Energy Conversion and Motion Control Systems Research Centre (SCECM)

Research profile

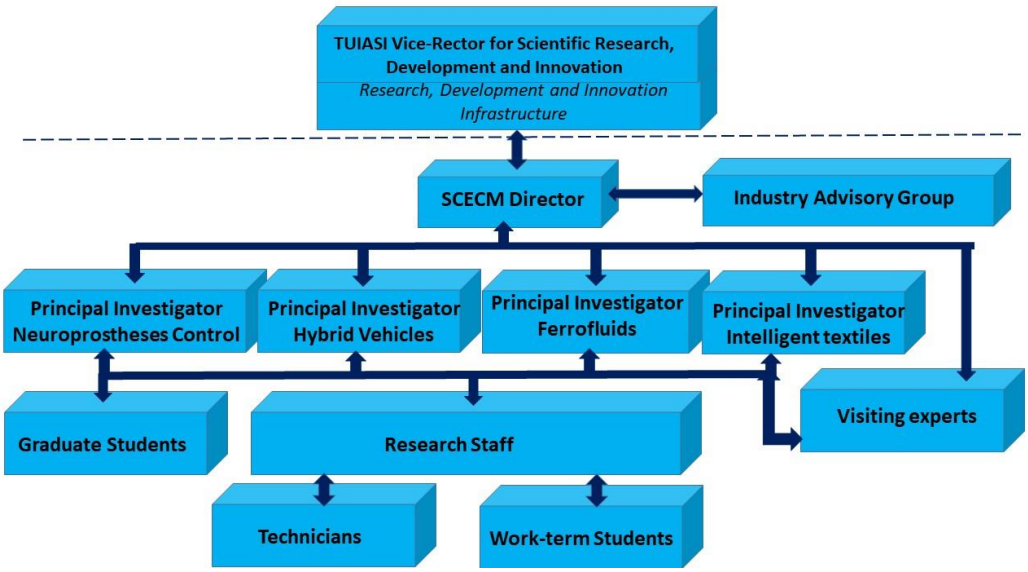
Goals

To strengthen the engineering research in fields as: Functional Electrical Stimulation (FES) and Brain-Computer Interfaces (BCI) based neurorehabilitation, Optimal design of electromagnetic devices, Electromechanical systems control, Functional and technological design and manufacturing of knitted products, as well as to enhance the technological transfer process towards industry of the research outcomes.

Field of activity

- FES&BCI based control in neuroprostheses field; embedded systems for neurorehabilitation.
- Electromechanical systems with improved performances (servos, field oriented control in electrical actuation systems, power electronics);
- Real time control for hybrid vehicles and industrial robots;
- Electromagnetic systems based on permanent magnets and ferrofluids;
- Functional and technological design of knitted products.

Structure



Staff

Prof. Marian-Silviu Poboroniuc: SCECM Director and Neuroprostheses Control Principal Investigator. Professor for Robotics, Neuroprostheses Control and Systems Theory at the Faculty of Electrical Engineering (IEEIA-TUIASI). His current research interests involve mobile robots control, human motion analysis and synthesis, neuroprosthetics, biomechanics, and rehabilitation robotics.

Prof. Gheorghe Livinţ: Hybrid Vehicles Field Principal Investigator. Domains of competence and research interest: Systems Theory, Robust control of electrical systems, Fuzzy logic, H infinity Control, CRONE control, Hybrid electric vehicles.

Prof. Radu Olaru: Ferrofluids Field Principal investigator. Main research interests: electromagnetic devices and systems for measuring, control and actuation.

Prof. Antonela Curteza: Intelligent Textiles Field Principal Investigator. Full professor at the Knitting and Clothing Engineering Department within the Faculty of Textile - Leather Engineering and Industrial Management. Main research interest: Design, Clothing comfort and functions, Smart and functional textile products, Sustainable fashion.

Prof. Dorin Lucache, is professor at Utilizations of Electrical Energy disciplines. Main research interest: energy efficiency utilization, modern lighting, smart electric installations, optimal design of electromagnetic devices, devices for diagnostic based on alternative and complementary medicine.

Prof. Cristian-Gyozo Haba, Faculty of Electrical Engineering. His current research interest is in the fields of: Embedded System Design, Design of digital systems, Remote measuring systems, Digital control of electrical machines.

