

20TH IFAC CONFERENCE ON TECHNOLOGY, CULTURE AND INTERNATIONAL STABILITY (TECIS'2021)

INTRODUCTION

The 20th International Conference on Technology, Culture and International Stability (TECIS'2021) was held on September 14–17, 2021, in the virtual format at Trapeznikov Institute of Control Sciences, Russian Academy of Sciences (ICS RAS, also referred to as the Institute). TECIS conferences are traditionally held under the auspices of the International Federation of Automatic Control (IFAC). The organizer of the anniversary 20th conference was ICS RAS, together with the National Committee on Automatic Control and IFAC Technical Committee (TC) 9.5. Technology, Culture and International Stability. Also, the conference was supported by IFAC TC 5.4. Large Scale Complex Systems and IFAC TC 9.1. Economic, Business and Financial Systems.

In his opening speech, D.A. Novikov, Director of ICS RAS, welcomed the participants of TECIS'2021. He reminded that the IFAC has been a scientific community in the field of control since 1957. In 1960, the first IFAC Congress was held in Moscow, particularly at the Institute. Nowadays, the IFAC is a worldwide federation of researchers and experts in the theory and practice of control from fifty countries from all continents.¹ The IFAC holds dozens of scientific conferences and symposia annually. Russia's scientific organizations resumed holding conferences under the auspices of the IFAC in 2009. Only five IFAC scientific events were held in the USSR and Russia, and four of them were organized by the Institute.

1. TRADITIONS AND FUNDAMENTAL PRINCIPLES OF TECIS CONFERENCES

TC 9.5 is one of the most important IFAC committees, traditionally dealing with global technological challenges to humanity that affect the technical, social, and political spheres. The forerunner of TC 9.5 was the IFAC Committee on “Supplemental

Ways for Improving International Stability – SWI-IS,” founded in 1983 by H. Chestnut and P. Kopacek.² Its main direction was to study and develop the possibilities of applying control theory tools to improve international stability at the end of the 20th century. As a result, international mechanisms for managing dual-purpose technologies³ were developed and implemented at the beginning of the 21 century.

Accelerating changes lead to new technological challenges with technical, social, and political implications. Consequently, the work of control and management professionals is changing accordingly. Who will conduct research and development in these spheres? According to The 2019 World Economic Forum in Davos, engineers are actively entering politics. As noted in a feature article in *The Guardian*, engineers are going into the core of politics... Is that not a way of adapting to rapid change?

Traditionally, the fundamental principle of SWI-IS and TC 9.5 is *engineering outside the box*. Guided by this principle, TECIS conferences have been held for 25 years to discuss global aspects of technology development and its impact on technical, social, and political trends.

2. PAPERS, SESSIONS, AND DIRECTIONS

Initially, it was supposed to hold seventeen regular TECIS sessions. In addition, groups of researchers from different countries applied for seven invited sessions. The International Programme Committee (IPC) and the National Organizing Committee (NOC) supported six invited sessions for TECIS'2021.

A total of 177 papers were submitted to the conference. Their distribution is illustrated in Fig. 1. Note that 138 papers (78%) were accepted after peer review. The conference was attended by 262 researchers from 25 countries: Russia, Austria,

¹ <https://www.ifac-control.org/about/overview-of-ifac>

² <https://tc.ifac-control.org/9/5>

³ Dual-purpose technologies can be used both for peaceful tasks and the creation of mass destruction weapons.

Bulgaria, Ireland, Colombia, Norway, Slovenia, the USA, and others. The participants represented all continents (Fig. 2). The proceedings of TECIS'2021 were published in *IFAC-PapersOnLine*, 2021, vol. 54, iss. 13, pp. 1–774, by Elsevier.⁴

The TECIS'2021 program included four plenary sessions, a panel discussion, seventeen regular ses-

sions, and six invited sessions initiated by the speakers; see Sections 4 and 5 of this paper.

The main keywords of the conference papers are “intelligent systems and applications,” “modelling and simulation,” “control and automation for improved stability,” “artificial intelligence,” and others (Fig. 3).

