2021

The Newsletter

DEPARTMENT OF INFORMATION ENGINEERING AND PROCESS CONTROL

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Dear friends,

another whole year has passed by, and we are taking this opportunity to reflect on the accomplishments of our students and colleagues. We are happy to announce that we significantly strengthened the number of our students on the master level. Our students can now benefit from a wholly digitalized library of lectures and exercises.

We passed through the new accreditation of the teaching process with the highest marks within Slovakia. This year we organized two successful international conferences, which highly increased the visibility of our department within world-class science.

I would like to sincerely extend my deepest gratitude to all my colleagues and doctoral students, who daily contribute to our shared goals: excel in teaching and make relevant science.

Dr. Martin Klaučo
Head of the department

Student Awards

IAM Students Were Awarded the Best Master Thesis

The students who defended the outstanding master thesis were awarded at FCHPT, STU in Bratislava. IAM students are **Martin Bachorík**, who received an award from SIEMENS, **Samuel Hrstka**, and **Lucia Míková** received awards from HUMUSOFT.

Best Diploma Thesis in the Field of Automation

ACTEMIUM awarded the best diploma thesis prize to **Diana Dzurková** for her thesis on the topic: "Design and Development of a Human-operated Remote Robotic Manipulator". Diana continues as a PhD student in our study programme.

Winner of the Student Scientific Conference

Monika Špaková received a price from HUMUSOFT for the winner of the student scientific conference.

STU Student of the Year 2020

In the online ceremony, the rector of STU Prof. Miroslav Fikar awarded the outstanding students. Among them, IAM students: **Michaela Horváthová, Lenka Galčíková, Lucia Míková,** and **Michaela Lehotová**.
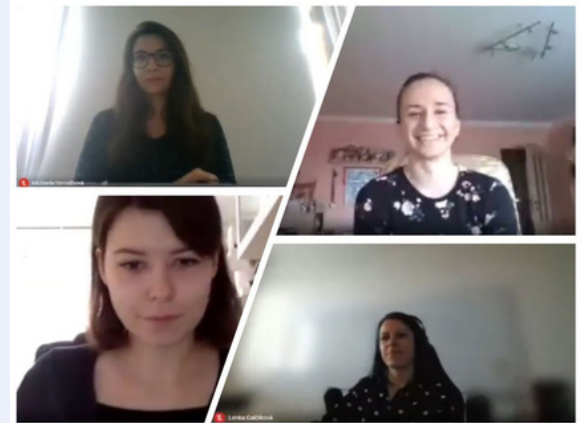
Female Engineers Scholarship Programme

Our student **Katarína Karaffová** reached the finals of the international competition GROWW Female Engineers MOL Programme. PhD student **Lenka Galčíková**, as the last year winner, became the face of the campaign.

Dean Prices for the Best Students

Dean of the FCHPT Prof. Anton Gatial awarded the outstanding students. IAM students among them are:
- **Zuzana Vagaská**
- **Michaela Horváthová**
- **Lucia Míková**
- **Marek Wadinger**

Awards and Honours

Vice-Chairman of the IEEE Czechoslovakia Section

Dr. Martin Klaučo became the Vice-Chairman of the prestigious Czechoslovakia section of IEEE, Control Systems Chapter.

Teacher of the Year 2020

Dean of the FCHPT Prof. Anton Gatial awarded the Teacher of the Year 2020 award on the occasion of Teachers' Day, which was won by **Assoc. Prof. Juraj Oravec** from IAM. In addition to the best ratings in teaching, he is devoted to promotion and science popularization activities.

Industrial Partners

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

MATLAB promotion materials from HUMUSOFT

Students may periodically win motivational items from HUMUSOFT when they present an earned certificate from the MATLAB-ACADEMY self-paced online courses.

Studying at IAM

Laboratory work

At the beginning of the semester last academic year, student exercises were held in the laboratories before switching back to online education.

We Are Prepared

In our studio, we can record videos not only for IAM students, but the whole faculty appreciates our help.

