is, approaches and algorithms employed. We use the human-in-the-loop paradigm for decision making and control. We argue that the most promising solution in this context is the use of the human centric systems philosophy, originated at MIT, in which no (additional) interface between the human being and the computer is postulated. Therefore, to attain this we advocate to use in the problem formulation and solution (support) some tools and techniques of natural language which is the only fully natural means of articulation and communication for the humans. Specifically, we use the linguistic data summaries, introduced by Yager and then developed by him and Kacprzyk. They are meant to represent large data sets by short, comprehensible sentences. For instance, if we have a (large) set of data on employees, a static linguistic summary can be „most young employees earn around the mean salary”, and a dynamic summary can be „in most recent years the increase of salaries of experienced employees was slightly growing”. Notice that no matter how big the data set is, such short sentences are fully comprehensible for the human being, and imprecise terms are natural. We present various aspects of such linguistic summaries, such as context dependence, representation of language modalities, etc. We show how they can be used for an effective and efficient human-in-the-loop AI based systems for supporting decision making (mostly static summaries) and control (dynamic summaries). We present an implementation for supporting a day-to-day running of a small computer retailer.

TOWARDS AUTOMATED ALGORITHM PERFORMANCE PREDICTION USING PROBLEM LANDSCAPE DATA: A USE-CASE IN SINGLE-OBJECTIVE OPTIMIZATION

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Abstract: Many real-world scenarios involve optimization problems, for example, when minimizing risks, minimizing cost, maximizing reliability, and maximizing efficiency. For this reason, evolutionary computation focuses on development of algorithms for global optimization inspired by biological evolution. These algorithms are efficient for finding good solutions to NP-hard problems for which solutions cannot be computed in analytical or semi-analytical form, or by using deterministic algorithms. Additionally, in combination with machine learning algorithms they represent powerful techniques for solving many prediction problems in industry. Benchmarking in evolutionary computation is a crucial task and is used to evaluate the performance of an algorithm against other algorithms. Existing approaches for assessing the performance of algorithms are based on a statistical comparison of the algorithms' results focusing only on the performance data. On the other side, efficient solving of an unseen optimization problem is related to appropriate selection of an optimization algorithm and its hyper-parameters. For this purpose, automated algorithm performance prediction should be performed that in most commonly-applied practices involves training a supervised ML algorithm using a set of problem landscape features. To provide more explainability in the algorithms' behaviour, we are going to present a recently proposed approach known as Deep Statistical Comparison that provides more robust results in benchmarking studies focussing only on performance data, followed by recently proposed approaches for representing the optimization problem landscape data. Finally, we are going to present different ML pipelines that are used for automated algorithm performance prediction that link the problem landscape data to the performance data by exploring the relations between the problem and the performance space. Such kinds of analysis are extremely welcome to understand the algorithm's behaviour and stop treating them as a black-box, which will further allow more easily to transfer the learned academic knowledge into industry. Recent work on vision-correcting displays will also be discussed. Given the measurements of the optical aberrations of a user's eye, a vision correcting display will present a transformed image that when viewed by this individual will appear in sharp focus. This could impact computer monitors, laptops, tablets, and mobile phones. Vision correction could be provided in some cases where spectacles are ineffective. One of the potential applications of possible interest is a heads-up display that would enable a driver or pilot to read the instruments and gauges with his or her lens still focused for the far distance.



ЕТАИ СЕСИИ ETAI SESSIONS

ETAI1 : CIRCUITS AND SYSTEMS

ETAI 1-1

A SONAR-BASED OBSTACLE DETECTION SYSTEM FOR THE BLIND AND VISUALLY DISABLED

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Abstract: People who are blind and visually impaired face many difficulties in their daily lives. They often suffer while performing even the most basic things that lead them to live at risk. We present an obstacle detection system that is an assistive technology device aimed at helping the blind and visually impaired to move more safely and securely in their surroundings. The system is mounted on the head and detects obstacles that appear in the area from the waist to the head. The device is based on three ultrasonic sensors for obstacle detection. The information that an obstacle is detected is transmitted to the user via vibration. Two sensors are placed horizontally at an angle of 0 deg and these sensors detect up to a maximum distance of 250 cm. The third sensor is placed in the central axis and points downwards at a 14 degree angle with a detection range of 257 cm. A power bank is used for a power supply. Additionally, the user can adjust the vibration intensity via a potentiometer. The device is lightweight at only 220 g. Our initial tests have shown that it provides ample navigation assistance and is comfortable to use.

Key words: obstacle detection; assistive technology; ultrasound; navigation; sonar

ETAI 1-2

LIGHTING DESIGN, AUTOMATION, EFFICIENCY AND ADVANTAGES MADE WITH LIGHTING LEVEL CONTROL IN INDUSTRIAL FACILITIES

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Abstract: Today, in addition to energy saving and comfort in lighting systems for industry and other areas, the need for control is increasing. It is important to meet this need easily and do so without any technical staff and special training required. Therefore, modern and smart lighting management systems are needed. With smart lighting systems, control is now provided with a computer, tablet or smart phone via the web interface. No software language is needed. The Internet Protocol IP-based system allows control and monitoring from anywhere. It includes comfort levels and wireless solutions according to European Norm (EN) standards. At the same time, there is the ability to address, periodically check and report emergency lighting and exit signs in accordance with Occupational Health and Safety (OHS) rules. Lighting methods used to include simple solutions before the use of smart systems, but today, energy efficiency is provided and high savings are achieved thanks to optional control and brightness level adjustment. In addition, it supports environmental practices and efficient maintenance management. In this way, smart lighting systems will be used more in daily life in the near future.

Keywords—Light Level control, Lighting Design, Energy Efficiency, Lighting Automation

ETAI 1-3

DETECTION OF INDIVIDUAL FINGER FLEXIONS USING TWO-CHANNEL ELECTROMYOGRAPHY

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Abstract:Abstract—Due to technological advances in biomedical engineering, electronics, 3D printing and artificial intelligence, there has been a significant increase in the feasibility of producing accurate, fast and fully functional prosthetics. This paper discusses the possibility of designing an artificial forearm prosthetic with the ability of individual control of each finger, which involves using electromyography signals measured by only two sensors placed on the remaining part of the amputated arm. This approach enables crucial improvement in prosthetic control for only a fraction of the cost of prosthetics that are currently available on the market, as expensive hardware components are replaced by inexpensive software solutions. The detection and classification of the type of movement that is being performed is done by using a hybrid convolutional-recurrent neural network. The network provides extremely satisfactory results with the F1 accuracy of the signal predictions being 91.3%. These results are especially significant because of the fact that using only two-channel electromyography to measure the signals notably reduces the cost of the prosthetic, due to the need for a smaller number of EMG sensors.

Keywords—electric prosthetics, electromyography, signal processing, artificial intelligence, neural networks

ETAI 1-4

THE SELECTION OF BI-FRACTIONAL ORDER REFERENCE MODEL PARAMETERS FOR MINIMUM SETTTLING TIME

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Abstract: In this study, the effects of bi-fractional order reference model parameters on time domain characteristics are analyzed. A relation between damping ratio and fractional order that exhibits minimum settling time is observed and the damping ratio is expressed in terms of fractional order by fitting a polynomial. Consequently, a bi-fractional order reference model that guarantees minimum settling time is derived. The effectiveness of the newly derived reference model is shown through examples.

Key words: bi-fractional order system model; reference model; minimum settling time, time domain characteristics.

INTRA-NODAL CACHING ASSISTED UAV BASED DATA ACQUISITION FROM WIRELESS MOBILE AD-HOC SENSOR NETWORKS

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Abstract: Unmanned aerial vehicle assisted data collection is not a new concept and has been used in various mobile ad hoc networks. In this paper, we propose a caching assisted scheme alternative to routing in MANETs for the purpose of wildlife monitoring. Rather than deploying a routing protocol, data is collected and transported to and from a base station using a UAV. Although some literature exists on such an approach, we propose the use of intermediate caching between the mobile nodes and compare it to a baseline scenario where no caching is used. The paper puts forward our communication design where we have simulated the movement of multiple mobile sensor nodes in a field that move according to the Levy walk model imitating wildlife animal foraging and a UAV that makes regular trips across the field to collect data from them. The unmanned aerial vehicle can collect data not only from the current node it is communicating with but also data of other nodes that this node came into contact with. Simulations show that exchanging cached data is highly advantageous as the drone can indirectly communicate with many more mobile nodes.

Keywords—UAV; caching; sensors; MANETs; WSN; waypoint

ETAI 2: CYBER SECURITY AND MATEMATICS

ETAI 2-1

АНАЛИЗА НА БЕЗБЕДНОСТ ВО ПАМЕТЕН ДОМ СО ПРИМЕНА НА АЛГОРИТМИ ОД МАШИНСКО УЧЕЊЕ

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Апстракт—Популарноста на паметните домови расте како одговорна експоненцијалниот раст на Интернет на нештата (IoT). Како резултат на тоа, одржувањето на безбедноста на поврзаните уреди станува сè поголем предизвик во мрежите од Интернет на нешта. Во овој труд се проучува детектирање на аномалии и упади во ваквите мрежи, со помош на алгоритми за машинско учење: логистичка регресија и метод на случајна шума (random forest). Двата од споменатите алгоритми се изработени во програмскиот јазик Пајтон, а податоците кои се користат за тренирање и тестирање се од UNSW-NB15 податочното множество. Резултатите кои се добиени укажуваат на Test F1 и AUC (area under the curve) вредности од 78,2% и 81,4% за алгоритмот на логистичка регресија (LR), и 89,3% и 97,7% за методот на случајна шума (CS), соодветно.

