CEEPUS Summer School
"Advanced communications and Global Impact"

06-15.07.2023, TU-Graz, Austria

In parallel with CONTEL'2023, 12-14 July 2023

Organized by the CEEPUS network BG-1103-07-2223 "Modelling, Simulation and Computer-aided Design in Engineering and Management"

Chairs: Galia Marinova and Erich Leitgeb

Courses:

Galia Marinova (Bulgaria), Modelling IoT for Green Transformations

Vassil Guliashki (Bulgaria), Optimization and AI for IoT for Green Transformation

Blaz Rodic (Slovenia), Agent-based Modelling

Malgorzata Pankowska (Poland), Design Science Research

Corina Gutu (Moldova), Smart energy management and green transformation

Erich Leitgeb (Austria), Optical Communications (including optical wireless)

Edmond Hajrizi (Austria and Kosovo), Smart Small Scale Systems

Krisel Tola (Albania), Tutorial on Innovative e-management of academic network

Ziad Salem (Austria) , Visible light communication, positioning and sensing

Students projects:
Topics for study will be distributed to student's teams in the beginning of the Summer school
A session for presenting students projects will be organized at the end of the Summer school
Students can also prepare a common poster to be presented at ConTEL 2023

Social program: Guided tour in Graz and visit to Zotter Schokoladen Manufaktur

Summaries of course and short bios of teachers (applying for CEEPUS teachers' mobilities)

1. Galia Marinova (Bulgaria), Modelling IoT for Green Transformations

Galia Marinova (Short Bio) Galia Marinova graduated as engineer with Master degree in electronics in 1988 in Technical University-Sofia. She received a Ph.D. degree in 1994 in the Faculty of electronics in TUS. From 2011 she's associate professor in the faculty of telecommunications. She's responsible for research and innovation activities in the department "Technology and management of communication systems". G.Marinova did one year post-doctoral research in CNAM-Paris, France in 1999/2000. She has 10 Ph. D. students – 3 graduated, one is preparing his theses defense and 6 are currently developing her Ph.d. thesis. G. Marinova is author and co-author of more than 100 scientific papers, mainly in the area of computer-aided design in electronics and telecommunications. She got several awards: Certificate of merit at the World Congress on Engineering in London, UK in 2007, the Best paper award at AICT 2016, May 22 - 26, 2016 - Valencia, Spain and Best paper of a young scientist at ICEST'2019, Sozopol, 28-30 June 2018. She's coordinator of CEEPUS network project: CIII-BG-1103-06-2122. Modelling, Simulation and Computer-aided Design in Engineering and Management. She has experience as coordinator of several Erasmus+ projects with program and partner countries. She's also involved in some other national and international educational and research projects, like DRILA project in cooperation with CentraleSupelec, Rennes, France, IoT-ECO CBHE project, etc.. She is Senior IEEE member, CAS and WIE and vice chair of the Bulgarian IEEE Chapter CAS/SSC.

Course summary

The course will present the basics of IoT and those of green transformation, then the role of IoT for green transformation; different implementations of IoT will be discussed as IoT for air, water, soil quality control. The possibilities to model IoT for green transformation of different areas and infrastructure will be discussed. Digital twins for IoT simulations will be introduced.

2. Vassil Guliashki (Bulgaria), Optimization and AI for IoT for Green Transformation

Vassil Guliashki (Short Bio) Vassil G. Guliashki is currently a Professor at the Institute of Information and Communication Technologies – Bulgarian Academy of Sciences (IICT - BAS), department "Information Processes and Decision Support Systems". He earned his Master of Science degree in "Automation and System-Engineering" at Technical University – Sofia, Bulgaria, in 1988 and his PhD degree in the scientific field: Technical Cybernetics, professional area: "5.2 Electrical engineering, electronics and automation" from the Institute of Information Technologies – BAS in 1994. His thesis work is entitled "Algorithms for Solving Convex Nonlinear Integer Programming Problems" and includes a novel Tabu Search heuristic algorithm for single objective problems and a developed interactive reference direction algorithm for multiple objective problems. In 2009, V. Guliashki accepted an Associate Professor position at the IIT – BAS. Since October 2022 he is a Full Professor at the Institute of Information and Communication Technologies – BAS (IICT – BAS since 2010), scientific field: "4. Natural sciences, mathematics and informatics", professional area: "4.6. Informatics and computer sciences", scientific specialty: "01.01.12 Informatics". The main research areas of

