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

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 and 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. **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