PROCESS AND ENERGY SYSTEMS ENGINEERING

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Name	**Process and Energy Systems Engineering**
Acronym	**PSE**
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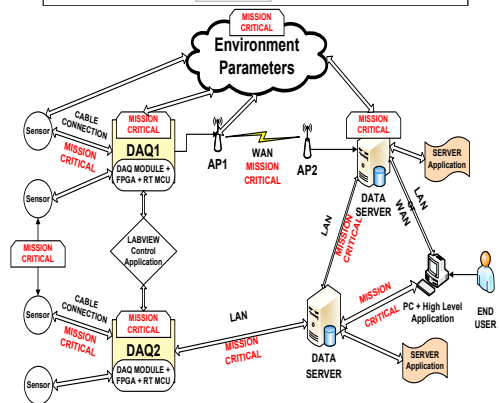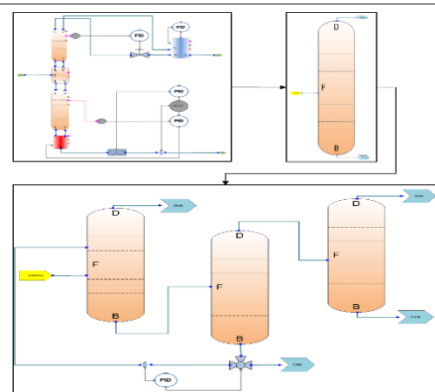
Areas of expertise

Process modelling and simulation: First principle modelling; Gray box modelling with partial derivative equations; Neural networks
Process control: Plantwide control, Control strategies for unconventional processes (e.g. cryogenic separation units, heavy water production); Development of control algorithms for processes with distributed parameters; System identification technologies, Dedicated control solutions for: rotary hearth furnaces, blunting systems, rolling mills, piercers and storage tanks, Intelligent control; Fractional-order control; Artificial intelligence applications
Energy systems: Renewable energy systems; Nuclear power plants; Laser, plasma and electron irradiation processes; Steam power plants
Medical systems: Pandemic dynamics; Respiratory system; Dental systems
Buildings automation: Energy efficiency and environmental parameters control (Certifications: SIEMENS: Synco 700 ACS Engineering; KNX; Security Systems)

Team

Prof. Dr. Eng. Mihail Abrudean, Prof. Dr. Eng. Tiberiu Coloși, Prof. Dr. Eng. Vlad Mureşan, Assoc. Prof. Dr. Eng. Ionuţ Muntean, Assoc. Prof. Dr. Eng. Iulia Clitan, Senior Lecturer Dr. Eng. Valentin Ioan Sita.

Representative projects

"Dynamics of SARS-CoV-2 virus transmission in Romania" - granted by UEFISCDI (no. 10Sol∕2020). Project period: 2020 - 2021. The team structure: Coordinator: Technical University of Cluj-Napoca; P1 partner: "Alessandrescu-Rusescu" National Institute for Maternal and Child Health, Bucharest; P2 partner": Cluj-Napoca Infectious Diseases Clinical Hospital
"Embedded mode for advanced pressure control in protected spaces", PNIII-CI-2017
"Optimizing the length of steel bars according to the process of programming the production of tubular material and in relation to the production process in the steel works" internal project funded by TUCN (2016-2017)
"Stimulation of the return curve (metallographic process)", internal project funded by TUCN (2016-2017)
I3E, "Promoting Innovation in the Industrial Informatics and Embedded Systems Sectors through Networking", South East Europe Transnational Cooperation Programme (SEE), (2010-2012)
"Advanced metallurgical process control for the production of seamless steel tubes", BD-CNCSIS, (2008-2010)

Significant results

The most representative publications of the past 5 years:
1. Vlad Mureșan, Mihaela-Ligia Unguresan, Mihail Abrudean, Honoriu Vălean, Iulia Clitan, Roxana Motorga, Emilian Ceuca, Marius Fișcă, "AI versus Classic Methods in Modelling Isotopic Separation Processes: Efficiency Comparison", Mathematics 2021, vol. 9, no. 23: 3088, pp. 1-31. https://doi.org/10.3390/math9233088.
2. Roxana Motorga, Vlad Mureșan, Mihaela-Ligia Unguresan, Mihail Abrudean, Honoriu Vălean, Iulia Clitan. "Artificial Intelligence in Fractional-Order Systems Approximation with High Performances: Application in Modelling of an

Isotopic Separation Process", Mathematics 2022, 10, 1459, pp. 1-32. https://doi.org/10.3390/math10091459.

3. Tiberiu Coloşi, Mihail Abrudean, Mihaela Ungureşan, Vlad Mureşan, "Numerical simulation of distributed parameter processes", Editura SPRINGER, 2013, 363 pagini ISBN: 978-3-319-00013-8.

4. Mureşan V, Abrudean M, „Conducerea proceselor industriale , Editura Galaxia Gutenberg, Cluj-Napoca 2017, 181 pagini, ISBN 978-973-141-699-1.

5. Tiberiu Coloşi, Iulia Clitan, Mihaela Ligia Ungureşan,Vlad Mureşan, Mihail Abrudean - Posibile extinderi ale matricei derivatelor partiale a vectorului de stare, asociate unor categorii de ecuatii cu derivate partiale, Editura Galaxia Gutenberg, 2020, 49 pag., ISBN 978-973-141-878-0.