Vassil Guliashki are Discrete Optimization, Meta heuristic strategies, Evolutionary algorithms, Multiple Objective Programming, Decision Support Systems, Linear Discriminant Analysis, Combinatorial optimization. He participates in solving many practical problems by means of single and MCDM approaches. His recent works are in the areas of Single- and Multi-Objective Energy Optimization Problems in Microgrids, algorithms for solving Flexible Job Shop Scheduling Problems, algorithms for Portfolio Optimization Applications, IoT Application Problems and others. He is member of International Society on Multiple Criteria Decision Making, International Federation of Automatic Control (IFAC) TC 9.5 Technology, Culture and International Stability (TECIS), Bulgarian Society on Operational Research - a member of IFORS, and Union of Automation and Informatics in Bulgaria. Vassil Guliashki has more than 130 refereed publications in international scientific journals and in proceedings of international conferences, as well as one monograph book. He has participated in more than 30 research and applied projects up to now. Web site: https://www.iict.bas.bg/ipdss/v_guliashki.html

Course summary
The course will present the following topics: Smart cities and artificial intelligence (AI), fundamental shortfalls in mainstream AI system conceptualization and practice; The Green (consolidated) AI Approach for the Flourishing of Humans and the Planet, "Green AI" concept for smart city transformation; Green Sensing, Communications and Computing;
Optimization models and tasks aimed at efficient, sustainable and equitable solutions for desired urban future; Directions for Making AI Greener and Cities Smarter.

3. Blaz Rodic (Slovenia), Agent-based Modelling

Blaž Rodič (Short Bio) Blaž Rodič is an associate professor of Information Studies at the Faculty of Information Sciences in Novo mesto, Slovenia. He obtained a PhD in Social Sciences - Organizational Sciences in 2004 and a BSc in Electrical Engineering in 1996. He has been a visiting scholar at the Waterford Institute of Technology, Ireland and at the University of Houston and has participated as an expert evaluator for the Horizon 2020 programme. He is the author or co-author of 25 papers in recognized scientific journals with over 200 citations in the Scopus and WoS citation databases. He is a reviewer for several scientific journals. His researcher profile can be found at https://scholar.google.com/citations?user=uEw_j8oAAAAJ&hl=en. His research interests include development of decision support systems and multi-method simulation (System Dynamics, Agent Based Modelling, Discrete Event Simulation) models of societal and organizational systems. He is currently the principal investigator in a national project dealing with the modelling of fake news dissemination in social networks, and a researcher in projects dealing with modelling of migration routes in the Balkans and the modelling of platform-based work.

Course summary
The aim of this course is for students to gain basic knowledge of modelling the living world using the concept of "agents" - models of individual living beings, which may be simple on their own, as individuals, but their interaction in a group can lead to interesting, complex phenomena (e.g. a multitude of ordinary ants or bees creates a complex society). Within the course, the students will learn how we can use models to learn about

systems and phenomena, and where we already use or encounter models in our lives, e.g., in computer games. Students will be familiarized with the fundamentals of the simulation modelling research method and the comparison between agent-based modelling (ABM) with alternative and complementary modelling methodologies (system dynamics, discrete event simulation). Main concepts of ABM methodology and the model building process will be presented in more detail, with the focus on the use of agents in modelling of living beings and societies. Finally, students will engage in a hands-on tutorial of using the Anylogic PLE software for interactive agent-based modelling.