Клучни зборови—паметен дом; машинско учење; UNSW-NB15 податочното множество; Интернет на нешта; безбедност; детекција на аномалии

ETAI 2-2

АНАЛИЗА НА МРЕЖНА БЕЗБЕДНОСТ СО ПРИМЕНА НА АЛГОРИТМИ ОД МАШИНСКО УЧЕЊЕ

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Апстракт — Со порастот на бројот на компјутери и уредикои се поврзани на Интернет, се зголемија и ризиците од можни нарушувања на нивната безбедност. Како што се зголемува волуменот од собраните податоци за мрежниот сообраќај, така се повеќе се воочува примената на техниките за машинско учење за интелигентна обработка и анализата на овие големи податоци. Во оваа насока е и истражувањето претставено во овој труд, каде со примена на алгоритми за машинско учење се создава модел кој служи за откривање на аномалија, односно детекција на упад во мрежи. За потребите на ова истражување се користи KDD’99 податочното множество, при што развиениот модел се базира на следните алгоритми за класификација: Наивен Баесов (НБ) и машини со носечки вектори (СВМ). Добиените резултати покажуваат дека НБ успешно ги класифицира нападите со точност од 88%, додека пак СВМ се карактеризира со повисока точност од 99%.

Клучни зборови — машинско учење; KDD’99 податочното множество; детекција на аномалии; безбедност на мрежи; системи за спречување упад

ETA1 2-3

НУМЕРИЧКО РЕШАВАЊЕ НА ЛАПЛАСОВАТА ДИФЕРЕНЦИЈАЛНА РАВЕНКА СО ПРИМЕНА НА МЕТОДОТ НА КОНЕЧНИ РАЗЛИКИ

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Апстракт—Диференцијални равенки кои немаат директно аналитичко решение се многу честа појава како во науката, така и во инженерството. Меѓу нив е и Лапласовата –диференцијална равенка од втор ред со која може да се опишат голем број електрични и физички појави во инженерството, а особено во неговата потесна област био медицината. Користејќи ги придобивките од развојот на компјутерската технологија развиени се нумерички постапки за решавање на ваквите проблеми. Една од најшироко распространетите нумерички техники е методот на конечни разлики, со кој диференцијалната равенка се претвора во систем од линеарни равенки. Во овој труд е направен придонес кон нумеричкото решавање на Лапласовата равенка со развој на алгоритам за примена на методот на конечни разлики во слободниот програмски јазик Пајтон. Развиениот алгоритам вклучува итеративна техника за решавање на добиените системи од равенки, односно тој е оптимизиран од аспект на зачувување на компјутерските ресурси.

Клучни зборови — Лапласова равенка; нумеричко решавање; метод на конечни разлики; Пајтон; итеративни постапки.

ETAI 2-4

MODELING POPULATION DYNAMICS AND ECONOMIC GROWTH AS COMPETING SPECIES FOR NORT MACEDONIA

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Abstract: The aim of this paper is to apply nonlinear dynamical systems to models used in data analysis and through which the future flows of the system can be predicted. With this theory we analyze the population dynamics in the Republic of North Macedonia, and its revenues. Depending on the results, an insight is given into what trend we expect for the population and income in the future.

Keywords—predator, prey, population GDP, Lotka-Volterra

PERFORMANCE OF GRADIENT ALGORITHMS FOR SOLVING LEAST SQUARES PROBLEM

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Abstract—Stochastic gradient descent is the most important optimization method in machine learning. In this paper, we compare the performances of three stochastic gradient methods to tackle a simple least squares problem: the conventional Stochastic gradient descent (SGD), the Adaptive moment estimation stochastic gradient descent (Adam), and Nesterov-accelerated adaptive moment estimation stochastic gradient descent (Nadam). The input-output data set for the least squares problem is generated by an uncorrelated Gaussian random process with an adjustable variance. We use three performance metrics for benchmarking: the mean squared error between the estimated and the true optimal solutions, and the number of iterations and execution time needed to reach the optimal solution with a certain accuracy. The numerical results show that the conventional SGD outperforms Adam and Nadam. However, Adam and Nadam are much less sensitive to the algorithms' learning rate, which is a crucial advantage that justifies their dominance in most machine learning applications.

Keywords—Least Squares Problem; Optimization; Gradient Descent Algorithms, Machine Learning.

ETAI 3: CONTROL SYSTEMS AND AUTOMATION

ETAI 3-1

MULTI-OBJECTIVE OPTIMIZATION BASED FRACTIONAL ORDER PID CONTROLLER DESIGN

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Abstract—In this study, multi-objective optimization based integer and fractional order PID controllers are designed for first order plus dead time system models using two different cases. For the first case, the objective function is selected as the integral square error (ISE) and for the second case it is chosen as the integral time square error (ITSE). In both cases, multi-objective optimization is carried out for both set-point following and load disturbance rejection responses together. All optimization problems are solved by genetic algorithm to obtain the coefficients of the integer and fractional order PID controllers. After a set of Pareto optimal solutions is obtained, the Nash bargaining point is specified in order to make comparisons. The simulation results show that fractional order PID is superior to integer order PID when the dead time is small. However, fractional and integer order PID controllers show similar performances as the amount of dead time increases.

Key words: fractional order PID controllers; multi-objective optimization; Nash solution; first order plus dead time models

FRACTIONAL INTEGRATING INTEGER ORDER PI CONTROLLER DESIGN FOR THE FIRST INTEGER ORDER PLUS TIME DELAY SYSTEM

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Abstract—In this study, a robust fractional integrating integerorder PI controller design is proposed for the first integer orderplus time delay systems. Phase and gain margins are selected asthe robustness criteria. Moreover, the delayed Bode’s idealtransfer function is employed as a reference model to design ananalytical controller. The phase and gain margin specifications areexactly determined by virtue of this transfer function. Insimulation studies, the proposed fractional integrating integerorder PI controller is compared with integer order PI controllersusing various phase and gain margin values. The simulationresults show that the proposed controller is superior to integerorder PI controller in both frequency and time domain criteriaaspects.

Key words: fractional integrating PI controllers; phase and gain margins; delayed Bode’s ideal transfer function; first order plus time delay system models

FUZZY LOGIC BASED MAXIMUM POWER POINT TRACKING FOR PHOTOVOLTAIC SYSTEMS

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Abstract–The power demand has been continuously increasing due to the increasing population and increasing technological requirements. There is a need to meet this power demand from alternate energy sources. Solar energy is one of the most important energy sources of this kind. The PV systems are used to obtain electrical power from solar energy. The power produced by PV system changes with the change in weather conditions. Therefore, it is important to draw maximum power in all weather conditions. For this purpose, maximum power point tracking algorithms are developed for use with PV based energy producing systems. Fuzzy logic based maximum power point tracking is studied in this paper. The developed PV fed boost converter with fuzzy logic maximum power point tracking is simulated with various weather conditions. The system is implemented in Matlab/Simulink. The simulations have been done with various solar irradiation and temperature values. The results are checked with the PV producers' technical data for extracting maximum power. Results show that the PV system with fuzzy logic based maximum power point tracking ensures drawing maximum power in all weather conditions.

Keywords –boost converter, fuzzy logic control, maximum power point tracking, photovoltaic system

FUZZY-LOGIC OUTPUT-TRACKING CONTROL FOR UNCERTAIN TIME-DELAY DYNAMICAL PROCESSES: EXPLORING TAKAGI-SUGENO FUZZY MODELS

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Abstract—A novel solution to the fuzzy-logic output tracking control for uncertain time-delay dynamic processes (with uncertain perturbations) is derived by employing the synergy of Takagi-Sugeno fuzzy-logic representation models and theory of variable structure sliding-mode control. Firstly, the sliding mode is chosen by applying the variable structure control theory. According to the reaching condition, the variable control method was proposed for two condition cases when the time delay is available known precisely and when it is unavailable unknown, respectively. The proposed design synthesis does guarantee the trajectory of controlled system to arrive at the sliding surface in finite time interval and be kept on it thereafter. Secondly, the sufficient condition for globally bounded plant state in the closed loop is derived by using the ISS theory and LMI method. An example and its simulation results are explored to illustrate the validity and effectiveness of the proposed design, which apparently outperforms many known previous solutions in the literature.

Keywords—Fuzzy Takagi-Sugeno models; nonlinear time-delay dynamical processes output tracking control; sliding-mode control.

DISCRETE-TIME UNSCENTED KALMAN FILTERS WITH OPERATING OF UNCERTAINTIES: STOCHASTIC STABILITY ANALYSIS

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Abstract: – The performance of the Unscented Kalman Filter (UKF) for a class of general nonlinear stochastic discrete-time systems in presence of uncertainties is investigated in this paper. It is proved that the estimation error of the UKF remains bounded provided certain conditions are satisfied. It is further shown that the estimation error remains bounded provided the system satisfies the nonlinear observability rank condition. Furthermore, it is shown that the design of noise covariance matrix plays an important role in improving the stability of the UKF algorithm. These results are verified by simulations for a given illustrative example of an inherently nonlinear plant.

Key words: Estimation, Kalman filtering, stochastic nonlinear systems, stochastic stability, unscented Kalman Filter.

COMPLEX MULTI-NETWORKS WITH FAULTY INTER-NETWORK CONNECTIONS: SYNCHRONIZATION VIA NOVEL PINNING-NODE CONTROL

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Abstract—A synchronization control is derived by using the pinning control theory in this paper. A sufficient stability condition and a pinning control scheme are given by which the nodes in the same network can achieve synchronization via Lyapunov's general stability theory of nonlinear systems. A multi-network system structure consisted of two coupled dynamical networks is explored as an illustrative simulation example. Numerical simulation results demonstrate the proposed controller can achieve stabilized synchronization for the multi-network system despite the fault. In addition, it is shown the especially designed pinning control scheme is more effective than the randomly created pinning control scheme.

