

CEEPUS Summer School

“Modelling and Simulation for Advanced communications and Global Impact”

02-13.07.2024, University of Maribor, Maribor, Slovenia

In parallel with IEEE Workshop on Remote Sensing



Courses:

Galia Marinova (Bulgaria), Modelling IoT for Green Transformations

Vassil Guliashki (Bulgaria), Optimization and the Green “AI- and IoT-concept” for smart city transformation

Blaz Rodic (Slovenia), Agent-based Modelling

Malgorzata Pankowska (Poland), Ecosystem Architecture Modeling with ArchiMate language and BPMN notation

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

Akos David (Hungary), Information, IT and IoT security

Gabor Aranyi (Hungary), Development of a ransomware resistant file server solution

Erich Leitgeb (Austria), Optical Communications

Adriana Borodzhieva (Bulgaria) Modelling and Simulation of Digital Devices for Telecommunications

Vineta Srebrenkoska (North Macedonia) Full factorial experimental design

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 will prepare a common **poster** to be presented at IEEE Workshop.

Social program: see the web site <https://urbanify2024.feri.um.si/>

Course summaries and short bios of teachers

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 CentraleSupélec, Rennes, France, IoT-ECO CBHE project, etc.. She is Senior IEEE member, CAS , chair of the WIE Affinity group 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 – ports, university campuses, will be discussed. IoT modelling tools will be considered. Digital twins for IoT simulations will be introduced.

2. Vassil Guliashki (Bulgaria), Optimization and the Green “AI- and IoT-concept” for smart city transformation



Vassil Guliashki (Short Bio) Vassil Georgiev Guliashki is presently working as a full professor at the Institute of Information and Communication Technologies – BAS, “Acad. G. Bonchev” Str. Bl. 2, 1113 Sofia, Bulgaria. He has a Master's degree in Engineering (ME) from Technical University - Sofia, Bulgaria. He is Ph.D. since 1994. He received 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". His research interests include Discrete Optimization, Tabu Search Strategies, Genetic Algorithms, Evolutionary algorithms, Multiple Objective Programming, Decision Support Systems, Linear Discriminant Analysis, Distributed Research Systems, Combinatorial optimization methods. He has published more than 140 research papers in scientific conferences and journals, and one monography. 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. He has participated in more than 30 research and applied projects up to now. Web site: https://www.iict.bas.bg/jpdss/v_guliaszki.html

Course summary

The topics of the lectures in the course are Basics of Green Transformation AI- and IoT-concept, Green Transformation and sustainability, Green Transformation and processes, Green Transformation and applications, Green Transformation and Optimization models and Directions for making cities smarter.

The students will obtain information on the architecture, sensors, and technologies connected to IoT/AI and its implementation for the green transformation. They will acquire skills to model and simulate IoT scenarios in infrastructure areas for obtaining ecological goals, and implementing diverse tools. Different applications and possible optimization models will be considered and discussed.

3. Blaž Rodič (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_j8oAAAJ&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), Ecosystem Architecture Modeling with ArchiMate language and BPMN notation



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 EU European Funds Programme, Marie Skłodowska Curie Action, MSCA grant applications' 2008 – 2016, Expert for the evaluation of projects within EU European Funds Programme, Infrastructure and Environment, Information Processing Centre, Warsaw, Poland 2009 – 2015, 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 objectives are: Development of knowledge and capabilities of organizational ecosystem design and multi-level business architecture design; Development of knowledge and competencies of modelling business process, information, software and hardware architecture; Recognition of different ecosystem architecture stakeholders, risks and benefits of ecosystem modelling; Understanding the basic principles of ecosystem modelling; Development of capabilities to align ecosystem modelling with enterprise strategy; Application of enterprise architecture modelling

information technology tools, i.e., open source Archi 5.1 for ArchiMate language, Bizagi Modeler 4.0 for BPMN (Business Process Model & Notation);

The topics of the course are as follows: Theoretical Approaches to Ecosystem Architecture modeling; Modelling roles, business processes and organizational structures; Ecosystem modelling principles and frameworks; Archimate as a language for ecosystem architecture modeling; Business Process Model and Notation (BPMN) as a notation for process modeling; Case studies presentations.



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. Guțu-Chetrușca 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. Dr. Akos David (Hungary), Information, IT and IoT security



Dr. Akos David (Short Bio) Dr. David Akos is currently assistant professor at the Faculty of Information Technology at the University of Pannonia. He is coordinating the professional work of the Network and Infrastructure Unit. Since 2013 he has been the Acting Manager of the Research and Development Center for Cyber Defence (RDCCD) as well. His research interests include networking technologies, information & network security, component-based software engineering, automatic software verification, and model checking methods. Between 2011 and 2015 he was the manager of the Networking Office in charge of operating and developing the ICT infrastructure university-wide.

Course Summary

The emergence of IoT has brought with it many new opportunities, but also a growing attack surface. A further challenge for today's organizations is the need to securely implement many new devices into existing IT infrastructures. This course will equip students with the fundamental knowledge to intelligently discuss and evaluate IoT security at a basic level in a given enterprise environment.

The topics in the course are: The IoT in focus! IoT security challenges and case studies; IoT systems and architectures; IoT systems modelling, (a) model of IoT security, IoT threat modelling; IoT device layer attack surface; Overview of IoT devices, vulnerabilities and attacks on the hardware layer, threats to physical devices; Attack surface of the IoT communication layer; The IoT communication layer, TCP/IP vulnerabilities on IoT networks, IoT communication threats; The IoT application layer attack surface; IoT applications, threat mitigation; Vulnerability and risk analysis in IoT systems; Vulnerability and intrusion detection in IoT systems, risk analysis, IoT security news.