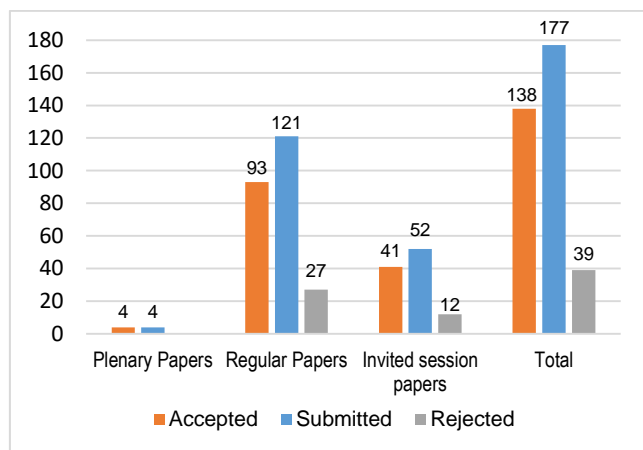


Fig. 1. Distribution of papers submitted to TECIS'2021.

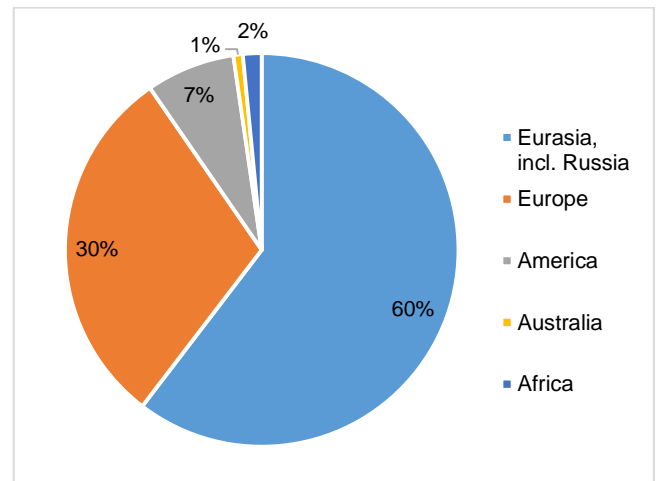


Fig. 2. Distribution of TECIS'2021 participants by continent.

