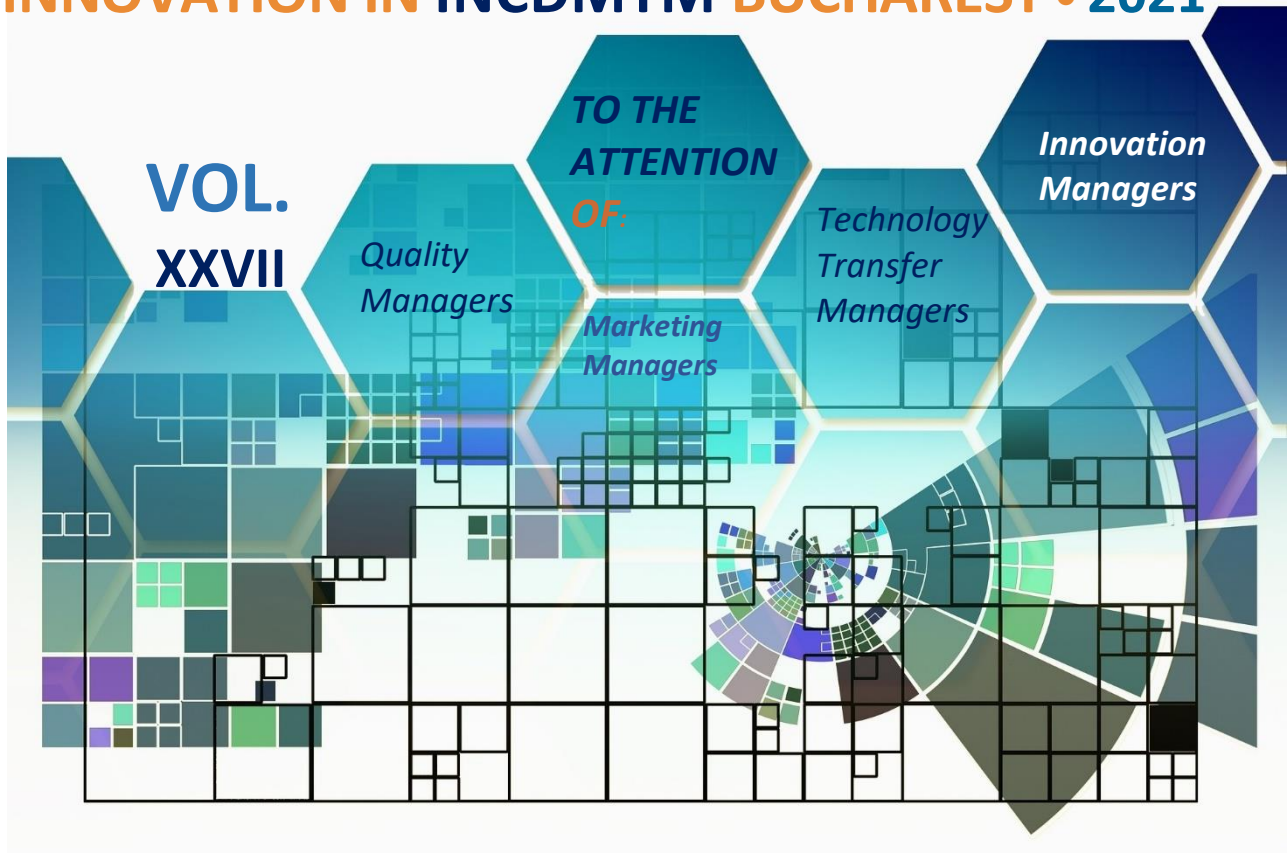


## RESULTS OF RESEARCH, DEVELOPMENT & INNOVATION IN INCDMTM BUCHAREST • 2021





# RESULTS OF RESEARCH, DEVELOPMENT & INNOVATION IN INCDMTM BUCHAREST 2021 VOL. XXVII



## CONTENTS

INSTITUTE OVERVIEW .....	5
«SMART MECHATRONIC MEASUREMENTS» R&D DEPARTMENT .....	6
«BIOMEDICAL AND ROBOTIC MECHATRONICS» R&D DEPARTMENT .....	6
«MECHATRONIC MICRO AND NANOTECHNOLOGIES» R&D DEPARTMENT .....	6
STRATEGY & MARKETING DEPARTMENT .....	6
«INTEGRATED MANAGEMENT» DEPARTMENT.....	6
THE RELAY CENTRE FOR TECHNOLOGY TRANSFER AND CONSULTANCY .....	6
CRTTC – INCDMTM .....	6
BENCHMARKING NETWORK .....	6
“CE-MECATRON” - CENTRE FOR PROFESSIONAL COMPETENCES IN MECHATRONICS EVALUATION	
“CF-MECATRON” - CENTRE FOR PROFESSIONAL TRAINING IN MECHATRONICS .....	6
CYBER-MECHATRONICS RESEARCH LABORATORY .....	6
ACCREDITED TESTING LABORATORIES.....	6
RESEARCH-INNOVATION LABORATORIES .....	6
2021 SCIENTIFIC OUTCOMES.....	6

## INSTITUTE OVERVIEW

The National Institute of Research and Development in Mechatronics and Measurement Technique (INCDMTM), headquartered in Bucharest, Romania, is active in basic and applied research and development, focused on mechatronics and smart measurement techniques, with more than 50 years of experience in the field.

INCDMTM is a reliable partner for organizations from research, education and business environment, as proven by successful partnerships in two directions: scientific cooperation and technological services for private companies.

INCDMTM developed its capabilities in accordance with National and European trends and guidelines, as proven by advanced laboratory infrastructure, the existence of the technology transfer centre and the existence of the Regional Cluster for Mechatronics.

Since November 2020 we have created the Support Centre for international RDI projects in the field of Mechatronics.

The quality of research work is proven by a large number of national and international prizes and distinctions received by our research staff every year.

Our staff is composed of more than 100 employees, with strong backgrounds in research, engineering, marketing, strategy, IP and technology transfer.

Our skilled teams of engineers and researchers work together to find new perspectives and innovative solutions to problems arising from today's industry and society needs, that require multidisciplinary approaches in the following competence areas:

1. Smart Measurement Mechatronics and manufacturing technologies
2. Biomedical Mechatronics and Robotics
3. Mechatronic Micro and Nanotechnologies

Our research topics are useful in a variety of industries:

- Mechanical and plant engineering
- Industrial automation
- Automotive
- Smart home and smart city.

Besides, we have a team of experts in technology transfer, IP, communication and dissemination of RDI results, and also professionals actively involved in shaping national RDI strategy and public policies.

**Strategy, mission and vision:**

- ✓ Our strategy is to enhance innovation and creativity driven by inter and multidisciplinary research in Mechatronics and Measurement Techniques. At the same time, we are constantly increasing our focus on the transfer of knowledge, products, technologies and smart services to business environment, and especially to SMEs.
- ✓ As we implement our strategy, we focus on excellent and innovative research for developing knowledge-based economy in Romania and integration in the European Research Area.
- ✓ INCDMTM assumes the concept of innovative institute both regarding the training of human resources in excellent and innovative research and regarding the R&D activity itself, that produces know-how, innovations and products, and advanced technologies related to intelligent economic growth.

**Aims & Objectives:**

- ✓ The main goal of our institute is excellence and innovative research. To reach this goal, INCDMTM has a long-term strategy for human resources in accordance with the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers, and a sound IP, Technology Transfer and Innovation Management Policy.
- ✓ To promote, support and develop the creative potential of the young generation of researchers
- ✓ To encourage creativity, freedom and perpetual self-actualization of all categories of employees
- ✓ To increase the international involvement of our institute, to develop as a consequence the international cooperation
- ✓ To be actively involvement in digital transformation process and shaping public policies in RDI field

NCDMTM contribute to specific ecosystem field of mechatronics by getting involved as an official member in the following organizations:

- Romanian Chamber of Commerce and Industry, Bucharest
- Strategic Innovative Cluster for Mechatronics Smart Specialization Domain - «MECHATREC»
- General Engineers' Association in Romania
- Romanian Society of Mechatronics
- The Patronage Confederation of Romanian Industry
- Association of the Romanian Patronage in Precision Mechanics, Optics and Mechatronics Industry

**INCDMTM has been the subject of an international evaluation process and received the highest rank A+.**

**In 2021, following the institutional evaluation process, INCDMTM was accredited for the next five years.**



**«SMART MECHATRONIC  
MEASUREMENTS» R&D  
DEPARTMENT**

**THE R&D DEPARTMENT FOR  
SMART MECHATRONIC MEASUREMENT  
offers  
Professional solutions and services**

The INCDMTM proposal – through the **DEPARTMENT OF RESEARCH AND DEVELOPMENT FOR SMART MECHATRONIC MEASUREMENT**-comprises a wide palette of computer-aided intelligent complex measuring and integrated control equipments.

The **DEPARTMENT OF RESEARCH AND DEVELOPMENT FOR SMART MECHATRONIC MEASUREMENT**, oriented on producing and developing mechatronic measuring means and techniques is prepared to help clients efficiently with the view to obtaining a quality production and to transform production in a intelligent production processes.

The **DEPARTMENT OF RESEARCH AND DEVELOPMENT FOR SMART MECHATRONIC MEASUREMENT** also offers service; this facility includes:

- Putting into operation;
- Training;
- Warranty;
- Service;
- Maintenance and product remedy contracts.

## DEVELOPING AND TESTING/OPTIMIZATION OF A TECHNOLOGICALLY ADVANCED SYSTEM FOR MANUFACTURING AND INSPECTION OF THE MEDIUM SIZE INNER AND OUTER RINGS OF ROLLER BEARINGS, MANUFACTURED ON CNC MACHINETOOLS

### Part 2 - Nondestructive testing of rolling bearings rings

**Subsidiary contract 2791/2018 of the project:** Knowledge Transfer Partnerships to Enhance Business Competitiveness in the Field "Automotive Industry and Components" and Improve Road Traffic Safety – KTAutoComp

Project co-financed by the European Regional Development Fund through Competitiveness Operational Programme 2014 – 2020

Call identifier: **POC-A1-A1.1.4-E-2015**

**SMIS Code:** 105552

**Partner:** SC COMIS SRL

#### Generalities

Bearings are critical components in almost all rotating machines. There are many safety-critical applications and major economic consequences if the bearing components fail or do not meet their quality requirements. Bearing components manufacturers need to ensure 100% of manufactured parts sent to customers are defect-free.

Today, modern non-destructive testing technologies are performed at large bearing companies (SKF, Schaeffler, etc.) in different stages of the manufacturing process, to ensure products integrity and reliability. Nondestructive Testing (NDT) techniques assess the conditions of tested components without affecting their structural functionality.

The most common types of defects that can occur on the surface of bearing rings as a result of the manufacturing process are: cracks, cavities, pores, grinding burn, inclusions.

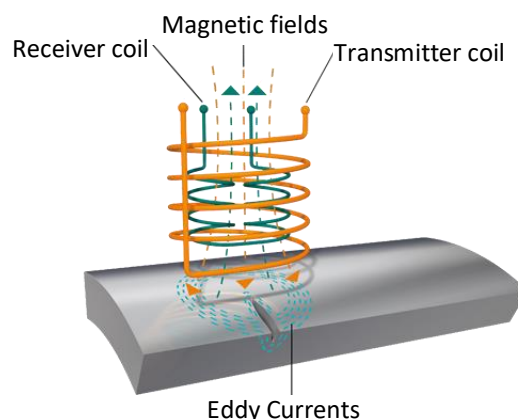


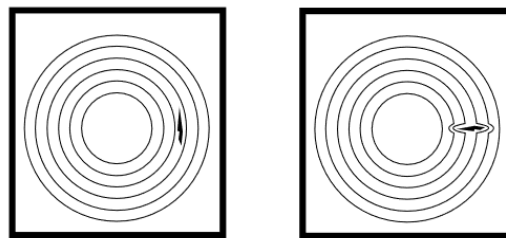
Figure 1: Eddy Current Testing principle

Eddy current testing is very effective at finding surface cracks and flaws in conductive metal components. For eddy current testing, a probe is moved contactless over the test part. Inside a probe are two coils. One of the coil is used as transmitter coil, which is supplied with an alternating current. These alternating current generates an alternating magnetic field (primary field), which induces eddy currents in the test part. These eddy currents generates also a magnetic

field (secondary field), which according to the law of Lenz counteract against the temporal change of the primary field. A receiver coil measures the induced voltage of the resulting magnetic field [Michael Pfaller - Eddy Current Instruments: advantages, applications, and capabilities for defects detection].