Prof. Camelia Mihaela Petrescu holds a full professorship tenure at Faculty of Electrical Engineering. Her research interest is in finite element analysis, optimization of electromagnetic devices using stochastic algorithms, high frequency dielectric heating, power quality, magnetic actuators.

Assoc. Prof. Mihai Albu: Director of the Department of Energy Utilization, Actuation and Industrial Automation at IEEIA. Main research: Power Electronics and Urban and railway vehicles: design, monitoring and diagnosis.

Assoc. Prof. Georgel Paicu holds a professorship tenure at Faculty of Electrical Engineering. His current research interest are in the field of motion control systems analysis and design, neuroprostheses control and design.

Assoc.Prof. Nicoleta-Laura Macovei, Knitting and Clothing Engineering Department, Faculty of Textile. Main research interest: Knitting Technologies and Machines, Textile products for people with special needs, Development and optimisation of knitting technologies.

Assoc. Prof. Viorica Creţu, Faculty of Textile, Leather Engineering and Industrial Management. Main research interest: Knitting Technologies and Machines, Textile Metrology, Functional and technological design of knitted products, Technical textile products, Textile products for people with special needs, Design and product development, etc.

Lecturer Mitica Temneanu, IEEIA, expertise area is in Algotithms, Numerical Methods, Systems Theory, Control Engineering, Industrial Informatics.

Lecturer Gabriel Chiriac, IEEIA, research area covers: electric transport, lighting, furnaces.

Lecturer Costica Nituca, IEEIA, research interest's covers the vehicles power collecting, Electrical traction, Technical creativity, Modelling and simulation of the electrical equipment.

Lecturer Elena Serea, IEEIA, deals with design of indoor and outdoor lighting installations, including road and urban lighting, architectural floodlighting, tunnel and underpass lighting, plants growth lighting.

Lecturer Daniel Sticea, IEEIA, deals with Power Electronics, Electrical Drives, Electronic Power Systems, Microprocessors, Scalar Control of Electrical Drives, Vector Control of Electrical Drives and Numerical Control Systems.

Assist.Prof. Danut-Constantin Irimia, IEEIA, deals with Brain-Computer Interface (BCI) based rehabilitation; Functional Electrical Stimulation based rehabilitation, Design and control of neuroprostheses etc.

Assist. Prof. Emil-Constantin Loghin holds its position at Faculty of Textiles, Leather and Industrial Management. His research interests include industrial engineering and electromagnetic shielding materials.

Highlights and achievements

- Grand prize EUROINVENT2017 – "*Mechatronic glove for hand rehabilitation*" (Patent application No. 00072/10.02.2017)- among 544 exhibited inventions from 39 countries.
- INTELLIGENT SYSTEMS AWARD and GOLD MEDAL, CYBER-ARM (OSIM no.693/15.09.2014), 7th Int. Fair of Inventions and Practical Ideas, INVEST-INVENT2016, 15-17.09.2016, Iasi, RO.
- GOLD MEDAL. Curteza A., V. Cretu, L. Macovei, M.Poboroniuc, M. Buzdugan, M. Radu, S. T. Radu, *Knitted product with embeded knitted electrodes as neuroprosthesis to rehabilitate the disabled people due to a neuromotor handicap*; Poster and product. INVENTICA2016-The XX-th Int. Salon of Research, Innovation and Technological Transfer, Iasi, 29.06-01.07.2016.
- CYBERLIFE AWARD - Poboroniuc M. S., Irimia D.C., Serea F., Hartopanu S., Future Medical Devices controlled by means of Brain-Computer Interface. Euroinvent2014.
- GOLD MEDAL - Diplom awarded by Int. Salon of Inventions and New Technologies "NEW TIME" from Sevastopol, Ukraine, Paper: Designing functional products for persons with neuromotor diseases (Curteza A., Macovei L., Cretu V.,Poboroniuc M. S., Kalaoglu F., Karakas H., Gorgun B.), Inventica 2011.

Scientific events

- International Conference and Exposition on Electrical and Power Engineering (EPE2016 and every two years), Iasi, Romania (http://www.epe.tuiasi.ro/);
- International Conference on Electromechanical and Power Systems (SIELMEN2017 and every two years), Chisinau, Republic of Moldavia (http://www.sielmen.tuiasi.ro/2017/).
- *Functional Electrical Stimulation* postuniversitary course, together with "Gr T. Popa" Medicine and Pharmacy University of Iasi and Clinical Rehabilitation Hospital of Iasi (10 editions).