Virtual Education

Because of the pandemic situation, many of us were forced to stay at home, but education continued. IAM students and the bachelor students in the Process Control course got used to online learning.

Laboratory Work

When students are not allowed in the laboratory, measuring instruments are shipped to them.


Intelligent ECO-Greenhouse

Within the Process Control Project, the students designed this smart eco-greenhouse.

Graduate Students

IAM Students Defended Their Master Theses and Attend the Graduation

IAM students: Martin Bachorík, Diana Dzurková, Martin Gömöry, Michal Gubrický, Samuel Hrstka, Michal Mateáš, Lucia Míková, Katarína Karaffová, Juraj Kavor, Darko Križan, Daniel Ondra, Peter Szedlák, Jozef Štofa, and Zuzana Vagaská, successfully defended their master theses and took part in the graduation.
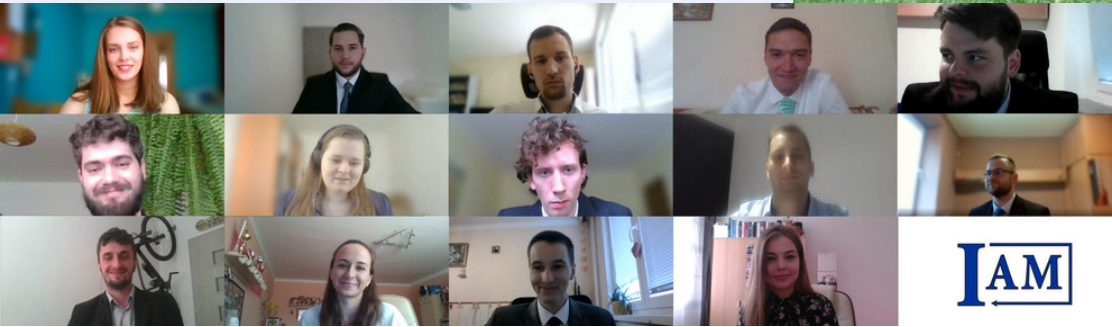
PhD Students Passed the Dissertation Examination and Defend Their Written Work

- **Matúš Furka** – Sensor networks with advanced security and anonymization properties
  - Supervisor: Dr. Martin Klaučo

- **Martin Mojto** – Data-based Design of Inferential Sensors for Petrochemical Industry
  - Supervisor: Assoc. Prof. Radoslav Paulen

- **Karol Kiš** – Machine Learning Assisted Process Control
  - Supervisor: Dr. Martin Klaučo

- **Michaela Horváthová** – Robust Predictive Control Design for Plants in Chemical Industry
 - Supervisor: Assoc. Prof. Juraj Oravec

STU FCHPT
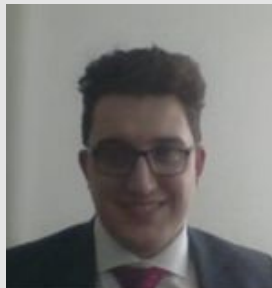
Journal Papers

Yuning Jiang – Juraj Oravec – Boris Houska – Michal Kvasnica: Parallel MPC for Linear Systems With Input Constraints. *IEEE Transactions on Automatic Control*

- Paper on accelerating predictive control through parallel computations, published through IEEEXplore.

Sankaranarayanan Subramanian – Sergio Lucia – Radoslav Paulen – Sebastian Engell: Tube-enhanced multi-stage model predictive control for flexible robust control of constrained linear systems with additive and parametric uncertainties. *International Journal of Robust and Nonlinear Control*