Defect sensitivity is proportional to the magnitude of the field in surface probe. As a general rule the field diameter should be equal to or less than the expected defect length.

The defect sensitivity also depends on direction of the crack in relation to the eddy current flow. When testing for flaws such as cracks, it is essential that the eddy current flow be at a large angle (preferably perpendicular) to the crack to obtain maximum response. Thus, a discontinuity is least detectable when its longest dimension is parallel to the trajectory of the eddy current (Figure 2.a) and most detectable when its longest dimension is perpendicular to the flow paths (Figure 2.b).



a. Low sensitivity    b. Maximum sensitivity

- a. Discontinuities parallel to the direction of eddy current flow;
- b. Discontinuities perpendicular to the direction of eddy current flow

Figure 2. Influence of crack direction on eddy current testing sensitivity

Suitable electronics can analyze the receiving signals while the test parts is scanned to get information about the surface conditions. If a defect pattern is well known, the test electronics can be specifically set to these defined cracks in order to only sort out parts with these defects. The probes can be specially adapted and individually manufactured for various applications. Companies like Foerster, ROHMANN and others, produce a wide range of fixed and rotary eddy-current probes, with high test sensitivity, various types of construction (e.g. round, pointed, flat, angled), with different track widths (0,5 ...5 mm) and different test frequencies (up to 1 MHz or 10 MHz), for the targeted testing.



Figure 3: Eddy current standard probes [Foerster]

Bearing rings manufacturing provides good conditions for eddy current inspection (Juergen Lauer – Rohmann GMBH):

- Low manufacturing tolerances in the  $\mu\text{m}$  range
- Very good runout properties (concentricity)
- Low roughness (very good signal/noise ratio)
- Simple geometries (parts of revolution – best conditions for automation)

- Clean surfaces
- Probes available in different types
- Non-contact testing with distance compensation or contact testing with sliding shoes
- Very fast inspection.

Since the need for bearing rings testing is increasing, manual testing methods are no longer cost-effective. Faster and more reliable solutions are needed. Therefore, an automated test system that can test different types and sizes of bearing rings is essential.

INCDMTM in partnership with SC COMIS SRL made and tested a semi-automatic eddy current crack-detection system for checking the integrity of the bearing ring surfaces. This inspection system is easily integrated into production processes.

**Test system overview**

The developed eddy current test system consists of the following components, as shown in figure 4:

1. Base table; 2. Rotary table; 3. Standard part with artificial defects; 4. Probe fixing and positioning system; 5. Eddy current probe (D, AK – Foerster; 2.5 mm track width allows high test speeds with high test sensitivity; this sensor allows testing at frequencies up to 1 MHz); 6. DC- Micromotor with planetary gearhead for rotary table; 7. Control block support; 8. Statograf ECM 8F (Foerster); 9. DC-Motor with planetary gearhead for eddy current probe moving; 10. Proximity sensors to limit the moving range of the eddy current probe; 11. Console with control buttons; 12. Electronic control unit.

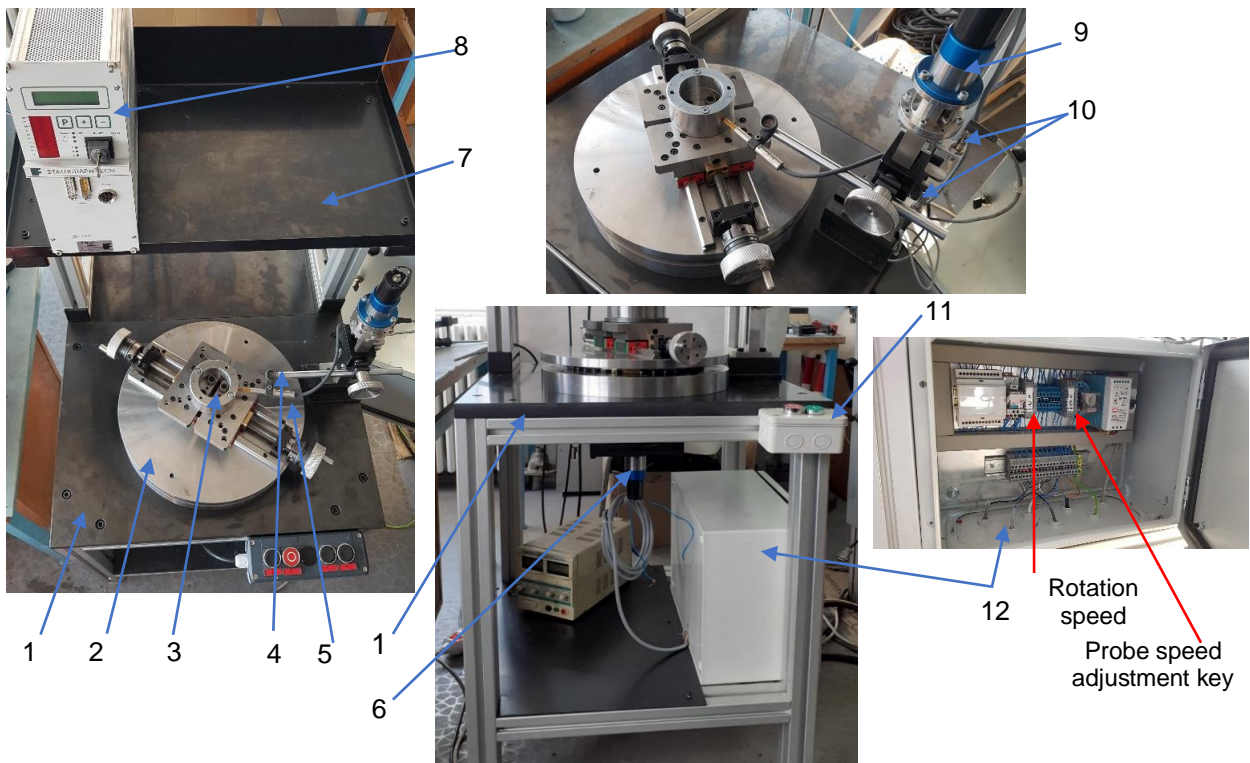


Figure 4: Semi-automatic eddy current bearing rings inspection system

The bearing is placed on rotary table, with clamping jaws to ensure that the ring is centered and runs smoothly. Via an arm, the probes are guided along the rotating bearing ring. Electronic distance compensation is used for a more accurate test.

In order to cover the entire surface of the part, the amount of feed per revolution ( $\Delta x$ ) may not be larger than the track width of the probe (BS). For a fixed rotational speed  $n$ , the speed ( $v$ ) of the probe must be:

$$v \leq BS \cdot n \quad (1)$$

For a safe detection of surface defects such as cracks, the flaw should be hit by the probe at least twice during the scan. The minimum crack length  $L$ , for a safety detectable longitudinal flaw must be:

$$L \geq 2 \cdot BS \quad (2)$$

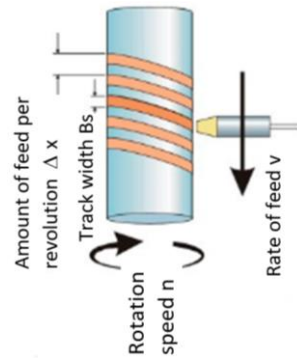


Figure 5. Cylindrical surface scan scheme

#### Technical features:

- High inspection speed and throughput
- 100% inspection with easy automation
- STATOGRAPH ECM 6.421 features:
  - Test frequency user-selectable (up to eight frequencies)
  - Frequency range 1 kHz to 3 MHz
  - Vector evaluation
  - Phase-selective component evaluation
  - Clearance compensation
  - PC interface to evaluation program eddyAssist running with MS WINDOW
- Standard probe D, AK 6.421.01-7787:
  - Track width 2,5 mm
  - Test frequencies up to 1 MHz
- Standard probe D, AK 6.421.01-7787:

**APPLICABILITY:** Bearing components manufacturing industry

**BENEFICIARY:** SC COMIS SRL

#### FURTHER INFORMATION:

PhD.eng. Daniela CIOBOATA, INCDMTM Bucharest, e-mail: [ciobatadoina@yahoo.com](mailto:ciobatadoina@yahoo.com)

Eng. Vasile Adrian SOARE, SC COMIS SRL, e-mail: [adyse\\_prod@yahoo.com](mailto:adyse_prod@yahoo.com)

## **KNOWLEDGE TRANSFER FOR THE DEVELOPMENT OF AN ELECTRIC POWER STEERING MOTOR FOR ELECTRIC VEHICLES – MOSERVEL**

Subsidiary contract 2794/2018 of the project: Knowledge Transfer Partnerships to Enhance Business Competitiveness in the Field "Automotive Industry and Components" and Improve Road Traffic Safety – KTAutoComp

Project co-financed by the European Regional Development Fund through Competitiveness Operational Programme 2014 – 2020

**Program:** Competitiveness Operational Programme 2014-2020

**Call identifier:** POC-A1-A1.1.4-E-2015

MySMIS Code: 105552

**Partner:** Icpe SA

### **Generalities**

The steering system is one of the most important and complex system installed on a vehicle. Steering system provides the directional change in the movement of an automobile. This system converts the rotation of the steering wheel into angular movement of the front wheels to control the direction of the vehicle motion.

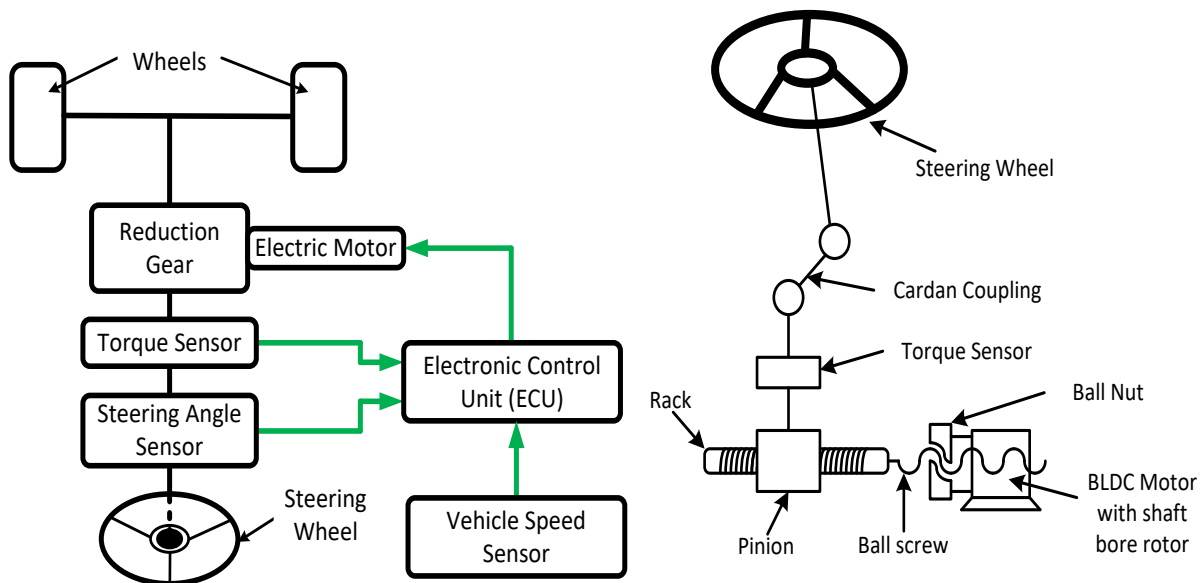
In recent developments, in automotive industry, the trend is that electrical power steering (EPS) replaces the hydraulic power steering (HPS) due their advantages:

- Improvement of the fuel economy (because the electric motor is driven only when the steering wheel is turned);
- elimination of hydraulic fluid;
- elimination of many components such as the pump, hoses, fluid, drive belt and pulley (for this reason, electric steering systems tend to be smaller and lighter than hydraulic systems);
- better response at different speeds compared to hydraulic steering system.