Collaborations

International (selection)

- FP7 project, "Strategic Alignment of Electrical and Information Engineering in European Higher Education Institutions (SALEIE)" No. 527877-LLP-1-2012-1-UK-ERASMUS-ENW, 2012-2015, Coodinator: University of York, UK; Project responsible P12-TUIASI: Marian Poboroniuc (WP3 leader) – more than 30 universities across Europe (http://www.saleie.co.uk/).
- FIPPTex-Advanced Materials and Products Designed for Persons with Special Needs – Romania- Turkey bilateral cooperation – Capacities Module III – 2010-2011, project no.408/03.05.2010); Members: Antonela Curteza (coordinator), Marian Poboroniuc.
- Slovene-Romanian Bilateral Scientific and Technological Cooperation Project: "Standing-up motion augmentation in paraplegia by means of FES and robot technology " (2005- 2007).

National (selection)

- PNII project, IHRG-"AN INTELLIGENT HAPTIC ROBOT GLOVE for the PATIENTS SUFFERING A CEREBROVASCULAR ACCIDENT" No. 150/2012, 2012-2015, Coodinator: University of Bucharest; Project responsible TUIASI: Marian Poboroniuc (other partners: University of Craiova; Rehabilitation Hospital of Iasi).
- PNII project, EXOSLIM -"A HYBRID FES-EXOSKELETON SYSTEM TO REHABILITATE THE UPPER LIMB IN DISABLED PEOPLE" No. 180/2012, 2012-2015, Coodinator: University of Iasi; Project coordinator: Olaru Radu, Scientific director TUIASI: Marian Poboroniuc (Other partners: Technical University of Cluj, Rehabilitation Hospitals of Iasi and Cluj).

Industrials

- PNII project NOVAFES, no.267/2014, Innovative garments with embedded electrodes for functional electrical stimulation based rehabilitation, UEFISCDI- Romania, 2014-2016, Director: Marian Silviu Poboroniuc (partners: Clinical Rehabilitation Hospital of Iasi, SC Magnum SX SRL, SC RO-GALU SRL, Bucharest).

Key publications

1. Poboroniuc M. S., Naaji, A., Ligusova, J., Grout, I., Popescu, D., Ward, T., Grindei, L., Ruseva, Y., Bencheva, N. & Jackson, N. (2017). ICT security curriculum or how to respond to current global challenges. World J. on Educational Technology: Current Issues. Vol.9(1), 39-48, 2017.
2. Grigoras V.-A., Irimia D.C., Poboroniuc M. S., Popescu C.D., 2016, Testing of a Hybrid FES-Robot Assisted Hand Motor Training Program in Sub-Acute Stroke Survivors, AECE J., Vol.16(4), pp. 89-94, ISSN: 1582-7445, e-ISSN: 1844-7600, DOI: 10.4316/AECE.2016.04014.
3. Curteza A., Cretu V., Macovei L., Poboroniuc M. S., 2016, The Manufacturing of Textile Products with Incorporated Electrodes, AUTEX Research J., DOI: 10.1515/aut-2015-0049.
4. Radu Olaru, Alexandru Arcire, Camelia Petrescu, Marius Mugurel. Mihai, Bogdan Gîrtan, A novel vibration actuator based on active magnetic spring, Sensors and Actuators A–Physical, vol. 264, 1 September 2017, pp.11-17. ISSN 0924-4247. DOI: 10.1016/j.sna.2017.07.041.
5. Livint Gheorghe, Horga Vasile, Sticea, Daniel, Ratoi Marcel, Albu Mihai, Hybrid Electric Vehicle Experimental Model with CAN Network Real Time Control, Advances in Electrical and Computer Engineering, Vol.10, Issue No.2, 102-107, 2010.

