- 2022 -
NEWSLETTER

DEPARTMENT OF INFORMATION ENGINEERING AND PROCESS CONTROL

CELEBRATING 60 YEARS ANNIVERSARY

Dear partners, colleagues, and friends,

As the year nears its end, it is time to reflect on our achievements. The year 2022 represents the year of significant strengthening of our scientific reach. We published several papers in high-end journals like Automatica or Journal of Process Control, our colleagues successfully kicked off a Horizon Europe project, FrontSeat, and our department is a proud holder of 2 major and four minor national scientific grants. We are thrilled to announce that we again strongly increased our network of PhD students.

This year, we fully renovated the electrical engineering laboratory, where students come into contact with state-of-the-art PLC hardware. We celebrated our 60th anniversary with a small conference, where we presented our 10-year progress. We hope that with our passion-driven colleagues, students and esteemed industrial and university partners, we will bring new ideas, new projects, new partnerships that will further strengthen our position on the global scale in the domain of cybernetics, automation and process control.
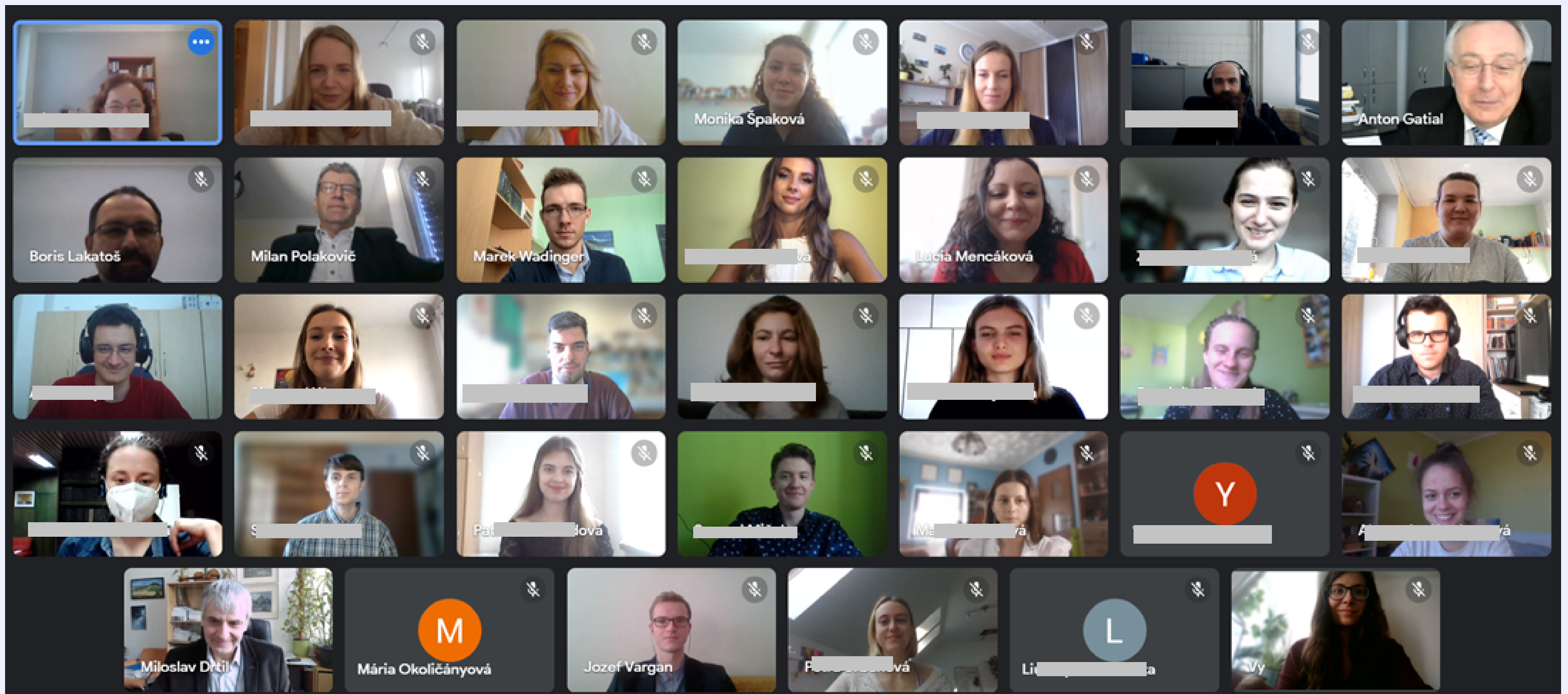
Dr. Martin Klaučo
Head of the department

Yearly Updates

Student Awards - 10
Awards and Honours - 2
Graduate Students - 10
Journal Papers - 80
Conference Papers - 14
International Projects - 3
National Projects - 6
Seminars and Workshops - 7

Student Awards

IAM Students Received Dean's Awards

We are thrilled, as this year, 7 of our students received the Dean's award.

