ADVANCED PROCESS CONTROL METHODS

Contact details

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Acronym	**ADAPTED**
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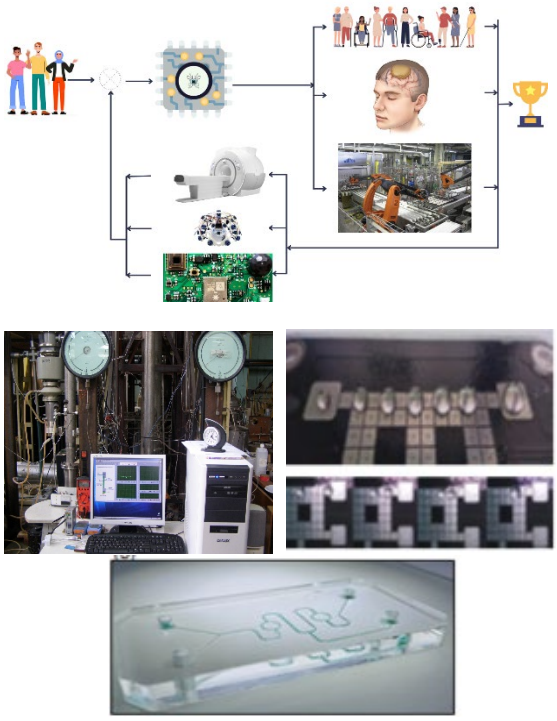

Areas of expertise

Complex process modelling and simulation
- Detailed models and simulations of various industrial, biotechnological and medical processes;
- Modelling and simulation for personalized medicine.

Tuning, design and testing of various control solutions including advanced control algorithms such as predictive, fractional, fault-tolerant or robust control
- Conceptual design of various control loops from classical PID to advanced control algorithms;
- Control strategy implementation;
- Control optimization.

Particular advanced monitoring, supervising and control methods for non-conventional processes and technologies
- Conceiving of new, efficient technologies in nonconventional processes;
- Modelling, monitoring and control of biochemical and biomedical processes;
- Improved efficiency based on optimization; process maintenance;
- Engineering in diagnosis and personalized medicine.

Team

Prof. Habil. Eng. Eva H. Dulf, PhD; Prof. Eng. Clement Festila, PhD; Assoc. Prof. Eng. Cristina I. Muresan, PhD; Assoc. Prof. Eng. Roxana Rusu-Both, PhD; Lect.Eng. Ioana Nascu, PhD; As. Eng. Izabela Birs, PhD
PhD students: MSc.Eng. Daniel D. Timis, MSc Eng. Ciprian Vogt, MSc Eng. Toader Seretan, MSc Eng. Alex Danku, Msc.Eng. Andrei Kovari, MSc Eng. Andrei Tulbure, MSc Eng. Karoly Lengyel, MSc Eng. Noemi Lorenzovici, MSc Eng. Elisabeta Kozma, MSc.Eng. Alexandru Berciu, MSc.Eng. Marcian Mihai.
Master students: Eng. Erwin Hegedus, Eng. Dragos Craciun, Eng. Andreea Ceoca, Eng. Dan Bulgar; Eng. Paul Pintea, Eng. Ovidiu Ceoca, Eng. Teodora Popescu, Eng. Nicoleta Badau

Representative projects

Centre of Excellence in Computer Assisted Systems for Drug Dosing Control and Optimisation, PNRR-III-C9-2022-I8 (2023-2026), https://control.utcluj.ro/projects/optimdrug/
Nanovaccinal Approaches for Colon Cancer, PN-III-P2-2.1-PED-2019-0844 (2020-2022), https://nanovacol.wixsite.com/home
Development of an intelligent combined imagistic–cytologic–molecular system to guide the diagnosis, risk stratification and the management of thyroid cancer, PN-III-P2-2.1-PED-2019-2536 (2020-2022), https://tircitogen.wixsite.com/home
Solid-State Bioprocess Development and Optimization for the Sustainable Production of Powerful Antioxidants from Grape Pomace using Filamentous Fungi, PN-III-P2-2.1-PED-2019-1660 (2020-2022), https://bioantox2020.wixsite.com/home
Novel Fractional Order Autotuners for Poorly Damped Systems to Ensure Improved Safety and Comfort, PN-III-P1-1.1-TE-2019-0745 (2019-2021), http://cristina-muresan.com/research/te1432020