- The paper presents a new method for nonconservative robust control of dynamic systems. The article was created in collaboration of the IAM with Technische Universität Dortmund.
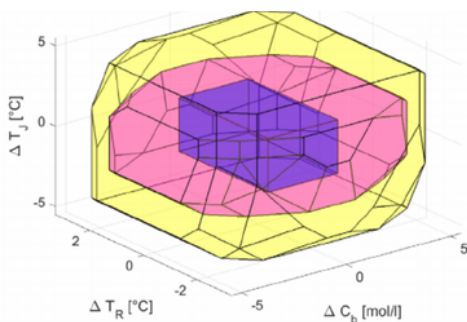
Martin Mojto – Karol Ľubušký – Miroslav Fikar – Radoslav Paulen: Data-based design of inferential sensors for petrochemical industry. *Computers & Chemical Engineering*
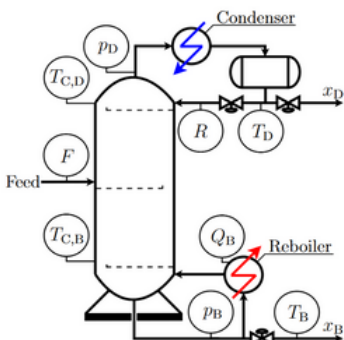
- Journal paper summarizes methods for data processing and design of inferencial sensors for the petrochemical industry. The paper was created in cooperation with our industrial partner SLOVNAFT, a.s.

Ján Drgoňa – Javier Arroyo – Iago Cupeiro Figuero – David Blum - Krzysztof Arendt – Donghun Kim – Enric Perarnau Ollé – Juraj Oravec – Michael Wetter – Draguna L. Vrabie – Lieve Helsen: All you need to know about model predictive control for buildings. *Annual Reviews in Control*

- The paper provides a unified framework for model predictive building control technology with the focus on the real-world applications.
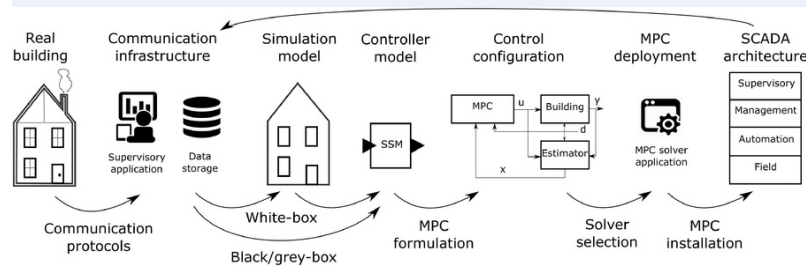
Anwesh Reddy Gottu Mukkula – Michal Mateáš – Miroslav Fikar – Radoslav Paulen: Robust multi-stage model-based design of optimal experiments for nonlinear estimation. *Computers & Chemical Engineering*

- The paper presents a new method for robust design of optimal experiments for nonlinear systems.
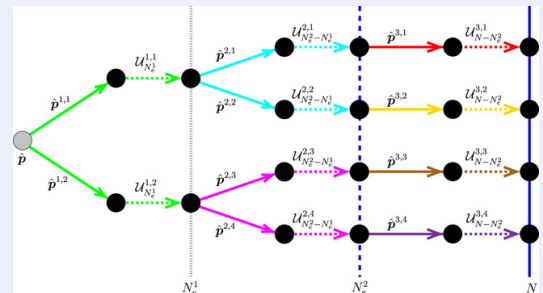
Juraj Oravec – Michaela Horváthová – Monika Bakošová: Multivariable Robust MPC Design for Neutralization Plant: Experimental Analysis. *European Journal of Control*

- The paper provides an extensive experimental analysis of offset-free multivariable robust model predictive control of a neutralisation plant.
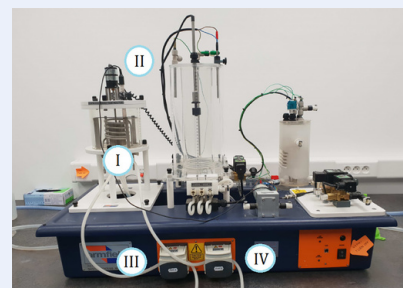
Conference Papers