The main components of an EPS are:

- Torque sensor which measures the effort being applied by the driver to the steering wheel;
- Electric Control Unit (ECU) which calculates the necessary assist torque, considering the driving situation;
- Electric Motor which assists the steering force of the driver according to the speed and steering condition of the car;
- Rotational angle sensor
- Vehicle speed sensor
- Reduction gear which input the necessary power assist to the steering mechanism.

A block diagram showing all these components is shown in Figure 1.



**Figure 1.** Electric power steering – block diagram **Figure 2.** Cinematic scheme of the designed EPS

One of the main parts of the EPS is the electric motor, typically a BLDC motor, which replace the hydraulic actuation mechanism to develop the required steering torque.

In this project, the experimental model of an electric motor with permanent magnets (BLDC) was designed and tested. This motor was dwsigned for an EPS with architecture presented in figure 2.

**Preliminary determination of the motor parameters**

The determination of the technical specification of the BLDC motor was performed by calculation (using the measurements made by Icp SA on a 1967 VW Beetle) and by simulation in the MATLAB / Simulink environment.

The BLDC motor and its control system were developed based on the functional equations and the transfer functions.

The simulations were performed for a motor with the parameters presented in Table 1.

**Table 1.** Parameters of the BLDC motor

Symbol	Description	Value	Unit
f	Frequency of the triangular signal	15	kHz
R	Stator phase winding resistance	30	mΩ
L	Winding inductance	123	μH
K <sub>e</sub>	Back EMF coefficient	3,59	Vpk/krpm
F <sub>f</sub>	Friction torque	0,1	Nm
J	Motor inertia	0,00018	kg·m <sup>2</sup>
n <sub>p</sub>	Number of pole pairs	3	
U	Supply DC voltage	12	V
T	Simulation time	0,2 or 0,4	sec.
ΔT	Simulation sample time	1	μs

The experimental model of the BLDC motor is presented in figure 3.

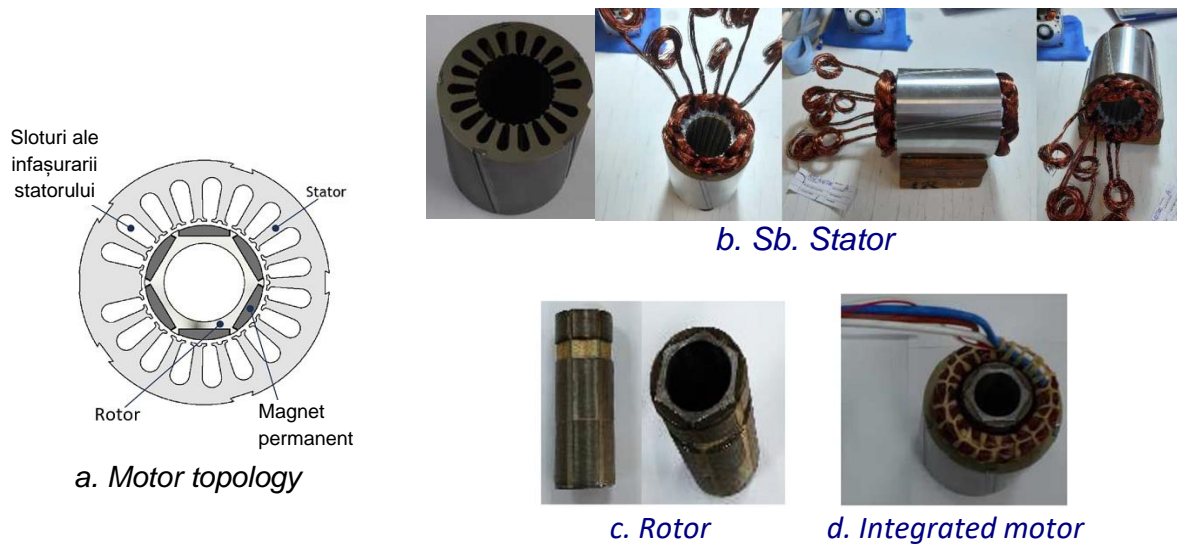


Figure 3 – Experimental model of BLDC motor

The BLDC motor is controlled using a three phases semiconductor bridge. The motor requires a rotor position sensor for providing proper commutation sequence. Based on the rotor position, the power devices are commutated sequentially ever  $60^\circ$ . The commutation sequences, back electromotive force and reference current generation are presented in figure 4.

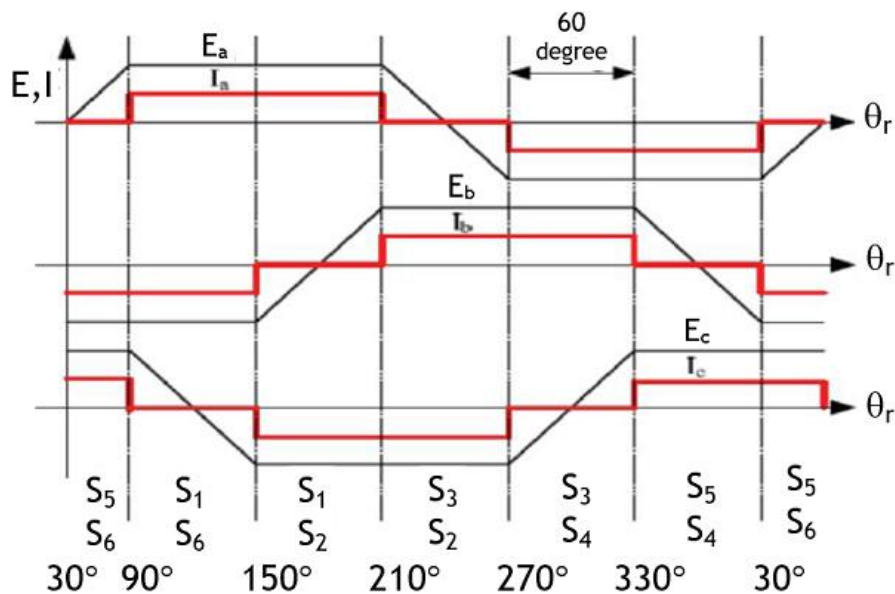


Figure 4. Trapezoidal back EMF of three phase BLDC motor and reference current generation

According to simulation model realized in Matlab, six groups of simulations were performed for various conditions.

After running the simulations, current and back EMF voltage waveforms, speed and torque diagrams and Hall signals were recorded and analysed.

The motor parameters were selected according the simulation results presented in figure 5.

The BLDC motor was tested on the experimental stand presented in figure 6.

#### Technical features:

- Motor type: BLDC;
- Control algorithm: six pulse control;
- Torque: 4 Nm;
- Rated speed: 500 rpm;
- The constructive solution of the power steering mechanism: direct assistance;
- Step of the ball screw: 10 mm;
- Ball screw displacement range: 150 mm.

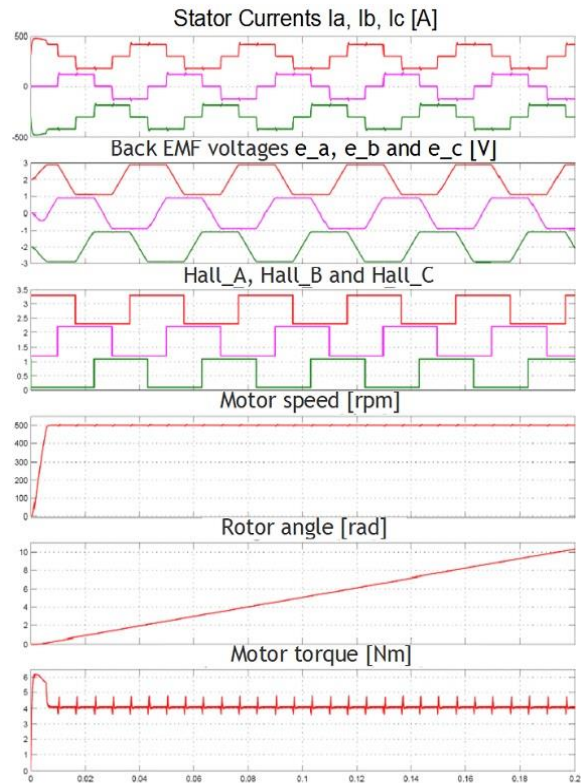


Figure 5. Diagram of simulation (MATLAB/SIMULINK)

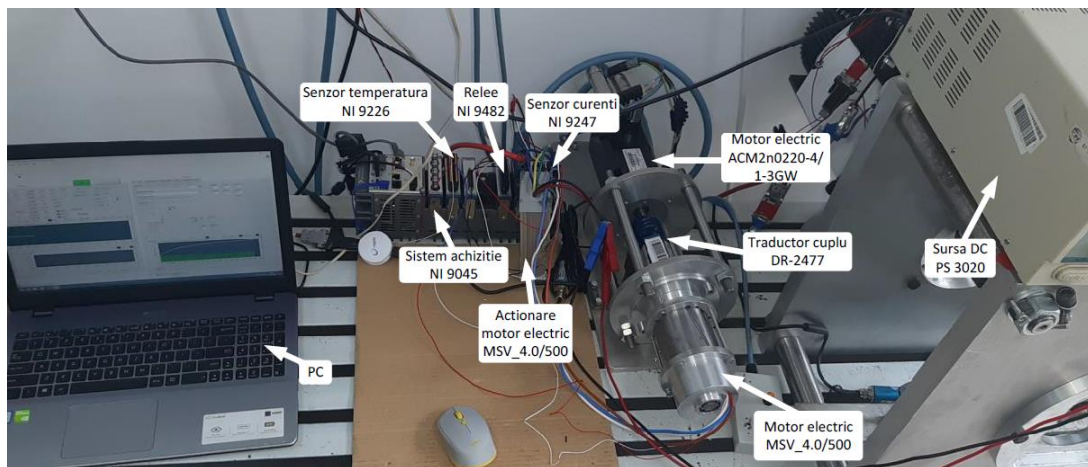


Figure 6. Experimental stand for BLDC motor testing

**APPLICABILITY:** Automotive industry.

**BENEFICIARY:** SC ICPE SA

#### FURTHER INFORMATION:

PhD.eng. Daniela CIOBOATA, INCDMTM Bucharest, e-mail: [ciobotadoina@yahoo.com](mailto:ciobotadoina@yahoo.com)

Phd.eng. Paul MINCIUNESCU, ICPE SA, e-mail: [paul.minciunescu@icpe.ro](mailto:paul.minciunescu@icpe.ro)

## **RESEARCH ON THE DEVELOPMENT, TESTING AND OPTIMIZATION OF AN AUTOMATION MEASUREMENT AND SORTING CELL FOR AUTOMOTIVE PARTS MANUFACTURED ON CNC MACHINE TOOLS - AutoCelMas**

Subsidiary contract 2799/2018 of the project: Knowledge Transfer Partnerships to Enhance Business Competitiveness in the Field "Automotive Industry and Components" and Improve Road Traffic Safety – KTAutoComp

Project co-financed by the European Regional Development Fund through Competitiveness Operational Programme 2014 – 2020

Call identifier: POC-A1-A1.1.4-E-2015

SMIS Code: 105552

**Partner:** SC IP Automatic Design SRL

### **Generalities**

In today's competitive environment, quality of manufactured parts becomes an important advantage. In the automotive industry, the quality of safety critical components directly reduces potential risks. Many of the automotive parts are small or medium in size and have complex geometry. Such parts are difficult to be handled and inspected. Cycle time, diversity and volume of production are important factors in the automotive industry. The ability to accomplish precise measurements for 100% inspection is very important for automotive industry, where the knowledge of dimensions and surface quality is essential to guarantee conformity of parts and to control the production processes.