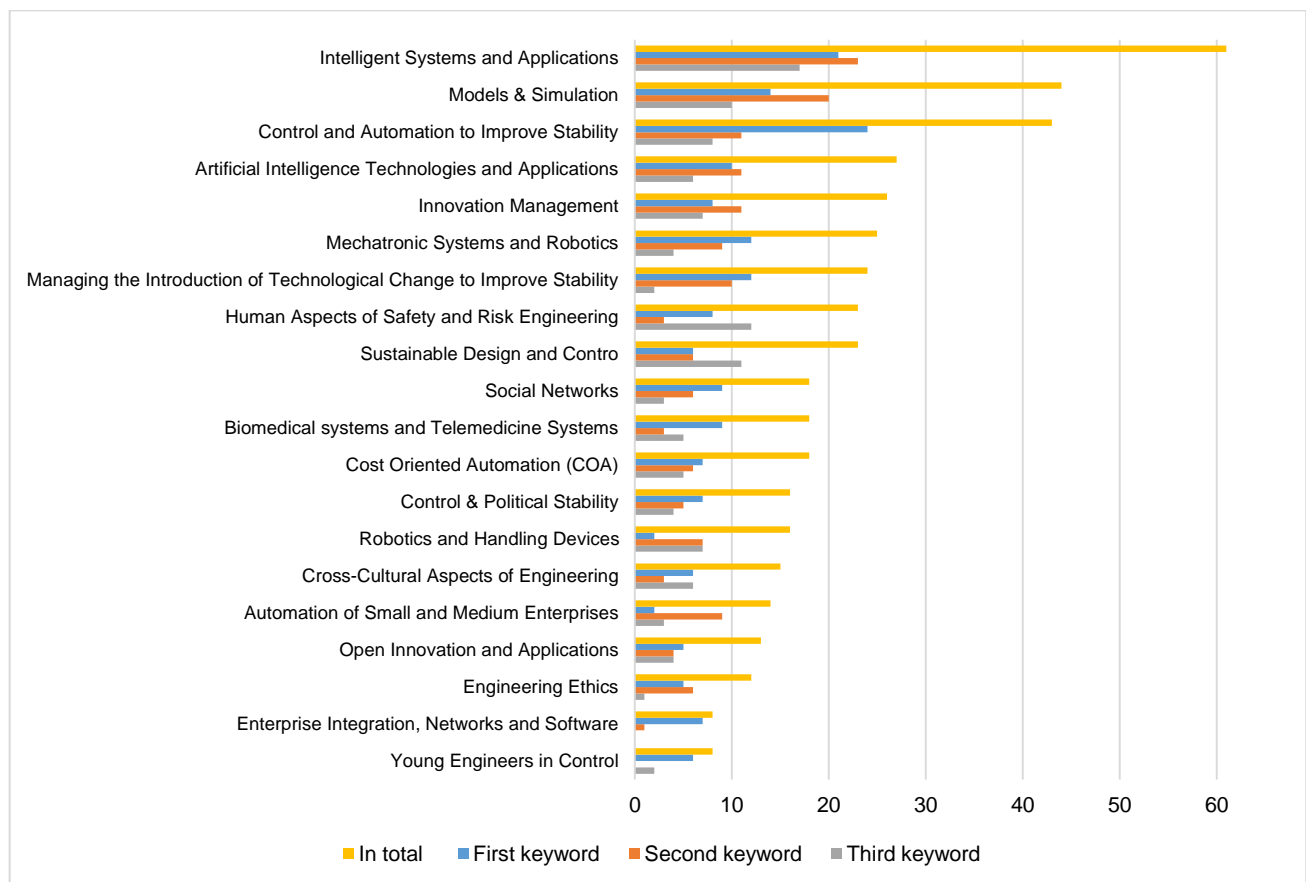


Fig. 3. Keywords in TECIS'2021 papers: distribution by occurrence.

⁴<https://www.sciencedirect.com/journal/ifac-papersonline/vol/54/issue/13>



3. PROGRAM AND MAIN DIRECTIONS OF TECIS'2021

Based on these quantitative data (Fig. 3) and the conceptual analysis of the papers, three main directions of TECIS'2021 can be identified:

- Control and Automation to Improve Stability;
- Intelligent Technologies and Their Applications to Manufacturing, Robotics, Mechatronics, Industrial, Medical, and Other Systems;
- Social Aspects of Automation.

4. PLENARY PAPERS AND PANEL DISCUSSION

The conference sessions were opened with "Selected Development Trends of TECIS," the plenary paper by *P. Kopacek* (TU Wien, Austria) and *M. Doyle-Kent* (Waterford Institute of Technology, Ireland). The authors noted that automation technologies and related information systems are important components of all kinds of objects, systems, and social relations of developed countries. Developing countries mainly need access to these technologies and systems to improve the living standards of their population. In response to these demands of the times, the IFAC is moving towards better management of the human-machine interface to enhance social and international stability.

The authors employed a socio-technical approach to creating Industry 4.0 technologies. Its essence is that new technologies should create favorable conditions for improving workers' level and quality of life. The authors highlighted the development trends of environmentally friendly technologies, mechatronic systems and robotics, smart factories, and products within cost oriented automation (COA). The main aspects of automation using robot systems were also considered. The ability of robots to learn will allow considering the characteristics of the environment and its living beings (inhabitants). In addition, robots have to assess their behavior through a reflexive process and learn their own experience, replicating the natural evolutionary processes of living beings' minds. The development of legislation, standards, and norms that adequately address the requirements of automation and robotics is crucial to the creation of such a technology. With increased technical complexity and competitive pressures, a new generation of managers is faced with the challenges of managing complex objects of an interdisciplinary nature. To manage effectively in a dynamic and often unstructured environment, manag-

ers must understand the technical, organizational, and behavioral aspects of these challenges.

P. Groumpos (The University of Patras, Greece) presented the paper "A Critical Historical and Scientific Overview of All Industrial Revolutions." He showed that the TECIS conferences are focused on the theories and technologies of control and automation to make the world a more stable place for all Earth inhabitants. The traditional vision of the community of scientists united around the TECIS conferences is a civilization in which technologies, systems, and processes serve all of humanity.

N. Jesse (QuinScape GmbH, Germany) presented the paper "Data Strategy and Data Trust – Drivers for Business Development." Insufficient data competence is one of the reasons why companies failed in the escalating process of creative destruction. The author addressed three competence dimensions: data architecture, data preparation and the interchange of data. The competence in these fields is a precondition for a company's survival and the ability to make profitable business decisions.

COVID-19 pandemic has created a difficult situation for the planet. This topic was considered by *F. Aleskerov* (ICS RAS) in the paper "COVID-19 – Spread of Morbidity, Quarantine Measures, Their Efficiency." The following panel discussion, "Covid, Technology and Ethics," was also attended by *M. Hersch* (The University of Glasgow, the UK), *D. Brandt* (Aachen University, Germany), *M. Doyle-Kent* (Waterford Institute of Technology, Ireland), *E. Bula* (The University of Business and Technology, Pristina, Kosovo), and other scientists. The participants discussed the issues of pandemic forecasting and the use of automation and robotics technologies to control the spread of diseases. The discussion showed that the pandemic had raised several ethical questions for individual citizens and society. Due to the pandemic, it was impossible to welcome TECIS'2021 participants from all continents in Moscow. The IFAC Conference App, a web application provided by the IFAC Secretariat, was widely used to create their virtual communication environment.