Bc. Jozef Vargan for extraordinary fulfillment of study duties.
Bc. Rastislav Fáber for extraordinary performance of study duties.
Bc. Marek Wadinger for significant extracurricular activities.
Bc. Lucia Mencáková for promoting the faculty in Radikál magazine.
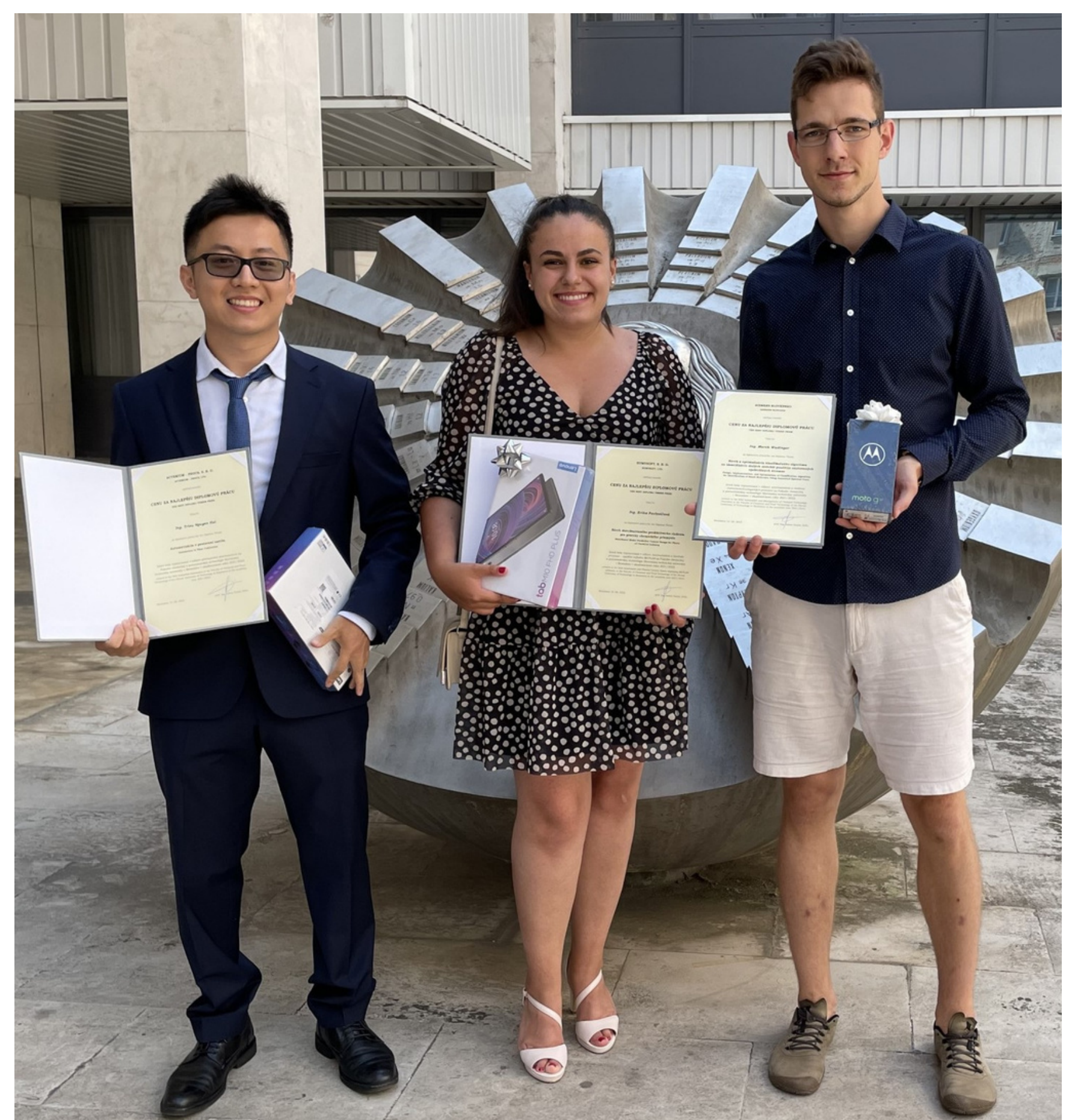**Bc. Monika Špaková** for significant extracurricular activities.
Ing. Lenka Galčíková for significant extracurricular activities and excellent academic results.
Ing. Michaela Horváthová for significant extracurricular activities and excellent academic results.
Congratulations!

IAM Students Awarded for the Best Master Thesis

Students who defended their outstanding master thesis were awarded for their hard work and dedication. Among those few chosen, three IAM students received special awards from our industrial partners. **Marek Wadinger** (Siemens - mobile phone), **Trieu Nguyen Hai** (Actemium - tablet), and **Erika Pavlovičová** (Humusoft - tablet).

IAM Students Defended Their Master Theses and Attended the Graduation Ceremony

On Friday, June 17, 2022, the graduation ceremony of proud young graduates from the FCHPT STU was held. Among the graduates of engineering studies at IAM, the following attended this special event: Ing. Rastislav Fáber, Ing. Lívia Homolová, Ing. Denisa Chowaniecová, Ing. Michal Krištof, Ing. Trieu Hai Nguyen, Ing. Erika Pavlovičová, Ing. Jakub Puk, Ing. Marek Wadinger and Ing. Alexandra Žabková. Congratulations to all and we wish you many more successes.

PhD Students Passed the Dissertation Examination

Ing. Kristína Fedorová defended her work on "Distributed Predictive Control of Microgrids". The supervisor of this work is Prof. Michal Kvasnica.

Ing. Lenka Galčíková defended her work on "Complexity Reduction of Large-Scale Model Predictive Control". The supervisor of this work is Dr. Juraj Oravec.

Ing. Roman Kohút defended his work on "Forecasting Algorithms for Electricity Consumption and Renewable Production". The supervisor of this work is Prof. Michal Kvasnica.

Industrial Partners

IAM cooperates in scientific research, as well as, in supporting talented students with the following companies:

This year, we established a unique collaboration with the Yokogawa company, which lent our department a control station with licensed software. Thanks to this equipment, our students will have the opportunity to experience simulated industrial control within the course Technical means of automation 2. We greatly appreciate the initiative for cooperation on the part of Yokogawa Slovakia s.r.o., which was led by our graduate from 2002 and currently the head of Yokogawa CZ/SK implementation department Ladislav Nagy, and we look forward to further cooperation.

Promotion materials from our partners

Students may periodically win motivational items from HUMUSOFT when they present an earned certificate from the MATLAB-ACADEMY self-paced online courses. As part of the MATLAB - STU Campus-Wide License, all STU students have access to a wide range of professionally prepared online courses. They can take a course in linear algebra, solving differential equations, programming, machine learning and much more.