4. Malgorzata Pankowska (Poland), Design Science Research

Malgorzata Pankowska (Short Bio)
Full Professor, social science, 2020; Professor of University of Economics, 2010, University of Economics, Katowice, discipline: management science; Doctor Habilitatus, 2009, Department of Information Systems, University of Economics, Katowice; Ph.D. 1988, Department of Econometrics and Statistics, University of Economics, Katowice; M.Sc. 1981, Department of Econometrics and Statistics, University of Economics, Katowice. 1990 - present, University Professor, Department of Informatics, University of Economics, Katowice, Poland (www.ue.katowice.pl); 2010 - present, Director of Department of Informatics, University of Economics, Katowice, Poland, https://www.ue.katowice.pl/pracownicy/wydzial-informatyki-i-komunikacji/katedra-informatyki/malgorzata-pankowska.html; 2020, Expert European Commission, Research Executive Agency, for SMEs sector project evaluations, EX2013D151744; 2017-2020, Expert for the evaluation of projects within EU European Funds Programme, Innovative Economics, Polish Agency of Entrepreneurship Development, Warsaw, Poland; 2009- 2013, Expert for the evaluation of projects within EU European Funds Programme, Agency of Regional Development, Bielsko Biala, Poland; 2008, Expert for research within Delphi Analysis Foresight National Programme Poland 2020

Course Summary
The course is to emphasize the value of Design Science Research (DSR) paradigm deployment in PhD research work. This course provides guidelines for doing design science in information systems and
software engineering research. In design science, researchers are expected to iterate over two activities: designing an artifact and investigating the performance of an artifact in a context. A key feature of the approach of this course is that the object of study is an artifact in a context of practical usage of Information Technology. In this course, the development of artifacts is located in system science. Therefore, the course focuses on DSR concepts, theories and frameworks, and explanation of empirical engineering cycles, i.e., relevance, rigor and design cycles. The course explains usage of various research methods in DSR design cycle. In the course, innovative approach provided by Hevner is confronted with practices and research methods presented by Wieringa. Finally, the pragmatism of DSR is emphasized and its place in the philosophy of science.

5. Corina Gutu (Moldova), Smart energy management and green transformation

Corina Gutu (Short Bio) Corina Gutu-Chetrusca Dr., engineer with degree in Energy Engineering sand Management from Technical University of Moldova (2000). Received a Ph.D. degree in 2010 after the post-graduate study at the Power Institute at National Academy of Science from Moldova. Dr. Guţu-Chetruşca successfully authored several

scientific works in the field of Renewable sources and Energy Efficiency. Over all her scientific achievements are incorporated in over 30 scientific publications. She works as a university lecturer at the Energy Department. The fields of activities are: Energy Management, Project Management, and Energy Efficiency in buildings.

Liaison faculty with international universities (assigned at Faculty of Power and Electrical Engineering to establish a maintain collaboration with International Universities). As a Responsible of Science at the Faculty of Power and Electrical Engineering, she got an experience of conferences and workshops organizing in the field of Energy Efficiency and Energy Management.

Corina Gutu-Chetrusca took part in Training course on Energy Efficiency and Renewable Energies organized by Forte Chance Piemonte – Torino, Italy; Workshop -Strategic Leadership for Internationalization of Higher Education organized by Erasmus office, Alba Iulia Romania; Training: Project management by Ilia Kleiman from Green Invest Company from Germany.

Course summary

The energy complex is a key sector of the economy, which largely determines the opportunities for the development of society in the economic, social, technological and political spheres. In the modern world, energy is the basis for the development of basic technologies that determine the progress of social production. At the same time, energy creates two crucial issues: political, related to the geographical non-uniformity of the location of the main energy resources, at the current stage - fossil fuels, and ecological - today energy consumption is the largest source of anthropogenic greenhouse gas emissions that contributes to global warming, accounting for more than 75% of global emissions. Mitigating the consequences of these problems requires a high-quality management of the branch, globally, macroeconomically and microeconomically.

Energy management is defined as a proactive, organized and systematic coordination of energy procurement, conversion, distribution and use to meet environmental and economic objectives, as a systematic effort to optimize energy efficiency for political and economic specific environment through engineering and management techniques. Pillars of sustainable energy policy are considered energy efficiency and renewable energy. In many countries, energy efficiency is also seen as having a benefit in terms of national security, as it can be used to reduce the level of energy imports from foreign countries.

Renewable energy, also called green energy, spread practically everywhere, also reduces the dependence of countries on energy imports and saves energy from such a negative side as greenhouse gas emissions and other harmful substances.

The general policy regarding the sustainable development of energy is carried out at the macroeconomic level, by interstate organizations and state governments, the practical implementation is carried out at the microeconomic level, by organizations, enterprises, entrepreneurs.

Energy management tools both at the macro-, but especially at the micro-energy level, are the energy balances and the energy audit.