Keywords—Dynamical multi-networks; control; faulty inter-network connections; nonlinear nodes systems; pinning control theory; stabilized synchronization.

ETAI 4: E-HEALTH

ETAI 4-1

INSIEME: A UNIFYING ELECTRONIC AND MOBILE HEALTH PLATFORM

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Abstract—This paper describes the current state of the electronic and mobile health platform, Insieme. The first prototype of the platform is already finalized showing the advantages of the new approach to electronic and mobile health. The final goal is to create a free and open e-health platform which will connect users who seek information about specific medical issue (e.g., diagnosis, health services, health products, and other health-related info), and the providers of that information. Information providers are doctors, nurses, call centers, and organizations and companies that offer health-related products. The architectural design of the platform consists of a web-based interactional user interface, the virtual assistants, and the Rocketchat communication platform for text-based messaging between call centers, experts in health domain, and the virtual assistants.

Key words: electronic and mobile health, connecting platform, e-health, virtual assistants

A SYSTEM FOR AUTOMATIC DETECTION OF MAJOR DEPRESSIVE DISORDER BASED ON BRAIN ACTIVITY

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Abstract—MDD or major depressive disorder is a psychiatric disorder which is present in today's society on a large scale. The complexity of the symptoms may lead to misdiagnosis. Automatic detection of depression is state of the art problem which would objectify the diagnosis. The electroencephalogram (EEG) as a medical device, records the human brain activity in real time. Besides all of the physiological characteristics, EEG signals portray the emotional brain activity in real time, which motivates the idea of creating a system for automatic depression detection based on EEG signals. For the methods proposed in this paper a database of 30 healthy controls (HC) and 34 depressed subjects (MDD), is used. For each of the subjects the brain activity of 3 different states is recorded i.e., Eyes Open (EO), Eyes Closed (EC) and doing a visual stimuli task (TASK). From the total number of 22 electrodes in the EEG, we have analyzed only the signals from channels F3 and F4. Those channels are located on the frontal lobe and are associated with the frontal alpha asymmetry which has been stated as a biomarker for depression. A dataset of extracted features of F3 and F4 is created and machine learning algorithms for classification are then applied. The highest achieved accuracy of 98.5% is obtained with the RF (Random Forests) classification model.

Keywords—Major depressive disorder – MDD; electroencephalogram – EEG; brain activity; frontal alpha asymmetry; feature extraction; classification; machine learning; Random Forests;

ETAI 4-3

PREDICTING TRENDS AND ANOMALIES IN DAILY ACTIVITIES

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Abstract—In this work, we analyzed behavioral data of 99 elderly users (their physical activity, sleep patterns, mental health) as part of the WellCo European project, whose objective was to develop a health and wellbeing coach. We tracked how this type of data changes from week to week and then tried to predict future data as well as find anomalies in the current data. This task was accomplished using a combination of statistical modeling and machine learning models. Machine learning models outperformed the baseline model in almost all cases, and the anomalies found matched well the human intuition of the concept.

Keywords—machine learning; sensor data; coaching; elderly; anomalies, pervasive health

FINDING EFFICIENT INTERVENTION PLANS AGAINST COVID-19

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Abstract: Covid-19 has so far affected every country in the world. The Non-Pharmaceutical Interventions (NPIs) by governments have proven themselves quite effective at stopping the spread of infections, but when applied in a very strict and long-lasting manner could have devastating consequences for the economic and social well-being of the population. XPRIZE and Cognizant organized the \$500,000 XPRIZE Pandemic Response Challenge, where the participants were tasked to find good trade-offs between the costs and benefits of NPIs. This paper describes the solution by the team JSI vs Covid that placed second and won a \$250,000 prize. The described solution uses an SEIR model to predict the spread of the infections, with the model parameters being dynamically changed based on active NPIs using machine learning. It then uses multi-objective optimization to find the desired trade-offs between NPI strictness and effectiveness.

Keywords—Covid-19; countermeasures; Non-Pharmaceutical Interventions; epidemiological models; multi-objective optimisation

MACHINE LEARNING BASED ANOMALY DETECTION IN AMBIENT ASSISTED LIVING ENVIRONMENTS

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Abstract: - Improving the security of the Internet of things is one of the most important and critical issues facing the modern world. With the rapid development and widespread use of the Internet of things, the ability of these devices to communicate securely without compromising their performance is a major challenge. The majority of these devices are limited in power and ability to perform complex computer calculations. This is where anomaly and intrusion detection systems come into play. In this paper, various machine learning algorithms are applied to effectively detect anomalies in such networks. The results obtained show great accuracy and precision (97%), as well as short execution time.

Key words: Internet of things, machine learning, security, anomaly detection, ambient assisted living

INVESTIGATING PRESENCE OF ETHNORACIAL BIAS IN CLINICAL DATA USING MACHINE LEARNING

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Abstract: An important target for machine learning research is obtaining unbiased results, which require addressing bias that might be present in the data as well as the methodology. This is of utmost importance in medical applications of machine learning, where trained models should be unbiased so as to result in systems that are widely applicable, reliable and fair. Since bias can sometimes be introduced through the data itself, in this paper we investigate the presence of ethnoracial bias in patients' clinical data. We focus primarily on vital signs and demographic information and classify patient ethnoraces in subsets of two from the three ethnoracial groups (African Americans, Caucasians, and Hispanics). Our results show that ethnorace can be identified in two out of three patients, setting the initial base for further investigation of the complex issue of ethnoracial bias.

Keywords—ethnoracial bias, clinical data, vital signs, machine learning

ETAI 5: COMMUNICATION NETWORKS – 5G

ETAI 5-1

EVALUATION OF DISTRIBUTED NFV INFRASTRUCTURES FOR EFFICIENT EDGE COMPUTING IN 5G

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Abstract—5G penetration in practice means increased demand for improvements on any possible level: network latency and bandwidth, computing, storage, security, etc. Bringing the resources at close proximity to the service consumers is one of the options for such improvements. 5G architecture is combined with Network Slicing and Network Function Virtualization (NFV) to segment the network and to instantiate the network functions. Distribution of the NFV Infrastructure (NFVI) is a key for the 5G Radio Access Network requirements for latency under 1ms. Designing the NFVI according to the specific needs, means that even some parts of the 5G Core network can be moved towards the edge, allowing offload from the devices at central datacenters and minimizing the backhaul traffic. Our work is focused on distribution of the NFVI and we are analyzing two possible scenarios: distribution of the data plane while keeping the Management and Orchestration (MANO) of the NFV at central location and full distribution scenario where all components are distributed across multiple locations. We've made analytical models of the distributed NFVI and we are investigating the network packet sojourn time. We draw conclusions on the parameters that are impacting the network packet sojourn time and we compare the two possible distribution scenarios. The analysis is important for choosing the right architecture given different service scenarios.

Key words: Analytical Model, Distributed, MANO, NFV, SDN.

PARTICLE SWARM OPTIMIZATION (PSO) BASED RESOURCE ALLOCATION FOR DEVICE TO DEVICE COMMUNICATION FOR 5G NETWORK

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Abstract: Device-to-device communication system (D2D) is an evolution-release 12 (LTE) technology built over the long term. For devices that are based on LTE, direct connection can be allowed when they are located nearby via a D2D is a peer-to-peer connection, which allows this. Improvement of the performance, energy consumption, spectral quality, and latency that's done by using D2D communication. This is seen as an increase and decrease in two cases, the first is to increase the spectrum quality of the network and energy usage, while the second case is to reduce the traffic offload on the base station and also reduce the transmission delay. Within this work and in order to achieve a PSO-based resource allocation system when using the fifth generation communication networks, we have described the overall numerical result of achieving this system. Using MATLAB, the results are analyzed, so that each program will be run 100 times, and then an average is taken to plot the graph for the simulation. Under the base station coverage area, the systems are deployed randomly. Half-duplex and full duplex D2D communications are supported by the network, so that the user reuses the block of uplink resources from the CU users.

Key words: Device-to-Device (D2D), Long term evaluation (LTE), Particle swarm optimization (PSO), Quality of Service (QoS), Resource Allocation (RA).

ETAI 5-3

INVESTIGATION OF EFFECT OF THE PILOT REUSE FACTOR VIA INTELLIGENT OPTIMIZATIONS ON ENERGY AND SPECTRAL EFFICIENCIES TRADE-OFF IN MASSIVE MIMO SYSTEMS

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Abstract: With the decrease in energy resources, energy saving has become vital nowadays. This situation has led to an increase in the importance given to the efforts to increase energy efficiency in the field of cellular network. However, factors that increase energy efficiency often reduce the spectral efficiency, which is extremely important for a cellular network. With the help of intelligent optimization techniques, it is possible to ascend energy and spectral efficiencies together in a cellular network using Massive MIMO systems. In this paper, three different intelligent optimization techniques have been used to find solutions to the aforementioned problem. In addition, the pilot reuse factor has been tried at three different values and the effect of this factor has been examined.