IAM 60

Learn about Automation

IAM participating at CHEMSHOW at FCHPT STU - Open Day, which took place on Friday, June 24, 2022 in Bratislava. Visitors from many high schools could try interesting practical demonstrations of automation and process control at our IAM stands.
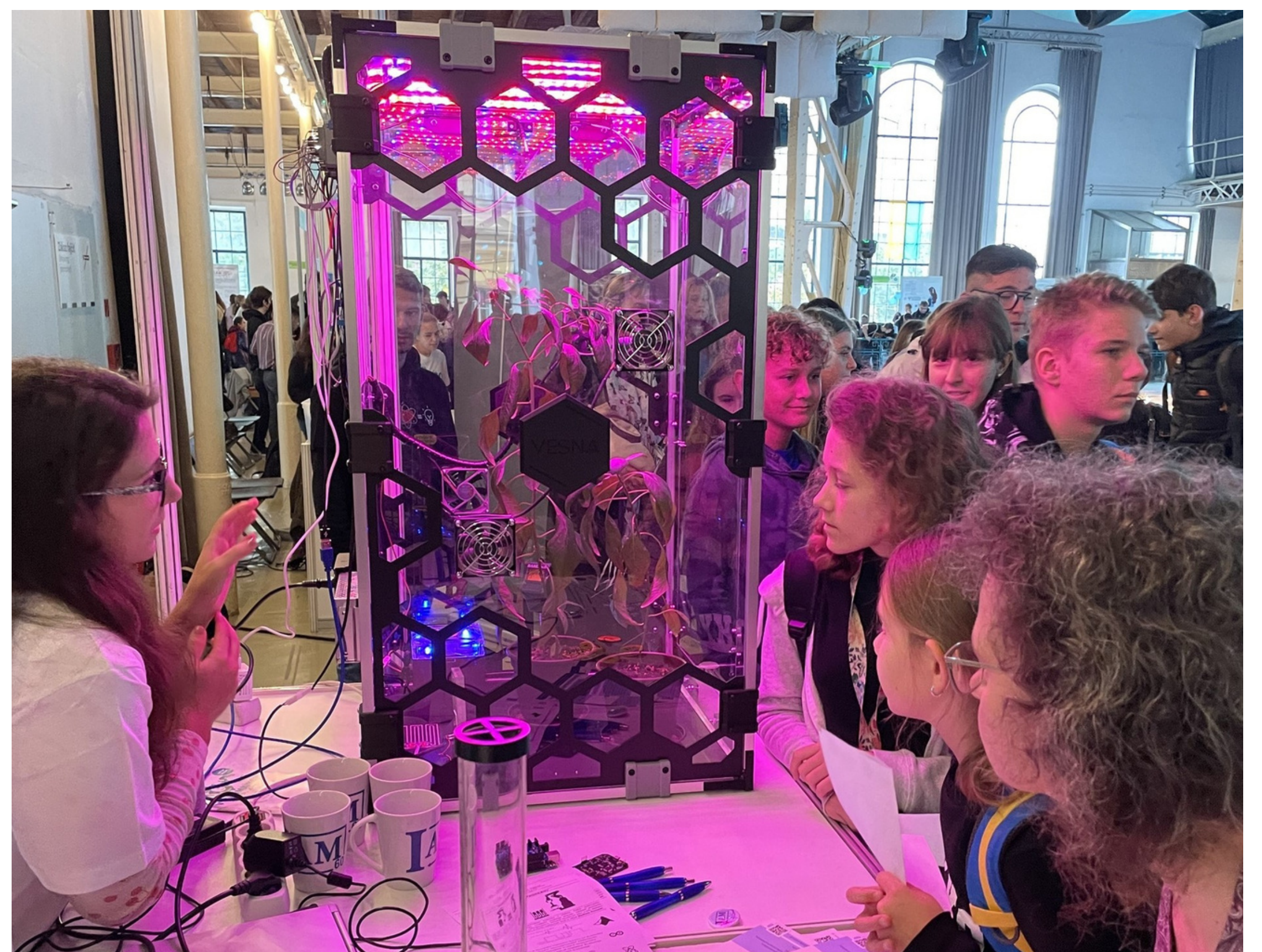

Dr. Richard Valo popularized science and technical education in the field of automation and process control at the event *BEYOND 7 MOUNTAINS* in the village of Liptovský Ján on July 1-4, 2022.

On Friday, September 23, 2022, visitors to the Science Fair can also visit our stand, where they can try out practical demonstrations of automation and process control with use in the chemical industry.

As part of the Summer University of High School Students at STU, high school students also visited us on Friday, September 9, 2022, where they learned more about automation, information engineering, and process control in the chemical and food industry. As part of this event, we presented our smart greenhouse VESNA, which we are developing in cooperation with students as a part of a successful ongoing team project.

Thousands of visitors of the European Researchers Night could try out practical demonstrations of automation and process control at our stand. We are very pleased with the high interest in our stand, where visitors were able to learn the basic principles of control.

IAM 60

Awards and Honours

Rector of STU, **Prof. Oliver Moravčík** awarded **Dr. Monika Bakošová** a prize for extraordinary results in educational activity. Congratulations, as during her entire teaching career, she significantly participated in the development of the faculty, especially in the field of education, as in spreading the good name of the faculty. She also held the positions of vice-dean and vice-rector very diligently, and her pedagogical contribution was and is highly valued throughout her tenure.

We are proud of our PhD. student **Michaela Horváthová**, who won the prestigious Student Personality of Slovakia award (2020/2021). Ing. Michaela Horváthová received a prize for her scientific results in the category: "Electrical engineering, industrial technologies". At the same time, she also received a special award: "JCI-Slovakia Award for emphasis on ecology in her field" We heartily congratulate and wish many more successes.

Seminars and Workshops

On Monday, May 23, 2022, a scientific seminar was held as part of the "Embedded Optimal Control" project supported by the "Alexander von Humboldt" foundation, which we organized in cooperation with colleagues from RUB Bochum University in Germany.

On June 2-4, we organized the "*Workshop on Advanced Technologies for Education*" (WANT-ED) conference. We discussed experiences with modern technologies and teaching methodologies for mathematically oriented subjects, practical demonstrations of the use of teaching materials, summary of tasks and tests, and other necessary aspects of using advanced technologies for teaching purposes in a university environment.

On July 26, a scientific seminar was held at IAM in cooperation with **Prof. Y. Shardt** from TU Ilmenau, Germany. The seminar included lectures on 2 topics:
- Data-driven System Identification for Nonlinear Closed-Loop Continuous Stirred-Tank Reactor (S. Santhakumaran)
- EVOLVE - INFOMAX: An Unsupervised Learning Principle for Nonlinear Dynamic System Evolution (X. Gao)

Seminars and Workshops

On June 23, we organized a seminar "Department of Information Engineering and Process Control - milestones and challenges". The event was organised on the occasion of the 60th anniversary of IAM.

After ten years, we publish the publication "Department of Informatization and Process Management - Milestones and Challenges". On its pages, you can read about significant milestones and achievements in science and pedagogy, where you will find a lot of interesting information not only from the last decade. This publication was issued as a companion publication to the seminar "Department of Informatization and Process Management - Milestones and Challenges".