6. Erich Leitgeb (Austria), Optical Communications (including optical wireless)

Erich Leitgeb (Short bio) - Erich Leitgeb was born in 1964 in Fürstenfeld (Styria, Austria) and received his master degree at the University of Technology Graz in 1994. From 1982 to 1984 he attended the military service, including a training to an officer for Communications in the Austrian army, and he is still active as an expert in military communications (current military rank Lieutenant-Colonel). In 1994 he started research work in Optical Communications at the Department of Communications and Wave Propagation (TU Graz). In February 1999 he received his PhD-degree with honours. Since January 2000 he is project leader of international research projects in the field of

optical communications and he established and leads the research group for Optical Communications at TU Graz and joined international projects (like COST 270, the EU project SatNEx and SatNEx 2, COST 291, COST IC0802, IC1101, MP1401, CA15127, CA16220 and currently CA19111) and ESA projects in different functions. End of 2003 he submitted his research work for the Associate Professor. Since 2011, he is Professor for Optical Communications and Wireless Applications at the Institute of Microwave and Photonic Engineering at TU Graz. He is giving lectures in Optical Communications Engineering, Antennas and Wave Propagation and Microwaves.

Erich Leitgeb had research stays at the Institute of Telecommuni¬cations (FER) at the University of Zagreb (Croatia), at the University of Ljubljana and the Jožef Stefan Institute (IJS) in Ljubljana (Slovenia), and later within international projects at Northumbria University (UK), TU Brno and TU Ostrava (Czech. Republic) and TU Poznan (Poland). He gave guest lectures in "Optical Wireless" in the frame of ERASMUS / SOCRATES lecture mobility at University of Patras (2008 and 2009) and at University of Zagreb (2010, 2011, 2012 and 2013). He is a Visiting Professor at the Northumbria University in Newcastle (UK) and he is a Member of IEEE, SPIE (the International Society for Optics and Photonics), OSA (Optical Society of America) and WCA (Wireless Communications Association). Since the EuCAP 2012, he is representative of "Optical Wireless" at EurAAP and since 2011 Austrian delegate of URSI Commission B (Fields and Waves).

Since 2003 he is reviewer for IEEE and SPIE conferences and journals and he acts as member of Technical Committees and Chairpersons on these conferences. Since 2007 he prepared international IEEE conferences (like CSNDSP 2008, ConTEL 2011, NOC 2013, ICTON 2014, ConTEL 2015, CoBCom 2016, CoBCom 2018, ConTEL 2019, CoBCom 2020, CoBCom 2022 and in 2023 ConTEL 2023) as local organizer in Graz.

Erich Leitgeb is author and co-author of 5 book-chapters, around 50 Journal publications, 160 reviewed Conference papers, around 40 Invited Talks and more than 60 international scientific reports. For further information see the TUG-Online system under https://online.tugraz.at/tug_online/webnav.ini or the publications at the PURE https://pure.tugraz.at/admin/workspace.xhtml?uid=6

Course summary

The lecture gives an overview on Optical Communications considering the basics of propagation in Optical Fibres and also the Optical Wireless Communication (OWC) and current research activities at the Institute of Microwave and Photonics Engineering at the Graz University of Technology.

A brief introduction shows the advantages and disadvantages of Optical Communications (including Optical Wireless (Free Space Optics, FSO) in comparison to RF technologies. An overview to the physical/electrical description of the various components, notably emitters (light sources), receivers (light detectors) and the transmission medium and -techniques are given. The transmission medium covers both fibre and free space optics (optical wireless) and is a main part of the theoretical considerations.

The next part describes the main influences and behaviour of fibre optics transmission and Free Space Optics units. The reliability and availability of using FSO technology in the atmosphere, mainly effected by molecular absorption, scattering on small particles and atmospheric turbulences are shown in detail (regarding their physical relation) by the relevant equations and graphs. The importance of high quality fibres for transmission and their functionality is shown. A look into the basics and possible applications (considering the research activities at TU Graz in the Optical Communications field is demonstrated.

In the final part investigations on Free Space Optics are discussed. Detailed fog measurements within international projects and the relevant influence on Free Space Optics are shown. Techniques to overcome the high attenuation of fog for Free Space Optics (Coding and Hybrid networks to increase the overall availability and reliability) are presented and discussed.

