

## INTELLIGENT EMBEDDED SYSTEMS

### Contact details

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|--------------------|--|
| Name               | <b>Intelligent Embedded Systems</b>  |
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### Areas of expertise

Intelligent embedded systems: Implementation of Intelligent embedded systems using field programmable gate areas (FPGA) having learning capabilities and adaptive behavior  
 Hardware implementation of artificial neural networks in FPGA circuits  
 Modern technologies for distributed software systems  
 Intelligent sensors devices, adaptive interfaces with hardware implemented artificial neural networks  
 Intelligent acquisition systems  
 Assistive robots and ambient assisted living platforms  
 Information representation. Data coding and compression techniques.

### Team and key skills

#### **Assoc. Prof. Dr. Eng. Oniga Ștefan**

Ph.D. degree in electronics from "Politehnica" University of Timisoara in 2005. Since 1992 he is with the Faculty of Engineering, North University Center of Baia Mare, where he currently holds a position of associate professor in Digital Design and Embedded Systems. He is the author and co-author of more than 70 journal and conference papers, 20 research projects and 4 books. Major areas of interest are embedded systems design and applications, implementation of artificial neural networks in field-programmable gate arrays, digital neural network based smart devices, and ambient assisted living and assistive robots. IEEE member, Industrial electronics society.

#### **Assoc. Prof. Dr. Eng. Cosma Ovidiu**

Ph.D. degree in automatics from "Politehnica" University of Bucharest in 2003. Since 1992 he is with the North University Center of Baia Mare, where he currently holds a position of associate professor in Computer Programming, Computer Networks and Image Processing. He is the author and co-author of more than 40 journal papers, 9 research projects and 5 books. His major areas of interest are image compression and computer networks.

#### **Assist. Prof. Dr. Eng. Buchman Attila**

Ph.D. degree in electronics from Technical University of Cluj in 2009. Since 2001 he is with the Faculty of Engineering, North University Center of Baia Mare, where he currently holds a position of lecturer in Electronics and Signals and Systems Theory. He is the author and co-author of more than 30 papers, 5 research projects and 1 book. His major areas of interest are data acquisition, signal processing and applications. IEEE member, Circuits and Systems Society.

#### **Dr. Eng. Costea Cristinel**

Ph.D. degree in automatics from "Gh. Asachi" Technical University of Iași in 2010, thesis „Multi-Agent Applications in Control of Complex Systems”; graduated from the Politehnica University of Iasi in 1987.

### Infrastructure

- Development systems for FPGA (Xilinx and Altera)
- Development systems for DSP (Texas Instruments and Analog Devices)
- Development systems with for microcontrollers (Texas Instruments, Analog Devices, Microchip, Atmel)
- Data acquisition systems from National Instruments
- instruments and measuring systems Hameg, Tektronics, etc.

### Development strategy



Research and development of the embedded system platforms for ambient assisted living and development of assistive robots prototypes with learning capabilities and adaptive behavior.

In the expected Internet of Things, heterogeneous devices should easily connect in an ad-hoc fashion and exchange information between each other; such interoperability can be provided by exploiting the concept of ontology that enables an agent to model its knowledge by means of semantic descriptions.

Applications like sensor-based services will be delivered on-demand through a cloud environment and expect to generate a vast amount of heterogeneous data, asking for virtualization of Internet-connected objects;

In conclusion, part of our researches is oriented to semantic interoperability between heterogeneous resources and multi-agent systems technologies.

### Representative projects

#### **M3 PASSED - CEEX - contract nr.: 253/01.08.2006**

Development of national and international partnerships, in the field of Dedicated Systems, with the purpose of organizing scientific events and preparing common projects in the frame program 7 of the EU.

The PASSED project aims at creating virtual excellence centers by concentrating the existing human and material resources. The consortium created within this project organized a series of scientific and promotional events in three stages: Information Day, Summer Schools and a Workshop that allowed the education of the young researchers that work in this field and the creation of bridges that connects them with world-renowned specialists. The spreading of the results obtained, through participating in prestigious international conferences has lead to an increased recognition of the Romanian research abroad. The support activities have assured the participation of the Romanian research-development teams in European and international programs.

**Electronic Nose, "Contributions regarding the study, the synthesis and the implementation of certain applications using systems with intelligent sensors"** CNCSIS Contract No. 602/2007, code TD-277.

**"Research regarding the implementation of a neural network used to process signals generated by the muscular and nervous system."** CNCSIS Contract No. 171/02.10.2007, TD-11.