5. REGULAR AND INVITED SESSION PAPERS

The TECIS'2021 sessions dealt with a wide range of topical scientific and applied issues; see Fig. 3. It seems bold and reckless to describe all the scientific and applied results presented at TECIS'2021. Therefore, let us characterize the papers that generated the most interest among the

participants, judging by expert appraisals and user activity in the IFAC Conference App. These papers are grouped below in 3 subsections corresponding to the TECIS'2021 main directions (Section 3 of this paper). The titles of the corresponding sessions are italicized.

5.1. Control and Automation to Improve Stability

Control and Automation to Improve Stability

is a traditional session of TECIS conferences going back to the SWIIS committee. At TECIS'2021, D. Novikov and A. Enaleev (ICS RAS) presented two papers, "Sustainable Control of Active Systems: Decentralization and Incentive Compatibility" (*jointly*) and "Incentive Mechanisms for the Implementation of Management Automation to Improve Stability" (A. Enaleev only). The papers made a significant contribution to the theory of control in organizational and technical systems. Control mechanisms with optimal planning and incentive procedures for agents were proposed and studied. They ensure decentralized and strategy-proof (non-manipulable) control in systems with a network structure of connections between agents, and therefore, their sustainable operation. The authors introduced an approach to the organization and incentives to improve automation efficiency in man-machine complexes under asymmetric uncertainty in the "human-automated system" loop. Incentive-compatible and strategy-proof mechanisms were developed to solve Principal-agent problems with side payments. These mechanisms decompose the interaction of agents, allowing the Principal to consider incentive and planning problems independently by solving general optimization problems. With the proposed mechanisms, the agents provide reliable data (truth-telling) and fulfill their plans.

In the papers "Mechanism of Citizen Evaluation of Policy Using Machine Self-Learning" and "Machine Learning of Citizens with a Teacher and Political Stability," V. Tsyganov (ICS RAS) considered the stability problem of a social system that depends on the supply of a vital commodity (such as a COVID-19 vaccine). According to the author, political stability is achieved if society approves the authorities' actions to increase the supply of this commodity. However, the supply opportunities depend on random factors unknown to citizens. Consequently, they must learn to recognize and adequately evaluate the authorities' actions under uncertainty. The problem was considered for a so-

ciety model in which citizens are either self-taught or trained by a teacher (media, social networks, etc.). Social stability is guaranteed if every citizen regularly evaluates the activity of a politician positively. Mechanisms were developed to quantify the evaluation of a politician by citizens using artificial intelligence procedures such as machine self-learning and teacher-assisted learning. Sufficient conditions were found to design progressive mechanisms in which the politician is interested in using all available opportunities for the benefit of citizens. The operation of these mechanisms was illustrated by an example of machine learning and evaluation of COVID-19 vaccination policies in Northern Ireland and the entire UK. Any citizen can use the mechanisms developed to evaluate policies using machine learning procedures continuously. For this purpose, he or she needs to install a corresponding application on a smartphone. In this way, artificial intelligence will contribute to social and political stability.

R. Bertelsen (UiT The Arctic University of Norway) addressed practical aspects of international stability management in his paper "Space Science & Technology in the Arctic: Promises of Cooperation and Development amid New Security Challenges." The Arctic houses key infrastructure for nuclear strategic stability, weapon systems, early warning and ballistic missile defense. Arctic high latitudes provide significant advantages to space science and technology (S&T) with the potential for dual-use. Space, which now underpins all societies, may become militarized. Strategic stability safeguards humanity. During the Cold War, there was an effective decision-making process mediated by game theory and modelling. However, new technologies, a far more complex multi-player, multi-nation environment and new space S&T reduce the effectiveness of traditional approaches. The author proposed to address the current intellectual vacuum by creating a clearer understanding of the parameters, players, technologies and their interactions and develop a new and robust theoretical basis that will contribute in the longer term towards appropriate and balanced Arctic governance for achieving strategic stability and space security. New theory, empirical overview, and modelling will provide a new intellectual basis for governance of Arctic space S&T for strategic stability and space security in the new era.

N. Kereselidze (Sokhumi State University, Georgia) presented the paper "Models of Epidemiological Security Management in the Spread of the



SARS-CoV-2 Virus.” The author constructed a mathematical model of the spread of this virus without and with vaccination based on a system of differential equations. Applying solutions to the Cauchy problem, he verified the model on the epidemiological control protocol adopted in Georgia. The national epidemiological safety management problem was posed: maximize an objective function considering the financial consequences of introducing a lockdown in the country and the cost of treating the infected. A computational experiment confirmed the effectiveness of the model’s computer implementation to predict the spread of the SARS-CoV-2 virus and showed that the analytical solution of the national epidemiological security management problem is applicable to justify appropriate decisions.