On August 31, a scientific seminar on the topic: "Differentiable Programming for Modeling and Control of Energy Systems" was held at UIAM. The scientific seminar was led by our successful graduate Ing. Ján Drgoňa, PhD., who works at the Pacific Northwest National Laboratory, USA.
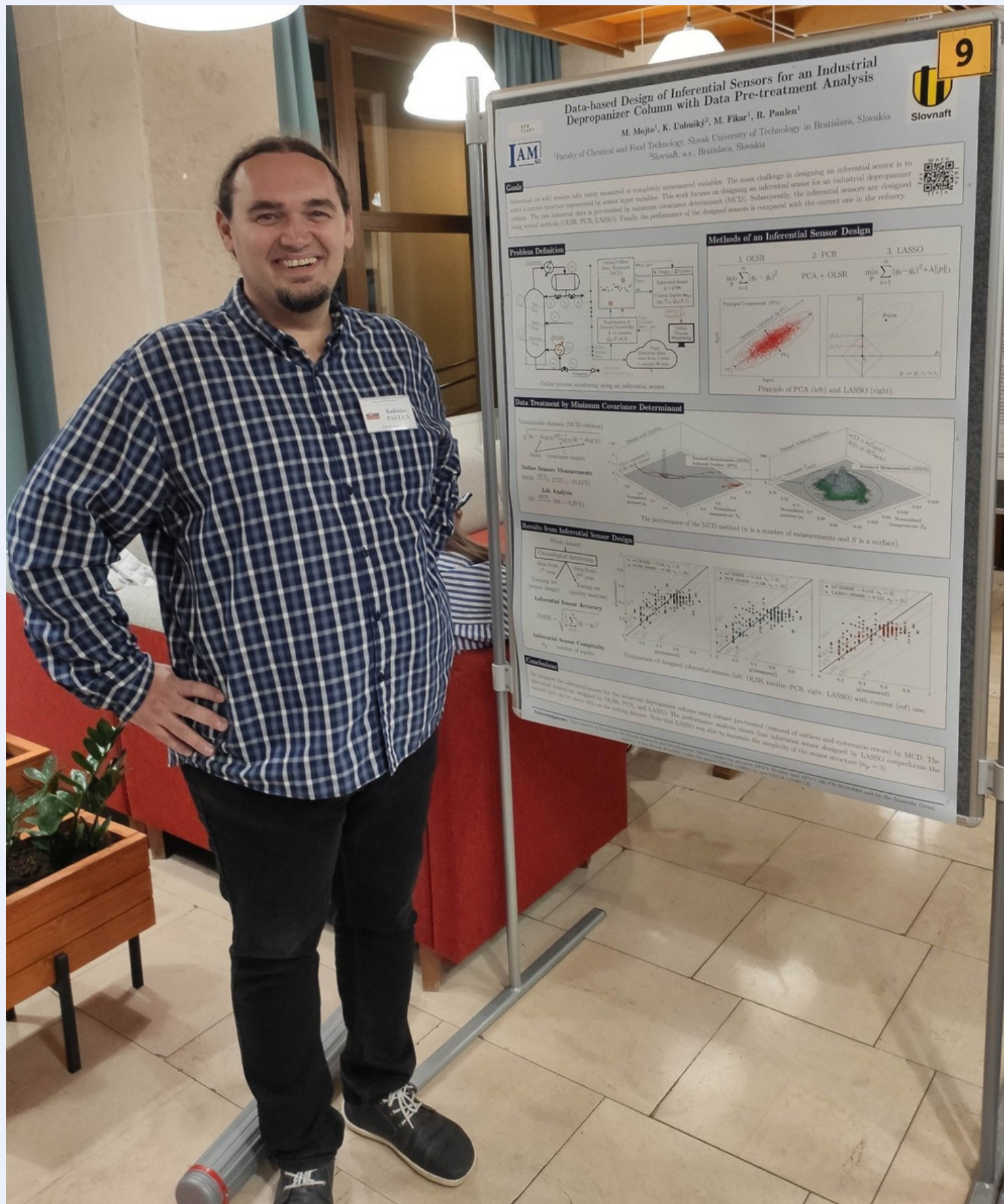

On September 30, together with the management of FCHPT, we organized the second meeting of STU young scientists. As part of the program, cross-sectional information on cooperation between faculties was discussed, and the participants had the opportunity to see the laboratory of chemical processes and the mechatronics laboratory at our institute, the laboratory of environmental analysis at the department of environmental engineering, and also the branch of FABLAB at our faculty.

On October 18, a scientific seminar was held at IAM on the topic: "Modeling and optimization of low-pressure gas-carburizing furnaces". The scientific seminar was led by Fatima Matamoros, PhD student at the Reactions and Chemical Engineering Laboratory, National Center for Scientific Research / Université de Lorraine, Nancy, France. Her supervisor is Prof. Abderrazak M. Latifi.