Most manufacturers understand the value of automation in machined part manufacturing process. A flexible automatic inspection cell, being able to combine multiple processes into a single setup can significantly reduce cycle times and improve quality with less handling of the workpiece.

The directions for the development the factory of the future in context of the Industry 4.0 concept, includes the use of innovative solutions enabling the integration of manufacturing processes and quality inspection in modular structures of production lines.

One of the directions of the development of advanced inspection systems consists in the use of hybrid measuring stations using both, non-contact optical measurement methods and contact methods.

Currently, advanced optoelectronic devices for for dimensional and geometric measurements are available on the market. In this project we are developing a flexible inspection cell for small and medium parts manufactured with CNC machine tools, which includes an optical measurement system, a contact measurement system, a manipulator to perform all the movements of the machined parts inside the cell, feeding and out feed module and a central controller.

### **System overview**

The architecture of designed inspection cell for automatic multi-parametric quality inspection of parts manufactured with CNC machine tools is shown in figure 1. This is a flexible inspection system, easy to set up for the production requirements. The compact design allows for in-process placement on the shop floor. The assembled flexible cell is built around a manipulator robot type UR10 (collaborative robot). It ensures the handling of the parts inside the cell, taking over the

parts from the feeding system, positioning the parts in the measuring stations, positioning the measured parts on the out station for compliant or non-compliant parts.

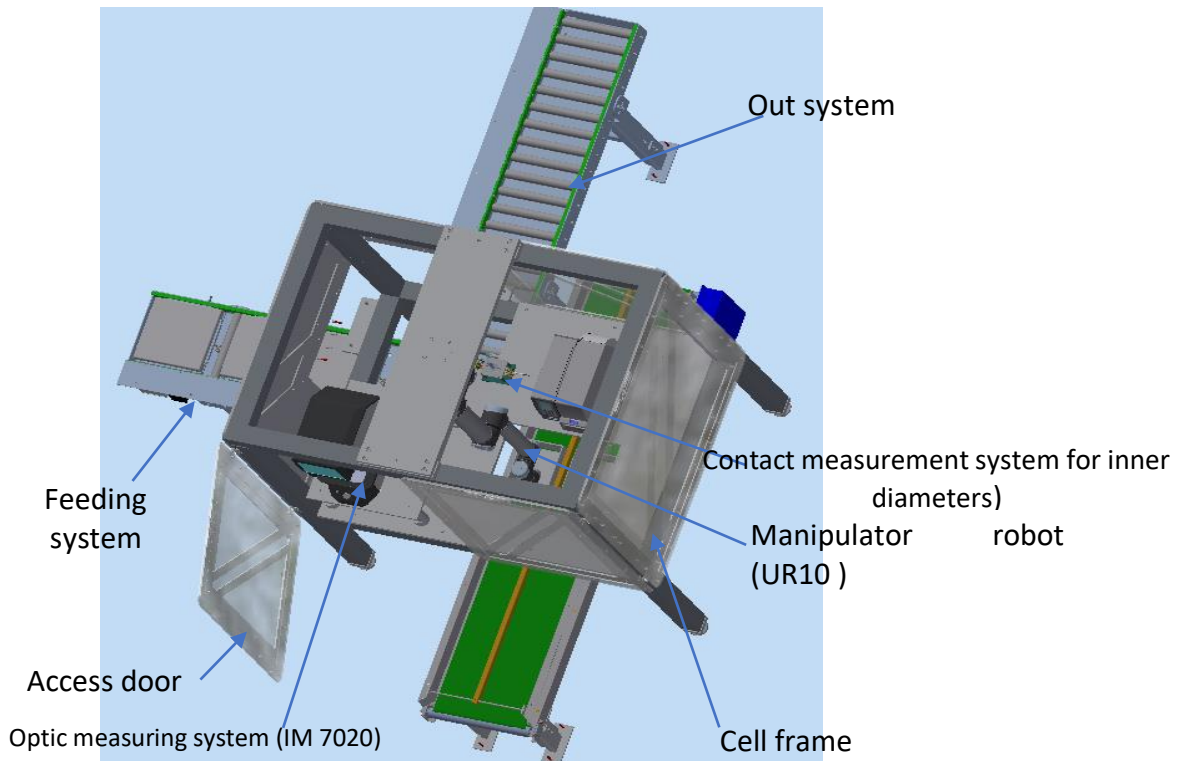


Figure 1. Inspection cell architecture

This inspection cell includes two types of measurement equipment:

- an optical measuring system based on image dimension measurement (figure 2)
- a contact measurement system for inner surfaces (figure 3)

Feeding and out systems consist in motorized conveyors, easily adaptable to the configuration of the production line.

The optical measurement system (IM – 7020 - Keyence) has following features:

- Automatic recognition of part position and orientation
- Fast measurement (multiple parts simultaneously in seconds)
- Versatile programming for in-process and final inspections
- Accurate and repeatable measurements
- Ability to record results and create inspection reports.

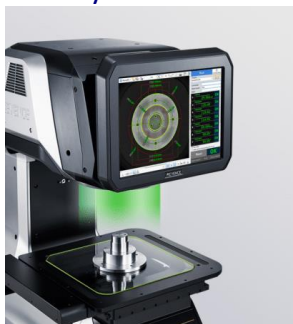


Figure 2. Optical measurement system (IM – 7020 - Keyence)



Figure 3. Inner diameter measurement system



Figure 4. UR10 manipulator robot with 2F-140 adaptive gripper

**Technical features:**

- Optoelectronic measurement system:
  - Max. measurement range: image-based measurement: x axes: 200 mm; Y axes: 200 mm; Z axes: 4x R50
  - Measurement system resolution: 0,2  $\mu\text{m}$
  - Repeatability (without/with measuring table displacement):  $\pm 1 \mu\text{m}$  /  $\pm 2 \mu\text{m}$
- Contact inner diameter measurement system feature:
  - Measurement range: 10 to 50 mm diameters
  - Repeatability: 0,005 mm
- UR10 cobot features:
  - Payload: 10 kg
  - Reach: 1300 mm
  - Joint ranges: +/- 360°
  - Repeatability: +/- 0.1 mm
- Gripper features:
  - Stroke: 140 mm
  - Grip Force: 10 to 125 N
  - Form-fit Grip Payload: 2,5 Kg
  - Friction Grip Payload: 2,5 Kg
  - Closing speed: 30 to 250 mm/s

**APPLICABILITY:** Manufacturing industry.

**BENEFICIARY:** SC IP Automatic Design SRL

**FURTHER INFORMATION:**

PhD.eng. Daniela CIOBOATA, INCDMTM Bucharest, e-mail: [ciboatadoina@yahoo.com](mailto:ciboatadoina@yahoo.com)

Eng. Ion PĂTRASCU, SC iP Automatic Design SRL, e-mail: [patrascu@ipad.ro](mailto:patrascu@ipad.ro)

## EQUIPMENT FOR MICROPROCESSING OF METALLIC, CERAMIC AND PLASTIC MATERIALS WITH FIBRE LASER

**Project:** Knowledge Transfer Partnerships to Enhance Business Competitiveness in the Field "Automotive Industry and Components" and Improve Road Traffic Safety – KTAutoComp  
Project co-funded by the European Regional Development Fund through Competitiveness Operational Programme 2014 – 2020

**MySMIS Code:** 105552

**Subsidiary contract:** Researches Regarding Achievement of a Equipment with Fiber Laser for Metallic, Ceramic and Plastic Materials Microprocessing, Integrated in the Automotive Emerging Processing Technologies - IMPLA

**Partner:** SC Apel Laser SRL

### GENERALITIES

Ultrafast lasers have become essential tools for advanced micro-machining and materials processing. Today, modern industries are demanding a large list of requirements regarding lasers processing systems: easy to focus laser beam in a large area, great stability, ultrafast and high precision processing, compact form and adapted to work in rough manufacturing environments, etc.

The main challenges of this project consist in development of a flexible equipment able to: delivery laser pulses to the workpiece with a high degree of accuracy and repeatability; development the human machine interface software, integration of the system for scanning the processed surfaces; automation of working process; getting reference combinations of parameters for various applications.

At this moment 3 types of laser sources are mostly used for industrial production: the CO<sub>2</sub> laser, the Nd:YAG-laser and the fiber laser.

CO<sub>2</sub> laser are gas lasers that are based on a carbon dioxide gas mixture, which is stimulated electrically. With a wavelength of 10,6 μm, they are mainly suited for working on non-metallic materials, organic materials and on most plastics (because metals have high reflectivity at this wavelength).

Crystal lasers (Nd:YAG, Nd:YVO) are solid-state lasers. They have the same wavelength as fiber lasers (1.064 nm) and are suitable for marking metals and plastics. Unlike fiber lasers, these laser types include the relatively expensive pump diodes, which are wearing parts. The crystal itself also has a shorter service life than a fiber laser.

The fiber laser, the ideal successor of the Nd:YAG laser for most of his applications, produces an extremely small focal diameter. As a result their intensity is up to 100 times higher than that of CO<sub>2</sub> lasers with the same emitted average power. Fiber lasers are optimally suited for metal marking, metal engraving and high-contrast plastic markings.

### Advantages of Fiber Laser Technology

The main advantages of fiber laser include:

- compact solid state design configuration;
- high absorption of the fiber wavelength and high power density created by the focused beam combine to achieve high processing speed

- high power (ease of cooling);
- high stability;
- high reliability;
- lower maintenance costs;
- low noise;
- immune to environmental changes.

#### PRODUCT OVERVIEW:

In figure 1 is presented the block diagram and in figure 2 the 3D model of the of the equipment for microprocessing of metallic, ceramic and plastic materials with fibre laser.

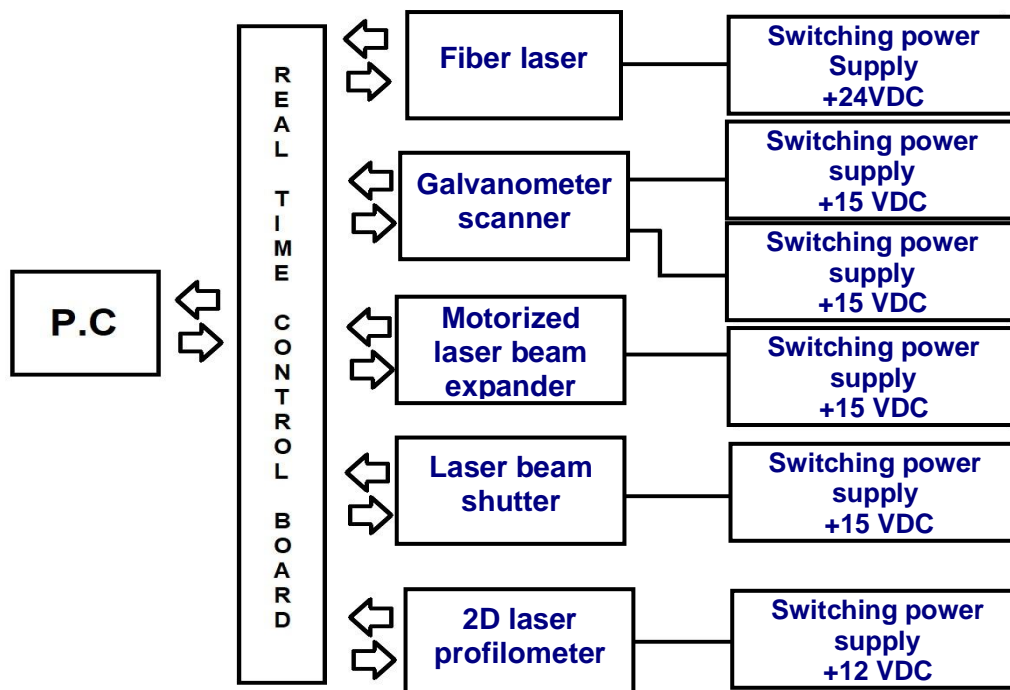


Figure 1. Block diagram

The microprocessing equipment consist of:

- 3D controlled moving system;
- Laser processing head;
- Complex surfaces blue laser scanning system;
- Controller
- Display

**TECHNICAL FEATURES:**

- Microprocessing of materials with different characteristics, in a selective manner, by using a controlled laser source for removing and modifying the material
- Laser type: fiber laser, wavelength 1064 nm
- Laser power: 100 W
- Laser power stability:  $\leq \pm 3\%$
- Laser beam parameters controlling (power, propagation direction, spot diameter, etc.)
- Laser autofocus
- Working surface: 200x300 mm
- Capability to move the processing/scanning head on complex trajectories
- High processing speed.
- 2D laser profilometer with blue light 405 nm wavelength)
- Measurement range:
  - X axis: 62 mm
  - Z axis: 96 mm ( $\pm 48$  mm)

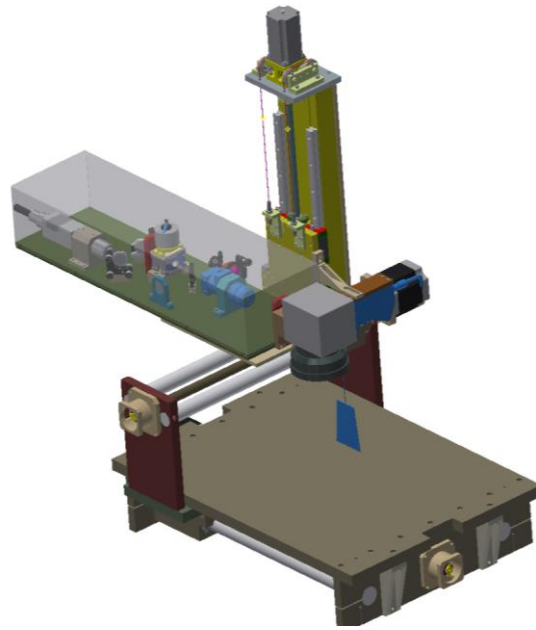


Figure 2. Laser microprocessing and scanning system 3D model

**APPLICABILITY:** marking, engraving, drilling, cleaning in automotive industry and other manufacturing industries.

**BENEFICIARY:** SC Apel Laser SRL

**FURTHER INFORMATION:**

PhD.eng. Daniela CIOBOATA, INCDMTM Bucharest, e-mail: [ciboatadoina@yahoo.com](mailto:ciboatadoina@yahoo.com)

PhD. Student Mihai SELAGEA, SC APEL LASER SRL, e-mail: [mihai.selagea@apellaser.ro](mailto:mihai.selagea@apellaser.ro)

## **DEVELOPMENT OF INTEGRATED FLEXIBLE CELL, WITH A HIGH DEGREE OF ADAPTABILITY, BASED ON CYBER-MECHATRONIC PRINCIPLES, FOR TRANSPORT, HANDLING, INSPECTION AND CONTROL OF MACHINED PARTS WITH HIGH RISK POTENTIAL IN THE AUTOMOTIVE INDUSTRY, IN THE CONTEXT OF INDUSTRY 4.0**

Contract 17N/2019, Project PN 19 24 01 03  
Project financed by the NUCLEU 2019-2022 Program

### **Generalities**

The demands regarding the quality of machined parts with a decisive role in the automotive safety are constantly increasing. Currently, quality control in an industrial context is predominantly realized as an end-of-line inspection system that checks certain specifications of the products. On the other hand, it is well known that checking the quality of products in the final stage of the manufacturing process is more expensive than the inspection integrated in the manufacturing flow. The integration of intelligent inspection systems in automatic mode on the manufacturing flow contributes to:

- Increasing product quality
- Reducing manufacturing costs by controlling manufacturing processes.

Automatic inspection performs several tasks of which the most important is to remove rejected parts out of the system. In many cases, it also provides signals to automatically compensate tools, make adjustments, initiate alert signals for self diagnosis.

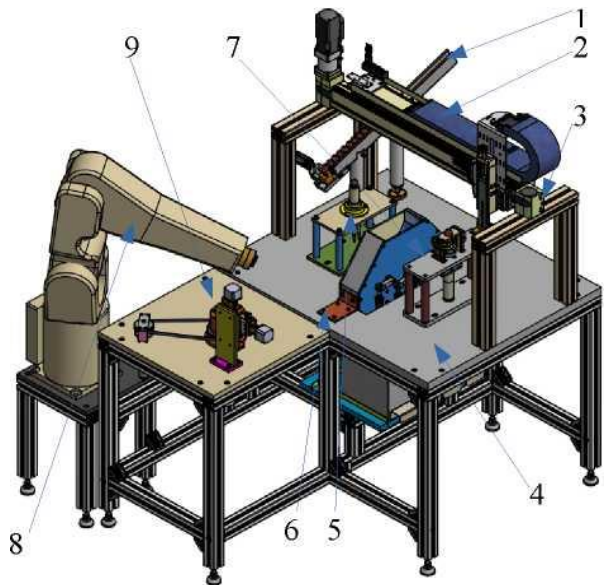
In the last decade, the new industrial revolution "Industry 4.0" has emerged as a new paradigm associated with the concept of sustainable manufacturing concept, which focuses on creating industrial value through automation, intelligent technologies and processes that include cyber-physical systems (CPS), the Internet of Things (IoT), the Industrial Internet of Things (IIOT), cloud computing, cognitive computing and artificial intelligence.

The new industrial era aims to increase the flexibility of manufacturing processes and develop individualized mass production, supported by a massive exchange of data between intelligent manufacturing stations and cells with mechatronic systems and sensors networks embedded.

This project aims to develop high-performance and flexible solutions in order to achieve a flexible cell for inspection automotive mechanical parts. The designed handling, feeding and transport systems can be adapted to be used to make flexible cells for the inspection of various parts with the axis of revolution. To test the proposed solutions, in the project is developed an flexible cell for steering joint pivot inspection on the manufacturing flow.

### **Product overview:**

The architecture of the experimental model of the designed cell, established based on the analysis of the steering joint pivot manufacturing technology at SC Componente Auto Topoloveni SA is presented in figure 1.



1. Parts feeding and evacuating systems
2. XZ cartesian Gantry robot
3. Supporting structure of the linear handling system (Gantry)
4. Inspection cell frame
5. Pivot thread integrity control station
6. Non-compliant parts sorting station
7. Pivot length and torx depth measuring station
8. Six axes articulated robot
9. Defectoscopic control system

Figure 1. Flexible cell for multiparametric inspection of steering joint pivot

**Technical features:**

- Inspected parameters:
  - Pivot thread integrity;
  - Pivot length and torx depth (figure 2)
  - Pivot surface integrity
- Gantry robot range: X: 650 mm; Z: 100 mm
- Communication protocols: PROFINET, PROFIBUS;
- Central unit: SIEMENS CPU 315-2 PN

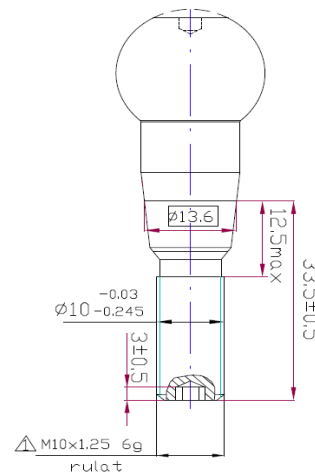


Figure 2. Measured parameters

**APPLICABILITY:** Automotive industry.

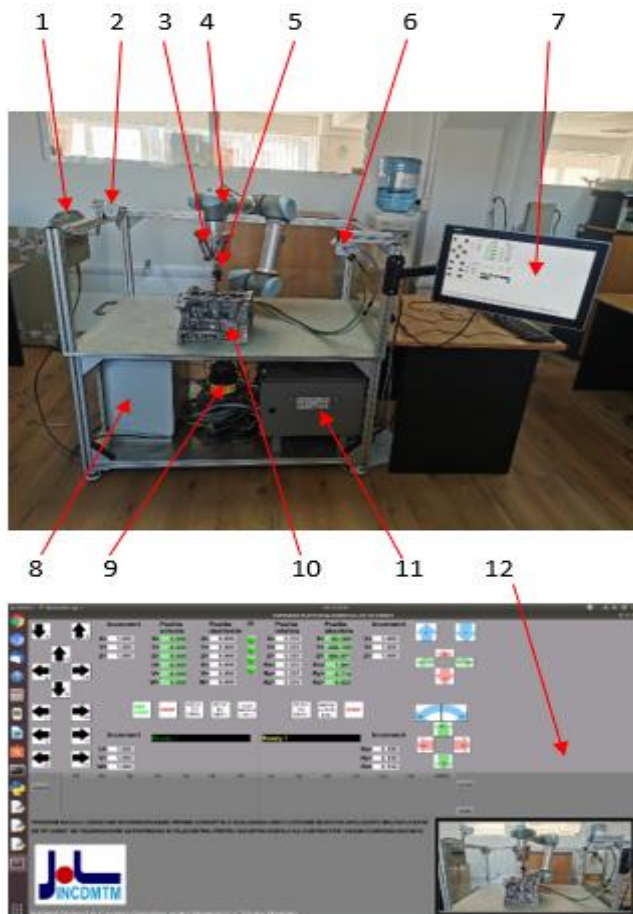
**POTENTIAL BENEFICIARY:** Manufacturers of automotive components

**FURTHER INFORMATION:**

PhD.eng. Daniela CIOBOATA, INCDMTM Bucharest, e-mail: [ciboatadoina@yahoo.com](mailto:ciboatadoina@yahoo.com)

Phd.eng. Dănut STANCIU, e-mail: [danutstanciu@yahoo.com](mailto:danutstanciu@yahoo.com)

## MULTIAPPLICATIVE INTELLIGENT ROBOTIC PLATFORM TYPE "COBOT" WITH REMOTE CONTROL CAPABILITY FOR DIGITAL INDUSTRY 4.0



- (1) Touch-screen panel
- (2) Smart color sensor
- (3) Very high precision hexapodal robot
- (4) UR5e collaborative robot
- (5) Ultra-precise probe
- (6) Smart camera
- (7) IPC-Display with touch-screen
- (8) Cabinet with automation and network components
- (9) Security sensor
- (10) Measuring piece
- (11) Electronic control controller
- (12) Remote control and telemonitoring software

### OVERVIEW:

- Collaborative robotic platform integrates two robotic systems (3) and (4) ensuring 11 (DOF) degrees of mobility and allows the positioning with high precision of the final effector, respectively an ultra-precise probe transducer (5). The orientation of the probe throughout the general workspace is achieved with the positioning accuracy of the universal robot UR5e (4) combined with the very high resolution positioning ( $0.2 \mu\text{m}$  on the X, Y axis,  $0.08 \mu\text{m}$  on the Z axis) achieved by the hexapodal robotic subsystem (3).
- Intelligent multiapplicative platform type "Cobot" is configurable and allows remote control of cyber mix-mechatronic collaborative robotic systems by bidirectional data transmission and implementation of remote control, telemonitoring and teleservice functions through cyberspace in the Remote Control and Teleservice Center using specialized software (12).
- The intelligent measuring / control stand is a rigid table on which several functional subassemblies are positioned on two levels by clamping. At the lower level is the robot controller (11) and the electrical and electronic circuit cabinet (8). At the upper level is the Universal Robot (4), the hexapodal robotic subsystem (3) and the ultra-precise probe transducer (5), as well as the intelligent component identification video system (2) and (6) which allow the automatic identification of parts or bores as well as their indexing / counting. Also

here is fixed the measuring piece (10) or subjected to an intelligent control process. The upper level also delimits the effective working area of the collaborative robotic platform.

- IP camera (6) allows remote viewing of the workspace with HD image quality, allows automatic realization of intelligent video inspection functions and image capture.
- A display (removable) (1) provided with a touch-screen with which it is possible to program and store the system variables of the collaborative robot (4).
- During automatic or remote control work, various information on the status of the entire system, measurement results, etc. can be displayed on the IndustrialPC (IPC-Display) with touch-screen features (7).
- The measured \ controlled part (10) is fixed on the rigid table stand. The “supply” of the system with parts \ work objects is done, depending on the application, automatically with the additional robotic system with Forklift “Robotino” or manually, by the human operator.
- The connection of the cobotic system with the higher level of command and communication (cyberspace) is made through the controller (11).