7. Edmond Hajrizi (Austria and Kosovo), Smart Small Scale Systems

Edmond Hajrizi (Short bio) Education Background: Mechatronics and Robotics, Computer Science and Information Systems, Management and Business Administration; Doctoral Studies at Vienna University of Technology and Post Doc. Studies at City University London. The main Specialization

areas in Research And Development are Complex Systems Design and Management, Intelligent Systems, Sustainable Development, Quality Management, Project Management, Leadership and Business Management, education and Knowledge Management, Information Systems, Mechatronics Management, Entrepreneurship, and Innovation. Different experiences as an Entrepreneur, Teacher, Researcher, Innovator, Trainer, Consulter/ Adviser / Expert, Assessor, Publisher, and Member of different Professional and Scientific Councils as follow: University teaching experience is like in Vienna University of Technology, Danube University Krems, UBT – University for Business and Technology, University of Prishtina, Warsaw University, University of Tirana and other universities.

He is the Founder, President, and CEO of UBT – University for Business and Technology. IEME – Institute of Enterprise Management and Engineering, Quality Kosova – Kosova Association for Quality Management, Standards, Cerficaon and Confirmation, KA CASE – Kosova Association for Control, Automation and Systems Engineering, KAM – Kosova Association for Management, KAAAF – Kosova Association for Accounting, Auditing and Finance, Kosova Virtual Incubation and Start-Ups Head of Research and Development Institute-UBT, Research Staff Member at Institute of Intelligent Systems, Research Staff Member Institute of Model Building and Simulation, City University London Research Follower, working on SIEMENS Austria, Austrotech, World Bank as Expert for Research and Innovation; Accredited First IPMA Assessor for Project Management (A, B, C, D) according to IPMA – International Association for Project Management; Accredited Examiner and Trainer for Quality according to Quality Austria and European Organization for Quality; Accredited Assessor for Excellence based on EFQM (European Foundation for Quality Management) and ILEP Germany; Member of General Assembly of IFAC, EUROSIM, IPMA, EOQ, AESOP; Team Member of Experts for Bologna Membership Process and Head of Higher Education Reform Experts; National Contact Point for Horizon 2020 ICT and FET; Head of Advisory Board of Kosovo Agency for Statistics; Member of Board Directors of Post and Telecom Kosovo; Leading different Development Projects for Governments, Business, International and Local Organization; Editor of International Journal of Business and Technology, Books and Conference Proceedings; Member in different scientific and professional bodies (SC, TC, RB), Forums, and Associates; Book Author and more than a hundred publications and presentations. Center, UBT Science and Innovation Campus, Kosova Robot Soccer Team, Center of Expertise for Tourism and Hospitality, and Center of Life Sciences and Technology.

Course summary

We are living today in the convergence revolution where interoperability, modularization, sustainability, real-time capability, and responsible innovation are the main frameworks for the design and development of complex smart systems. The innovation-based Ecosystem is a Complex System and is going to consider a system of systems, knowledge of knowledge, and Hub of Hubs. In this lecture, we present Smart Sustainable Innovation Ecosystem which is made from different Sub-Innovation systems (HUBs, Centers, Labs). This system belongs to highly complex systems because policy, structures, environments, and people are in place to form a small-scale city. Small Scales Smart System design and incorporate different environments (subsystems) for resilience, smart, and

sustainable development like: • Future Network Lab • Smart Living Lab • Innovation Ecosystem • Knowledge Ecosystems • Place Based Ecosystems • Business Ecosystems • Digital Innovation Hub • Sensors Hub • 5g Lab / Testbeds • Immersive Technology (Vr/Ar) • Intelligent Connectivity (Ai + 5g + Iot) … •Social Innovation Lab • Incubation and Acceleration • Science and Technology Park • Innovation Campus • Smart City Ecosystem • Sustainability • Data Science • Artificial Intelligence • Cybersecurity And Privacy Different Indicators are monitored to measure the impact of the Smart innovation-based ecosystem and different impacts will be presented.