7. Gabor Aranyi (Hungary), Development of a ransomware resistant file server solution

Gabor Aranyi (short bio) Gabor Aranyi is currently assistant professor at the Faculty of Information Technology at the University of Pannonia His research topics are development of a ransomware resistant file server solution and by noting a topical and complex problem. Furthermore, as an experienced penetration tester (OSCP, CEH, OSWP), I could provide useful pieces of advice and practical solutions to the interested participants.

8. 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 Telecommunications (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.



9. Adriana Borodzhieva(Bulgaria) Modelling and Simulation of Digital Devices for Telecommunications

Adriana Borodzhieva (Short Bio) – Adriana Borodzhieva ia currently an Associate Professor
University of Ruse “Angel Kanchev”
Department of Telecommunications

Main activities and responsibilities: Scientific and teaching activity

Taught courses: "Communication Circuits", "Digital Signal Processing", "Reliability and Security of Communication Networks and Systems", "Coding in Telecommunication Systems", "Pulse and Digital Devices", "Pulse and Digital Circuits", "Synthesis and Analysis of Logic Circuits", "Digital Circuits", "Discrete Structures and Modeling", "Teletraffic Design", "Databases", "Multiplex Systems", as well as in English for Erasmus students: "Communication Circuits", "Coding in Telecommunication Systems", "Digital Electronics", "Pulse and Digital Devices", "Digital Signal Processing", "Databases" (for Internet and Mobile Communications), "Discrete Structures and Modeling". She has more than 200 scientific publications, one monograph, 9 articles in scientific journals, 10 textbooks (study aids), 83 scientific papers indexed in Scopus and 60 indexed in Web of Science; Her known publication citations are 370 (in Google Scholar, with self-citations), 30 (in Web of Science, without self-citations), 59 (in Scopus, without self-citations).

Course summary

The course examines the principle of operation of various digital devices used in computer and communication technology (arithmetic circuits and linear block encoders and decoders, Hamming encoders and decoders, convolutional encoders and encryption and decryption modules in stream cipher systems based on linear and non-linear feedback shift registers, A5/1 stream cipher used in GSM cell phones.). Various computer-based tools for their modeling and simulation research are considered, such as MS Excel, Logisim, ISE Project Navigator used for FPGA programming and testing with a laboratory mock-up created at the University of Ruse for the courses "Digital Circuit Engineering", "Pulse and Digital Devices", "Coding in Telecommunication Systems", etc., in the curriculum of electrical specialties at the University of Ruse.

10. Vineta Srebrenkoska (North Macedonia) Full factorial experimental design



Vineta Srebrenkoska (Short Bio) Vineta Srebrenkoska (VS) is employed as a full professor at Faculty of Technology, Goce Delcev University Stip, R. North Macedonia. VS is teaching the courses of Technology of Synthetic Polymers, Fiber Forming Processes, Technical and High Performance Fibers, Polymer Composite Materials and topics of Polymer Characterization Methods. VS has been doing research in the areas of material development and characterization, polymer composite materials, thermal characterization of polymeric materials, polymer synthesis and modification, surface modification of polymers and fibers for more than thirty years. She had many researches in areas of polymer composite materials for ballistic protection and more than fifty years she had been head of the Department for ballistic protection in the company "11 Oktomvri-Eurokompozit" of Prilep,

Macedonia. VS authored and co-authored more than 80 published papers (13 in impact factor-journals), 100 conference papers and 10 technical innovations for ballistic materials (accepted and applied in "11 Oktomvri-Eurokompozit" of Prilep, Macedonia). The last research projects are oriented towards development of environmentally friendly technologies for production of composites - fiber reinforcement plastics (FRP), including newly developed textile preforms based on synthetic/technical or natural fibers which offer potential of recycling and reutilization of technological waste and mechanical characterization of composites. VS was the WB-participant of the ECO-PCCM project (FP6-INCO-CT-2004-509185) and EUREKA E 4548-DE_AMATECH, project-leader/principal investigator of over 20 scientific projects and programs for industrial partners, coordinator for UGD of the TEMPUS project (PROJECT 158989 - TEMPUS-1-2009-1-BE -TEMPUS-JPHES) and MC member of in several COST Actions (CA19124, CA18125, CA19124, CA15202, FP1405, TU1301, TU1207).



Course summary

The course deals with Full factorial experimental design and it will upgrade the theoretical and practical background in the field in the field of planning of experiments in engineering and management. Different scientific topics, especially those connected with engineering and modelling of the processes, polymer composite materials production and their valorization will illustrate the approach. The aim is to give students insight into the production processes of advanced composites and optimization of the process parameters to solve the problems with the varying of the quality of the composite's structures. The students will follow a short description about the production processes of the advanced composites and applying of the mathematical modeling for optimization of the process parameters. After that, the production processes will be demonstrated online, and the students will analyze the different properties of the composite materials and they will prepare optimized mathematical model which the best describes the process. The topics of the course are: Production processes of advanced composite materials – description and choice of one process; Principles and techniques of experimental design and analysis of experiments with checklist for the planning of experiments, covering analysis of variance, inferences for treatment contrasts, regression, and analysis of covariance; Full factorial experimental design with two factors; Full factorial experimental design with three factors; Preparing mathematical model which the best describes the process.