In Proceedings of the 23rd International Conference on Process Control

- **R. Dyrska – R. Mitze – M. Fikar – M. Kvasnica – M. Mönnigmann:** Skipping Optimization Problems in Nonlinear Model Predictive Control by Exploiting Saturation
- **M. Fikar – M. Furka – M. Horváthová – K. Kiš – M. Mojto:** Dynamic Optimisation Toolbox dynopt 5.0
- **M. Furka – K. Kiš – M. Klaučo – M. Kvasnica:** Usage of Homomorphic Encryption Algorithms in Process Control
- **M. Horváthová – N. Ishihara – J. Oravec – Y. Chida:** Robust Setpoint Tracking of a Linear System with Discrete Actuators
- **K. Kiš – M. Klaučo – M. Kvasnica:** Explicit MPC in the form of Sparse Neural Networks
- **R. Kohút – L. Galčíková – K. Fedorová – T. Ábelová – M. Bakošová – M. Kvasnica:** Hidden Markov Model-based Warm-start of Active Set Method in Model Predictive Control
- **M. Mateáš – R. Paulen:** Optimal Experiments via Sequential and Two-stage Designs
- **M. Mojto – K. Ľubušký – M. Fikar – R. Paulen:** Data Treatment of Industrial Measurements: From Online to Inferential Sensors
- **C. E. Valero – M. Bakošová:** Classic Methodologies in Control of a Yeast Fermentation Bioreactor
- **A. Vasičkaninová – M. Bakošová – A. Mészáros:** Control of Heat Exchangers in Series Using Neural Networks

In 31st European Symposium on Computer Aided Process Engineering

- **M. Mojto – K. Ľubušký – M. Fikar – R. Paulen:** Data-based Industrial Soft-sensor Design via Optimal Subset Selection

In 16th IFAC Symposium on Advanced Control of Chemical Processes ADCHEM

- **P. Valiauga – X. Feng – M. Villanueva – R. Paulen – B. Houska:** Set-membership Estimation using Ellipsoidal Ensembles

In Proceedings of the 7th IFAC Conference on Nonlinear Model Predictive Control

- **K. Fedorová – R. Kohút – M. Kvasnica:** Streamlining Active Set Method in MPC using Cache Memory
- **M. Furka – K. Kiš – P. Bakaráč – M. Klaučo:** Nonlinear MPC Policy for Systems with Data Driven Identification

In IEEE Intelligent Vehicles Symposium

- **D. Efremov – T. Haniš – M. Klaučo:** Haptic Driver Guidance for Lateral Driving Envelope Protection Using Model Predictive Control

Projects

International Projects

- APVV: Full-Authority Vehicle Control Strategy **(M. Klaučo)**
- APVV: Optimal design and control of processes **(R. Paulen)**
- Embedded Optimal Control **(M. Fikar)**
- Mobility of students and university employees between program countries and partner countries **(R. Paulen)**

National Projects

- APVV: Energy-efficient Safe and Secure Process Control **(M. Kvasnica)**
- VEGA: On-Line Tunable Explicit Model Predictive Control for Systems with a Fast Dynamics **(M. Kvasnica)**
- VEGA: Advanced Control of Energy Intensive Processes with Uncertainties in Chemical, Biochemical and Food Technologies **(M. Bakošová)**
- VEGA: Efficient control of industrial plants using data **(R. Paulen)**
- Safe process control focused on energy and cost savings **(M. Horváthová)**
- Research in SMART Monitoring and Disease Prevention Against Coronavirus (SARS-CoV-2) **(M. Klaučo)**
- Complexity reduction of explicit model predictive control of plants in the chemical industry **(L. Galčíková)**
- Design and Implementation of control algorithms for plants in the chemical industry **(M. Horváthová)**

Conferences

In 2021, the IAM organized two international conferences, both in the virtual format.

7th IFAC Conference on Nonlinear Model Predictive Control 2021

Assoc. Prof. Michal Kvasnica and **Dr. Martin Klaučo** organized the 7th IFAC NMPC Conference on July 11-14. The research community on model predictive control met online and presented their current work from both academia and industry.


