

## Low-cost Fuzzy Control Solutions for Electromechanical Applications

Claudia-Adina Dragoş, Radu-Emil Precup, Stefan Preitl and Mircea-Bogdan Rădac  
Department of Automation and Applied Informatics, “Politehnica” University of Timisoara,  
Romania

**Abstract:** The electromechanical systems are widely used in many control applications as either actuators integrated to the controlled processes or as controlled processes themselves. Low-cost control algorithms are very attractive because of the relatively simple mathematical models, control design and tuning and implementation as well. Low-cost fuzzy controllers can ensure good control system performance and they also can compensate for the nonlinearities in the structure of the electromechanical systems. This paper is dedicated to the presentation of some design methods dedicated to low-cost control structures with Takagi-Sugeno fuzzy controllers with emphasis on electromechanical applications. Comparisons supported by simulation and experimental results are included in order to validate the solutions.

**Keywords:** electromechanical actuators, electromechanical applications, Magnetic Levitation System with 2 Electromagnets, Takagi-Sugeno fuzzy control.

### 5 Acknowledgment

This work was supported by the CNMP and CNCSIS of Romania. This work was partially supported by the strategic grant POSDRU 6/1.5/S/13 (2008) of the Ministry of Labor, Family and Social Protection, Romania, co-financed by the European Social Fund – Investing in People.

### References

- [1] R. Isermann: Mechatronic Systems: Fundamentals, Springer-Verlag, Berlin, Heidelberg, New York (2005).
- [2] U. Kiencke, L. Nielsen: Automotive Control Systems for Engine, Driveline and Vehicle, 2<sup>nd</sup> ed., Springer-Verlag, Berlin, Heidelberg, New York (2005).
- [3] C. Lazăr et al.: Real-time informatics technologies for embedded-system-control of power-train in automotive design and applications, Research Report 1 of the SICONA CNMP Grant, “Gh. Asachi” Technical University of Iasi, Iasi, Romania (in Romanian) (2009).
- [4] S. Di Cairano, A. Bemporad, I. V. Kolmanovsky, D. Hrovat: Model predictive control of magnetically actuated mass spring dampers for automotive applications, International Journal of Control, 80 (2007) 1701-1716.
- [5] S. Di Cairano, A. Bemporad, I. Kolmanovsky, Hrovat: Model predictive control of magnetic automotive actuators, Proceedings, 2007 American Control Conference (ACC '07) (New York, NY, USA, 2007), 5082-5087.
- [6] Inteco Ltd: Magnetic Levitation System 2EM (MLS2EM), User’s Manual (Laboratory Set), Inteco Ltd, Krakow, Poland (2008).
- [7] Z. C. Johanyák, S. Kovács: Fuzzy rule interpolation based on polar cuts, in Computational Intelligence, Theory and Applications, B. Reusch, Ed., Springer-Verlag, Berlin, Heidelberg, New York (2006) 499-511.