8. Ziad Salem (Austria) , Visible light communication, positioning and sensing

Dr. Ziad Salem received his Ph.D. from the Intelligent Systems Laboratories, Department of Systems Engineering, Cardiff School of Engineering, Cardiff University, Cardiff, UK in 2002. He also received his BSc from the Department of Industrial Electronics and Automatic Control, Electrical and Electronics Engineering, University of Aleppo, Syria in 1996. Since December 2018, Ziad is Senior Scientist at Joanneum Research (JR), Institute of Surfaces and Photonics Technologies, Smart Connected Lighting research group. He is responsible for the acquisition, management and implementation of projects in the field of smart connected lighting. Ziad was a Postdoctoral Researcher at Karl Franzens University Graz, Department of Biology, Artificial Life Laboratories between December 2013 and September 2018. Between 2004 and 2013, Ziad was Associate Professor at the American University of Nigeria (AUN), Department of Computer Science and at the University of Aleppo, Department of Computer Engineering, Aleppo, Syria. Ziad was Dean of the Faculty of Information Engineering at Al-Shahba Private University, Aleppo, Syria between 2010 and 2012. Ziad was granted a patent with his colleagues at Karl Fernenz University Graz in 2019. Ziad has supervised several graduate and final year undergraduate students. Dr. Salem has over 18 years of experience in teaching and academic research in the Middle East, Africa and Europe. His research interests are machine learning and data mining, optical wireless communications, visible light communications, positioning and sensing, inertial measurement unit, optical receiver, and sensor data fusion.

Course summary

Nowadays, the fast development of the Internet of Things (IoT) and machine-type communication networks have imposed further requirements for higher wireless network capacity. In this regard the research activities into optical wireless communication (OWC) have intensified in the last years. In particular visible light communication (VLC) which combines communication with illumination as a mean of OWC is been regarded as an indoor high-speed and high data-rate promising approach. In addition, the visible light cannot penetrate through walls, which makes it a high secure way of communication. VLC systems have a wide range of applications in homes, offices, aeroplanes, sensitive areas that requires chemical reactions, mines, etc. Indoor positioning is critical for indoor navigation services, especially with the increasing demand for indoor robots, location-based services (LBS), autonomous vehicle, etc. The dominant Global Positioning System (GPS) cannot be directly applied to indoor environments because signal are blocked by the building's exterior wall. Radio frequency based indoor positioning (IP) technologies, such as Bluetooth and Wi-Fi, etc. have some disadvantages in terms of low accuracy, high latency, electromagnetic interference or high hardware cost. In the last years, visible light positioning (VLP) has attracted more and more attention due to high positioning accuracy, low cost and dual functionality of illumination and positioning. Furthermore, also sensing functionalities can be made possible by visible light constitution what is known as visible light sensing (VLS). Applications of VLS are pose detection, occupancy estimation and gesture recognition. VLS exploits the light received at a photosensitive device in order to infer information necessary to perform the mentioned applications. The lecture will cover the following topics:

1- Visible light communications (VLC): What is VLC, motivation, key difference from RF, modulation schemes,

current systems and applications.

2- Visible light positioning (VLP): Basic principles, algorithms, receiver's types, challenges.

3- Visible Light Sensing (VLS): Concept, applications in human sensing and smart spaces

9. **Krisel Tola (Albania), Tutorial on Innovative e-management of academic network**

Krisel Tola (Short bio) - Krisel Tola graduated as a software engineer with a bachelor's degree in Information Technology and a Master's degree in applied informatics in 2012 at "Aleksander Moisiu" University of Durres, Albania. Krisel works as a lecturer at the "Aleksander Moisiu" University of Durres, Albania, and is actually a Ph.D. student in the fourth year at the "Technical University" of Sofia (TUS). In the framework of his doctoral studies, in collaboration with his tutor Dr. Galia Marinova, he has developed IMA-NET application to help facilitate the activity management of academic networks such as summer schools.

Course Summary

The aim of this course is for students to gain a general overview of e-management and its sub-areas, the advantages and disadvantages of these tools, and their impact nowadays. Web application technologies are taking over physically installed software in the daily routine and many companies turned their focus to this approach to perform their management tasks. A list of the most used tools in different e-management subareas will be provided to the students with a focus given to e-management in education or differently. They will be presented with all the features of IMA-NET, how these features are developed and how they interact with each other. Finally, the students will be registered on this platform, will take a survey where they can choose their preferred topic, will learn how to leave feedback for the course he/she followed, and will be equipped with a participation .