#### **TECHNICAL FEATURES:**

The mixed-mechatronic cobotic system with serial - parallel structure of ultra-precise measurement and dimensional control in the laboratory and the digitized industry 4.0, allows obtaining the following characteristics:

- fine ultra-precise repeatability of the final effector: **0,5  $\mu\text{m}$** ;
- fine ultra-precise repeatability X,Y hexapodal robotic subsystem:  **$\pm 0.15 \mu\text{m}$** ;
- fine ultra-precise repeatability Z, hexapodal robotic subsystem:  **$\pm 0.06 \mu\text{m}$** ;
- fine repeatability  $\theta\text{X}$ ,  $\theta\text{Y}$ , hexapodal robotic subsystem :  **$\pm 2 \mu\text{rad}$** ;
- fine repeatability  $\theta\text{Z}$ , hexapodal robotic subsystem :  **$\pm 3 \mu\text{rad}$** ;
- repeatability of the global positioning UR5e: **0.03mm**;
- effective global workspace radius: **400mm**;
- working space hexapodal robotic subsystem in X.Y:  **$\pm 17 \text{ mm}$** ;
- working space hexapodal robotic subsystem in Z:  **$\pm 6,5 \text{ mm}$** ;
- working space hexapodal robotic subsystem in  $\theta\text{X}$ ,  $\theta\text{Y}$ :  **$\pm 10^\circ$** ;
- working space hexapodal robotic subsystem in  $\theta\text{Z}$ :  **$\pm 21^\circ$** ;
- power consumption: **150W**;
- Collaborative functions: **17 advanced safety functions** approved by TÜV NORD and tested according to standard **EN ISO 13849: 2008 PL d**;

#### **APPLICABILITY:**

The cobotic platform can be used by industrial intelligent production companies in the field of High-Tech, Research Laboratories in Institutes and Universities.

**TECHNOLOGY TRANSFER:** Center of Excellence in Cyber Mix-Mechatronics

#### **BENEFICIARY:**

- Innovative SMEs in the field of micro and nanotechnology
- Institutions / centers of research, development, innovation in the Cyber Mix-Mechatronic fields;

**FURTHER INFORMATION:** Dr.Ing. Anghel Constantin

Tel. 021.252.30.68/69, Fax. 021.252.34.37, e-mail: [incdmtm@incdmtm.ro](mailto:incdmtm@incdmtm.ro)

## UNIT FOR TESTING ENGINES H4D 470 (HR10DET) & H4D 480 (HR10DET GPL) V-BAND CIRCUIT TIGHTNESS CONTROL



### OVERVIEW:

The unit for testing Dacia H4D 470 (HR10DET) & H4D 480 (HR10DET GPL) engines is used for testing / experimentation within the Renault Titu Test Center and the SC Automobile Expertise Laboratory Dacia Groupe Renault SA. Leak testing is done under pressure on fully assembled engines.

Depending on the type of engine tested, air feeding and obturation plugs can be selected.

The plugging is performed, after which the tightness of the V-Band circuit is checked.

The coupling to the compressed air supply source is done with the help of quick couplers.

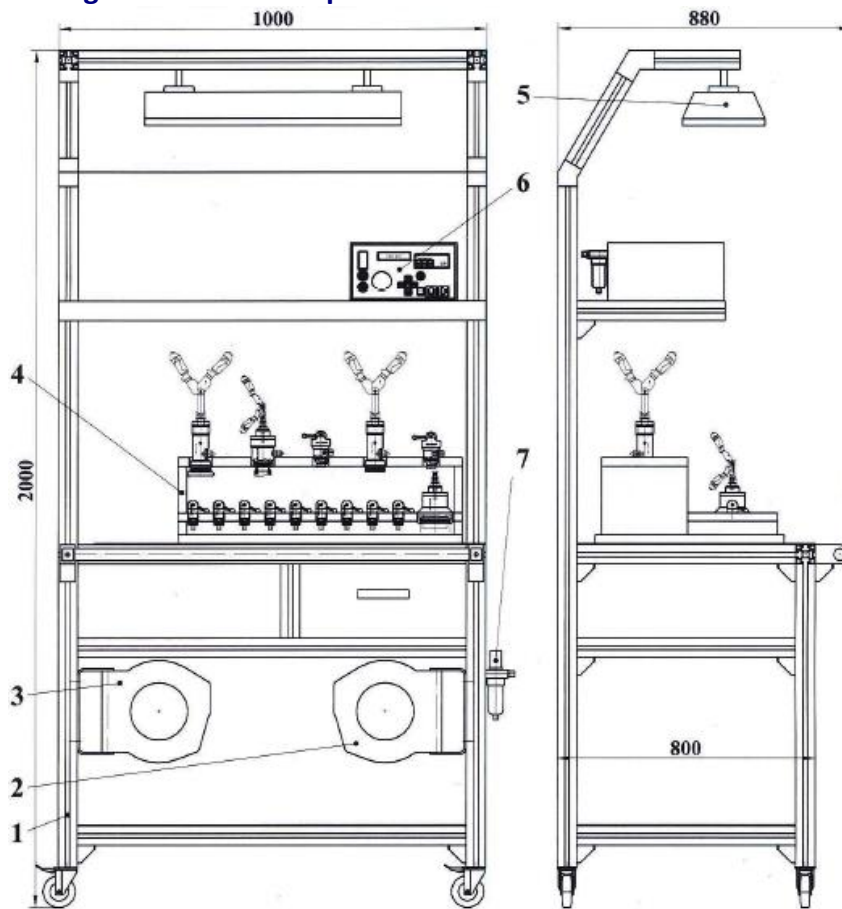
Plugging / un-plugging is performed manually.

### TECHNICAL FEATURES:

- power supply: 220 V AC/50 Hz;
- air supply pressure: min. 6 bar;
- test pressure: 50 mbars /100 mbars /150 mbars /200 mbars /250 mbars /300 mbars to identify leakage values at the V-Band collar and other engine components;
- Leak test: FORTEST 8730 cell with calibrated nozzle and flow calibrator.

**BENEFICIARY:** SC Automobile DACIA Group Renault SA Mioveni and the Technical Test Centre of Titu.

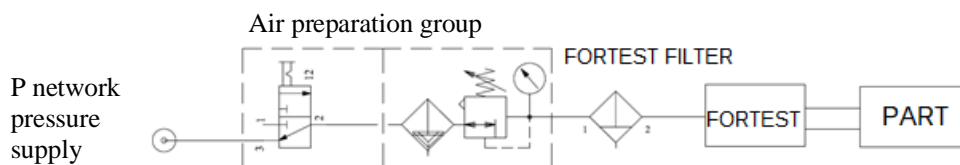
**V-Band circuit tightness control expertise unit**



Structure expertise unit:

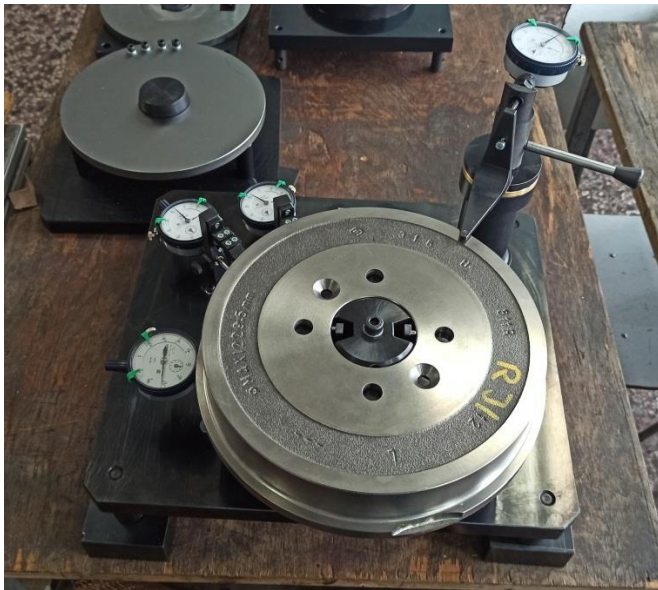
- 1- mobile frame with locking wheels
- 2- retractable compressed air hose drum
- 3- retractable electric cable drum
- 4- pedestal plugs: up= 5 air supply plugs; down 10 plug caps
- 5- lamp
- 6- FORTEST 8730 cell & flow calibrator
- 7- pressure regulating filter

**Pneumatic scheme:**



**AUTO PARTS CONTROL DEVICES AND EQUIPMENT**

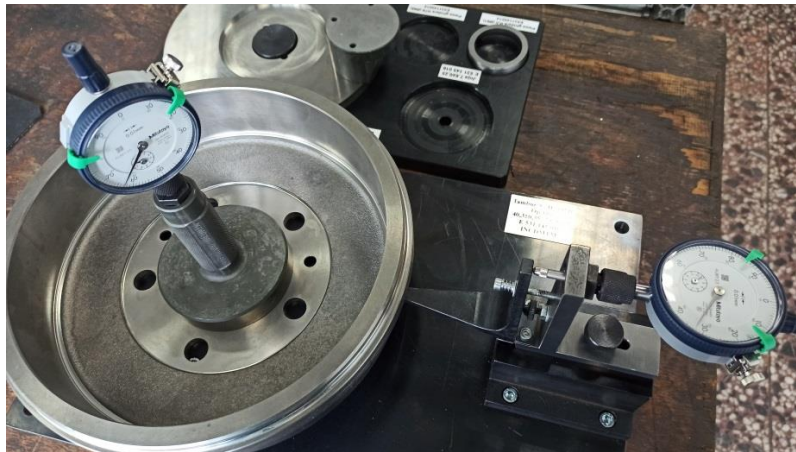
**1D BdL Multiparameter Control Devices Drums Types: T9", RJI at Operations 110, 120, 130**



**Multi-parameter control device:**

- distance in front of the plate - hub
- distance front hub - collar
- distance rim - front hub

**Collar position control device**



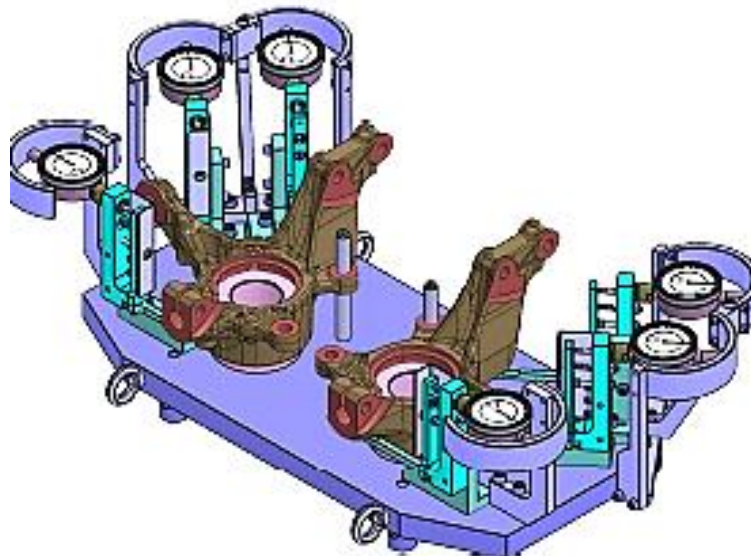
**Machining / raw balance control device with comparator and standard measuring element**



### Square 52 RJI Spindle Port Control Devices Turkey - Op.150



**Yoke face position control device – bearing face position**



**Multi-parameter control device:**

- position of the gross plane protective support in relation to the bearing face position (V plane);
- position defect of the protective gross plane support in relation to the bearing placement face (VV plane);
- shape / position gross defect of the protective gross plane support in relation to the bearing placement face (VVV plane).