Keywords—massive MIMO; intelligent optimization techniques; energy efficiency; spectral efficiency

COMPUTING ON THE EDGE: A SYSTEM AND TECHNOLOGY OVERVIEW

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Abstract: Abstract—The Internet of Things is an emerging concept that unites an enormous number of smart devices continuously producing and exchanging data. Driven by the requirements of the IoT devices and applications, there has been a paradigm shift from centralized mobile cloud computing towards distributed mobile edge computing. Mobile edge computing is characterized by reallocation of the computation functions from the user device to the network edge, usually to the base station. In this way, computation-intensive and time-sensitive applications are offloaded from the user devices that usually have limited resources and capabilities. This paper covers a broad outlook on mobile edge computing, including its architecture, comparison between mobile edge and cloud computing and computation and communication models. Finally, we analyze how mobile edge computing can be applied to three different technologies: Internet of Things, wireless powered communications, and intelligent reflective surfaces.

Keywords—Internet of Things (IoT); cloud computing (CC); mobile edge computing (MEC);

ETAI 5-5

MOBILE EDGE COMPUTING SERVICES WITH QOS SUPPORT FOR BEYOND 5G NETWORKS – USE CASES

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Abstract—This paper presents a novel research in intelligent multi-access QoS mobile edge computing (MEC) for beyond 5G services. Also, the improved advanced QoS model and architecture for beyond 5G systems and services are proposed. The proposed model combines the most powerful features of both Cloud and Edge computing, independent from any existing and future Radio Access Technology, leading to high performance utility networks with high QoS provisioning for any used multimedia modern service over present and future mobile and wireless networks and systems. Moreover, the proposed architecture will allow applications and network services to be executed at the edge part of the network, giving lower end-to-end delay for the end-user services and applications. Finally, this paper gives an overview of the existing Mobile Edge Computing technologies and several use cases. Undoubtedly, MEC is an innovative network paradigm going beyond 5G to cater for the unprecedented growth of computation demands and the ever-increasing computation quality of user experience requirements.

Keywords—Aggregation; Cloud; Edge Computing; Machine Learning; Quality of Service; Vertical Multi-Homing.

ETAI 6: INSTRUMENTATION AND MEASUREMENTS

ETAI 6-1

POSITIONAL VALUE MEASUREMENT FOR A ROOK AND KING VS ROOK CHESS ENDGAME ALGORITHM

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Abstract: In this paper, we will take a look at an algorithm which plays as White in the King and Rook vs King chessendgame. First, we will explore the history of ArtificialIntelligence and the evolution of chess machinery over a 70year time span. Next, we will go over the foundation with whichour program was made, and then take a deep look at itsstructure to better understand how it functions. Moreover, wewill discuss the ways in which the program can be improved inthe future. Finally, we will conclude the paper by going overthe results of the program and Artificial Intelligence’s impactin the present.

Keywords—Chess, Algorithm, Artificial Intelligence

ETAI 6-2

OVERVIEW OF SECURITY AND SAFETY SYSTEMS IN THE AUTOMOTIVE INDUSTRY

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Abstract—This paper focuses on an overview of modern security and safety systems in the automotive industry, as well as the intelligent platform of integrated sensors on which they are based. The purpose of this paper is to give a brief explanation of current security and safety systems, such as anti-lock braking system, airbag and seat belt system, emergency call system (E-Call system), as well as theft and cyber-security systems. The technological progress of these systems is the basis for the existence of partially and fully autonomous vehicles, and their functionality fully and directly affects the safety and security of drivers, passengers, and all other participants in traffic.

Keywords: security systems; safety systems; automotive industry; sensors; autonomous vehicles

ETAI 6-3

DESIGN AND EVALUATION OF COLLABORATIVE LEARNING PLATFORM WITH INTEGRATED REMOTE LABORATORY ENVIRONMENT

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Abstract: In this paper, the design and evaluation of a computer-based remote virtual laboratory with an integrated collaborative environment in vocational education have been presented. The remote virtual laboratory was implemented as a joint effort of several participating institutions from Universities and Vocational education in the framework of the Erasmus+ project CORELA. The paper summarizes the design and implementation concepts and presents the user experience evaluation results obtained from students from vocational education. The results presented in the paper suggest that the CORELA platform provides a good professional user space for remote laboratory experimentation but also give insight into where the virtual platform could be improved.

Keywords—remote laboratory, collaborative learning, virtual laboratory, vocational education

ETAI 6-4

ERROR EVALUATION IN REACTIVE POWER AND ENERGY MEASUREMENTS ADOPTING DIFFERENT POWER THEORIES

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Abstract: The prevalence of high order harmonics in power systems results in demand for measurement equipment calibration in such non – sinusoidal conditions. This is especially challenging in case of reactive power/energy instruments for 2 reasons: their role in the billing of electrical energy and the fact that the reactive power is not unambiguously defined in case of harmonics. These instruments are based on different measuring principles which provides additional complication for a unified calibration procedures establishment. Because the decomposition of harmonically distorted waveforms is a multivariable problem and in order a valid conclusions to be adopted, instruments' output is supposed to be analyzed from the perspective of different signals' parameters, such as: harmonic order of single components, their amplitude and phase shift, as well as the phase shift of voltages and currents at fundamental frequency.

Key words: high order harmonics, electricity meter, phase shifts, reactive power.

ETAI 6-5

VIRTUAL REAL TIME POWER QUALITY DISTURBANCE CLASSIFIER BASED ON DISCRETE WAVELET TRANSFORM AND MACHINE LEARNING

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Abstract—Power quality has risen in interested in recent years due to the integration of renewable energy sources, the usage of power electronics, increasing power consumption etc. Modern technologies like FPGA, Virtual Instrumentation, Machine Learning algorithms enhanced the power quality monitoring possibilities. In this paper a Virtual Instrument is proposed that classifies Power Quality Disturbances in real time. The classification is done using Random Forest (RF) algorithm and the feature extraction was done using Discrete Wavelet Transform (DWT). Additionally, the classifier was tested with a virtual power quality disturbance generator. From the obtained test results the classifier shows good results. The virtual instruments are developed in LabVIEW and the RF algorithm was implemented in Python.

Keywords—Power Quality; DWT; Machine Learning; LabVIEW; Python, Virtual Instrument

IMPROVING THE EFFICIENCY OF GROUNDING SYSTEM ANALYSIS USING GPU PARALLELIZATION

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Abstract: Safety analyses of the effectiveness of large grounding systems are often hampered by the lengthy computation times. Using even the simplest image models, the evaluation of touch and step voltages can require from several minutes to several hours of computations on modern CPUs. Our analysis shows that substantial reduction of computation times can be achieved by utilizing GPU parallelization. In this paper we provide basic steps in the implementation of GPU parallelization on the simplest equipotential model for grounding analysis in inhomogeneous earth, and we test the effectiveness of this approach in different scenarios.

Keywords—ArrayFire; grounding; parallelization; GPU; step voltages; touch voltages; ground potential rise

ETAI 7: CLOUD AND IOT TECHNOLOGIES

ETAI 7-1

TECHNOLOGICAL, REGULATORY AND BUSINESS ASPECTS OF LPWAN IMPLEMENTATION IN IOT

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Abstract: The Internet of Things (IoT) concept consists of a large number of connected devices placed on a large area and the most suitable communication for this type of implementations are the Low Power Wide Area Networks (LPWANs) which are characterized with low power consumption and high coverage range. These features of LPWANs are obtained by using digital modulation techniques that produce a sufficiently strong signal to transmit long distances. For efficient use of the radio spectrum, which from the aspect of telecommunications is not an infinite resource, several regulations have been adopted that define the work of LPWANs. IoT has an increasing role in everyday life (business, medicine, education, entertainment, etc.) and it is necessary to adjust the characteristics of LPWANs (range, transmission speed, security, number of nodes) in order for IoT applications to be appropriate for the field in which they are implemented.

Key words: ICT, Internet of Things, IoT, ISM, LoRa, LPWAN, NB-IoT, Sigfox.

EXTENDED PERFORMANCE EVALUATION OF THE TENDERMINT PROTOCOL

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Abstract: Blockchain technology emerges as a promising solution to a wide variety of problems in the financial, industrial, healthcare, and logistic sectors. The Bitcoin and the Ethereum networks are the most often used as Blockchain technologies. However, they are unable to scale with the increased demand and are highly energy inefficient. Besides these two technologies, there are alternatives that are promising the same functionality but with increased scalability. As one of the best alternative Blockchain technology is the Tendermint protocol. There is a lack of papers showing the performance of the Tendermint protocol. This paper presents a performance analysis of the Tendermint protocol in a controlled environment. The achieved transaction throughput makes the Tendermint protocol a promising consensus mechanism for large-scale implementation scenarios. The evaluation also shows the ability of the Tendermint protocol to serve applications that require exchanging larger transactions with acceptable transaction throughput.

Keywords— Tendermint, performance, throughput, transaction size

ANALYSIS OF SECURITY MECHANISMS OF CONTAINERS IN CLOUD

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Abstract: As more and more organizations expand their use of tools for container orchestration, and Kubernetes is becoming a popular choice for many companies, it is crucial to understand its architecture and how the components are connected to protect the mutual communication and the applications that are installed on containers. Development speed and agility are key elements in the world of containerization. Increased use of containers leads to inability to use security mechanisms, only at the end of the software lifecycle. Instead of that, more frequent checks, and installation of security mechanisms in more stages of container lifecycle, will bring greater opportunities in detecting software vulnerabilities and shorter time to find a solution for them. This paper presents the security issues in Kubernetes and mechanisms that are used to protect the cluster.

