

Scientific Seminars at Department

Corona, D.: Optimality Principles and Decomposition of Tracking Controllers for Underactuated Systems (University of Camerino, Italy)



Mönnigmann, M.: Regional Predictive Control (Ruhr-Universität Bochum, Germany)

Berner, P.: Event-Triggered Networked Model Predictive Control (Ruhr-Universität Bochum, Germany)

König, K.: Speeding Up Regional Predictive Control-An Optimal and Suboptimal Approach (Ruhr-Universität Bochum, Germany)



Villanueva, M.: Backward-forward Reach Set Splitting for Constrained Differential Games (ShanghaiTech University, China)



Misener, R.: Learning-based Cutting Plane Approximation of Quadratic Programming Convex (SDP) Relaxations (Imperial College, UK)

Houska, B.: Gram-Charlier Expansion Methods and their Applications in Control (ShanghaiTech, China).

Master Theses:

Artzová, P.: Model Predictive Control of an Inverted Pendulum.

Boloz, M.: The SCADA Prototype Application for Traffic Control and Monitoring.

Hanulová, L.: Robust Model Predictive Control of the Laboratory Chemical Reactor.

Horňák, M.: Control of Robotic Vehicles System.

Kukla, J.: Optimal Control of Industrial Storage Tanks.

Bachelor Theses:

Bačíková, B.: Creating of Dynamic Web Pages.

Bányi, K.: Automatic Pasteurization Plant.

Fedorová, K.: Robotic Optimization.

Galčíková, L.: Robust Control Design for the Laboratory Chemical Reactor.

Hrstka, S.: Estimation of Process Values based on Machine Learning and Artificial Intelligence.

Kohút, R.: Path Planning and Following for Robotic Systems.

Morozov, A.: Robotic Optimization.

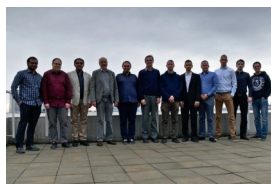
Slávik, M.: Robust Control Design for the Laboratory Heat Exchanger.



Dyrska, R.: Accelerating Nonlinear Model Predictive Control by Constraint Removal (Ruhr-Universität Bochum, Germany)

Löehr, Y.: Optimal Operation of Electrical Heating System with (Hybrid) Model Predictive Control (Ruhr-Universität Bochum, Germany)

Faulwasser, T.: Economic NMPC: Turnpike Properties and the Role of Adjoint (KIT Karlsruhe, Germany)



Scientific seminar on *Reliable and Real-time Feasible Estimation and Control of Chemical Plants* related to our cooperation project with research group of prof. S. Engell (Technical University of Dortmund, Germany).

Prof. M. Fikar and prof. S. Engell introduced the main research activities of both groups. From Slovak group presented J. Oravec, R. Paulen, M. Kalúz, J. Holaza and M. Klaučo. From German group presented A. Ahmad and S. Thangavel.

Process Control '19

Our department would like to invite you to *22nd International Conference on Process Control*. Conference will be held in Štrbské Pleso, High Tatras, Slovak Republic on **June 11–14, 2019**.

Full papers or abstracts are to be submitted by **January 31, 2019**.

For more information: www.uiam.sk/pc19

Contact information

Department of Information Engineering and Process Control
Institute of Information Engineering, Automation, and Mathematics
Faculty of Chemical and Food Technology
Slovak University of Technology in Bratislava
Radlinského 9
812 37 Bratislava, Slovakia
Tel.: +421 259 325 366
e-mail: office@uiam.sk

web: www.uiam.sk

Edited by: Ing. P. Artzová, prof. M. Fikar



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



Department of Information Engineering and Process Control

Dear co-workers, project colleagues, project partners, former members of the department,

As the year 2018 is nearing its end, it is time to look back and evaluate it. It has been quite a successful year for us. We finished FP7 project TEMPO, started H2020 project GuEst, and continued in bilateral projects with Bochum (A. v. Humboldt), Dortmund (DAAD), and ShanghaiTech. The last one resulted in an international workshop at ShanghaiTech.

The publication activity was above

average with 8 papers in journals like Applied Energy, Computers & Chemical Engineering, Journal of Process Control, or IEEE Transactions on Control Systems Technology. The group was present at various international conferences with 14 contributions (ESCAPE, ADCHEM, MNPC, ECC, SYSID, MATHMOD).

I was appointed as the head of the department 15 years ago. Starting with 2019, I will serve as the rector of our university. The department will be headed by Michal Kvasnica, who, I am sure will strengthen its

position in Slovakia and accelerate its development and international recognition.