Conference Papers

On days May 23-26, the 48th international conference of the *Slovak Society of Chemical Engineering* (SSCHE) 2022 and the membrane conference PERMEA 2022 took place in Tatranské Matliary. On behalf of the IAM, **Dr. Radoslav Paulen** actively participated in the conference with a contribution on "Data-based Design of Inferential Sensors for an Industrial Depropanizer Column with Data Pre-treatment Analysis".
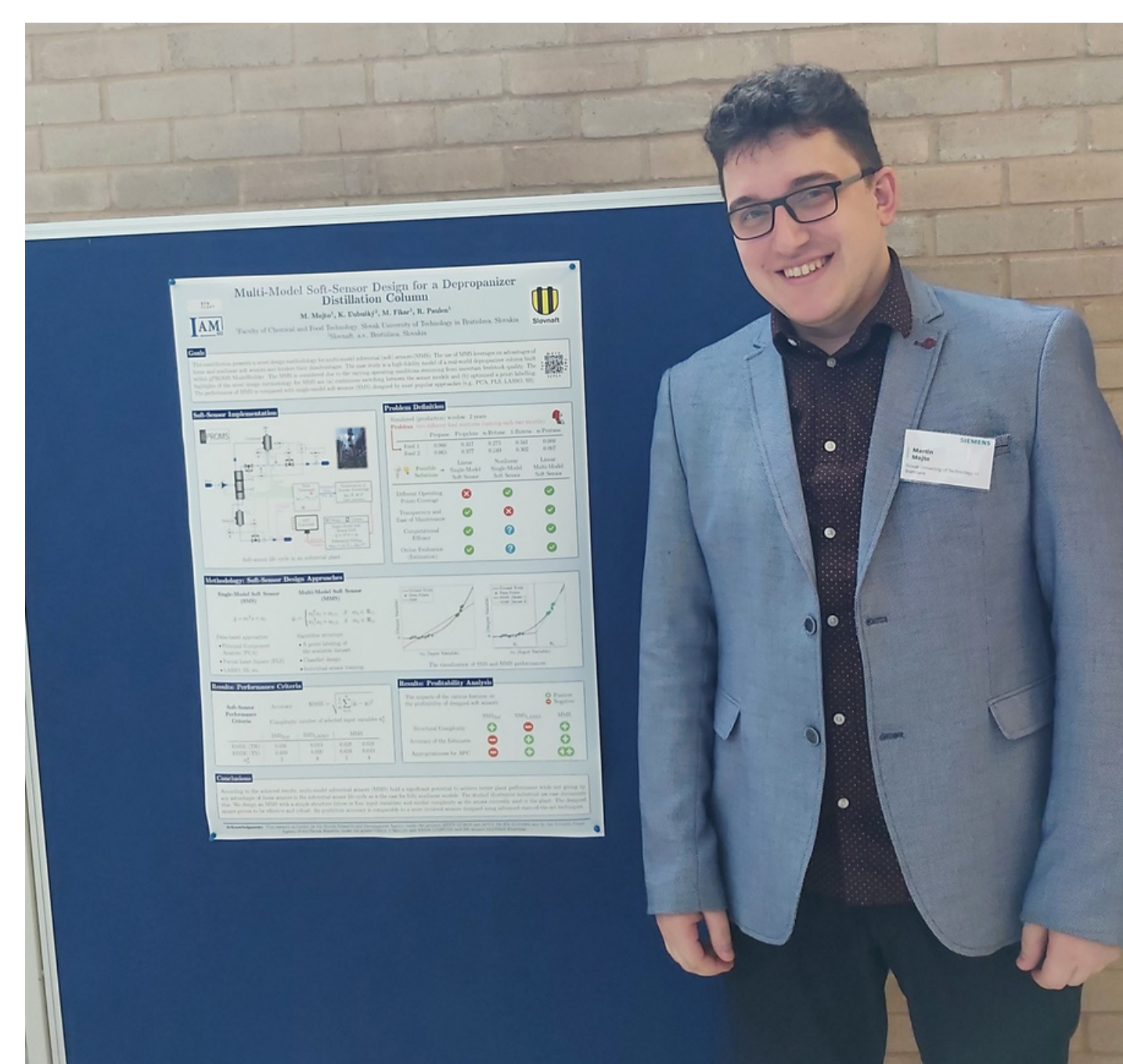

On June 14-17, the 13th *IFAC Symposium on Dynamics and Control of Process Systems, including Biosystems* (DYCOPS) was held in Busan, South Korea. The conference was held as a hybrid event with both in-person and virtual participation. On behalf of IAM, **Dr. Radoslav Paulen** participated in the conference with the contribution on "Robust Design of Optimal Experiments Considering Consecutive Re-Designs". The presented paper is the result of our institute's cooperation with *Technische Universität Dortmund.*

Dr. Martin Klaučo and **Ing. Karol Kiš** participated in the *IFAC Workshop on Control Applications of Optimization* (CAO), which took place on July 18-22, at Centrale Supélec, Paris-Saclay University. Ing. Karol Kiš presented a paper on "Nearly Optimal Tunable MPC Strategies on Embedded PlatformsIng". Dr. Martin Klaučo chaired the section "Optimization-Based Applications".

On September 11-14, young scientists from ÚIAM presented the results of their scientific work at the international IEEE scientific conference *Cybernetics & Informatics* (K&I) in Visegrad, Hungary. **Dr. Martin Klaučo** was the chairman of a plenary session.

Ing. Martin Mojto participated in the *Advanced Process Modeling Forum* (APMF) on the October 18th-19th, conference in London. This conference was organized by SIEMENS Process System Engineering branch (SPSE). Martin presented his poster on "Multi-Model Soft-Sensor Design for a Depropanizer Distillation Column", where he summarized the results of his work in cooperation with Slovnaft, a.s.

Conference Papers

Cybernetics & Informatics (K&I)

K.Fedorová, M.Kvasnica: Predictive Thermal Management of an Industrial Battery Energy Storage System.

M.Furka, K.Kiš, M.Klaučo: Control of a Chemical Reactor with High Precision Encryption Framework.

M.Horváthová, L.Galčíková, J.Oravec: Control Design for a Nonlinear Reactors-Separator Plant.

R.Kohút, M.Kvasnica: Construction of Robust Load Forecasting Models for the Process Industry.

T.Ábelová, **M.Kvasnica:** Modelling of Battery Energy Storage Systems for Predictive Control in Microgrid Applications.

R.Fáber, **R.Valo**, **M.Roman, R.Paulen:** Towards Temperature Monitoring in Long-Term Grain Storage.

International Federation of Automatic Control

A.R.Gottu Mukkula, R.Paulen: Robust Design of Optimal Experiments Considering Consecutive Re-Designs, IFAC DYCOPS.

K.Kiš, P.Bakaráč, M.Klaučo: Nearly Optimal Tunable MPC Strategies on Embedded Platforms, IFAC CAO.

European Symposium on Computer Aided Process Engineering

M.Mojto, K.Ľubušký, M.Fikar, R.Paulen: Support Vector Machine-based Design of Multi-model Inferential Sensors.

A.Vasičkaninová, M.Bakošová, A.Mészáros: Cascade fuzzy control of a tubular chemical reactor.

Other

M.Mojto, K.Ľubušký, M.Fikar, R.Paulen: Data-based Design of Inferential Sensors for an Industrial Depropanizer Column with Data Pre-treatment Analysis, SSCHE & PERMEA.

M.Mojto, K.Ľubušký, M.Fikar, R.Paulen: Multi-Model Soft-Sensor Design for a Depropanizer Distillation Column.

C.E.Valero, R.Paulen: Zonotope Order Reduction in Robust Estimation, IEEE ICCC.

Projects

International Projects

The FrontSeat project **(M.Fikar)**, which received support within Horizon Europe, has been kicked off. The project is aimed at increasing the level of research and academic perspectives of the Slovak University of Technology in Bratislava and starting its evolution into a modern, recognized institution that conducts high-quality research in the field of advanced automatic control, educates top-quality scientists and industrial experts and is successful in active dissemination and using its research and innovation efforts.