### Significant results

Oniga Stefan – AGEPI Medal - International Fair of Inventions and Practical Ideas "INVEST-INVENT SIR 21" – Gesture recognition system

#### Publications list excerpt

Articles indexed on ISI Web of Knowledge

1. S. Oniga, J. Vegh, I. Orha, "Intelligent Human-Machine Interface Using Hand Gestures Recognition", *Automation Quality and Testing Robotics (AQTR), 2012 IEEE International Conference on*, pp. 559 - 563
2. E. Monmasson, L. Idkhajine, M. N. Cirstea, I. Bahri, A. Tisan, M. W. Naouar, FPGAs in Industrial Control Applications, *IEEE Transactions on Industrial Informatics*, vol.2, issue 2, pp. 224-243, 2011
3. A. Tisan, M. Cirstea, A. Buchman, A. Parera, S. Oniga, D. Ilea, Holistic modeling, design and optimal digital control of a combined renewable power system, *IEEE International Symposium on Industrial Electronics, ISIE 2010; Bari; 4-7 July 2010*, ISBN: 978-142446391-6, pp. 2733-2738
4. A. Tisan, M. Cirstea, S. Oniga, A. Buchman, "Artificial olfaction system with hardware on-chip learning neural networks", *12th International Conference on Optimization of Electrical and Electronic Equipment, OPTIM 2010*, ISSN: 1842-0133, ISBN: 978-1-4244-7020-4, pag. 884-889
5. S. Oniga, A. Tisan, C. Lung, A. Buchman, I. Orha, "Adaptive Hardware-Software Co-Design Platform for Fast Prototyping of Embedded Systems", *12th International Conference on Optimization of Electrical and Electronic Equipment, OPTIM 2010*, ISSN: 1842-0133, ISBN: 978-1-4244-7020-4, pag. 1004-1009
6. Costea C., Load Frequency Control using Multi-Agent Consensus, *Proceedings of the International Conference on Optimization of Electrical and Electronic Equipment, OPTIM, 2010*, Pages 1269-1274, ISSN: 1842-0133 ISBN: 978-1-4244-7019-8
7. Mic, D., Tisan, A., S. Oniga, Lung, C., Sabau, S., 2009, The Development of a Simulink Library with FPGA Compatible Parametric Components for Electric Machines Control, *International Symposium on Signals, Circuits and Systems*, Date: JUL 09-10, 2009 Iasi ROMANIA, ISSCS 2009: International Symposium on Signals, Circuits and Systems, Vols 1 and 2, Proceedings, pag. 561-564
8. Oniga, A., Tisan, D., Mic, C., Lung, I., Orha, A., Buchman, A., Vida-Ratiu, A., 2009, FPGA Implementation of Feed-Forward Neural Networks for Smart Devices Development, ISSCS 2009: *International Symposium on Signals, Circuits and Systems*, Vols 1 and 2, Proceedings, pag. 401-404., WOS:000275854200099
9. Nasui, V., Buchman, A., Implementation of a high resolution velocity sensor using an optical quadrature shaft encoder for electromechanical linear actuators, *Advanced Topics in Optoelectronics, Microelectronics, and Nanotechnologies IV*, 28-31 august, Constanta, Romania, ISBN 978-973-755-387-4, Proc. SPIE, Vol. 7297, 729725 (2009); doi:10.1117/12.823689, Online Publication Date: 7 January 2009