**FURTHER INFORMATION:** E-mail: [laborator\\_tm1@yahoo.com](mailto:laborator_tm1@yahoo.com)

## INTELLIGENT UNIT FOR TIGHTNESS CONTROL IN VACUUM FOR POWER TRANSFER UNIT - MDR HJD-DP8 ADAPTATION FOR AUTONOMOUS LOADING/DOWNLOADING ROBOT



### Product overview:

The product is an adaptation for feeding the control stations with pieces by a robot.

The testing intelligent unit is a duo-block construction and verifies the air loss from the pieces who composed the Reverse module (Power transfer unit).

The loading-unloading of the installation with pieces in order to check for leaks is done with the help of an autonomous robot, based on a communication protocol.

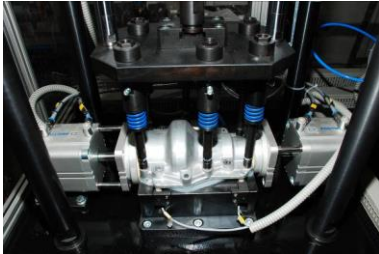
The “Reverse Module” (or PTU) is assembled by three pieces: “body”, “coupling” and “cover”.

In our case, the body and coupling are the same for two types of PTU but the covers are different.

The unit consists of:

1) Three control stations for HJD TL8/DP8, fitted on the same body for:

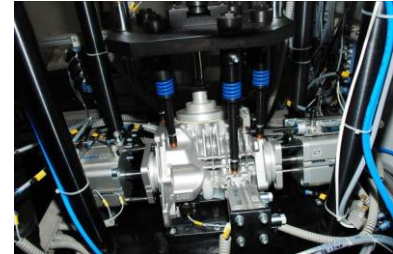
“cover” HJD TL8/DP8



“coupling” HJD TL8/DP8



“body” HJD TL8 only



2) One control station for HJD DP8, separated, only for “cover” reverse module HJD DP8



- The unit has an automatic working cycle;
- The intelligent measuring program is set for each type of pieces ;
- The measuring is made sequentially: “cover-coupling-body”
- The pieces are set inside the machine, on the corresponding tightening plate;
- The pressure subassemblies press the pieces on the tightening plates;
- The tapered and clamping subassemblies pressurize the bores of the pieces;
- The ATEQ-cell introduces air in the obtained cavity of the piece (-0,5 bar);the admissible air loss must be under 0,25 cm<sup>3</sup> /s;
- If the piece is good it’s automatically marked;

The machine is protected with immaterial barriers against the intruders over the function, in the work space. The access is admitted for loading the machine with pieces, only through the front.

The all work-process of the machine is driven and monitored by a programmable automaton Siemens with a specialized controller; there is a continuous communication (man-machine) with final decision and feed-back.

The vacuum source and the pneumatic panel (with pneumatic elements for command) are part of the unit.

**TECHNICAL FEATURES:**

- electrical supply: 220 V.c.a./50 Hz;
- pressure supply: 6 bar;
- work pressure 5 bar;
- tightness test pressure (vacuum): -0,5 bar;
- admissible air loss: 0,25 cm<sup>3</sup>/s;
- accuracy: ± 0,02 cm<sup>3</sup>/s;
- work time/tour: ~ 85 sec/piece

**APPLICABILITY:**

The product is used for checking the tightness of the component parts for Power Transfer Unit HJD TL8-DP8.

**BENEFICIARY:**

S.C. RENAULT MECANIQUE ROUMANIE S.A.

**FURTHER INFORMATION:** E-mail: [laborator\\_tm1@yahoo.com](mailto:laborator_tm1@yahoo.com)

## INTELLIGENT UNIT FOR TIGHTNESS CONTROL FOR BASE PLATE - ASSEMBLY CYLINDER BLOCK (SEMELLE) – TYPES: H4 & HR10



### **Product overview:**

The unit testing the tightness for two types of Baseplates Assambley Cylinder Block (Semelle), H4 and HR10.

The unit is equipped with a turntable which allows checking a piесе while uploding/downloading another piece.

The loading / unloading of the pieces from the measuring station is done with a Robot that supplies the turntable; thus it is possible to verify a piece at the same time as the loading-unloading of another piece.

The work cycle is automatic.

All moving parts are driven by pneumatic cylinders assisted by proximity sensors.

The piece is sealed on all sides with clamps and plugs.

The installation is equipped with two rows of protective barriers.

### **TECHNICAL FEATURES:**

- Supply/ work pressure: min. 6 bar/5 bar min
- Control pressure: 1 bar for both circuits (air and oil);

- Type of measurement: the pressure difference;
- The measuring mode:  $\hat{m}^3/\text{min}$  and Pa;
- Cycle time: 45s/piece;
- Electricity: 220 V c.a.; 50 Hz.
  - Accepted air loss:
    - $25 \text{ cm}^3/\text{min}$  for low pressure circuit;
    - $3,6 \text{ cm}^3/\text{min}$  for high pressure circuit
  - PLC: Siemens
  - Operating panel: OP77
  - Operating system: Win CC for OP77
  - Type control: 100% (piece by piece)
  - Marking: "E" for good piece

**APPLICABILITY:** The product is used for checking the tightness of the base plate of the assembly cylinder block on the manufacturing lines for the types HR10 and H4Bt8 - for Dacia-Renault engines.



**BENEFICIARY:** S.C Automobile Dacia Groupe Renault S.A.

**FURTHER INFORMATION:** E-mail: [laborator\\_tm1@yahoo.com](mailto:laborator_tm1@yahoo.com)

## APPLICATIONS OF CRYOGENICS AND ULTRASOUNDS IN MEDICAL RECOVERY

**Contract 17N/2019, Project PN 19 24 05 01**  
**Project funded under 'NUCLEU 2019-2022' Program**

### OVERVIEW:

**General objective:** the realization of mechatronic systems, based on low temperatures and ultrasounds, used in medical recovery in the field of orthopaedics, traumatology and rheumatology / SMCRM.

**The aim** of the project is to ensure the health of patients through the treatment of orthopaedic injuries and in rheumatology, using innovative mechatronic electromedical systems.

SMCRM is a device that is based on the synergy between the two therapeutic techniques known as cryotherapy and ultrasound therapy. These two techniques stimulate each other, avoiding possible complications due to the heat effect of ultrasound in acute and subacute trauma. The use of SCMRM facilitates the healing process, with a faster recovery due to the interruption of the cycle of inactivity of the painful spasm.

### PRODUCT OVERVIEW:

#### Design and Implementation of the Ultrasound Generation System

It is known that ultrasonic transducers ensure the reciprocal and successive conversion of electrical energy into mechanical energy. Their active element is the piezoelectric crystal. It has the shape of a disc and is covered on both sides with two layers of metal, good conductors of electricity, onto which two electrodes are placed, one on each surface. Applying an electrical voltage between the electrodes will cause the crystal to deform and consequently emit mechanical energy to both surfaces. The metal layers have both the role of transferring the electrical voltage to the crystal, and that of taking over the electrical impulse created at its surface after the action of ultrasound reflected in the tissues. This created electrical impulse is then conducted to the amplification system of the device. The thickness of the piezoelectric disk determines the nominal frequency. Ultrasound physiotherapy has the following effects: analgesic, metabolic, muscle relaxant, bone recovery. Thus, within the project, the execution drawings for parts and the overall drawing were elaborated. The parts of the ultrasound system were executed and the components were assembled.

Decreasing the temperature in the deep tissue increases the density of the tissue, thus potentiating the mechanical effect induced by a 1-3 MHz interval ultrasound. The simultaneous use of cryogenics and ultrasounds allows the treatment of patients with acute pathologies, with trauma and inflammatory conditions, thus accelerating the recovery time.

SCMRM will be equipped with a cold generation system, an ultrasound system and an IT command, control and regulation interface.

Simultaneously with cold therapy up to -10 C, an ultrasonic wave from 1 MHz and one at 3 MHz is performed. The working interface with 10 " touch screen will allow you to monitor the delivery parameters of both therapies and manage the treatment throughout it.

### Development of IT system for command, regulation, control of SMCRM functions

Using the Access program, a database structure was created that is installed on the laptop, which includes the following fields:

- the start date of the treatment;
- patient data: name, surname, age, address;
- general health (chronic diseases);
- indications for treatment;
- type of treatment (cryogenics, ultrasound, both).

The following changes can be made to the format database, if necessary:

- New data can be added to the database, such as a new person;
- You can edit existing data in the database, such as modifying people's data;
- Information can be deleted, for example, if a person no longer exists;
- You can share data with others through reports, e-mails, an intranet or the internet.

Using the Python program, an IT software application was created which is installed on the "Medical Recovery Device" - SMRMC - 02, as follows:

- The software application consists of selection screens specific to each mode of work.
- The current value of the temperature and a selectable threshold are displayed in the Crio screen.
- A random number generator was used to simulate the purchased temperature.
- In the Ultrasound screen there is a Start / Stop Timer button and two selection buttons (disjunction) of the two frequencies.
- Enter the H Min Sec values, in the appropriate range for each field, and press START TIMER.
- A soft timer is launched which decreases per second.
- During the timer duration, the three buttons are hidden so that switching to another page is not allowed.
- The timer can be turned off by pressing the STOP Timer button.
- When the timer is interrupted or expires normally, the 3 bottom buttons are displayed on the era again.
- The CRIO or Ultrasound screen contains the elements of both screens.
- A confirmation message is displayed when the application is closed.
- If yes, the application closes.



### TECHNICAL FEATURES:

SMCRM system parameters

- SMCRM has 3 main modules:
  - The cryogenic modules
  - Ultrasound generating module

- Dual module (combination of the two modules)
  - They can work separately or together.
  - The parameters of the 2 separate modules were presented in the previous chapters.
  - The parameters of the SMCRM system, shown on the display are:
    - Maximum ultrasonic output power: 3 watts / cm<sup>2</sup>
    - Operating frequency: 1 MHz ± 10%, 3 MHz ± 10%
    - Cryotherapy: adjustable temperature down to -10 °C.



#### APPLICABILITY:

Post-traumatic medicine, in the treatment of people who have suffered a recent trauma or in the presence of an acute or subacute disease in inflammatory conditions.

#### FURTHER INFORMATION:

Diana Mura BADEA, PhD., Eng., INCDMTM Bucharest, e-mail: [dianammura@gmail.com](mailto:dianammura@gmail.com)

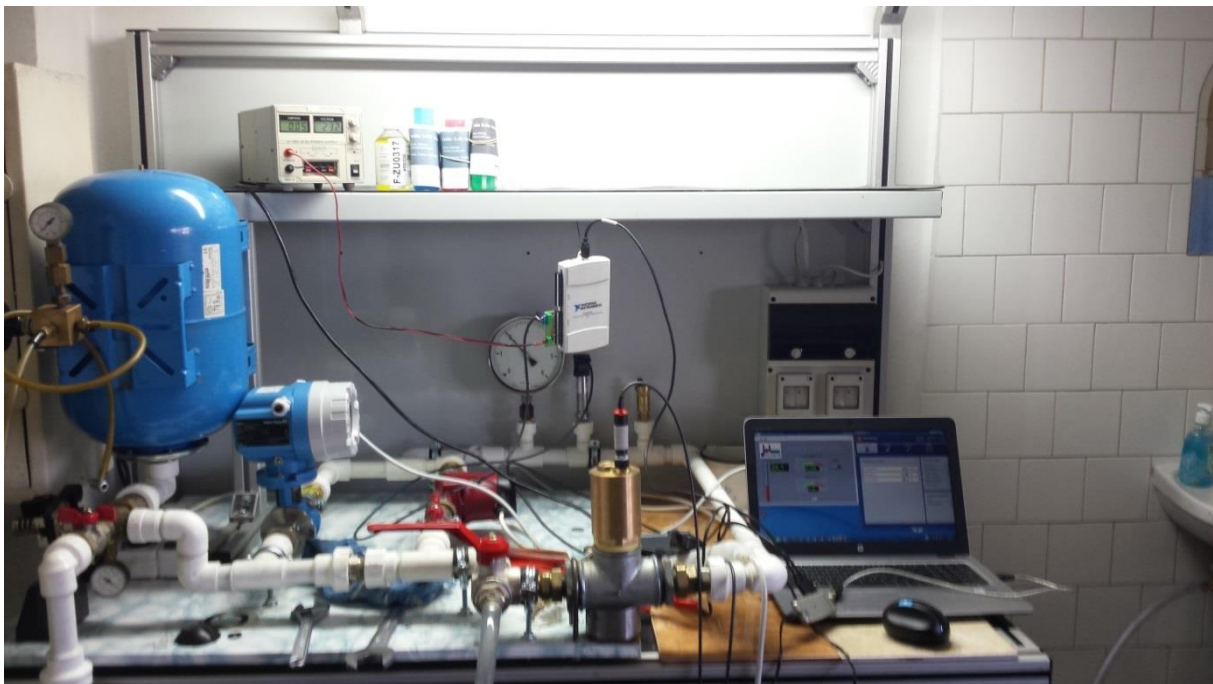
Valentina BAJENARU, PhD., Eng., INCDMTM Bucharest, e-mail: [valibajenaru@yahoo.com](mailto:valibajenaru@yahoo.com)

