ADVANCED MECHATRONIC SYSTEMS LABORATORY

Contact details

Name	**Advanced Mechatronic Systems Laboratory**
Acronym	**AMS**
Logo	Advanced Mechatronic Systems
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Areas of expertise

Advanced Mechatronic Systems:
- Virtual Reality: design mechatronic systems with the assistance of virtual reality technology, which can benefit clearly from immersion and 3D. This virtual reality-based approach can be applied for the testing of intelligent mechatronic systems. Virtual reality facilitates the analysis of tests by the combination of virtual 3D models and visualization techniques.
- **Optimal design and control of parallel robots:** Parallel robots present better performances in comparison with serial robots. However, due to the strong dependence of geometric parameters and their performances, the corresponding design problems for the parallel robots are much more complex and the adequacy and effectiveness of the design method become more critical. In order to overcome this genetic algorithm optimization can be applied.
- **Haptic devices and Exoskeletons:** these mechatronic systems can be used for virtual reality and tele-presence applications. The development of even more capable devices that can accurately reproduce a large range of haptic information is an important component for the technologies of virtual reality and tele-presence. Exoskeletons can bring up a valuable contribution to the applications where the workspace is strategic.
- **Mechatronics research and training:** current research includes development of concepts, algorithms, theories, and methodologies for synergistic integration of precision mechanical engineering with advanced electronics and computer control in the design of mechatronic systems.
- **Advanced programming in MATLAB:** advanced topics like GUIs/APPs, Simulink/Simscape, interfaces with Arduino/Raspberry Pi & QUANSER control boards, ROS with MATLAB.
- Robot programming: FANUC, Epson T3 SCARA robot

Team

Assoc. Prof. Dr. Eng. Sergiu-Dan Stan, Assoc. Prof. Dr. Eng. Emil Teuțan, Senior lecturer. Dr. Eng. Alin Plesa, Assoc. Prof. Dr. Eng. Ionut Muntean.

Representative projects

EXORAS. "**New Haptic Arm Exoskeletons for Robotics and Automation in Space**" (2012-2015). National project, the project seeks to develop in Romania capacity building at national level and to stimulate Romania's participation to international space missions and programs – in particular ESA, in the field of Robotic Exploration. The impact will be to develop new haptic arm exoskeleton to enable in-space force-feedback telemanipulation with redundant robotic arms, and so help enable new policies in Romania such as robotic exploration, as well as supporting Romania towards increased participation to ESA programs.
GREENet. "**Globally Recoverable and Eco-friendly E-equipment Network with Distributed Information Service**

Management" (2011-2014). European FP7 project, aimed to establish closer international cooperation and to share and develop research on globally sustainable Waste Electrical and Electronic Equipment (WEEE) management is timely and significant. This GREENet project is aimed at teaming up multi-disciplinary research teams from the EU and China to enhance the knowledge base and achieve research synergies as integrated technical solutions in the relevant areas.
SMART. "**Complex mechatronic systems for medical applications**" (2008-2011). National project, the project aimed of realization of integrated, innovative system regarding the complex mechatronic systems for medical applications.
CLEM. "**CLoud services for E-learning in Mechatronics technology**" (2012-2013). European project, Leonardo da Vinci Development of Innovation type, the CLEM project is the first step to fulfil the vision of establishing "a global Mechatronics technology in VET knowledge repository for exchange and sharing".
MIND. Development of mechatronics skills and innovative learning methods for Industry 4.0 (2019-2021).
XP2P. Crossing Borders: Peer-to-Peer Education in Mechatronics (2019-2022).
SMART2. "Advanced integrated obstacle and track intrusion detection system for smart automation of rail transport" (2019-2022). SMART2 research on-board long-range all-weather obstacle detection (OD) and track intrusion detection (TID) system. 2 new systems will be also researched, innovate and developed: advanced SMART2 trackside (TS) /airborne OD&TID systems. All 3 systems will be integrated into a holistic OD&TDI system via interfaces to central Decision Support System (DSS). **AMS laboratory** responsible for airborne OD&TID system.