To this end, STU has teamed up with two renowned research groups in the field of automatic control from Ruhr-Universität Bochum, Germany (RUB) and Pisa University, Italy (UNIPI).

Visit the official website and subscribe to the project newsletter.

front-seat.eu

STUBA   RUB   UNIPI

International Projects

Marie Sklodowska Curie Fellowship: Advancing Guidelines for RESponsible Machine Learning (RESML) **(M.Kvasnica)**

Mobility of students and university employees between program countries and partner countries (STU - Thailand) **(R.Paulen)**

National Projects

APVV: Data Based Process Control **(M.Fikar)**

APVV: Energy-efficient Safe and Secure Process Control **(M.Kvasnica)**

VEGA: Controller design methods for low-level carbon footprint process automation **(J.Oravec)**

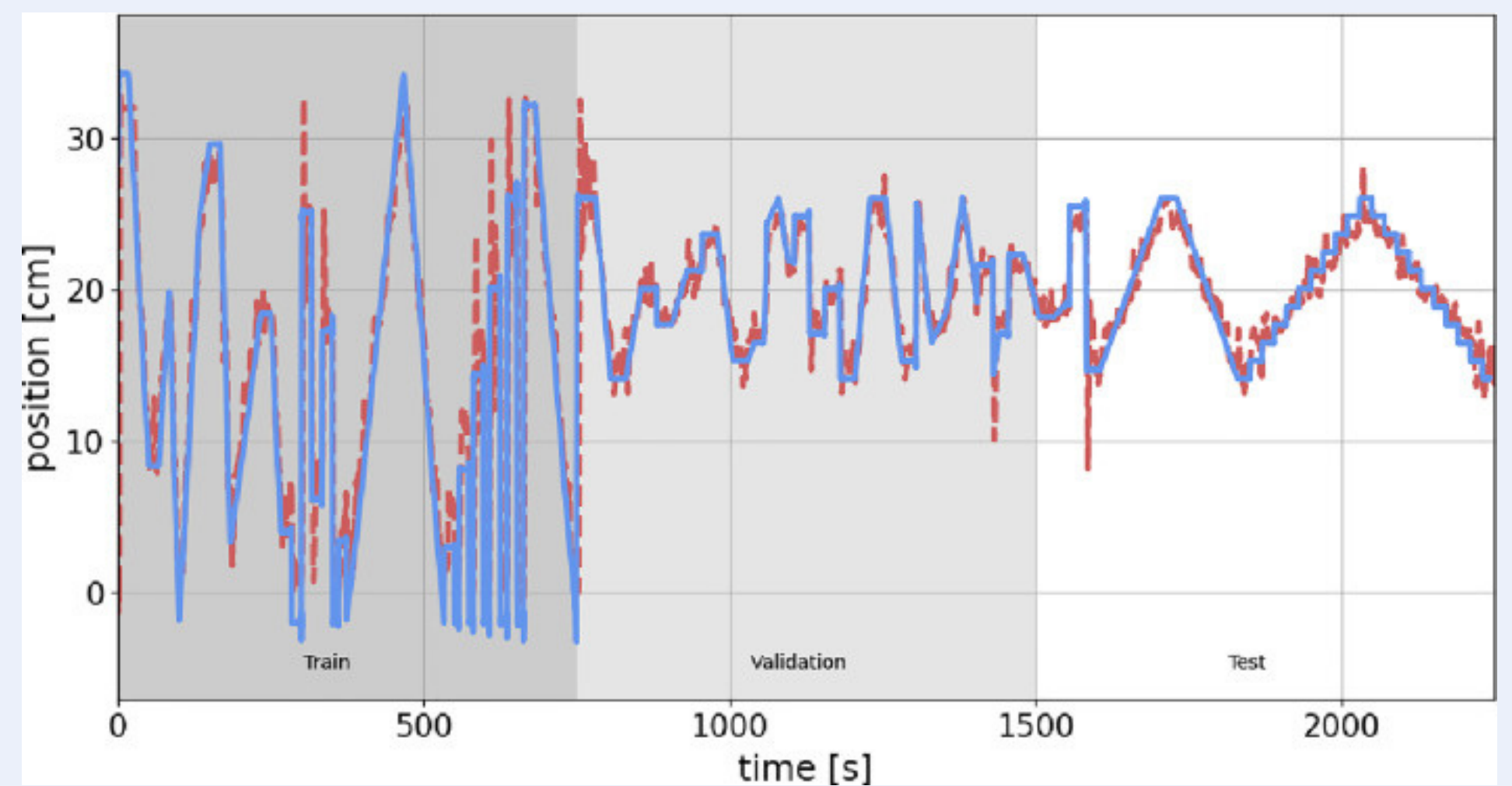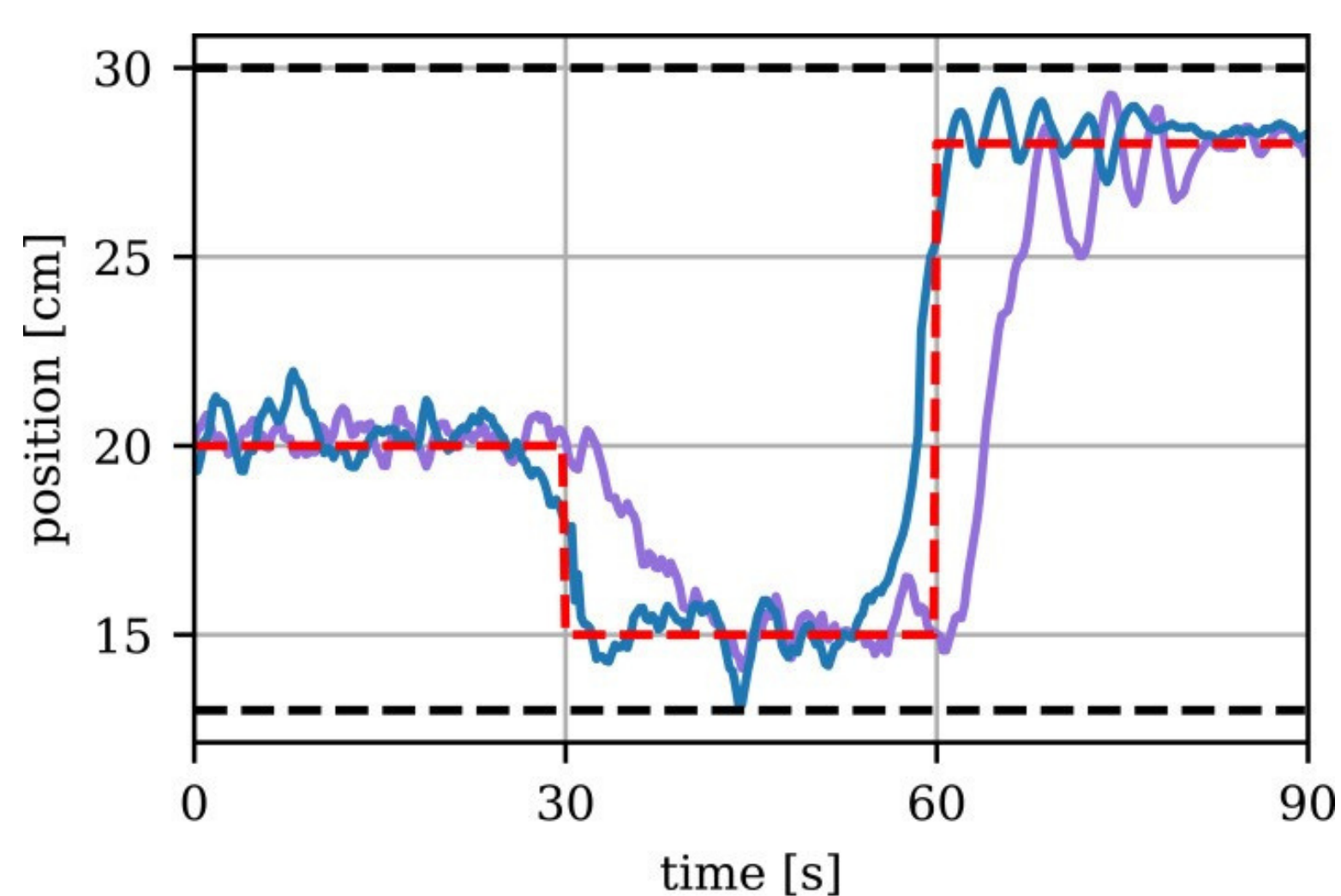VEGA: Efficient control of industrial plants using data **(R.Paulen)**