10. Buchman, A., Lungu, S., Oniga, St., Tisan, A., Ultrasonic Echo Detection: Experiments Using Large Beam Angle Transducers in Narrow Tubes, *International Spring Seminar on Electronics Technology*, ISSE 2008, Budapest, Hungary, May 7-11, 2008, pp 111-116, ISBN 978-1-4244-3972-0
11. Costea C., Horgos M.: An Agent-Based Approach to Power System Control, *Proceedings of the 11th International Conferences on Optimization of Electrical and Electronic Equipment*, Braşov, 22-23 mai, 2008 pag 179-184, IEEE Catalog Number 08EX1996, ISBN 1-4244-1544-6, Library of the Congress 2007905111, ISBN 978-973-131-032-9, ISSN 1842-0133
12. Mic, D., Oniga, S., Micu, E., Lung, C., 2008, Complete hardware/software solution for implementing the control of the electrical machines with programmable logic circuits, OPTIM: *Proceedings of the 11th International Conference on Optimization of Electrical and Electronic Equipment*, VOL III, pag: 107-114, May 22-23, 2008 Brasov Romania
13. Oniga, St., Tisan, A., Mic, D., Buchman, A., Vida-Ratiu, A., Optimizing FPGA implementation of feed-forward neural networks, *International Conference on Optimization of Electrical and Electronic Equipment OPTIM 2008*, Brasov, Romania, May 22-23, Vol. IV, pp. 31-36
14. Tisan, A., Oniga, S., Gavrincea, C., Buchman, A., 2008, FPGA Implementation of a self-organized map with on-chip learning, *International Conference on Optimization of Electrical and Electronic Equipment OPTIM 2008*, Brasov, Romania, May 22-23, Vol. IV, pag. 81-86, IEEE Catalog Number 08EX1996, ISBN 1-4244-1544-6
15. Buchman, A., Tisan, A., Oniga, S., Ultrasonic Data Acquisition: Signal to Noise Ratio Improvement, *30th International Spring Seminar on Electronics Technology*, ISSE 2007. Technical University of Cluj-Napoca, ROMANIA, May 9-13, 2007, p. 393 - 398, ISBN 1-4244-1218-8,
16. Gavrincea, C., Tisan, A., Buchman, A., Oniga, S., Survey of wavelet based denoising filter design, *30th International Spring Seminar on Electronics Technology*, ISSE 2007. Technical University of Cluj-Napoca, ROMANIA, May 9-13, 2007, p. 112 - 116, ISBN 1-4244-1218-8
17. Oniga, St., Tisan, A., Mic, D., Buchman, A., Vida-Ratiu, A., Hand Postures Recognition System Using Artificial Neural Networks Implemented in FPGA, *30th International Spring Seminar on Electronics Technology*, ISSE 2007. Technical University of Cluj-Napoca, ROMANIA, May 9-13, 2007, p. 507 - 512, ISBN 1-4244-1218-8, IEEE Catalog Number: 07EX1780C
18. Tisan, A., Buchman, A., Oniga, St., Gavrincea, C., A Generic Control Block for Feedforward Neural Network with On-Chip Delta Rule Learning Algorithm, *30th International Spring Seminar on Electronics Technology*, ISSE 2007. Technical University of Cluj-Napoca, ROMANIA, May 9-13, 2007, p. 567 - 570, ISBN 1-4244-1218-8
19. Tisan, A., Oniga, S., Buchman, A., Gavrincea, C., Architecture and Algorithms for Syntetizable Neural Networks with On-Chip Learning, *8-th International Symposium on Signals, Circuits and Systems*. ISSCS 2007, Iasi, iulie 12 -13, vol 1, pag 265 – 268, ISBN 1-4244-0968-3
20. C.Costea, A.L. Dicso, A distributed control for interconnected systems, *IEEE International Conference on Automation Quality and Testing Robotics, (AQTR)*, 2012 pp.74 - 78, INSPEC Accession Number: 12853508,
21. Ovidiu Cosma, "An evaluation of the multithreading benefits for a network scan application", *Creative Mathematics and Informatics* vol. 17, 2008, ISSN: 1584 – 286X, pp. 110-114
22. Ovidiu Cosma "Image Compression with a human touch", *Creative Mathematics and Informatics* vol. 17 no. 2, 2008, ISSN: 1584 – 286X, pp 93-100
23. Ovidiu Cosma "A method for improving the error diffusion algorithms", *Creative Mathematics and Informatics* vol. 17 no.3, 2008, ISSN 1584 – 286X pp. 375-380
24. Ovidiu Cosma "The efficiency of the image subband coding algorithms based on zerotrees" *Creative Mathematics and Informatics* vol. 18 no.2, 2009 ISSN 1584 – 286X, pp.153-158
25. Ovidiu Cosma "A method of uneven image compression for increasing the accuracy of relevant areas", *Carpathian Journal of Electronic and Computer Engineering* vol. 3 2010, ISSN 1844-9689, pp. 9-12
26. Ovidiu Cosma, "Hiding secret data into a carrier image", *Carpathian Journal of Electronic and Computer Engineering* 2012 Vol. 5 no. 1, ISSN: 1844 – 9689, pp. 53-56

**The offer addressed to the economic environment**

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| Research & development in core areas     | <ul style="list-style-type: none"> <li>– Hardware implementation of artificial neural networks in FPGA circuits.</li> <li>– Development of neural network’s specific blocks for rapid prototyping of application specific neural networks</li> <li>– Intelligent sensors network</li> <li>– Adaptive interfaces with learning capabilities able to adapt to the input signals changes</li> <li>– Multi-agent systems</li> <li>– Ontologies and evolutionary computation</li> <li>– Computer networks, routing protocols</li> <li>– Signal processing, audio signal analysis in stress conditions</li> <li>– Mobile devices communication protocols for collision avoiding</li> </ul> |
| Research & development in applied fields | <ul style="list-style-type: none"> <li>– Development of an intelligent platform (with learning capabilities and adaptive behavior) for health condition monitoring of elderly or persons with disabilities, using wearable wireless sensor</li> <li>– Mobile applications</li> </ul>   |
| Consulting                               | <ul style="list-style-type: none"> <li>– Embedded systems with microcontrollers and PLDs</li> <li>– Data acquisition systems</li> </ul>  |

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|                              | <ul style="list-style-type: none"> <li>- Computer networks</li> <li>- Graphics and Image Processing</li> </ul>   |
| Applied engineering services | idem   |
| Training                     | <ul style="list-style-type: none"> <li>- Design with microcontrollers</li> <li>- Design with FPGA circuits</li> <li>- C/C++, Java, PHP programming languages</li> <li>- Databases</li> <li>- Web programming</li> <li>- Computer networks</li> </ul> |



**Fig.1.** Assistive robots for elders or persons with disabilities



**Fig.2.** Modules for physiological parameters monitoring



**Fig. 3.** Experimental setup for researches regarding wireless sensors



**Fig. 4.** Experimental setup for wireless sensors researches



**Fig. 5.** NI ELVIS Emona DATEx platform



**Fig. 6.** Experimental setup for adaptive interfaces with hardware implemented artificial neural networks