Keywords—Cloud; Container; Docker; Kubernetes; Security

THE APPLICATION OF THE INTERNET OF THINGS IN EVERYDAY EQUIPMENT AFFECTS TO HAVE A MORE EFFICIENT AND QUALITY LIFE

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Abstract: With the advancement of Automation technology, life is becoming simpler and easier in all aspects. In today's world, automated systems are more preferred than manual systems. With the rapid increase in the number of Internet users over the past decade it has made the Internet a very important part of life, and IoT is the latest technology in under development. IoT is a network of facilities that are constantly evolving from industrial machinery to consumer goods that can share information and perform tasks while you are busy with other activities. Wireless Home Automation system (WHAS) using IoT is a system that uses computers or mobile devices to control basic home functions and features automatically via the Internet from anywhere in the world, an automated home is sometimes called a smart home. It aims to save electricity and human energy. The home automation system differs from other systems by allowing the user to operate the system from anywhere in the world via the internet connection. Through this paper, we will try to briefly describe the importance of IoT in people's daily lives, and the possibilities of applying IoT to devices used in people's daily lives. The IoT is undoubtedly of particular importance, as through intelligent devices every day more and more our lives are being facilitated and opportunities for efficiency and a better quality of life.

Key words: internet of things, smart house, smartphones, security, technology, models.

USER-TO-CLOUD LATENCY PERFORMANCE CHARACTERISTICS IN AN EUROPEAN CLOUD INFRASTRUCTURE

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Abstract: The cloud infrastructures of today become a de-facto standard in everyday life being used for work, study, as well as private home needs. As a result, the performance of cloud infrastructures and cloud services availability is quite crucial. The academic community is continuing its efforts to characterize the cloud infrastructure performance, since the cloud providers usually provide partial and only qualitative information about network performance. This paper will provide practical measurements of network latencies and the user experience of cloud services, focusing on European cloud infrastructures and user's experience in East European geographical regions. The work also encompasses in depth analysis of access segment latencies: user to exit from ISP provider, ISP provider to cloud provider and intra cloud segment. For this analysis we collected 10-day measurements from an Eastern European user location to services deployed in several distinct geographical locations using the infrastructure of one of the most renowned European public-cloud infrastructure providers-Exoscale. The experiments enable a detailed latency performance characterization and fine-grained view of cloud data paths perceived by East European users. Results show that most network latency measurements are within the boundaries of the expected human perceivable latency of 50-100 ms, thus enabling even real-time cloud applications.

Keywords—cloud infrastructures, cloud performance measurements, network latency CDF, European cloud infrastructure, European GDPR

ETAI 8: ARTIFICIAL INTELLIGENCE IN AUTOMATION

ETAI 8-1

FORECASTING DYNAMIC TOURISM DEMAND USING ARTIFICIAL NEURAL NETWORKS

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Abstract—Planning tourism development means preparing the destination for coping with uncertainties as tourism is sensitive to many changes. This study tested two types of artificial neural networks in modeling international tourist arrivals recorded in Ohrid (North Macedonia) during 2010-2019. It argues that the MultiLayer Perceptron (MLP) network is more accurate than the Nonlinear AutoRegressive eXogenous (NARX) model when forecasting tourism demand. The research reveals that the bigger the number of neurons may not necessarily lead to further performance improvement of the model. The MLP network for its better performance in modelling series with unexpected challenges is highly recommended for forecasting dynamic tourism demand.

Key words: Time series, Tourism demand, Tourism planning, Modeling, COVID-19.

FORECASTING POWER CONSUMPTION FOR RESIDENTIAL SECTOR

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Abstract: The fast increase of power consumption as a result of fast development of the technology and the growth of population, has a big impact of stability of the electric grid. These two main reasons arise the need of forecasting the power consumption. In this paper statistical methods: exponential smoothing method and ARIMA are used for forecasting power consumption on daily and monthly basis. They are autonomous methods because they used historical data to predict future values. The data is gathered from household in France, in a period of four years. The proposed models give good experimental results in one-year forecasting regarding to RMSE and MAE.

Keywords—ARIMA; exponential smoothing method; forecasting; power consumption; statistical methods;

MODULATION CLASSIFICATION WITH DEEP LEARNING: COMPARISON OF DEEP LEARNING MODELS

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Abstract—Automatic modulation classification (AMC), which defines the modulation type of the received signal, is an important part of non-cooperative communication systems. Automatic modulation classification plays an important role in many civil and military applications such as cognitive radio (CR), adaptive communication and electronic reconnaissance. Effective modulation classification is required for CR systems to describe the modulation techniques applied for data transmission. Classical signal identification methods used in the past are based on complex feature extraction methods such as cyclic stationarity, high order cumulants and complex hierarchical decision trees. It should also be noted that conventional methods cannot be generalized over all types of signals and are not readily adaptable when a new wireless communication technology emerges. On the other hand, deep learning (DL) has been suggested as a useful method for such classification problems, and has recently been intensively researched in the field of communications. In this paper, a convolutional neural network model, a long/short term memory model and a fully connected neural network models were designed and applied to datasets for implementing radio signal identification tasks, which is an important facet of constructing the spectrum-sensing capability required by software defined radio. Simulation results and training times are given, the advantages of the models over each other are stated and innovations that can be added in the future are proposed.

Keywords—deep learning; cognitive radio; convolutional neural network; long/short term memory; fully connected network; automatic modulation classification

ETAI 8-4

MACHINE LEARNING APPROACH FOR AUTONOMOUS CONTROL OF VERTICAL CEMENT ROLLER MILLS

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Abstract—The production of cement requires fine grinding of materials and thus consumes a lot of energy. In the search for savings, the development of the vertical cement roller mills (VCRM) significantly reduced the energy consumption. The control of any cement roller mill is a complex process and requires the monitoring of many variables by the operator. This work proposes a novel Real Time Optimizer (RTO) for autonomous control of VCRM, focusing on a machine learning algorithm which uses historical data to predict the values of essential process variables. These support vector machine (SVM) prediction models are trained on real plant data and are an integral part of the optimizer designed for the process. The final optimization goal is the improvement of the mill operation with increase of the production, decrease of energy consumption, and reduction in the variability of the cement quality.

Keywords—Real-time optimization; Machine learning; Vertical cement roller mill.

ETAI 8-5

SELECTING AN OPTIMISATION ALGORITHM FOR OPTIMAL ENERGY MANAGEMENT IN GRID-CONNECTED HYBRID MICROGRID WITH STOCHASTIC LOAD

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Abstract: Decentralisation of the power system and the implementation of microgrids into the standard power system, leads to a complex system which requires a reliable operation and a proper energy management. Finding the right set of optimisation algorithms is the base for solving the optimisation problem. This paper overviews the usage of optimisation algorithms for microgrid energy management, with an accent on a classical optimisation algorithm (Dynamic Programming), and heuristic algorithms, such as Genetic Algorithm and Particle Swarm Optimisation. The paper also proposes a methodology for optimal energy management in a hybrid grid-connected distribution microgrid, with a storage system and stochastic load. The algorithm analyses the optimal scheduling of the installed generators considering the state of charge of the battery and electricity price for power trading with the utility grid. The optimal solution is the most economically justified solution from which the microgrid can benefit, and the one with the least impact on the nodal voltages.

Keywords—Microgrid; Optimisation Methodology; Energy Management System; Unit Commitment

ETAI 8-6

COMPARATIVE ANALYSIS OF DIFFERENT HELIOSTAT FIELD CONTROL ALGORITHMS

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Abstract: This study presents the use of various algorithms for control of a field of heliostats, through which a thermal power plant with concentrated solar energy is controlled. The design of the control algorithms consists of several steps. First, in order to obtain the mathematical model of the system, the real system is identified according to the gray box and the least-square method. The data used to identify the system is generated by step excitation on the real system, for a specific sampling period. The resulting mathematical model is used to design and simulate a continuous and discrete PID controller, Mamdani and Sugeno fuzzy logic controllers, as well as ANFIS based fuzzy logic controller. The results of the applied controllers are analyzed and compared, based on the output overshoot, the rise and settling time. It can be concluded that we got best results (least settling time and the least overshoot) when fuzzy logic controller with ANFIS was used, while in terms of speed and rise time, the best results were obtained when discrete PID control algorithm was used.

Key words: Heliostat, least-square, PID, fuzzy logic 65 nsembl, Adaptive Neuro-Fuzzy Inference System (ANFIS)

ETAI 9: COMMUNICATION TECHNOLOGIES

ETAI 9-1

“UNCERTAIN AQM/TCP COMPUTER AND COMMUNICATION NETWORKS: FIXED-TIME CONGESTION TRACKING CONTROL USING GAUSSIAN FUZZY-LOGIC EMULATOR”

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Abstract: A novel control synthesis for fixed-time congestion control problem of uncertainty AQM/TCP computer and communication networks with UDP flows and un-modeled uncertainties is revisited by thorough analysis. The fluid-flow based nonlinear dynamics model of AQM/TCP networks is analyzed, and a fixed-time adaptive congestion control algorithm along with fuzzy-logic emulator of unknown UDP flows and un-modeled uncertainties is proposed. The new control algorithm has been derived using combined requirements for the fixed-time control and the prescribed performance control by employing the back-stepping technique and the fuzzy approximation of uncertain quantities. Using the back-stepping methodology, a fixed-time AQM/TCP controller is designed which does not depend on the initial condition so as to ensure that the fixed time of the closed-loop response and system signals remain bounded. The closed-loop simulation results demonstrate the extent of effectiveness and superiority of the proposed design relative to known previous control designs.

Key words: AQM/TCP communication/computer networks; nonlinear fluid-flow dynamics; back-stepping control synthesis; fixed-time practical stabilization; Gaussian fuzzy-logic emulator; congestion minimization.