A sedation patient simulator for patient-individualised optimal drug dosing in general anaesthesia, PN-III-P2-2.1-PED-2019-0322 (2019-2021), http://cristina-muresan.com/research/552ped2019/
SWEETCONOMY - Functional collaboration model between public research organizations and the economic environment for the provision of high-level scientific and technological services in the field of bio-economy, PNIII-P1-1.2 PCCDI 2018, (2018-2020) https://sweetconomy.com
Robust fractional order event-based control for optimised resource allocation in complex cyber-physical closed loop systems, PN-III-P1-1.1-TE-2016-1396 (2018-2020), http://cristina-muresan.com/research/te652018/

Significant results

The most representative publications of the past 5 years:

1. Nagy, P., Dulf, E. H., Kovacs, L. (2023). Mathematical Oncology: Tumor Evolution Models. *Computational and Mathematical Models in Biology* (pp. 213-234). Cham: Springer Nature Switzerland.
2. Alinei-Poiana, T., Dulf, E. H., Kovacs, L. (2023). Fractional calculus in mathematical oncology. *Scientific Reports*, 13(1), 10083.
3. Ghita, M., Birs, I. R., Copot, D., Muresan, C. I., Neckebroek, M., & Ionescu, C. M. (2023). Parametric Modeling and Deep Learning for Enhancing Pain Assessment in Postanesthesia. *IEEE Transactions on Biomedical Engineering*.
4. Giurgiu, R., Dulf, E. H., Kovács, L. (2023). Fractional-Order Control of Fluid Composition Conductivity. *Fractal and Fractional*, 7(4), 305.
5. Berciu, A. G., Dulf, E. (2023). Smart Textiles and Artificial Intelligence for Analysis of Sleep Quality and Early Disease Diagnosis. *Applied Medical Informatics*, 45, S25-S25.
6. Timis D.D., Muresan C.I., Dulf E.H.* (2022) Design and Experimental Results of an Adaptive Fractional-Order Controller for a Quadrotor, *Fractal and Fractional*, 6 (4), 204
7. Stoleru CA, Dulf E.H.*, Ciobanu L. (2022) Automated detection of celiac disease using Machine Learning Algorithms, *Scientific Reports* 12 (1), 1-19
8. Tulbure, A. A., Tulbure, A. A., & Dulf, E. H.* (2022). A review on modern defect detection models using DCNNs–Deep convolutional neural networks. *Journal of Advanced Research, 35, 33-48*
9. Dulf, E. H., Bledea, M., Mocan, T., & Mocan, L. (2021). Automatic Detection of Colorectal Polyps Using Transfer Learning. *Sensors*, *21*(17), 5704.
10. Lorenzovici, N., Dulf, E. H*., Mocan, T., & Mocan, L. (2021). Artificial Intelligence in Colorectal Cancer Diagnosis Using Clinical Data: Non-Invasive Approach. *Diagnostics*, *11*(3), 514.

Significant solutions:
Monitoring, modelling and control of complex processes (chemical, biomedical applications)
Fractional order control strategies for time delay and MIMO processes
Modelling and control of physiological systems

Products and technologies:
1. Mathematical models of complex chemical and biochemical processes
2. Medical applications
3. Special transducers designed for isotope separation columns
4. Advanced control strategies for ^{13}C cryogenic isotope separation column and a separation cascade

Patents:
1. R.A. Munteanu, E.H. Dulf, C. Festila, R. Munteanu, G. Todoran, “Analogue electronic transducer for measuring power in direct current circuits, RO-128666/2018
2. Experimental unit for studying the fractional order characteristics of non-Newtonian fluids, Romanian patent proposal no. A00389/31.05.2018
3. Process for tuning fractional controllers for multivariable processes with deadtimes, , RO132450-A2/2016
4. Wind turbine, RO133354-A2/2017
5. Procedure for detection and diagnosis of intrathoracic pulmonary tumours based on ultrasound image analysis, Patent proposal A01040/04.12.2018

The offer addressed to the economic environment

Research & development	Identifying fundamental principles and methodologies that enable systems to exhibit intelligent, goal-oriented behaviour, and developing innovative instruments to monitor, manipulate, and control systems; Tuning, design and testing of various control solutions using advanced control algorithms, such as predictive, fractional or robust control; Modelling biochemical and biomedical processes.
Consulting	Consulting in simulation, design, implementation and maintenance of control systems for multiple industrial field; Consulting in structural and nonlinear modelling of complex processes; Consulting in process management using different simulation environment.
Training	Complex process modelling and simulation; Tuning, design and testing of various control solutions including advanced control algorithms such as predictive, fractional or robust control; Biomedical engineering.

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