# Advanced Mechatronic Systems

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<tr>
<th><strong>Activity area, research objectives</strong></th>
<th><strong>Keywords</strong></th>
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<td>• Development of high performance mechatronic systems for the analysis and test of human body behaviour;</td>
<td>Mechatronics, biomechatronics, pneumatics, hydronics, agromechatronics, integronics, light structures.</td>
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<td>• Design, modelling and testing of intelligent systems for measuring, acquisition and interpretation of high precision products results;</td>
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<tr>
<td>• Modelling, simulation and optimization of light and ultra-light structures, with applications in mechatronics systems;</td>
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<td>• Scientific research, design, expertise and consulting for high precision products and mechatronic systems.</td>
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## Profile of research group

The research group was formed in 2005 on the structure of the old Research centre CESMA CC-C68. The research centre **Advanced Mechatronic Systems** consists of 16 permanent members, out of which 4 are Ph.D. supervisors coordinating 16 doctoral research programs and 2 post-doctoral. The activity of the team members is focused upon: scientific research, results capitalization (development, innovation and technology transfer), consulting and testing services provided to beneficiaries of the economic environment on two important directions:

- **Advanced mechatronic systems with applications in industry and agriculture**;
- **Advanced mechatronic systems with applications in medicine**.

These two activity directions are found in five complementary sub-areas:

I. Measurements of structural and functional parameters as well as quality assessment for high precision products;

II. Data acquisition for processes investigation, monitoring and control;

III. Monitoring the human comfort state in the development of productive activities; Analysis of physiological performances in motion activities; Medical assessment/ sportive assessment/ biomechanical recovery/ rehabilitation degree;

IV. Screening activities and services for human behaviour evaluation, human performance level, ergonomics and work safety;

V. Concept, design and rapid prototyping of high precision mechatronic systems.

## Research development products, inventions, use cases


   *Sandwich panel with expanded cellular core.*

   The applicability of this product can be found in the vehicle construction field, generally (terrestrial, naval, aircrafts), in order to reduce weight, thus accomplishing lower energy consumption required by setting them into motion. Also, the sandwich panel with expanded cellular core *ExpaAsym* may be used in special constructions to damp energy resulted from impacts, explosions, thus accomplishing the impact protection.

Materials property of impact energy dissipation due to some impulse type forces (collisions, explosions) is of high interest in case of some applications related to terrestrial, naval or space vehicles, in order to increase the safety for passengers, cargo or some vital functional assemblies, as well as in civil constructions industry, for the protection of high security objectives.


The invention refers to a mechatronic system for medical recovery in case of locomotion problems of the lower limb. The systems works upon the principle of medical recovery by kineto-therapy (therapy by motion) and assumes training the leg with locomotion problems based upon a recovery program created by similarity to the natural motion of the healthy leg.

### Completed projects and research projects in progress at national and international level

1. **Project Microscopic analysis of atypical bearings structures** - RKB Europe SA–Switzerland.
   The project was financed by RKB Europe-Switzerland with 50000€, (2009-2011) consisted of the quality, dimensional, structural and material analysis of 50 types of special bearings for manufacturing these products at RKB Europe-Switzerland.

2. **Project PNII CAPACITĂŢI** - Multidisciplinary research base for the management of modelling, design and manufacturing of mechatronic systems with applications in industry and medicine, (2007-2009), CNPM-114 – Manager - Prof. dr. eng. CRISTEA L. Based upon the developed research infrastructure, the research team of the centre provides the following services:

   - Modelling, design and implementation of measuring, acquisition and results interpretation in order to characterize them in real time.
   - Scanning objects of any size, parts’ surfaces inspection, generation of 3D digital files for existing objects, correction, reconstruction, conversion in different CAD formats and preparing for prototyping.
   - Assessment of 3D models conformity with respect to the original parts and of manufactured parts with respect to the models, surfaces reconstruction, 3D modelling, investigation, errors assessment and correction.
   - Analysis of moving objects, analysis of different parts of the body in motion (biomechanics), non-destructive testing, industrial inspection, faults identification.
   - Design and manufacturing of electronic modules.
   - Design, modelling and manufacturing of assemblies, subassemblies and single parts of ABS Plus (Acrylonitrile Butadian Styrene), as well as manufacturing of prototypes and models with applications in industry and medicine.
   - Design, optimization and implementation of processes' automation in industry and medicine, study and testing human-machine interfaces, creation of control algorithms based on: perception and reasoning; Fuzzy logics; neural networks.

