

## ROBOTICS AND NONLINEAR CONTROL

### Contact details

Name	Robotics and Nonlinear Control	
Acronym	ROCON	
Logo		
Site	<a href="http://rocon.utcluj.ro/">http://rocon.utcluj.ro/</a>	
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### Areas of expertise

Our group works on **Robotics and Nonlinear Control (ROCON)** at the Department of Automation of the Technical University of Cluj-Napoca. Our research interests range from **mobile robotics** and **robot modeling**, to fundamental **nonlinear control and estimation** using methods from **computational and artificial intelligence**. These two major directions are connected via **applications of nonlinear control to robotics**, with a focus on **assistive robotics**.

### Team

**Assoc. Prof. Dr. Eng. Lucian Busoniu**, Assoc. Prof. Dr. Eng. Zsófia Lendek, Assist Prof. Dr. Eng. Levente Tamás, Assist. Prof. Dr. Eng. Cosmin Marcu, Prof. Dr.Eng. Gheorghe Lazea, honorary member, PhD students: Eng. Előd Páll, Eng. Koppány Máthé, Eng. Zoltan Nagy

### Representative projects

**REDOUBT - Reliable FPGA DataPath Design Using Control Techniques**, ESA grant, (2018-2019)  
**Handling non-smooth effects in control of real robotic systems**, PN-II-RU-TE-2014-4-0942, (2015-2017), PI Zsofia Lendek, <http://lendek.net/TE88/>  
**AI methods for the networked control of assistive UAVs (NETASSIST)**, CB AUF-RO, (2016-2017)  
**Reinforcement learning and planning for large-scale systems**, PNII-RU-TE-2012-3-0040, 2013-2016. PI Lucian Busoniu, <http://yt.busoniu.net/>  
**Artificial-Intelligence-Based Optimization for the Stable and Optimal Control of Networked Systems (AICONS)**, PHC Brancusi international cooperation grant, 2015-2016; PI on the Romanian side Lucian Busoniu, <http://rocon.utcluj.ro/node/77>  
**Observer design for structured distributed dynamic systems**, PN-II-RU-TE-2011-3-0043, 2011-2014. PI Zsofia Lendek, <http://lendek.net/TE/>  
**3D Reconaissance** - SCIEX NMS Postdoctoral project, Switzerland, 2013-2014; PI Levente Tamas

### Significant results

#### Representative publications in the past 5 years

1. Busoniu, Lucian; Pall, Elod; Munos, Remi, Continuous-action planning for discounted infinite-horizon nonlinear optimal control with Lipschitz values AUTOMATICA Volume: 92 Pages: 100-108 Published: JUN 2018
2. Morarescu, Irinel-Constantin; Varma, Vineeth Satheeskumar; Busoniu, Lucian; et al., Space-time budget allocation for marketing over social networks 6th IFAC Conference on Analysis and Design of Hybrid Systems (ADHS) / Federated Logic Conferences (FLOC) Location: Univ Oxford, Dept Comp Sci, Oxford, ENGLAND Date: JUL 06-19, 2018 Volume: 51 Issue: 16 Pages: 211-216 Published: 2018
3. Mathe, Koppány; Busoniu, Lucian; Munos, Remi; et al., Optimistic planning with an adaptive number of action switches for near-optimal nonlinear control ENGINEERING APPLICATIONS OF ARTIFICIAL INTELLIGENCE Volume: 67 Pages: 355-367 Published: JAN 2018
4. Postoyan, Romain; Busoniu, Lucian; Netic, Dragan; et al., Stability Analysis of Discrete-Time Infinite-Horizon Optimal Control With Discounted Cost IEEE TRANSACTIONS ON AUTOMATIC CONTROL Volume: 62 Issue: 6 Pages: 2736-2749 Published: JUN 2017
5. Busoniu, Lucian; Daafouz, Jamal; Bragagnolo, Marcos Cesar; et al., Planning for optimal control and performance certification in nonlinear systems with controlled or uncontrolled switches AUTOMATICA Volume: 78 Pages: 297-308 Published: APR 2017