I would like to thank my colleagues and partners for successful and pleasant collaboration. I sincerely hope for even more involved participation in research, project proposals, and industrial cooperation in 2019.

Miroslav Fikar
head of the department



International Workshop on Advanced Methods for Control and Estimation of Dynamic Systems

ShanghaiTech University (China) and Slovak University of Technology in Bratislava (Slovakia) organized the workshop on *Advanced Methods for Control and Estimation of Dynamic Systems (AMCEDS)*, which was held at the premises of ShanghaiTech University on July 23. The objective of the workshop was to bring together theoretical experts and

control systems specialists, to evaluate the new avenues in techniques for design and implementation of modern control and estimation paradigms, methods, and tools. The main topics of the workshop were: Non-linear Control System Design, Modeling, Simulation and Identification of the Processes, Process Optimisation, Robust and Adaptive Control, Model Predictive Control and Algorithms and Computing for Control and Estimation. The Keynote Speakers were Cesar de Prada (University of Valladolid, Spain), Miroslav Fikar, Radoslav Paulen (Slovak University of Technology in Bratislava, Slovakia),



Rolf Findeisen (Otto-von-Guericke University Magdeburg, Germany), Boris Houska, Mario E. Villanueva, Jie Lu (ShanghaiTech University, China), Ali Mesbah (University of California, Berkeley, USA), Gabriele Pannocchi (University of Pisa, Italy) and Sigurd Skogestad (Norwegian University of Science and Technology, Norway).



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Participation at Conferences

R. Paulen and J. Oravec presented at *28th European Symposium on Computer-Aided Process Engineering* in Graz, Austria.



R. Paulen and M. Fikar authored a publication presented at the *10th IFAC Symposium on Advanced Control of Chemical*



Processes (ADCHEM) in Shenyang, Liaoning, China.



Members of our department are authors of two papers presented at *European Control Conference* in Limassol, Cyprus.

Dr. R. Paulen presented his paper at the *18th IFAC Symposium on System Identification (SYSID)* in Stockholm, Sweden.

Members of our department are authors of four papers presented at *IFAC Conference in Nonlinear Model Predictive Control* in Madison, Wisconsin, USA.



M. Kalúz, L. Čirka and M. Fikar presented a paper at *International Conference on Automatic Control and Soft Computing* in Ponta Delgada, Azores (Portugal).

Awards



Prof. Michal Kvasnica has been awarded with *Prize of the Literary Fund of the Slovak Republic* for the most frequently cited article: M. Herceg, M. Kvasnica, C. Jones, M. Morari: *Multi-Parametric Toolbox 3.0*, European Control Conference, 2013.

Workshop in Valtice, CZ

Discussions evolved around the status of research and teaching activities, HW and SW infrastructure of the department. New PhD students, Petra Artzová and Carlos Valero gave lectures about their research and goals.



New Members



Petra Artzová received her MSc. degree in Automation and Information Engineering in Chemistry and Food Industry from STU in Bratislava. At present, she continues to work at our department as a PhD. student in Process Control (supervisor: R. Paulen). Her main research interests include guaranteed parameter estimation.

Carlos Eduardo Valero received his MSc. degree in Biomedical Engineering at Simon Bolívar University in Caracas, Venezuela.



At present, he is a PhD. student in Process Control (supervisor: R. Paulen). He focuses mainly on set-membership estimation and its connection to model predictive control.

International Projects

Training in Embedded Predictive Control and Optimization (TEMPO) is an international PhD program for highly motivated young scientists financed by the European Commission - Framework Program 7, MC ITN, (7FP, EU).

New Directions in Guaranteed Estimation of Nonlinear Dynamic Systems and Their Applications to Chemical Engineering Problems (GuEst) is an EU project under the MSCA scheme, which is granted to our department and Dr. R. Paulen. Up to now, only three projects of this kind were awarded to Slovak institutions (MSCA, IF H2020).

Embedded Optimal Control is a joint research project between the group of prof. M. Fikar and the group of prof. M. Mönnigmann from Department of Automatic Control and Systems Theory, Faculty of Mechanical Engineering of the Ruhr-Universität Bochum, Germany (A. von Humboldt Foundation, Germany).

Reliable and Real-time Feasible Estimation and Control of Chemical Plants is a joint research project between the group of assoc. prof. R. Paulen and the group of prof. S. Engell Technische Universität Dortmund (DAAD, Germany).

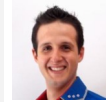
Verified Estimation and Control of Chemical Processes is a joint mobility grant with participation of the group of assoc. prof. R. Paulen and the group of prof. B. Houska, ShanghaiTech University, China (APVV, Slovakia).