VEGA: Advanced Control of Energy Intensive Processes with Uncertainties in Chemical, Biochemical and Food Technologies **(M.Klaučo)**

VEGA: On-Line Tunable Explicit Model Predictive Control for Systems with a Fast Dynamics **(M.Kvasnica)**
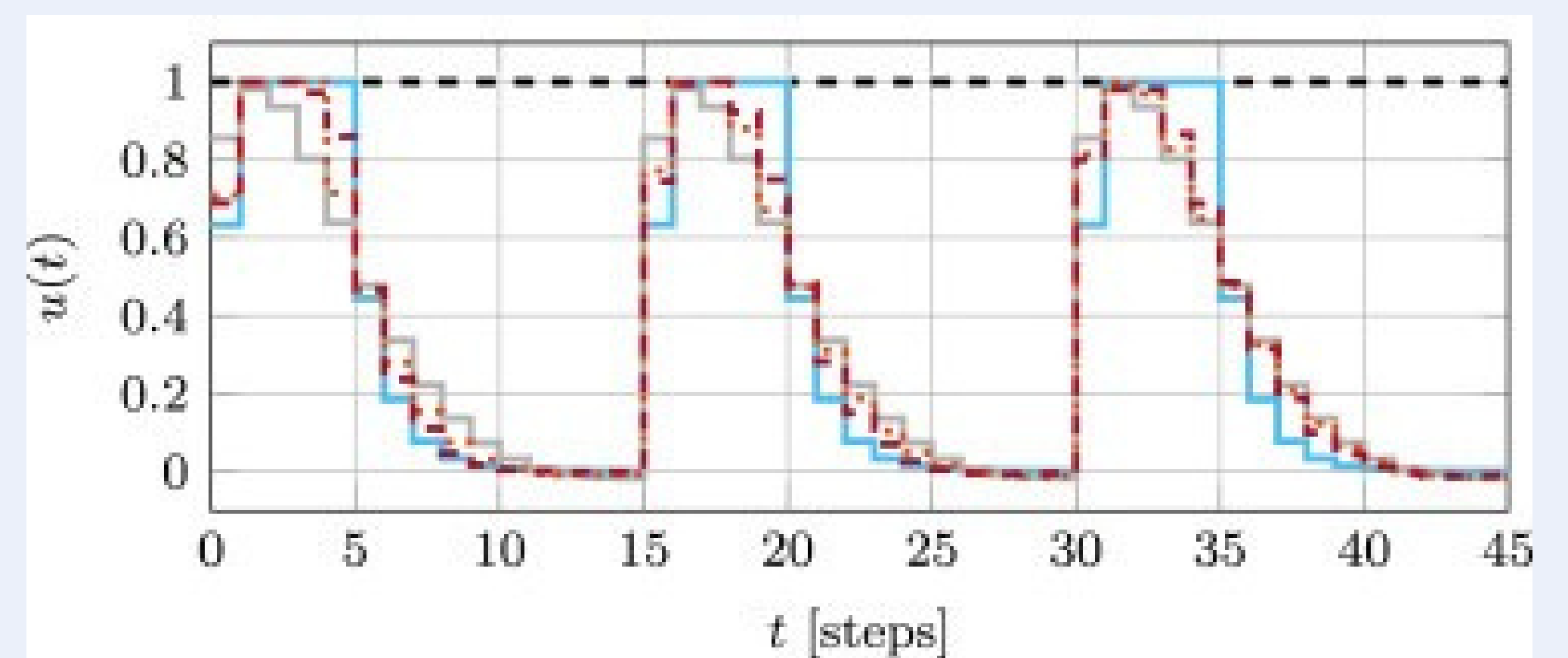
Tatra Bank Foundation: Construction of a Smart Eco Greenhouse VESNA **(J.Oravec)**
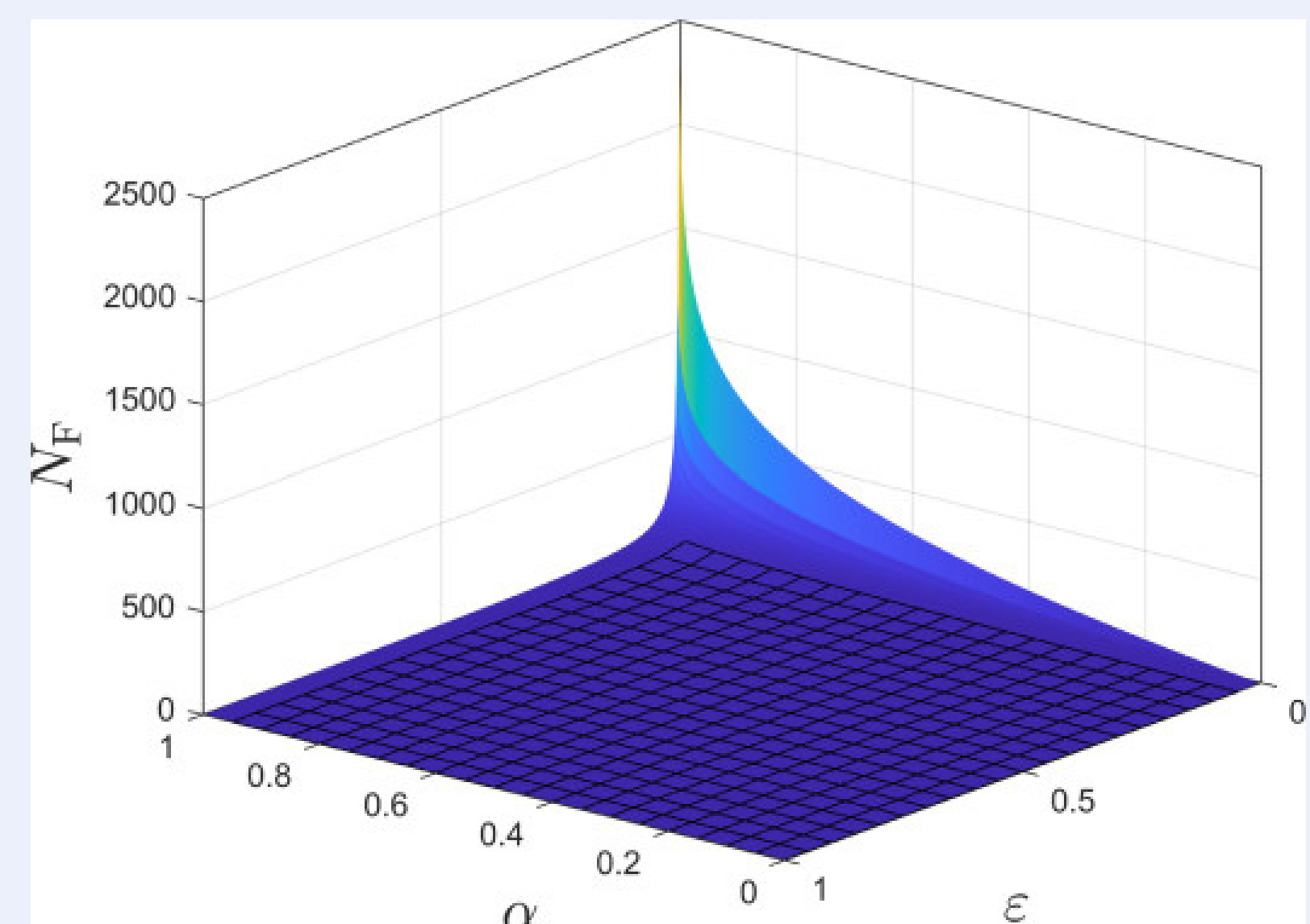
Journal Papers

Differentiable predictive control: Deep learning alternative to explicit model predictive control for unknown nonlinear systems (J.Drgoňa, K.Kiš, A.Tuor, D.Vrabie, and M.Klaučo) - published in a prestigious _Journal of Process Control_.

This paper demonstrates linear scalability of DPC, and its potential for wide adoption in large-scale control systems. Created in cooperation with Pacific Northwest National Laboratory, Richland, WA, USA.

Real-time tunable approximated explicit MPC (J.Oravec, M.Klaučo) - published in a prestigious journal _Automatica_, provides a solution to a problem of producing a suboptimal parametric guarantees on the stability and recursive feasibility to the optimal control problem, where the change of the weighting factor does not warrant the reconstruction of the explicit MPC.

Approximated MPC for embedded hardware: Recursive random shooting approach (P.Bakaráč, M.Horváthová, L.Galčíková, J.Oravec, and M.Bakošová) - published in Computers & Chemical Engineering journal. This paper presents a random-shooting-based approximation of MPC, and its implementation on embedded hardware, where implicit MPC or explicit MPC is limited due to high computational complexity or strict memory requirements.