6. Feng, Guoxi; Guerra, Thierry Marie; Busoniu, Lucian; et al., Unknown input observer in descriptor form via LMIs for power-assisted wheelchairs PROCEEDINGS OF THE 36TH CHINESE CONTROL CONFERENCE (CCC 2017) Book Series: Chinese Control Conference Pages: 6299-6304 Published: 2017
7. L. Busoniu, L. Tamas (editors), "Handling Uncertainty and Networked Structure in Robot Control", Springer, Series Studies in Systems, Decision and Control. February 2016. <http://rocon.utcluj.ro/roboticsbook/>
8. L. Busoniu, R. Postoyan, and J. Daafouz, "Near-Optimal Strategies for Nonlinear and Uncertain Networked Control Systems", *IEEE Transactions on Automatic Control*, vol. 61, pp. 2124-2139, Aug 2016.
9. L. Busoniu, A. Daniels, and R. Babuska, "Online learning for optimistic planning", *Engineering Applications of Artificial Intelligence*, vol. 55, pp. 70-82, Oct 2016.
10. V. Estrada-Manzo, Z. Lendek, and T. M. Guerra, "Generalized LMI observer design for discrete-time nonlinear descriptor models", *Neurocomputing*, vol. 182, pp. 210-220, Mar 2016.
11. Z. Lendek, P. Raica, J. Lauber, and T. M. Guerra, "Finding a stabilising switching law for switching nonlinear models", *International Journal of Systems Science*, vol. 47, pp. 2762-2772, Sep 2016.
12. Lendek Zs., Guerra T-M, Lauber J., "Controller design for TS models using non-quadratic Lyapunov functions", *IEEE Transactions on Cybernetics*. 45:453–464, 2015.
13. Lendek Zs., Raica P., Lauber J., Guerra T-M., "Observer design for discrete-time switching nonlinear models", *Lecture Notes in Control and Information Sciences*. 457:27–58, 2015.
14. Guerra T-M, Estrada-Manzo V., Lendek Zs., "Observer design for Takagi-Sugeno descriptor models: an LMI approach", *Automatica*, 52:154–159, 2015.
15. Kato Z, Tamas L. "Relative Pose Estimation and Fusion of 2D Spectral and 3D Lidar Images. Computational Color Imaging", *LNCS:33–42.*, 2015.
16. Tamas L, Goron LCosmin, "3D semantic interpretation for robot perception inside office environments", *Engineering Applications of Artificial Intelligence*, 32:76–87, 2014.
17. Tamas L, Kato Z., "Targetless Calibration of a Lidar-Perspective Camera Pair", *International Conference on Computer Vision 2013, BigData3DCV Workshop*.
18. Mathe K., Busoniu L.. "Vision and control for UAVs: A survey of general methods and of inexpensive platforms for infrastructure inspection", *Sensors* 15(7): 14887-14916, 2015.
19. Busoniu L, Morarescu C. "Topology-Preserving Flocking of Nonlinear Agents Using Optimistic Planning", *Control Theory and Technology*, 13:333-344, 2015.
20. Busoniu L, Morarescu C. "Consensus for Black-Box Nonlinear Agents Using Optimistic Optimization", *Automatica*. 50:1201–1208. 2014.

**Patent:** Automatic Obstacle Detection and Breaking System for Cars, nr A10006/16.02.2011: L. Tamas, Gh. Lazea.

#### What we offer to the economic environment

Research & development	Signal processing Control algorithms Monitoring and estimation Artificial intelligence and machine learning. Mobile robotics and robotic manipulation Advanced system control and monitoring Embedded software design
Consulting	Control system design and development Monitoring system design and development Robotic system design & engineering 2D and 3D mapping and surveys
Applied engineering services	Process and control engineering Robotics related services Process equipment related services
Training	Control and monitoring System identification Optimization and optimal control Computer integrated manufacturing Process equipment Industrial robotics Mobile vehicles