- [8] H. Wu, Y. Hu: Study on fuzzy control algorithm for magnetic levitated platform, Proceedings, 2009 International Conference on Measuring Technology and Mechatronics Automation (ICMTMA 2009) (Hunan, China, 2009), vol. 2, 598-601.
- [9] C.-A. Dragoş, S. Preitl, R.-E. Precup, R.-G. Bulzan, C. Pozna, J. K. Tar: Takagi-Sugeno fuzzy controller for a magnetic levitation system laboratory equipment, Proceedings, International Joint Conferences on Computational Cybernetics and Technical Informatics (ICCC-CONTI 2010) (Timisoara, Romania, 2010), 55-60.
- [10] S. Preitl, R.-E. Precup: On the algorithmic design of a class of control systems based on providing the symmetry of open-loop Bode plots, Scientific Bulletin of UPT, Transactions on Automatic Control and Computer Science, vol. 41 (55), no. 2, pp. 47-55, Dec. 1996.
- [11] J. Vaščák, K. Hirota, M. Mikloš: Hybrid fuzzy adaptive control of LEGO robots; International Journal of Fuzzy Logic and Intelligent Systems, 2 (2002) 65-69.
- [12] S. Preitl, Z. Preitl, R.-E. Precup: Low cost fuzzy controllers for classes of second-order systems, Proceedings of 15<sup>th</sup> IFAC World Congress, Barcelona, Spain, 2002, vol. 15 (part 1), pp. 397-402.
- [13] I. Škrjanc, S. Blažič, D. Matko: Model-reference fuzzy adaptive control as a framework for nonlinear system control, Journal of Intelligent and Robotic Systems, 36 (2003) 331-347.
- [14] R.-E. Precup, S. Preitl: Optimisation criteria in development of fuzzy controllers with dynamics, Engineering Applications of Artificial Intelligence, 17 (2004) 661-674.
- [15] B. Paláncz, Z. Benyó, L. Kovács: Control System Professional Suite, IEEE Control Systems Magazine, 25 (2005) 67-75.
- [16] I. Harmati, B. Lantos, S. Payandeh: Fitted stratified manipulation with decomposed path planning on submanifolds, International Journal of Robotics and Automation, 20 (2005) 135-144.
- [17] G. Hermann: Geometric error correction in coordinate measurement, Acta Polytechnica Hungarica, 4 (2007) 47-62.
- [18] B. M. Wilamowski, N. J. Cotton, O. Kaynak, G. Dundar: Computing gradient vector and Jacobian matrix in arbitrarily connected neural networks, IEEE Transactions on Industrial Electronics, 55 (2008) 3784-3790.
- [19] R.-E. Precup, S. Preitl, B.-I. Ursache, P. A. Clep, P. Baranyi, J. K. Tar: On the combination of tensor product and fuzzy models, Proceedings of 2008 IEEE International Conference on Automation, Quality and Testing, Robotics (AQTR'08) (Cluj-Napoca, Romania, 2008), 2, 48-53.
- [20] R. E. Haber, R. Haber-Haber, A. Jiménez, R. Galán: An optimal fuzzy control system in a network environment based on simulated annealing. An application to a drilling process, Applied Soft Computing, 9 (2009) 889-895.
- [21] J. L. Wright, M. Manic: The analysis of dimensionality reduction techniques in cryptographic object code classification, Proceedings, 3<sup>rd</sup> Conference on Human System Interaction (HIS '10) (Rzeszow, Poland, 2010), 157-162.
- [22] R.-E. Precup, L.-T. Dioanca, E. M. Petriu, M.-B. Rădac, S. Preitl, C.-A. Dragoş: Tensor product-based real-time control of the liquid levels in a three tank system, Proceedings of 2010 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM 2010) (Montreal, Canada, 2010), 768-773.
- [23] R. R. Sumar, A. A. R. Coelho, L. D. Coelho: Computational intelligence approach to PID controller design using the universal model, Information Sciences, 180 (2010) 3980-3991.

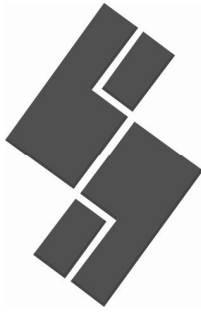
## **Author data**

Claudia-Adina Dragoș: Department of Automation and Applied Informatics, Faculty of Automation and Computers, “Politehnica” University of Timisoara. Bd. V. Parvan 2, RO-300223 Timisoara, Romania. E-mail: [claudia.dragos@aut.upt.ro](mailto:claudia.dragos@aut.upt.ro)

Radu-Emil Precup: Department of Automation and Applied Informatics, Faculty of Automation and Computers, “Politehnica” University of Timisoara. Bd. V. Parvan 2, RO-300223 Timisoara, Romania. E-mail: [radu.precup@aut.upt.ro](mailto:radu.precup@aut.upt.ro)

Stefan Preitl: Department of Automation and Applied Informatics, Faculty of Automation and Computers, “Politehnica” University of Timisoara. Bd. V. Parvan 2, RO-300223 Timisoara, Romania. E-mail: [stefan.preitl@aut.upt.ro](mailto:stefan.preitl@aut.upt.ro)

Mircea-Bogdan Rădac: Department of Automation and Applied Informatics, Faculty of Automation and Computers, “Politehnica” University of Timisoara. Bd. V. Parvan 2, RO-300223 Timisoara, Romania. E-mail: [mircea.radac@aut.upt.ro](mailto:mircea.radac@aut.upt.ro)



**INTERNATIONAL TEAM SOCIETY**

PROCEEDINGS OF THE

**2ND INTERNATIONAL SCIENTIFIC  
AND EXPERT CONFERENCE**

**TEAM 2010**

**AGTEDU 2010**

**A MAGYAR TUDOMÁNY ÜNNEPE ALKALMÁBÓL RENDEZETT  
11. TUDOMÁNYOS KONFERENCIA KIADVÁNYA**

**VOLUME 1**

**KECSKEMÉT COLLEGE**

4-5. NOVEMBER 2010.