Long-Term International Visits



Wachira Daosud received her B.Eng. degree in Chemical Engineering from Burapha University, Thailand in 1998 and her D.Eng. Degree in Chemical Engineering from Chulalongkorn University, Thailand in 2007. Her research interests include modeling and

optimization, model predictive control, neural network and their applications in chemical and biochemical processes. She stayed at STU from June to November.



Dario Corona obtained his BA and MA in Mathematics and Applications at University of Camerino, Italy. He has worked in different research projects: the development of lower-limb exoskeleton for health care and the implementation of a 3D mounting and maintenance manual for electric cars. Dario Corona is a co-funder and CEO of Limix srl, a spin-off of the University of Camerino. He stayed at STU from February to May.

Slovak Projects

Optimal Control for Process Industries is a research project funded by the APVV organization. The principal investigator is prof. M. Fikar.

Control of Energy Intensive Processes with Uncertainties in Chemical Technologies and Biotechnologies is a VEGA research project where the principal investigator is assoc. prof. M. Bakošová.

Energy Efficient Process Control is a VEGA research project where the principal investigator is prof. M. Fikar.

Verifiably Safe Optimal Control is a VEGA research project where the principal investigator is assoc. prof. M. Kvasnica.

Optimal and Predictive Control as a Tool for Diagnostics, Energy Savings, Increase of Safety and Effectivity of Technological Processes is a postdoc research stay financed by the Slovak University of Technology in Bratislava. The principal investigator is prof. M. Fikar.

Machine Learning and Artificial Intelligence in Process Control and Automation is a postdoc research stay financed by the Slovak University of Technology in Bratislava. The principal investigator is assoc. prof. M. Kvasnica.

Economically Effective Control of Energy Intensive Chemical Processes is a Grant: Excellent Teams of Young Researchers at STU in Bratislava. The principal investigator is Dr. M. Klaučo.

Design of a Chemical Reactor for Educational and Research Purposes is a Grant for Young Researchers of STU in Bratislava. The principal investigator is P. Bakaráč.

Optimal Control of Chemical Processes is a Grant for Young Researchers of STU in Bratislava. The principal investigator is Dr. J. Holaza.

Journal Papers

Drgoňa, J. – Picard, D. – Kvasnica, M. – Helsen, L.: Approximate model predictive building control via machine learning. *Applied Energy*, vol. 218, pp. 199 – 216, 2018.

Holaza, J. – Klaučo, M. – Drgoňa, J. – Oravec, J. – Kvasnica, M. – Fikar, M.: MPC-Based Reference Governor Control of a Continuous Stirred-Tank Reactor. *Computers & Chemical Engineering*, vol. 108, pp. 289 – 299, 2018.

Oravec, J. – Bakošová, M. – Trafczynski, M. – Vasičkaninová, A. – Mészáros, A. – Markowski, M.: Robust model predictive control and PID control of shell-and-tube heat exchangers. *Energy*, vol. 159, pp. 1 – 10, 2018.

Oravec, J. – Bakošová, M. – Vasičkaninová, A. – Mészáros, A.: Robust Model Predictive Control of a Plate Heat Exchanger. *Chemical Engineering Transactions*, vol. 70, pp. 25 – 30, 2018.

Peric, N. – Paulen, R. – Villanueva, M. v Chachuat, B.: Set-membership nonlinear regression approach to parameter estimation. *Journal of Process Control*, vol. 70, pp. 80 – 95, 2018.

Števek, J. – Kvasnica, M. – Fikar, M. – Gomola, A.: A Parametric Programming Approach to Automated Integrated Circuit Design. *IEEE Transactions on Control Systems Technology*, vol. 26, pp. 1180 – 1191, 2018.

Vasičkaninová, A. – Bakošová, M. – Oravec, J. – Mészáros, A.: Gain-Scheduled Control of Counter - Current Shell - and - Tube Heat Exchangers in Series. *Chemical Engineering Transactions*, vol. 70, pp. 1399 – 1404, 2018.

Thangavel, S. – Lucia, S. – Paulen, R. – Engell, S.: Dual robust nonlinear model predictive control: A multi-stage approach. *Journal of Process Control*, vol. 72, pp. 39 – 51, 2018.

Chapters or Pages in Books

Kvasnica, M. – Jones, C. – Pejčić, I. – Holaza, J. – Korda, M. – Bakaráč, P.: Real-Time Implementation of Explicit Model Predictive Control, In *Handbook of Model Predictive Control*, Editor(s): Sasa V. Rakovic, William S. Levine, Birkhauser, pp. 387 – 412, 2018.