WIRELESS POWERED ALOHA NETWORKS WITH FIXED USER RATES AND UAV-MOUNTED BASE STATIONS

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Abstract: In this paper, we propose a resource allocation scheme for a wireless powered communication network (WPCN) whose base station (BS) is mounted on an unmanned aerial vehicle (UAV). The UAV flies along a circular trajectory and maintains a line of sight (LoS) link between the BS and each energy harvesting user (EHU). The EHUs utilize a common random access channel by employing the slotted ALOHA protocol. The BS broadcast RF energy to the EHUs. The EHUs transmit information codewords to the BS at fixed rates, and so the BS cannot successfully decode these codewords if the path loss of the BS-EHU channel is too high. For such WPCN, we determine the optimal fixed rates of the EHUs and the corresponding optimal channel access probabilities that guarantee proportionally fair resource allocation. Also, using numerical results, we determine the conditions where non-zero outage probability is optimal.

Key words: Wireless powered communication networks; slotted ALOHA; unmanned aerial vehicles; fixed rate transmission; outage probability

PERFORMANCE INVESTIGATION OF BIDIRECTIONAL OPTICAL IM/DD OFDM WDM-PON USING RSOA AS A COLORLESS TRANSMITTER

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Abstract: In this paper, we have designed and simulated bidirectional hybrid Intensity Modulated and Direct Detected Optical Orthogonal Frequency Division Multiplexing Wavelength Division Multiplexing Passive Optical Network (IM/DD-OFDM-WDM-PON) with 40 Gbps 16-QAM downstream and 2.5 Gbps On-Off keying (OOK) upstream signal by using Optisystem software. The simulated system is considered as a simple, low cost and colorless network as a Reflective Semiconductor Optical Amplifier (RSOA) transmitter was used at the Optical Network Unit (ONU) and no Dispersion Compensating Fiber (DCF) is needed. Obtained results show that the simulated IM/DD-OFDM-WDM-PON can achieve good Bit Error Rate (BER) performance over propagation length of 20 km. For comparison and analysis, BER performance of the simulated network is analyzed and studied as well as the effect of the propagation length on the constellation diagram, and the relation of BER and bit energy and noise density ratio (E_b/N_0).

Key words: Intensity Modulated and Direct Detected (IM/DD), Orthogonal Frequency Division Multiplexing (OFDM), Wavelength Division Multiplexing (WDM), Passive Optical Network (PON), Quadrature Amplitude Modulation (QAM), Bit Error Rate (BER), Reflective Semiconductor Optical Amplifier (RSOA).

ETAI 9-4

DEVELOPMENT AND DEPLOYMENT OF A LORAWAN PERFORMANCE TEST SETUP FOR IOT APPLICATIONS

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Abstract—Emerging Internet of Things (IoT) trends including smart cities, smart factories, smart farming and many other applications comprising connected „things“ are imposing more and more demand on the Radio Access Network (RAN) in terms of power consumption, coverage and scalability. Most of the technologies utilized for the Internet of Things are not able to manage all of the needed and upcoming requirements, hence they are continuously upgrading and developing. LoRaWAN is an emerging Low-Power Wide Area Network (LPWAN) technology. In order to enhance the opportunities for the new requirements, this paper covers the development and deployment of a LoRaWAN performance test setup including two end nodes and a gateway to test the round-trip time, range, packet loss and signal strength of the network.

Key words: LoRa, LoRaWAN, IoT, End Node, Gateway, Network Server, Application Server, Join Server

ETAI 10: ARTIFICIAL INTELLIGENCE IN BIOMEDICINE

ETAI 10-1

THE REPRESENTATION OF SPOKEN VOWELS IN HIGH GAMMA RANGE OF CORTICAL ACTIVITY

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Abstract: Spoken language is what distinguishes humans from other species. It is the easiest, yet the most complex action we perform. Precise and coordinated movement of multiple articulators is required in order to generate spoken sounds or phonemes. The organization of phonemes into complex semantic structures is currently a system of communication that people use to understand each other. For pronunciation of different phonemes, different articulators are involved in sound production. Speech motor control and its manifestation in the central nervous system is still under intense research. Although it is such an important topic, the spectro-temporal representation of speech in the cortex is still a mystery. Understanding how different phonemes are encoded is important for the further development of speech synthesis systems based on brain activity. The main focus of this paper is to create a feature space for the representation of vowels that will further contribute to the realization of a system mapping vowel articulation to characteristics of brain activity. This approach is a step towards a system for speech synthesis based on brain activity, which will potentially help people with speech impairments and contribute to research in the field of mental illnesses that impair speech ability. The created feature space of brain activity representing vowels is a set of extracted features from each electrode. For that purpose, the medium high gamma power of each spoken vowel from the EcoG electrodes is computed. A random forest classifier was trained on the extracted features and the model achieved 54% accuracy. Furthermore, feature importance has given us a perspective for the most important electrodes for encoding the vowels.

Key words: speech; EcoG; cortex; consonant-vowel syllables; phonemes;

SCORPIANO – A SYSTEM FOR AUTOMATIC MUSIC TRANSCRIPTION FOR MONOPHONIC PIANO MUSIC

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Abstract: Music transcription is the process of transcribing music audio into music notation. It is a field in which the machines still cannot beat human performance. The main motivation for automatic music transcription is to make it possible for anyone playing a musical instrument, to be able to generate the music notes for a piece of music quickly and accurately. It does not matter if the person is a beginner and simply struggles to find the music score by searching, or an expert who heard a live jazz improvisation and would like to reproduce it without losing time doing manual transcription. We propose Scorpiano – a system that can automatically generate a music score for simple monophonic piano melody tracks using digital signal processing. The system integrates multiple digital audio processing methods: notes onset detection, tempo estimation, beat detection, pitch detection and finally generation of the music score. The system has proven to give good results for simple piano melodies, comparable to commercially available neural network based systems.

Key words: automatic music transcription, musical note recognition, pitch detection, onset detection, audio processing



ETAI 10-3

FACIAL EMOTION RECOGNITION USING DEEP LEARNING

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Abstract—Emotions play a significant role in everyday communication and interaction between people. There are different modalities for predicting emotions, the most famous one being the face. Most of the work is done on predicting emotions in posed scenes, because the spontaneous facial emotions are much more unpredictable. In this paper, we propose an approach for prediction of the spontaneous facial emotions in pictures, using deep learning, more specifically, a VGG network. The FER+ dataset is used for the experiments, which consists of spontaneous images carrying multiple labels for each face image. The pictures were used as originals, without doing any additional modifications. The results show that using the proposed approach, the overall prediction accuracy can be achieved, which is close to the accuracy of the algorithms that use posed expressions. This brings a real life value and usability of this method.

Key words: Emotion Recognition, Facial Expression, Deep Learning, Convolutional Neural Network

ETAI 10-4

AUTOMATIC COMPOSITION OF TEXT AND MUSIC FOR A SONG IN MACEDONIAN USING DEEP LEARNING

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Abstract: This paper presents an approach to develop deep learning models to automatically generate music and lyrics for a song in Macedonian language. The approach consists of two steps: (i) a deep learning model to generate text (lyrics) for songs using Gated Recurrent Unit approach, and (ii) a deep learning model for music generation for the lyrics of the song generated in the previous step. The model for lyrics generation is based on Gated Recurrent Units algorithm, and the model for music generation is based on a pre-trained Recurrent Neural Network and Variational Autoencoder model, which generates sequences of music that are later combined to produce the final music for the song. The music generation model interpolates between two-note sequences and thus completes the process of creating the music. The results show that our model generates understandable lyrics for songs and decent quality music for the same. The result songs are unique, new, and after some melodic post-processing, can be potentially used to help the process of song creation.

Key words: Text generation; Lyrics generation; Macedonian song; GRU; Deep learning; RNN; Machine learning.

ETAI 10-5

MACHINE LEARNING AND DATA SCIENCE AWARENESS AND EXPERIENCE IN VOCATIONAL EDUCATION AND TRAINING FOR HIGH-SCHOOL STUDENTS

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Abstract: Data Science Machine learning and are increasingly important in the world's economy and there is an increasing gap in the job market of skilled workers. To address this the Valence project proposes the design and implementation of a Data Science and Machine Learning focused curriculum in VET high schools. As a precursor to this, we designed a survey to assess the awareness/experience in these areas in students in Vocational Education and Training high schools. The survey was distributed across the three partner VET institutions. The analysis shows that While most students are aware of these two areas, only a small proportion of them have any practical experience in them or have followed an online tutorial. This reaffirms the need for the design and deployment of an accessible Data Science and Machine Learning curriculum.

Key words: machine learning; data science; high-school education; vocational education; survey

ETAI 10-6

TOWARDS A SYSTEM FOR CONVERTING TEXT TO SIGN LANGUAGE SYMBOLS FOR MACEDONIAN

**Stefan Spasovski¹, Branislav Gerazov¹, Risto Chavdarov¹, Viktorija Smilevska²,
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Abstract: The paper presents initial results in the design and development of a system for automatic conversion of text to sign language in Macedonian. The system will be an essential part of a larger system for the automatic generation of Macedonian sign language based on text. This system will facilitate the digital inclusion and will ease communication with the Macedonian deaf community. The system is implemented as a web application which allows input text to be encoded in the equivalent sequence of sign language signs. The initial results show an average sign error rate of 4.49%. Online testing was also organized that confirmed these promising results.