Note: In collaboration on an EU project SASPRO2 (Prof. M. Kvasnica), **Dr. Amir Mosavi** published 71 other journal papers.

Studying at IAM

From idea into a project

VESNA
vesna.uiam.sk

Learn about the next generation of Smart Eco Greenhouse developed by open-minded young researchers and students. Project VESNA aims for upskilling students and young researchers by solving challenging tasks and reaching innovation objectives. Therefore, the students and young researchers, of both bachelor and master level, are an integral part of the research and development of this Smart Eco Greenhouse VESNA, supported by Tatra Bank Foundation.

Educational lectures from the industry

Educational lectures hosted by people directly from the industry provide our students with useful know-how from people with many years of experience in the field - successful absolvents of IAM study programs.

Improvements not only scientific but also material

This year we fully renovated the electrical engineering laboratory, where students come into contact with state-of-the-art PLC hardware, microprocessors, robotics, and even chemical process units.

Outlook for 2023

PROCESS CONTROL '23

24th International Conference on
PROCESS CONTROL '23

June 6-9, 2023

We are honoured that next year the IAM will organize the event **Process Control '23** and welcome colleagues from other Slovak and Czech automation and cybernetics institutes (www.process-control.sk).

IAM 60

Contact

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CELEBRATING 60 YEARS ANNIVERSARY

STU FCHPT

SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA FACULTY OF CHEMICAL AND FOOD TECHNOLOGY

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Created by: Rastislav Fáber