In the paper “Towards Strategic Reengineering the Global Computer Environment for Control of Sustainable Development of Social Systems,” Yu. Zatuliveter and E. Fishchenko (ICS RAS) considered the trends of global computer environment (GCE) formation as a tool of global digitalization and its impact on social systems. The causes of intra-system imbalances in GCE development and their destructive impact on the sustainability of social systems were identified and analyzed. Ways to eliminate combinatorial barriers of the complexity of network resources integration by eliminating the fundamental causes of GCE heterogeneity were proposed. Also, ways to form a universal algorithmic space of distributed computing in the GCE based on computers with non-microprocessor architecture were developed.

L. Stapleton (Waterford Institute of Technology, Ireland) and F. Janisch (TU Wien, Austria) presented the paper “Digital Currencies and Community Empowerment in Austria: Gesell’s Concept of Effective Demand as a Basis for Local Digital Currencies.” The authors described the digital infrastructure of national cryptocurrencies and their acceptance by Austrian society. As it turned out, local cryptocurrencies have high potential and are more cost-effective than global crypto currencies. An experiment showed that local cryptocurrencies have a favorable effect when exacerbating economic crises caused by lockdowns in the pandemic process.

Z. Avdeeva, S. Kovriga, and H. Grebenuk (ICS RAS) presented the paper “Cognitive Modelling-Driven Time Series Forecasting for Predicting Target Indicators in Non-Stationary Processes.” The approach developed by the authors allows im-

proving the quality of forecasts by building and correcting competing models based on time series with subsequent activation of dominant models through correcting signals. These signals are formed (in monitoring mode) as a result of the analysis of qualitative information (judgments and opinions of the decision-makers and experts) using a fuzzy cognitive map of the situation – a model for representing causal influences between system-forming factors in such processes.

Large-Scale Systems Stability. In the paper “Structural Analysis of Large-Scale Socio-Technical Systems Based on the Concept of Influence,” O. Dranko (ICS RAS), Y. Rykov (Keldysh Institute of Applied Mathematics RAS), and A. Karandeev (Plekhanov Russian University of Economics) represented such a system as a fuzzy cognitive map (influence digraph). A. Pashchenko (ICS RAS) presented the paper “Smart Management for Smart Cities – Synchronized Solutions.” He proposed a management system and an integrated operation center to improve efficiency in the management and operation of a city.

5.2. Intelligent Systems and Applications

The main focus of TECIS’2021 was intellectualization technologies and their applications in robotics, mechatronics, industrial, social, medical, and other systems.

Robotics. F. d’Apollito and C. Sulzbachner (Austrian Institute of Technology) presented the paper “Flight Control of a Multicopter Using Reinforcement Learning.” Machine Learning, and in particular Reinforcement Learning, is a persistent trend in automation and robotics in recent years. Many researchers worldwide are developing intelligent controllers using Reinforcement Learning techniques. The authors presented a proof-of-concept Reinforcement Learning flight controller for a multicopter. The agent was trained in the Airsim simulation environment to achieve stable flight conditions by controlling its roll, pitch, yaw, and throttle. After training, the agent was tested on the same environment to prove its ability to maintain stable flight conditions while following a determined route.

The paper “An Incentive Mechanism for UAVs Crowdsensing Markets, a Negotiation Approach” by L. Jaimes and J. Kahr (Florida Polytechnic University, the USA) and J. Calderon (Bethune Cookman University, the USA) proposed a solution to the problem of sensing coverage of lower regions of the atmosphere where a set of UAVs transverse it

as part of their daily activities. Through sensors, UAVs acquire data while following their regular trajectories. In this model, participants use negotiation to compete and cooperate with each other while participating in data collection campaigns. Using the Virtual Robotics Environment (VRep) and extensive simulations, the authors showed that the algorithm performs well in terms of sensing coverage and participants retention while using a limited budget.

In the paper “COVID-Bot: UV-C Based Autonomous Sanitizing Robotic Platform for COVID-19,” *E. Camacho* (Universidad Santo Tomas, Colombia), *N. Ospina* (Universidad Nacional De Colombia), and *J. Calderon* (Bethune Cookman University, the USA) described the design and implementation of an open-source robotic platform for sanitizing single plant environments such as offices, houses, apartments. The proposed solution—a low-cost and easy-to-replicate robot—disinfects surfaces through type C ultraviolet radiation. According to the tests, the system is adequate to autonomously cover a one-floor apartment, based on the theoretical radiation distance of the used lamps.