Key words: natural language processing, assistive technology, text-to-sign language, sign language, deafness

ETAI 2021 TECHNICAL PROGRAMME AGENDA

THURSDAY, 23. IX. 2021

SESSION - 1: CIRCUITS AND SYSTEMS

09:30 – 11:00

Co-Chairs: Katerina Raleva and Tomislav Kartalov

ETAI 1-1	A SONAR-BASED OBSTACLE DETECTION SYSTEM FOR THE BLIND AND VISUALLY DISABLED
	Stefana Hristovska, Kristijan Lazarev and Branislav Gerazov
ETAI 1-2	LIGHTING DESIGN, AUTOMATION, EFFICIENCY AND ADVANTAGES MADE WITH ILLUMINATION LEVEL CONTROL IN INDUSTRIAL FACILITIES
	Mehmet Gürçan Gür and Yilmaz Uyaroğlu
ETAI 1-3	DETECTION OF INDIVIDUAL FINGER FLEXIONS USING TWO-CHANNEL ELECTROMYOGRAPHY
	Blagoj Hristov and Gorjan Nadzinski
ETAI 1-4	THE SELECTION OF BI-FRACTIONAL ORDER REFERENCE MODEL PARAMETERS FOR MINIMUM SETTLING TIME
	Ertuğrul Keçeci, Erhan Yumuk, Müjde Güzelkaya and İbrahim Eksin
ETAI 1-5	INTRA-NODAL CACHING ASSISTED UAV BASED DATA ACQUISITION FROM WIRELESS MOBILE AD-HOC SENSOR NETWORKS
	Umair Chaudhry and Chris Phillips

SESSION - 2: CYBER SECURITY AND MATHEMATICS

09:30 – 11:00

Co-Chairs: Danijela Efnusheva and Sanja Atanasova

ETAI 2-1	АНАЛИЗА НА БЕЗБЕДНОСТ ВО ПАМЕТЕН ДОМ СО ПРИМЕНА НА АЛГОРИТМИ ОД МАШИНСКО УЧЕЊЕ
	Irina Senchuk, Ana Cholakoska and Danijela Efnusheva
ETAI 2-2	АНАЛИЗА НА МРЕЖНА БЕЗБЕДНОСТ СО ПРИМЕНА НА АЛГОРИТМИ ОД МАШИНСКО УЧЕЊЕ
	Martina Shushlevska, Ana Cholakoska and Danijela Efnusheva
ETAI 2-3	NUMERICAL SOLUTION OF LAPLACE DIFFERENTIAL EQUATION USING THE FINITE DIFFERENCE METHOD
	Bojana Petrovska, Daniela Janeva, Emilija Tasheva and Andrijana Kuhar
ETAI 2-4	MODELING POPULATION DYNAMICS AND ECONOMIC GROWTH AS COMPETING SPECIES FOR NORT MACEDONIA
	Stefan Boshkovski and Sanja Atanasova
ETAI 2-5	PERFORMANCE OF GRADIENT ALGORITHMS FOR SOLVING LEAST SQUARES PROBLEM
	Naum Dimitrieski, Katerina Hadzi-Velkova Saneva and Zoran Hadzi-Velkov

SESSION - 3: CONTROL SYSTEMS AND AUTOMATION

13:30 – 15:00

Co-Chairs: Mile Stankovski, Georgi Dimirovski

ETAI 3-1	MULTI-OBJECTIVE OPTIMIZATION BASED FRACTIONAL ORDER PID CONTROLLER DESIGN
	Erhan Yumuk, Eda Budak, Müjde Güzelkaya and İbrahim Eksin
ETAI 3-2	FRACTIONAL INTEGRATING INTEGER ORDER PI CONTROLLER DESIGN FOR THE FIRST INTEGER ORDER PLUS TIME DELAY SYSTEM
	Erhan Yumuk, Müjde Güzelkaya and İbrahim Eksin
ETAI 3-3	FUZZY LOGIC BASED MAXIMUM POWER POINT TRACKING FOR PHOTOVOLTAIC SYSTEMS
	Zeynep Bala Duranay and Hanifi Guldemir
ETAI 3-4	FUZZY-LOGIC OUTPUT-TRACKING CONTROL FOR UNCERTAIN TIME-DELAY DYNAMICAL PROCESSES: EXPLORING TAKAGI-SUGENO FUZZY MODELS
	Yuanwei Jing, Janusz Kacprzyk, Imre J Rudas and Georgi Dimirovski
ETAI 3-5	DISCRETE-TIME UNSCENTED KALMAN FILTERS WITH OPERATING OF UNCERTAINTIES: STOCHASTIC STABILITY ANALYSIS
	Yuanwei Jing, Jiahe Xu, Peng Shi and Georgi Dimirovski
ETAI 3-6	COMPLEX MULTI-NETWORKS WITH FAULTY INTER-NETWORK CONNECTIONS: SYNCHRONIZATION VIA NOVEL PINNING-NODE CONTROL
	Yuanwei Jing, Guanrong Chen, Peng Shi and Georgi Dimirovski

SESSION - 4: E-HEALTH

13:30 – 15:00

Co-Chairs: Hristijan Gjoreski, Daniel Denkovski

ETAI 4-1	INSIEME: A UNIFYING ELECTRONIC AND MOBILE HEALTH PLATFORM
	Primoz Kocuvan, Erik Dovgan, Tine Kolenik and Matjaž Gams
ETAI 4-2	A SYSTEM FOR AUTOMATIC DETECTION OF MAJOR DEPRESSIVE DISORDER BASED ON BRAIN ACTIVITY
	Daniela Janeva, Silvana Markovska-Simoska and Branislav Gerazov
ETAI 4-3	PREDICTING TRENDS AND ANOMALIES IN DAILY ACTIVITIES
	Vito Janko and Mitja Luštrek
ETAI 4-4	FINDING EFFICIENT INTERVENTION PLANS AGAINST COVID-19
	Nina Reščič, Vito Janko, David Susič, Carlo De Masi, Aljoša Vodopija, Matej Marinko, Tea Tušar, Erik Dovgan, Anton Gradišek, Matej Cigale, Matjaž Gams and Mitja Luštrek
ETAI 4-5	MACHINE LEARNING BASED ANOMALY DETECTION IN AMBIENT ASSISTED LIVING ENVIRONMENTS
	Ana Cholakoska, Valentin Rakovic, Hristijan Gjoreski, Bjarne Pfitzner, Bert Arnrich and Marija Kalendar
ETAI 4-6	INVESTIGATING PRESENCE OF ETHNORACIAL BIAS IN CLINICAL DATA USING MACHINE LEARNING
	Bojana Velichkovska, Hristijan Gjoreski, Daniel Denkovski, Marija Kalendar, Leo Anthnoy Celi and Venet Osmani

SESSION - 5: COMMUNICATION NETWORKS - 5G

**(SUPPORTED BY THE COMMUNICATIONS AND INFORMATION THEORY CHAPTERS OF IEEE
N. MACEDONIA SECTION)**

13:30 – 15:00

Co-Chairs: Tomislav Shuminoski, Pero Latkoski

ETAI 5-1	EVALUATION OF DISTRIBUTED NFV INFRASTRUCTURES FOR EFFICIENT EDGE COMPUTING IN 5G
	Gjorgji Ilievski and Pero Latkoski
ETAI 5-2	PARTICLE SWARM OPTIMIZATION (PSO) BASED RESOURCE ALLOCATION FOR DEVICE TO DEVICE COMMUNICATION FOR 5G NETWORK
	Wisam Hayder Mahdi and Necmi Taspinar
ETAI 5-3	INVESTIGATION ON EFFECT OF THE PILOT REUSE FACTOR VIA INTELLIGENT OPTIMIZATIONS ON ENERGY AND SPECTRAL EFFICIENCIES TRADE-OFF IN MASSIVE MIMO SYSTEMS
	Burak Kürşat Gül and Necmi Taşpınar
ETAI 5-4	COMPUTING ON THE EDGE: A SYSTEM AND TECHNOLOGY OVERVIEW
	Marija Poposka and Zoran Hadzi-Velkov
ETAI 5-5	MOBILE EDGE COMPUTING SERVICES WITH QOS SUPPORT FOR BEYOND 5G NETWORKS – USE CASES
	David Nunev, Tomislav Shuminoski, Bojana Velichkovska and Toni Janevski

FRIDAY, 24. IX. 2021

SESSION - 6: INSTRUMENTATION AND MEASUREMENTS

12:00 – 13:30

Co-Chairs: Mare Srbinovska, Kiril Demerdziev

ETAI 6-1	POSITIONAL VALUE MEASUREMENT FOR A ROOK AND KING VS ROOK CHESS ENDGAME ALGORITHM
	Adrijan Bozinovski and Filemon Jankuloski
ETAI 6-2	OVERVIEW OF SECURITY AND SAFETY SYSTEMS IN THE AUTOMOTIVE INDUSTRY
	Aleksandra Gjorgjievska, Mare Srbinovska and Martin Gjorgjievski
ETAI 6-3	DESIGN AND EVALUATION OF COLLABORATIVE LEARNING PLATFORM WITH INTEGRATED REMOTE LABORATORY ENVIRONMENT
	Zivko Kokolanski, Bodan Velkovski, Tomislav Shuminoski, Dušan Gleich, Andrej Sarjaš, Ana B. Kokolanska, Anita K. Mijovska, Matjaž Šegula, Matic Podobnik, Zlatko Ruščić and Tibor Kratofil
ETAI 6-4	ERROR EVALUATION IN REACTIVE POWER AND ENERGY MEASUREMENTS ADOPTING DIFFERENT POWER THEORIES
	Kiril Demerdziev and Vladimir Dimchev
ETAI 6-5	VIRTUAL REAL TIME POWER QUALITY DISTURBANCE CLASSIFIER BASED ON DISCRETE WAVELET TRANSFORM AND MACHINE LEARNING
	Petar Vidoevski, Dimitar Taskovski and Zivko Kokolanski
ETAI 6-6	IMPROVING THE EFFICIENCY OF GROUNDING SYSTEM ANALYSIS USING GPU PARALLELIZATION
	Bodan Velkovski, Blagoja Markovski, Vladimir Gjorgjievski, Marija Markovska, Leonid Grcev, Stefan Kalabakov and Elena Merdjanovska