International Conference on Process Control 2021

On June 1-4, IAM was the organizer of the 23rd International Conference on Process Control. Researchers and experts in control systems from around the world participated in the conference program organized into plenary and keynote lectures, regular sessions, a poster session, and a workshop accompanied by discussions.

Seminars and Workshops

Industrial Guest Lecture by IAM Graduate

Our graduate from 2019 **Daniel Boroš,** who currently works at SIEMENS, delivered a lecture to our students within the course "Identification" in the summer semester on the topic of the workflow from data processing to designing a model predictive controller.
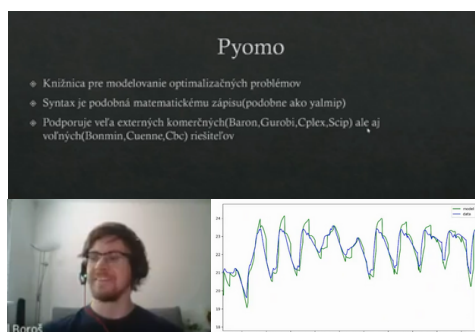

IAM at CDC 2020

At 59th IEEE Conference on Decision and Control in 12/2020, **Michaela Horváthová** presented our research paper: Real-Time Convex-lifting-based Robust Control Using Approximated Control Law. Michaela Horváthová was also a Chairman of the session Robust Control II.

Student Scientific Conference

In November, IAM members organized the annual Student Scientific Conference „Chemistry and Technologies for Life". The Process Control session was held online and the best project pre-sentations were awarded.
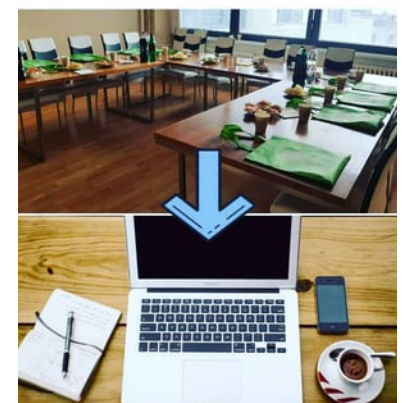
Seminars and Workshops

Online Workshop on Embedded Optimal Control

In March, April and June, we co-organised the online workshops on "Embedded Optimal Control" together with our colleagues from RUB Bochum, Germany. Our aim was to share the latest scientific results and discuss the opportunities to push forward the perspective ideas.
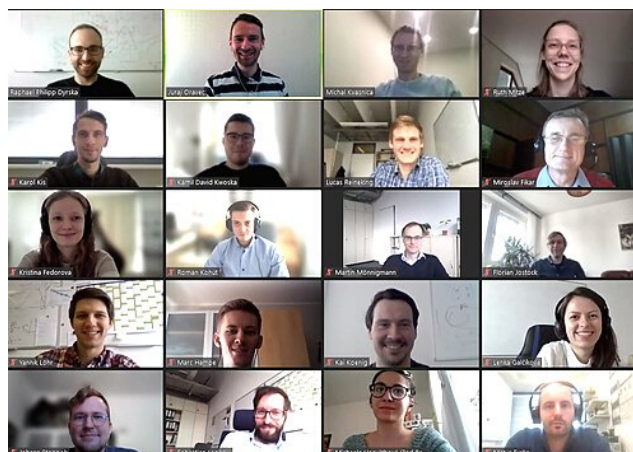
Summer School of Chemistry Visited IAM

We welcomed talented students who participated in the Summer School of Chemistry in July. Students who visited the IAM learned about automation and process control in the chemical industry and beyond.

Seminar for High School Science Teachers

During the seminar in 08/2021, **Assoc. Prof. Juraj Oravec** gave a lecture on the topic: Benefits of automation for traffic safety and use of hydrogen and other alternative energy sources in transport.

Workshops of the Department

At the department workshops in February and September, we prepared for the upcoming semester and discussed further improvements of research and teaching activities.

Outlook for 2022

Principia Cybernetica

We are honoured that next year the IAM will organize the event Principia Cybernetica and welcome colleagues from other Slovak and Czech automation and cybernetics institutes.

Contact

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