N. Unanyan and *A. Belov* (ICS RAS) presented the paper “Anthropomorphic Arm Control System with Remote Gesture Tracking.” The authors theoretically justified and developed an automatic control algorithm for a five-grip robotic arm. Such an arm can be applied in rehabilitation systems, cosmonautics, industry, and aggressive inaccessible environments. The authors described the design of an anthropomorphic robotic arm with an embedded solution for human gesture tracking using a radio-transmitter sensor glove with an experimentally validated feedback rate provided by optimization techniques.

A. Stepanov and *M. Stepanov* (Saratov Technical University, Russia) presented the paper “Self-Organizing Control Systems for Autonomous Educational Robotic Complexes.” To adapt the robot’s functionality to changes in the environment, the authors proposed automatically synthesizing a control law adequate to the current situation. *Artificial neural planning networks* (ANPN) were used for this purpose. The results were applied in a correctional and rehabilitation educational center for schoolchildren with disabilities.

The paper “Design and Construction of a Cost-Oriented Mobile Robot for Domestic Assistance” by *B. Pallares Olivares*, *T. Roza*, *E. Camacho*, and *J. Guarnizo* (Universidad Santo Tomas, Colombia)

was awarded a diploma for the best work of young researchers. The authors described the design of the mechanics, electronics and software necessary for the operation of the robot and carried out tests to ensure its correct operation. The robot is intended for many home applications. It can be easily equipped with multiple actuators for different social tasks (elderly supervision, medicine supply, support of dependent people, etc.).

Intelligent Control for Integrated Enterprises, Safety and Risk Engineering. This session was organized by *R. Meshcheryakov*, *E. Jharko*, *A. Poletykin*, and *A. Iskhakov* (ICS RAS). It was devoted to intelligent data analysis methods in control and information processing and promising information security methods for objects of different nature. Components of the modern world, including industries and enterprises, tend to be more interdependent and form large-scale complex systems. Their control systems rest on the top of a complex and distributed architecture, implementing multiple functions and integrating multiple digital components. Deeper automation of large-scale systems with intelligent support and control elements creates the potential for increased production, lower costs, and improved safety.

A research group led by *F. Paschenko* (ICS RAS) presented several papers on solving applied problems by modern methods of analysis, modeling, management, and decision-making based on machine learning, big data processing, and artificial intelligence. The paper “Convolutional Neural Network for Convolution of Aerial Survey Images” by *Van Trong Nguyen* (Moscow Institute of Physics and Technology (MIPT)), *F. Paschenko* (ICS RAS), *Duc Tip Le* (MIPT), and *Chien Cong Vu* (MIPT) was devoted to artificial intelligence and machine learning in aviation and geoinformation systems. The papers by *F. Paschenko* (ICS RAS), *E. Arakelyan*, *A. Andryushin*, *S. Mezin*, *A. Kosoy*, and *J. Yagupova* (Moscow Power Engineering Institute) were devoted to the problem of optimal control of the CHP operation modes with a complex composition of equipment, including traditional heating units and steam-gas installations. The possibility of applying various mathematical methods of multi-criteria optimization to solve the problem in the presence of many internal and external constraints and conditions in the form of inequalities and balance equations was considered. Also, the possibility of integrating station-level optimization algorithms into the application software of modern program and technical com-



plexes (PTC) to increase the intelligence of the automatic control systems (ACS TP) of thermal power plants was considered.

In the paper “Decision Support Systems for Stable Development of Agricultural SMEs,” V. Akinfiyev and A. Tsvirkun (ICS RAS) considered the problems of agricultural development for small and medium enterprises (SMEs). The features of modeling business processes in agriculture were analyzed. A financial decision support system was proposed to increase sustainability and reduce risks in the development of agricultural SMEs. The software modules are based on TEO-INVEST. This system considers the specifics of business processes in agriculture: duration of the production cycle exceeding the planning period, accounting for complex processing technology, the use of financial leasing for the purchase of agricultural machinery, etc.

E. Vergini and P. Groumpus (The University of Patras, Greece) presented the paper “Advanced State Fuzzy Cognitive Maps Applied on Nearly Zero Energy Building Model.” Experimental application of the maps confirmed the possibility of minimizing the energy consumption of a smart building under weather conditions.