Project manager: prof. dr. eng. Cristea L., work groups coordinators: prof. dr. eng. Baritz M. and
3. Projects CNCSIS A and PNII IDEI coordinated by teaching staff members of the centre

The projects solved by the researchers team can be divided into three basic directions:

A. Measurements of constructive and functional parameters as well as quality assessment for high precision products:

- Manufacturing of high resolution mechatronic systems used for manipulating, transport and control of products on technological transfer lines, CEEX (2006-2008) - Prof. dr. eng. OLTEANU C. - partner coordinator.

- Structural and functional improvement of automated systems for micro-dimensional inspection of micro-bearings, CNCSIS A (2005-2007) – Manager - Prof. dr. eng. CRISTEA L.

- Identification by modelling and experimental analysis of the nano-composites properties used in antifriction bearings construction. Application for directional gyro, CEEX (2006-2008) – Manager - Assoc. prof dr. eng. COTOROS D.

- Contributions to the measurement process at checkpoints level for industrial automatons, CNCSIS TD (2005-2006) – Lecturer. dr. eng. BRAUN B.

The team that participated in this contracts consisted of 11 researchers.

B. Monitoring of human comfort state in the development of productive activities; Analysis of physiological performances in motion activities; Medical/sportive evaluation/ biomechanical recovery/ rehabilitation degree;

- Investigation technique based on an interconnected computerized system of human bio-behavioural performances - PNII IDEI, (2009-2011), Manager - Prof. dr. eng BARITZ M.

- Contributions to the analysis, modelling and simulation of modern mechatronic systems for medical recovery, CNCSIS IDEI (2007-2009) – Manager – Assoc. prof. dr. eng. BARBU D.
- Computerized method for correlative biomechanical modelling of rigid implants, PNII IDEI, (2009-2011), Manager – Assoc. prof. dr. Eng. COTOROS D.
- Improvement of audio video techniques and intelligent environments implemented in the optimization of bio-systems investigation methods and assisting disabled persons, CNCSIS A (2005-2007) – Director - Prof. dr. eng. BARITZ M.
- Analysis, modelling and simulation of human body behaviour in an environment polluted by shocks and vibrations with involvement in eye prosthesis and orthotics, CNCSIS AT (2005-2007) – Manager – Assoc. prof. dr. eng. BARBU D.
- Advanced models and systems for human body protection against vibrations and prevention of professional diseases, CNCSIS A (2006-2009) – Manager - Prof. dr. eng. LACHE S.
- Improvement and optimization of investigation methods and structures used in public health preventions, CNCSIS A (2007-2008) – Manager - Prof. dr. eng. ROȘCA I.

The team who participated in these contracts consisted of 14 researchers.

C. Data acquisition for investigation, monitoring and processes control; Concept, design and rapid prototyping of high precision mechatronic systems; Modelling, simulation and optimization of light and ultra-light structures, with applications in mechatronic systems;
- Robotic miniature system with reconfiguration and self-multiplication abilities, CEEX (2006-2008) – Prof. dr. eng. CRISTEA L - partner coordinator.
- Checking and technological integration of intelligent materials and structures, CEEX (2006-2008) – Prof. dr. physicist ZAMFIRA S. - partner coordinator.
- Integrated system for indexing and on-line sharing of digitized technical documents, PNII Partnerships, (2008-2010), Prof. dr. eng. REPANOVICI A. - partner coordinator.
- Techniques for the management of digital content, PNII Partnerships, (2008-2010),Prof. dr. eng. REPANOVICI A. - partner coordinator.

The team that contributed to these contracts consisted of 17 researchers.

4. Projects coordinated by young researchers in the research centre
- Contributions to the study of prosthetic elements obtained by rapid prototyping, CNCSIS TD (2005-2006) – dr. eng. RADU C.
- Optimization and modularization of interdisciplinary techniques in order to develop sustainable innovative solutions in the field of prototyping and control of mechatronic components with application in industry and medicine POST – DOC DD (2010-2013) – Lecturer dr. eng. BRAUN B.
Practical and economical solution for manufacturing some orthopaedic orthotic devices.

Selection of 7 recent publications representative for the research team

Since the foundation, the team members published over 230 monographs and articles in ISI Thomson, Web of Science indexed journals and volumes dedicated to prestigious scientific manifestations in their research areas.


Contact

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