RC Coordinator

Marian-Silviu Poboroniuc is professor at Faculty of Electrical Engineering (IEEIA), and member of the IEEIA Council. He obtained the EE degree at the IEEIA-TUIASI and his PhD at Politehnica University of Bucharest. In 2001 he joined the Institute of Automatic Control Engineering, TU Munich where he has pursued postdoctoral research in modelling and control of neuroprostheses as NeuralPRO TMR Fellow. He continued his postdoctoral work as NeuralPRO Control Engineer within the Department of Medical Physics and Biomedical Engineering, University College of London. In 2003, he returned to the Gheorghe Asachi Technical University of Iasi where he coordinated several research projects dealing with neuroprosthesis control algorithms and he is also active in the Neurology Clinic of the Rehabilitation Hospital of Iasi by jointly teaching FES courses and developing neuroprostheses supporting gait and arm therapies. His current research interests involve human motion analysis and synthesis, neuroprostheses, biomechanics, and FES&BCI based rehabilitation. He authored and co-authored more than 100 journal and conference articles and 6 licence patents. The last important achievement is the Grand Prize at EUROINVENT2017.

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NEUROPROSTHESES AND MOBILE ROBOTICS CONTROL (ALGCON)

Research profile

Mobile robotics applications and control

Functional Electrical Stimulation (FES) & Brain-Computer Interface (BCI) based rehabilitation

Design and control of neuroprostheses

Embedded system design based on microcontrollers and FPGAs

Competences / Infrastructure
FES devices application in stroke rehabilitation

BCI-based application in mobile robotics and neurorehabilitation (e.g. RecoveriX)

Robotics control

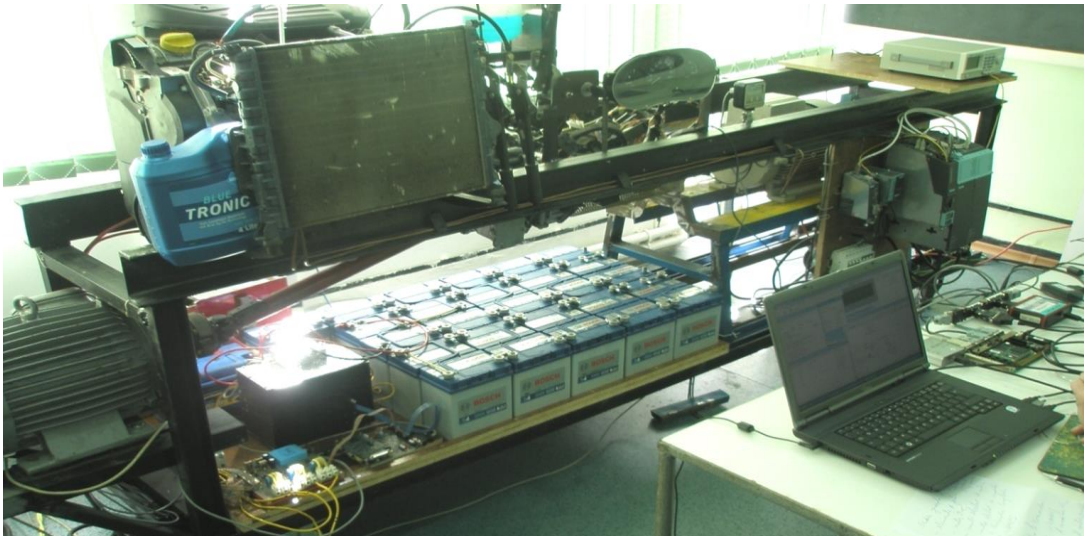
Infrastructure:

- mobile and humanoid robots (e.g. NAO, A4WD1, Kondo);
- FES devices: O4CHS, MS2v2, ODFS PACE, MotionStim8;
- BCI systems: g.BCIsys16USB, g.Nautilus, RecoveriX.
- Neuroprostheses test benches: Emulobody1, Emulobody2, EXOSLIM, IHRG.

RL Coordinator, contact details
Professor Marian-Silviu Poboroniuc, email: mpobor@tuiasi.ro ; WWW: http://iota.ee.tuiasi.ro/~mpobor/ , Faculty of Electrical Engineering, room. EN310, Bvd.Dimitrie Mangeron 21-22, Iasi, Romania.

RL location details
Faculty of Electrical Engineering, room. E303, Bvd.Dimitrie Mangeron 21-22, Iasi, Romania.

Contact details
https://erris.gov.ro/SCECM ; Email: mpobor@tuiasi.ro ; www.ee.tuiasi.ro .