In addition to these papers, the session included substantive discussions of cybersecurity risks generated by the active implementation of machine learning technologies in protection systems. The participants’ experience in building secure cyber-physical systems, designing a risk management system for the transport network of a smart city, and applying fingerprint technologies for personal identification and authentication was considered. Of particular interest were the papers on the problems of applying the visual and cognitive approach in systems engineering.

Socio-Informational Aspects of Managing Complex Systems under Conditions of Uncertainty and Risk. A research group from ICS RAS, led by V. Kulba, presented several papers on strategic planning and management problems solved using the methodology of scenario analysis and modeling. This methodology is intended to study the development processes of complex systems and multidisciplinary and multidimensional problems as well as construct and comprehensively analyze rational development scenarios (within the given objectives) for such systems. Therefore, it provides effective support when preparing, adopting, and implementing managerial decisions of different lev-

els. V. Schultz, V. Kulba, A. Shelkov, L. Bogatyreva presented the paper “Scenario Analysis of Improving the Effectiveness of Cybercrime Investigation Management Problems,” devoted to transforming the law enforcement system to counteract and investigate cybercrime. The current state and trends in the development of cybercrime analysis were described. The creation of a national cybercrime investigative agency was proposed based on the results of multigraph model research. In the paper “Scenario Analysis of the Impact of Rocket and Space Activities on the State of the Environment,” I. Chernov (ICS RAS) introduced a basic graph model and performed a scenario study of the impact of rocket and space activities (RSA) on the ecological burden on the environment in the surrounding regions. Forecast scenarios of socio-economic development of areas with rocket and space technology intensive operation under various RSA development strategies were created. V. Kulba, A. Shelkov, and Z. Avdeeva (ICS RAS) presented the paper “Analysis of Anti-Corruption Management Effectiveness Based on the Scenario Approach (on the Example of the Construction Industry).” The authors presented the results of a scenario study of the corresponding multigraph models and showed the possibility of anti-corruption analysis of management decisions at the stages of their preparation, adoption, and implementation control. The paper “Methods of Socio-Economic Systems Analysis in Order to Diagnose the Problems of Transformation of Law in the Context of Digitalization” by L. Bogatyreva, O. Shepeleva, and V. Gruzman (ICS RAS) proposed using the scenario-based predictive examination of draft laws to anticipate their quality assessment in conditions of uncertainty.

When addressing a wide range of problems to increase organizational control performance, the methodology proposed in these papers can be applied: to build simulation models describing alternative directions of development of the studied complex systems and their components; study problems with fuzzy factors and relationships, considering the set of current and possible changes in the environment; assess the current situation by analyzing the mutual influences of describing its factors; identify positive and negative trends in the development of situations; predict possible ways of development of the emerging situations and their analysis by key objectives; adapt the management system dynamically to the arising changes and en-

able its operation ahead of the anticipated complex problems within tough temporal constraints on strategic, tactical, and operative decision-making.

Biomedical Systems. A. Ivanov, N. Chivarov, K. Hrisafov (Institute of Information and Communication Technologies, Bulgarian Academy of Sciences), I. Budinska (Institute of Informatics, Slovak Academy of Sciences), and S. Chivarov (TU Wien, Austria) presented the paper “Tele-Medical System for Remote Monitoring of Patients with Covid 19 and Other Infectious Diseases.” The authors showed how an effective telemedicine platform could be created by combining free and open-source software products with commercial hardware.

Cost Oriented Automation (COA). V. Borodin, A. Borodin, D. Frantsev, and M. Yudin (Experimental Factory of Scientific Engineering (EZAN), Russia) presented the paper “Adaptive Automated Control Systems for Growing Single Crystals by the Methods of Czochralski, Stepanov (efg) and Kyropoulos Using a Weight Sensor.” The authors described models and methods of economic crystal growth for industrial and scientific needs.

5.3. Social Aspects of Automation

In terms of theory, the social aspect of automation is a complex subject of interdisciplinary research that requires the consistent formalization of subject areas at the intersection of humanities, natural and technical sciences. In this sphere, let us mention the papers “Notes about the Attitude Control Problem” by V. Korepanov (ICS RAS), “Psychological Antecedents and Opportunities for Correcting Negative Attitudes towards COVID-19 Prevention Measures” by V. Latynov and A. Vanin (Institute of Psychology RAS), and “Identification of Integrated Rating Mechanisms as an Approach to Discrete Data Analysis” by V. Sergeev and N. Korgin (ICS RAS).