SESSION - 7: CLOUD AND IOT TECHNOLOGIES

**(SUPPORTED BY THE COMMUNICATIONS AND INFORMATION THEORY CHAPTERS OF IEEE
N. MACEDONIA SECTION)**

12:00 – 13:30

Co-Chairs: Toni Janevski, Simon Bojadzievski

ETAI 7-1	TECHNOLOGICAL, REGULATORY AND BUSINESS ASPECTS OF LPWAN IMPLEMENTATION IN IOT
	Atanas Godzoski, Toni Janevski and Aleksandar Risteski
ETAI 7-2	EXTENDED PERFORMANCE EVALUATION OF THE TENDERMINT PROTOCOL
	Jovan Karamachoski and Liljana Gavrilovska
ETAI 7-3	ANALYSIS OF SECURITY MECHANISMS OF CONTAINERS IN CLOUD
	Martina Janakieska and Aleksandar Risteski
ETAI 7-4	THE APPLICATION OF THE INTERNET OF THINGS IN EVERYDAY EQUIPMENT AFFECTS TO HAVE A MORE EFFICIENT AND QUALITY LIFE
	Avni Rustemi
ETAI 7-5	F-Cloud Latency Performance Characteristics in an European Cloud infrastructure
	Teodora Kochovska, Marija Kalendar and Simon Bojadzievski

SESSION - 8: ARTIFICIAL INTELLIGENCE IN AUTOMATION

12:00 – 13:30

Co-Chairs: Gorjan Nadzinski, Vesna Latkoska-Ojleska

ETAI 8-1	FORECASTING DYNAMIC TOURISM DEMAND BY ARTIFICIAL NEURAL NETWORKS
	Cvetko Andreeski and Biljana Petrevska
ETAI 8-2	FORECASTING POWER CONSUMPTION FOR RESIDENTIAL SECTOR
	Aleksandra Zlatkova, Aneta Buckovska and Dimitar Taskovski
ETAI 8-3	MODULATION CLASSIFICATION WITH DEEP LEARNING: COMPARISON OF DEEP LEARNING MODELS
	Selçuk Balsüzen and Mesut Kartal
ETAI 8-4	MACHINE LEARNING APPROACH FOR AUTONOMOUS CONTROL OF VERTICAL CEMENT ROLLER MILLS
	Othon Manis, Gorjan Nadzinski and Mile Stankovski
ETAI 8-5	SELECTING AN OPTIMISATION ALGORITHM FOR OPTIMAL ENERGY MANAGEMENT IN GRID-CONNECTED HYBRID MICROGRID WITH STOCHASTIC LOAD
	Natasha Dimishkovska, Atanas Iliev and Borce Postolov
ETAI 8-6	COMPARATIVE ANALYSIS OF DIFFERENT HELIOSTAT FIELD CONTROL ALGORITHMS
	Ivan Andonov, Vesna Ojleska Latkoska and Mile Stankovski

SESSION - 9: COMMUNICATION TECHNOLOGIES

(SUPPORTED BY THE COMMUNICATIONS AND INFORMATION THEORY CHAPTERS OF IEEE

N. MACEDONIA SECTION)

14:00 – 15:30

Co-Chairs: Zoran Hadzi-Velkov, Slavce Pejovski

ETAI 9-1	UNCERTAIN AQM/TCP COMPUTER AND COMMUNICATION NETWORKS: FIXED-TIME CONGESTION TRACKING CONTROL USING GAUSSIAN FUZZY-LOGIC EMULATOR
	Jindong Shen, Yuanwei Jing, Janusz Kacprzyk, Georgi M. Dimirovski
ETAI 9-2	WIRELESS POWERED ALOHA NETWORKS WITH FIXED USER RATES AND UAV-MOUNTED BASE STATIONS
	Slavche Pejovski and Zoran Hadzi-Velkov
ETAI 9-3	PERFORMANCE INVESTIGATION OF BIDIRECTIONAL OPTICAL IM/DD OFDM WDM-PON USING RSOA AS A COLORLESS TRANSMITTER
	Mahmoud Alhalabi, Necmi Taşpinar and Fady El-Nahal
ETAI 9-4	DEVELOPMENT AND DEPLOYMENT OF A LORAWAN PERFORMANCE TEST SETUP FOR IOT APPLICATIONS
	Simeon Trendov, Marija Kalendar and Eduard Siemens

SESSION ETAI – 10: ARTIFICIAL INTELLIGENCE IN BIOMEDICINE

(SUPPORTED BY THE COMPUTATIONAL INTELLIGENCE CHAPTER OF IEEE N. MACEDONIA SECTION)

14:00 – 15:30

Co-Chairs: Branislav Gerazov, Andrijana Kuhar

ETAI 10-1	THE REPRESENTATION OF SPOKEN VOWELS IN HIGH GAMMA RANGE OF CORTICAL ACTIVITY
	Daniela Janeva, Andrijana Kuhar, Lidija Ololoska-Gagoska and Branislav Gerazov
ETAI 10-2	SCORPIANO - A SYSTEM FOR AUTOMATIC MUSIC TRANSCRIPTION FOR MONOPHONIC PIANO MUSIC
	Bojan Sofronievski and Branislav Gerazov
ETAI 10-3	FACIAL EMOTION RECOGNITION USING DEEP LEARNING
	Gjorgji Smilevski and Tomislav Kartalov
ETAI 10-4	AUTOMATIC COMPOSITION OF TEXT AND MUSIC FOR A SONG IN MACEDONIAN USING DEEP LEARNING
	Angela Najdoska, Emilija Kotevska, Tamara Markachevikj and Hristijan Gjoreski
ETAI 10-5	MACHINE LEARNING AND DATA SCIENCE AWARENESS AND EXPERIENCE IN VOCATIONAL EDUCATION AND TRAINING FOR HIGH-SCHOOL STUDENTS
	Stefan Zlatinov, Branislav Gerazov, Gorjan Nadzinski and Tomislav Kartalov
ETAI 10-6	TOWARDS A SYSTEM FOR CONVERTING TEXT TO SIGN LANGUAGE SYMBOLS FOR MACEDONIAN
	Stefan Spasovski, Branislav Gerazov, Risto Chavdarov, Viktorija Smilevska, Aneta Crvenkovska, Tomislav Kartalov, Zoran Ivanovski and Toni Bachvarovski

PROGRAM

Day	Time	Virtual room 1	Virtual room 2	Virtual room 3
THURSDAY, 23. IX 2021	09:30-11:00	Session 1 (Circuits and systems) Zoom Link ID: 943 9993 9052 Pass:ETAI_1	Session 2 (Cyber security and Mathematics) Zoom Link ID: 962 3612 0428 Pass:ETAI_2	
	11:00-11:30	Conference Opening Zoom Link ID: 935 5274 2669 Pass:ETAI_OPEN		
	11:30-12:15	Plenary lecture 1 Prof. Peng Shi (Formation Control Design for Multi-agent Systems) Zoom Link ID: 935 5274 2669 Pass:ETAI_OPEN		
	12:15-13:00	Plenary lecture 2 Prof. Matjaz Gams (Is Web Transforming Our Minds and Where is Our Civilisation Going to?) Zoom Link ID: 935 5274 2669 Pass:ETAI_OPEN		
	13:00-13:30	Lunch Break		
	13:30-15:00	Session 3 (Control systems and automation) Zoom Link ID: 990 6823 4264 Pass:ETAI_3	Session 4 (eHealth) Zoom Link ID: 955 0609 0111 Pass:ETAI_4	Session 5 (Communication networks - 5G) Zoom Link ID: 921 5973 7239 Pass:ETAI_5
	15:00-16:30	Round Table 1: e-Heath and Pervasive Technologies: Challenges and Opportunities (moderator Dr. Hristijan Gjoreski) Zoom Link		
FRIDAY, 24. IX 2021	10:00-10:45	Plenary lecture 3 Prof. Janusz Kacprzyk (Human-in-the-loop AI in decision and control systems: the role of linguistic data summaries) Zoom Link ID: 982 1242 8400 Pass:ETAI_PLEN		
	10:45-11:30	Plenary lecture 4 Dr. Tome Eftimov (Modern approaches for Benchmarking in Evolutionary Computation) Zoom Link ID: 982 1242 8400 Pass:ETAI_PLEN		
	11:30-12:00	Coffee Break		
	12:00-13:30	Session 6 (Instrumentation & Measurements) Zoom Link ID: 959 4581 0574 Pass:ETAI_6	Session 7 (Cloud and IoT technologies) Zoom Link ID: 985 2669 6825 Pass:ETAI_7	Session 8 (Artificial intelligence in Automation) Zoom Link ID: 941 5568 8584 Pass:ETAI_8
	13:30-14:00	Lunch Break		
	14:00-15:30	Session 9 (Communication technologies) Zoom Link ID: 979 4445 2721 Pass:ETAI_9	Session 10 (Artificial intelligence in Biomedicine) Zoom Link ID: 963 3489 3306 Pass:ETAI_10	
	15:30-17:00	Round Table 2: Next generation wireless communications - Opportunities and challenges for IoT (moderator Dr. Ljupco Jorgueski) Zoom Link ID: 910 8233 3630 Pass:ETAI_ROUND		
	17:00-17:30	Closing ceremony ETAI 40th anniversary celebration Best paper awards Zoom Link ID: 934 1811 1014 Pass:ETAI_CLOSE		