RESEARCH LABORATORY: **HYBRID ELECTRIC VEHICLE**

Research profile

Electrical drives and power electronics

- Power inverters and converters for machine drives
- Power supply sources for hybrid electric vehicles and industrial applications

Drive control and power management on hybrid electric vehicles

- Vectorial electric drive control
- Robust control algorithms: Crone, H^{∞}
- Power and energy management, efficiency management

Competences / Infrastructure

- Modeling and simulation of the power electronic systems (Orcad, PSpice)
- Power converters for electrical and hybrid vehicles, design and execution
- Modeling and simulation electrical drives (Matlab -Simulink, -SimPower Systems)
- Vectorial control for induction and synchronous machines
- Design and implementation of control algorithms for power management,
- Real time and distributed control of electric drives on hybrid vehicles

- **Modern test benches** provided with speed, torque, current and voltage transducers and acquisition data system

- **Specialized software package** for control and simulation (**Matlab - SIMULINK**)

- **dSPACE 1104 R&D Controller Board** with Real-Time Interface (RTI) that represents a powerful development system for rapid control prototyping

- **Sundry equipments**: oscilloscopes Tektronix, power analyzer Analyst / Chauvin Arnoux etc.

RL Coordinator, contact details: ***Professor Gheorghe Livinţ***

RL location details: Faculty of Electrical Engineering of Iasi, 21-23 Prof. D. Mangeron Str.Iasi 700050, Romania, www.ee.tuiasi.ro

RESEARCH LABORATORY: **NON-CONVENTIONAL ELECTROMAGNETIC AND ELECTROMECHANICAL SYSTEMS**

Research profile

Sensors and transducers

- Sensors based on ferrofluids and magnets
- Transducers using own sensors for measuring mechanical quantities

Actuators

- Ferrofluid and magnet based miniactuators
- Actuators based on magnets: vibration actuators (vibration-based electrical generators, generators and dampers of vibration), actuators with magnetic springs for the generation and control of movement and force

Competences / Infrastructure

- Mathematical modelling and numerical simulation of electromagnetic sensors
- Mathematical modelling and numerical simulation of electromagnetic actuators
- Numerical analysis and optimal design of electromagnetic and electromechanical devices
- **Modern test benches** provided with power signal generators, displacement, position and force transducers, accelerometers and acquisition data system (Arduino Uno)
- **Specialized software package** for simulation (**COMSOL Multiphysics**, **Matlab - SIMULINK**)
- **Sundry equipments**: oscilloscopes, vibrometer, gaussmeter, RLC meters etc.

RL Coordinator, contact details: ***Professor Radu Olaru***

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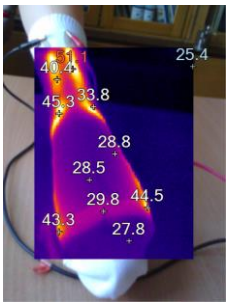

Smart Textiles Research Laboratory

Research profile

- Functional and technological design of knitted products
- Technical textile products
- Textile products for people with special needs
- Clothing comfort and functions
- Design and product development
- Sustainability in Textiles and Fashion

Competences / Infrastructure

-Functional development and evaluation of technical textiles.
-Comfort evaluation emphasizing the heat and humidity management of textile/products structures.
-Subjective and objective methods of comfort evaluation.
-Integrating new functions in textile structures.
-Development of highly functional products made of knitted textile layers, for flat and three-dimensional displays.
-Analyses and implementation of the product development processes.
-Specific design principles applied in the areas of technical textiles and of products for people with special needs (design for all, adaptive design).
-Implementation of the corresponding software solutions to maximize quality and profitability.
-Researches focused on the sustainability of textile products and assessment.
Drying Rate Tester - SDL ATLAS, USA: a method of measuring the drying rate of a fabric.
EinScan-Pro - Multi-functional Handheld 3D Scanner**:** for full 3D color scanning of the human body and objects.
PERMETEST: for the evaluation of thermal resistance of textile fabrics.
Togmeter: an instrument to measure the thermal resistance of textiles.
Water Vapor Permeability Tester: to determine the resistance of textiles and textile composites (particularly performance wear fabrics) to water vapour penetration.

RL Coordinator, contact details: ***Professor Antonela Curteza***, e-mail: ACurteza@gmail.com

RL location details: Faculty of Textiles-Leather and Industrial Engineering of Iasi, 53 Prof. D. Mangeron Str.,Iasi 700050, Romania, http://www.tpmi.tuiasi.ro