Significant results

The most representative publications of the past 5 years:

1. Teutan, Emil; Rafa, Vasile, ANALYSIS AND FUZZY SIMULATION OF A PUMP WITH ECCENTRIC FOR NATURAL GASES ODORIZED ACTA TECHNICA NAPOCENSIS SERIES-APPLIED MATHEMATICS MECHANICS AND ENGINEERING Volume: 61 Issue: 1 Pages: 55-60 Published: MAR 2018
2. Tatar, Mihai Olimpiu; Petre, Barbu; Teutan, Emil, Design and Development of the Hybrid Mobile Robots 21st IEEE International Conference on Automation, Quality and Testing, Robotics (AQTR THETA) Location: Cluj-Napoca, ROMANIA Date: MAY 24-26, 2018 Book Series: IEEE International Conference on Automation Quality and Testing Robotics Published: 2018
3. Verba, Nandor; Chao, Kuo-Ming; James, Anne; et al., Platform as a service gateway for the Fog of Things ADVANCED ENGINEERING INFORMATICS Volume: 33 Pages: 243-257 Published: AUG 2017
4. Lovasz, Erwin-Christian; Margineanu, Dan Teodor; Ciupe, Valentin; et al., Design and control solutions for haptic elbow exoskeleton module used in space telerobotics MECHANISM AND MACHINE THEORY Volume: 107 Pages: 384-398 Published: JAN 2017
5. Chao, Kuo-Ming; James, Anne E.; Nanos, Antonios G.; et al., Cloud E-learning for Mechatronics: CLEM FUTURE GENERATION COMPUTER SYSTEMS-THE INTERNATIONAL JOURNAL OF ESCIENCE Volume: 48 Pages: 46-59 Published: JUL 2015
6. Ordean, M.-N.; Oarcea, A.; Stan, S.-D.; Dumitru, D.-M.; Cobîlean, V.; Bîrză, M.-C. Analysis of Available Solutions for the Improvement of Body Posture in Chairs. Appl. Sci. 2022, 12, 6489. https://doi.org/10.3390/app12136489.
7. Stan, S.-D.; Popişter, F.; Oarcea, A.; Ciudin, P. Comparative Study Using CAD Optimization Tools for the Workspace of a 6DOF Parallel Kinematics Machine. Appl. Sci. 2022, 12, 9258. https://doi.org/10.3390/app12189258.

Products and technologies

1. Real-time control of mechatronic systems
2. Optimal design of parallel robots using genetic algorithms
3. Control of industrial Fanuc robots; 4. Design and development of Soft Robotics systems

The offer addressed to the economic environment

Research & development	Development of solutions for modelling mechatronic systems. Development of original algorithms for optimization with genetic algorithms of mechatronic systems, Development of solutions for control of CNC machines/ robot systems; Development of airborne OD&TID systems; Design, control and development of Soft Robotics systems.
Consulting	Consulting, design, research and prototyping of mechatronic systems, control of industrial Fanuc robots
Applied engineering services	Custom solutions for specific issues regarding the implementation of mechatronic systems
Training	**MATLAB programming**: getting started with Matlab, m-files, Graphical User Interfaces, Virtual Reality, Simulink/Simscape Toolbox..etc. **Optimal design with Genetic Algorithms**: optimization, genetic algorithms, Pareto optimal front, multicriteria optimization. **Arduino**: hardware, breadboards and prototyping, simple electronic components, Introduction to important programming concepts, software interface with MATLAB. **Quanser:** teaching platform for controls and mechatronics with MATLAB/Simulink **Fanuc robots:** hands-on robotics learning for the future of mechatronics and automation, teaching experience of programming and operating cutting-edge industrial Fanuc robots. **EPSON T3 SCARA robot:** teaching robot programming.

Last updated: January 2025