A research group from Florida Polytechnic and Bethune Cookman Universities (the USA) and Universidad Nacional De Colombia and Universidad Santo Tomas (Colombia), led by J. Calderon, presented several papers on intelligent systems and their applications in the social sphere. For example, the paper “Automation System Based on NLP for Legal Clinic Assistance” presented an algorithm for classifying natural language clinic requests and identifying problems for automated free consultation. As a result, the efficiency of identifying these problems reached 95%.

Development of Integrated Care Systems for Provision of Health and Social Care Services in Ageing Regions. The papers within this session

considered the development and introduction of innovative technologies in the social sphere of ageing regions, where rapid changes in the population’s age structure towards older people (including those with decreasing functional capacity) were observed. These changes shape the demand structure for adapted social infrastructure and health and care services. There is a need to expand the range and quality of services for older people. New services, technologies, and systems, such as *Ambient Assisted Living* and *Ambient Intelligence*, are being developed and implemented. The models and methods used in these systems focus on older people and are integrated into their living environment to support their independence and autonomy.

V. Rogelj (Institute INRISK, Slovenia), D. Bogataj (Institute INRISK and The University of Ljubljana, Slovenia), and S. Temeljotov (Norwegian University of Science and Technology) presented the paper “Digital Transformation of Community Health and Social Services for Ageing Cohorts.” The authors examined the challenges and opportunities for social infrastructure development and financing concerning the situation in Slovenia. They showed how technological innovations (such as home automation and robotics, Internet of Things, and supply chain optimization) and organizational innovations (self-managed communities) create new services, businesses, and enterprises to deliver goods and services to older people, providing new employment opportunities for young people.

J. Peterlin and V. Dimovski (The University of Ljubljana, Slovenia) and M. Bogataj (Institute INRISK, Slovenia) presented the paper “Engineering Technology-Based Social Innovations Accommodating Functional Decline of Older Adults.” As shown by the authors, the development of digital technologies such as cyber-physical systems, big data, machine learning, blockchain, artificial intelligence and Internet-of-Things, presents new opportunities for technology-based social innovations. The paper proposed the integration of social innovation methodology in the development of products or services for older people. The development of social innovations supporting multiple intelligences of older people was reviewed, and examples of good practice were provided to develop a model and propose a future research agenda. Cybersecurity and the ethical dimension within technically based social innovation were highlighted.

S. Colnar and V. Dimovski (The University of Ljubljana, Slovenia) and D. Bogataj (The University of Ljubljana, Slovenia) presented the paper “Review of Telecare in Smart Age-Friendly Cities.” They



considered the digital transformation of social infrastructure as a direction of smart city development to support the autonomy of older people.

CONCLUSIONS

The closing ceremony highlighted the sessions and papers that generated the most interest among the conference participants. Their evaluations were based on user activity in the IFAC Conference App. When awarding young researchers and delivering the closing speeches, *P. Kopacek* (the IPC Chair) and *L. Stapleton* (the IPC Co-Chair) noted the high scientific and practical level of TECIS'2021. *Z. Avdeeva*, an IPC and NOC member, thanked the NOC members, *P. Kopacek*, *L. Stapleton*, and the IFAC Secretariat staff for their assistance in organizing the conference.

Member of the Program and Organizing Committees
Z. K. Avdeeva

Member of the Organizing Committee
S.V. Kovriga

Member of the Program and Organizing Committees
V. V. Tsyganov

Author information

Avdeeva, Zinaida Konstantinovna. Cand. Sci. (Eng.), Trapeznikov Institute of Control Sciences, Russian Academy of Sciences, Moscow, Russia
✉ avdeeva@ipu.ru

Kovriga, Svetlana Vadimovna. Researcher, Trapeznikov Institute of Control Sciences, Russian Academy of Sciences, Moscow, Russia
✉ kovriga@ipu.ru

Tsyganov, Vladimir Viktorovich. Dr. Sci. (Eng.), Trapeznikov Institute of Control Sciences, Russian Academy of Sciences, Moscow, Russia
✉ bbc@ipu.ru

Cite this paper

Avdeeva, Z.K., Kovriga, S.V., Tsyganov, V.V. 20th IFAC Conference on Technology, Culture and International Stability (TECIS'2021). *Control Sciences* **6**, 51–59 (2021).
<http://doi.org/10.25728/cs.2021.6.6>

Original Russian Text © Avdeeva, Z.K., Kovriga, S.V., Tsyganov, V.V. 2021, published in *Problemy Upravleniya*, 2021, no. 6, pp. 60–69.

Translated into English by *Alexander Yu. Mazurov*,
Cand. Sci. (Phys.-Math.),
Trapeznikov Institute of Control Sciences,
Russian Academy of Sciences, Moscow, Russia
✉ alexander.mazurov08@gmail.com