## Szerkesztő bizottság

**Prof. Dr. Ferencz Árpád**  
főiskola tanár

**Dr. Klebniczki József**  
főiskolai tanár

**Lipócziné Dr. Csabai Sarolta**  
főiskolai tanár

**Borsné Dr. Pető Judit**  
főiskolai docens

**Dr. Fábián Csaba**  
főiskolai tanár

ISSN: 1586 – 846x

Összkiadás: ISBN 978-963-7294-85-3 ö  
I. kötet: ISBN 978-963-7294-86-0

Felelős kiadó: **Dr. Danyi József** rektor

Kiadó: **Kecskeméti Főiskola**

Munkaszám: 2010.154.

# Contents

## Volume 1

<b>Plenary Talks .....</b>	<b>9</b>
Low-cost Fuzzy Control Solutions for Electromechanical Applications .....	10
<b>Claudia-Adina Dragoş, Radu-Emil Precup, Stefan Preitl, Mircea-Bogdan Rădac</b>	
CFD analysis of originally designed car body in order to improve aerodynamic .....	24
<b>Dražan Kozak, Željko Ivandić, Marija Živić, Darko Damjanović</b>	
Modern materials and technologies in steam boiler power plant production .....	42
<b>Ivan Samardžić, Antun Stoić, Ivica Kladarić Marko Dunder</b>	
<b>Agriculture .....</b>	<b>49</b>
Mustisztítási eljárások hatása az Olaszrizling bor minőségére.....	50
<b>Baglyas F., Földházi O.</b>	
Influence of sowing time on germination of different lettuce types ( <i>Lactuca sativa</i> L.) .....	56
<b>Teuta Benković-Lačić, Krunoslav Mirosavljević, Robert Benković, Mirjana Brmež, Nataša Romanjek Fajdetić, Slavica Antunović</b>	
A gyümölcsösök ültetési anyagai .....	63
<b>Czinege Anikó</b>	
A nitrogén terméshozzájárulása az étkezési paprika terméshozzájárulására tenyészedényekben, különböző talajtípusokon.....	69
<b>Cserni Imre, Rajkai Kálmán, Borsné Pető Judit, Hüvely Attila, Szili-Kovács Tibor, Németh Tamás, Kovács András, Rajkainé Végh Krisztina</b>	
Felsőoktatásban részt vevő hallgatók környezettudatossági hajlandósága, egy vetélkedő tükrében .....	74
<b>Hoyk Edit</b>	
Eugley characteristics and limitations in plant production on the County of Slavonski Brod-Posavina area .....	80
<b>Božica Japundžić-Palenić, Slavica Antunović, Nataša Romanjek-Fajdetić, Monika Marković</b>	
The difference in the germination of maize hybrids ( <i>Zea mays</i> L.) .....	86
<b>Božica Japundžić-Palenić, Slavica Antunović, Nataša Romanjek-Fajdetić, Branimir Vujčić</b>	
Különböző baktériumtörzsek védő hatásának vizsgálata paprikánál <i>Xanthomonas</i> <i>vesicatoria</i> fertőzéssel szemben .....	92
<b>Kovács András, Tóthné Taskovics Zsuzsanna, Hraskó Istvánné, Nagy Győzőné</b>	
The challenges and common tasks of rural development .....	98
<b>Prof. Dr. Péter Lévai, Prof. Dr. Árpád Ferencz</b>	
Vágottvirágok növényházi termesztése hidrokultúrában.....	105
<b>Lévai Péter, Turiné Farkas Zsuzsa</b>	
Yield and quality parameter of maize hybrids grown in irrigated and N fertilized conditions.....	111
<b>Monika Marković, Jasna Šoštarić, Vlado Kovačević, Marko Josipović, Dario Iljkić, Božica Japundžić-Palenić</b>	