6. Vlad Mureşan, Mihail Abrudean, Mihaela-Ligia Ungureşan, Iulia Clitan, Tiberiu Coloşi, "Inteligent temperature control in an industrial furnace", ICCAE conference, Sydney, Australia, 14-16 Februarue, 2020.

7. Vlad Mureşan, Iulia Clitan, Valentin Sita, Mihail Abrudean, Mihaela-Ligia Ungureşan, "^{18}O Isotope Separation Process Control", Lecture Notes in Electrical Engineering book series (LNEE, volume 613), 26 Octombrie 2019.

8. Vlad Mureşan, Mihail Abrudean, "Fault Tolerant Control System of the Rotary Hearth Furnace Servicing Machines", 2019 IEEE 22nd International Symposium on Design and Diagnostics of Electronic Circuits & Systems (DDECS), 24-26 Aprilie 2019, Cluj-Napoca, România.

9. Manescu Radu, Valentin Sita, "Heating efficiency with multiple boilers. Case study for single, two and three boiler operation", 20th International Conference on System Lista de lucrări – Sita Ioan Valentin 3 Theory, Control and Computing, 13 - 15 October 2016, Sinaia, Romania, pp. 79-83, ISBN 978-1-5090-2719-4.

10. Iulia Clitan, Vlad Mureșan, Mihail Abrudean, Zoltan Kovendi, Eugen Ioan Gergely, "Discrete Modeling and Control of an Industrial Robot used in a Metallurgical Process" 15th International Conference on Engineering of Modern Electric Systems (ICEMES 2019), 13-14 Iunie, 2019, Oradea, România.

11. Vlad Mureşan, Daniel Moga, Dorin Petreuş, Mihail Abrudean, Nicoleta Stroia, Rozica Moga "Fault Tolerant Control System for Photovoltaic Panels Application", 2019 IFAC Workshop on Control of Smart Grid and Renewable Energy Systems, 10-12 Iunie, 2019, Jeju, Coreea de Sud.

12. Iulia Clitan, Vlad Mureşan, Mihail Abrudean, Valentin Sita, "Discrete Model for the Movement of Industrial Manipulator Used in Hot Rolling Process", The 14-th edition of the Simulation, Modeling and Optimization in the Fields of Aerospace, Robotics, Manufacturing Systems, Mechanical Engineering, Power Energy, Materials Technology and Neurorehabilitation - SLS&OPTIROB 2019,27iunie-1 Iulie 2019, Jupiter, Constanța, România.

13. Iulia Clitan, Vlad Muresan, Mihail Abrudean, Andrei Florin Clitan, Honoriu Vălean, Mihaela Ligia Ungureşan, "Comparison of Continuous and Discrete PI Control on Clamp Positioning of an Industrial Robot", 2019 23rd International Conference on System Theory, Control and Computing (ICSTCC), 9-11 Oct. 2019, Sinaia, România.

14. Vlad Mureşan, Mihaela-Ligia Unguresan, Delia Gligor, Codruța Varodi, "Neural Modeling of Laviron Treatment for Coating of Electrodes with Mediator", COATINGS, Vol.: 9, Issue 7, 2019, Article: Number 429, ISSN: 2079-6412, DOI: 10.3390/coatings9070429, WOS:000478656200029.

15. Unguresan, Mihaela-Ligia; Muresan, Vlad; Gligor, Delia; et al., Adsorption process of phenothiazine solution in dimethyl sulfoxide on graphite electrodes Journal of Solid State Electrochemistry, Vol: 22, Issue: 8, Pages: 2305-2314.

16. Muresan, Vlad; Moga, Daniel; Petreus, Dorin; et al., Fault Detection and Fault Tolerance Mechanism for DC/DC Converters in Microgrids 10th IFAC Symposium on Control of Power and Energy Systems (CPES) Location: Meiji Univ, Tokyo, JAPAN Date: SEP 04-06, 2018 IFAC PAPERSONLINE, Volume: 51, Issue: 28, Pages: 666-671.

Significant solutions

First principle modelling library for distillation processes with non-ideal mixtures, Tuning algorithm for PID controllers for discrete-time systems with dead time, Gray box modelling platform, Control strategies for isotopic processes, Plantwide control strategies for distillation processes, Tuning algorithms for coupled PID controllers for performance improvement, Intelligent control solutions for industrial processes, Fractional-order control solutions for industrial processes, Methods for pandemic dynamics modelling, Control and implementation solutions for the buildings environmental parameters.

Products and technologies:

17. First principle modelling framework for distillation processes with non-ideal mixtures
18. General modelling and control framework using partial derivative equations
19. Robust PID tuning algorithm for discrete-time systems

The offer addressed to the economic environment

Research & development	Development of open- and closed-loop identification solutions. Development of tailored solutions for the modelling, simulation and control of chemical and energy systems. Development of general first principle modelling libraries/frameworks for chemical and energy systems. Development of general control strategies for the chemical and energy sector. Development of optimal control strategies for renewable energy systems. Development of models for biomedical applications. Development of buildings automation systems.
Consulting	System identification. Process modelling. Tuning of coupled controllers. Calculation of the economic potential of implementing advanced control strategies. Support for the implementation of our proposed technical solutions. Buildings autmation.
Training	**Systems theory:** identification methods, stability analysis, control loops, controllers. **Process control:** optimal control algorithms, plantwide control, PID tuning (discrete and continuous systems), control of unconventional processes, intelligent control, fractional-order control, buildings automation. **Electronics:** power and basic electronics.

Last updated: January 2023