## **SPECIALIZED EQUIPMENT FOR CALIBRATION IN-LINE APPLIANCES FOR TESTING PHYSICAL PARAMETERS OF WATER QUALITY**

### **OVERVIEW:**

In recent years the development of IT and communications technologies have a more significant contribution in the water processing management and the technologies for water quality control are undergoing continuous improvements. These technologies not only must comply with strict rules, safety measures, and quality standards, social and environmental challenges but also face serious problems of obsolete infrastructure, network leaks and the quality of drinking water. On the other hand, supplying clean drinking water and protecting the health of the population of the adverse effects of any contaminated water intended for human consumption are fundamental requirements of the European Directive 98/83/EC, transposed into Romanian legislation law No. 458/2002 (amended and completed by law No. 311/2004 and the Governmental Ordinance No. 11/2011).

As a result, there is a market demand for drinking water management solutions considering that current technologies are far from satisfying the legal requirements in terms of monitoring, remote transmission and data processing for water quality. To know the water quality monitoring solution currently used is manual removal of samples, in certain specific points (especially the plug), transport to laboratory, measurements and issuing a report.



### **TECHNICAL FEATURES:**

The main technical characteristics of the specialized equipment for in-line calibration of the apparatuses for determining the physical parameters of the water quality are the following:

- Work environment: fluid (water);
- Pressure: minimum 0,7 bar and maximum 6 bar

- Working pressure: max. 3 bar
- Flow rate:  $F_{\min} = 0.1887$  mc /s;  $F_{\max} = 0.55$  mc /s;  $F_{\text{work}} = 0.25$  mc /s
- Temperature:  $25 \pm 5$  °C
- Power supply: 50Hz; 1x230 V; 0 ... 24 VDC
- Pump: 0.016 mc /s - 0.09 mc /s
- WaterTank: 80 l

**APPLICABILITY:** Computerization for the day-to-day management of the infrastructure is extensively used in the field of water. As a market requirement for the field of water, given its dimension, the introduction of the automation and computerization, we can state this seems to be a must. Thus, the use of sensors, systems of registration, and transmission of data remotely, energetic autonomy are topics for companies manufacturing and distribution of water.

**TECHNOLOGY TRANSFER:**

The main contribution to the promotion of the technological progress in this project is focused on the innovative solutions suggested to the current concerns of computerization of the water quality measurement process.

**BENEFICIARY:** Privat companies, R & D institutes, technical universities.

**FURTHER INFORMATION:** Dumitru VLAD, e-mail: [didivlad2006@yahoo.com](mailto:didivlad2006@yahoo.com)



**«BIOMEDICAL AND ROBOTIC  
MECHATRONICS» R&D  
DEPARTMENT**

## **The DEPARTMENT OF RESEARCH AND DEVELOPMENT FOR BIO-MEDICAL MECHATRONICS AND ROBOTICS**

**offers**

### **Professional solutions and services:**

- √ **Researches on scientific and laboratory devices;**
- √ **Researches on biomedical mechatronics;**
- √ **Researches on robotized technologies and devices used in medical processes.**

## **BIOMECHATRONICS LABORATORY-BIOLAB**

### **BIOLAB Objectives**

#### **I. General objective**

**BIOLAB** has, as a general objective, the contribution to increase the economic competitiveness in the medium and long term, by improving the quality and efficiency of research and development activities in national institutes, which will provide efficient services for public health units, by equipping with the most modern equipments, tools, rehabilitation software, and by creating new modern research laboratories.

**BIOLAB** will support the integration of research - development - innovation in INCDMTM Bucharest, in the field of biomechatronics, in innovative economic activity, based on knowledge, emergence in the Bucharest-Ilfov Development Region, as well as in the European Research Area (ERA).

#### **II. Specific objectives**

**BIOLAB** has the following specific objectives:

- increasing the research – development - innovation capacity of INCDMTM Bucharest by developing the R&D infrastructure and attracting young and highly qualified specialists;
- strengthening the offer of knowledge and research services in the medical field carried out by the beneficiary research institute;
- stimulating the technological transfer based on the cooperation between the R&D institute and enterprises;
- stimulating the demand for innovation of enterprises;
- supporting the formation and development of companies based on high technologies.

#### **III. Research areas**

- i. Research, design, prototyping of biomechatronic rehabilitation systems for:
  - Kinematics and dynamics of the human body;
  - Computational and experimental biomechanics;
  - Geometric modeling of anatomical structures;
  - Motion analysis;
  - Development of medical devices for anatomical reconstruction and physical rehabilitation;
  - Study of pathological and non-pathological human movement;
  - Assisting people with disabilities who have special needs in daily life activities;
  - Supporting mobility;
  - Supporting social rehabilitation (cognitive robots);
  - Assisting therapists in performing repetitive exercises with their patients (therapeutic exercise robots).
- ii. Verification of biomechatronic rehabilitation systems procured from import or domestic production for marketing.
- iii. Participation in interlaboratory comparisons at European level of medical devices and equipment.

### The main projects carried out in 2021

- Program PN-III-P1.-1.2-PCCDI-2017-0224 project no. contract 77/2018, “Implementation of additive technologies in the manufacture of complex and overloaded components – DIGITECH”, Beneficiary - INCDMTM, Period: 2018-2021;
- Nucleus Program, PN 19 24 05 02 no. contract 17N / 2019 “Rehabilitation and assistance of people with locomotor deficiencies with the help of intelligible intelligent biomechatronic systems”, Beneficiary INCDMTM, Period: 2019-2022;

### BIOLAB presentation

**BIOLAB** is located in the building of the National Research-Development Institute for Mechatronics and Measurement Technique (INCDMTM), 4th floor.

Both for partnerships with private and public business environments, as well as for involvement in research-development and innovation projects, we can be contacted at: [laborator\\_biomecatronica@yahoo.com](mailto:laborator_biomecatronica@yahoo.com).

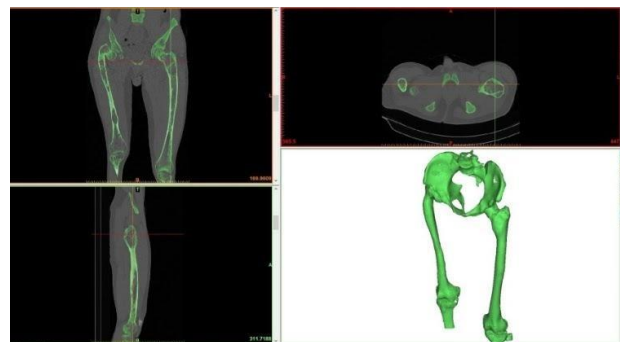
**BIOLAB** works closely with *Rapid Prototyping* and *Microsystems of investigation, biosensors and materials* laboratories, offering complete RDI services for the realization and testing of medical implants, testing of static / dynamic test parts and diagnosis and medical recovery for locomotor diseases.

**BIOLAB** includes:

#### 1. *Software for reconstructing anatomical elements from medical images MIMICS*

##### The main technical characteristics of the program:

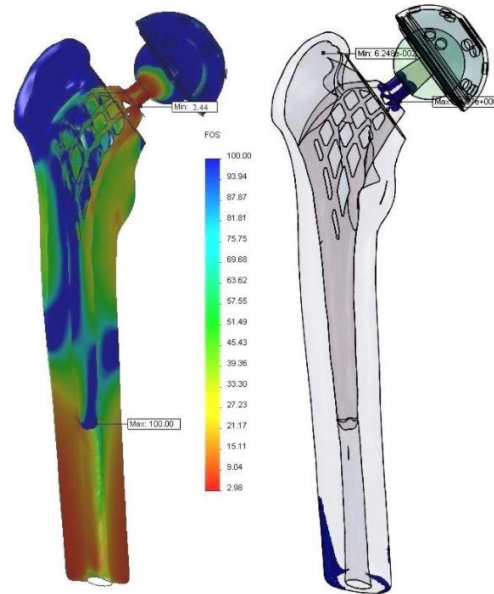
- allows the segmentation of medical images in order to reconstruct anatomical surfaces;
- performance of analysis and measurements for understanding the anatomy and pathology and checking the compatibility of the medical device;
- simulation of surgical procedures;
- has the design-modeling mode;
- prepares the models designed for finite element analysis;
- facilitates reversible anatomical engineering.



## 2. Interactive graphic design software and advanced finite element analysis

### The main technical characteristics of the program:

- parametric three-dimensional modeling of parts;
- parametric three-dimensional modeling of assemblies;
- automatic generation of execution drawings for parts and assemblies;
- project management;
- analysis and simulation with finite element for static calculus;
- analysis of the impact on the environment for parts;
- design analysis in terms of costs and their reporting;
- analysis and simulation capabilities;
- static, dynamic, nonlinear calculation, vibration, buckling, thermal, fatigue, resistance shock, optimization and cyclic loading, pressure vessels etc.

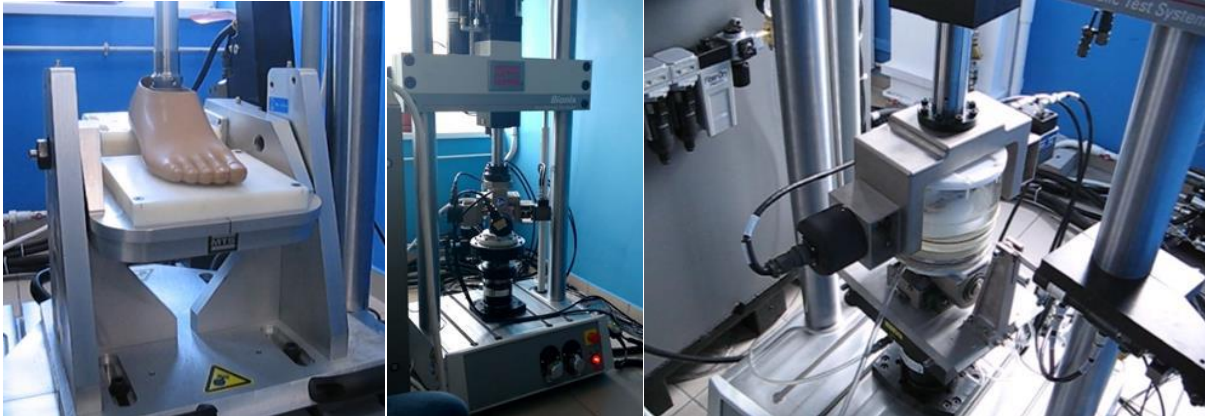


## 3. Equipment for testing, at complex loads, of biomechatronic systems under conditions similar to those in vivo

### A. MTS - BIONIX attrition test system

The wear test system of prosthetic implants and components consists of:

- multiaxial testing machine having the following components:
  - a loading stand;
  - a hydraulic drive system;
  - a command and control system;
  - a computer system (PC).
- dedicated programs (software) for testing machine control, data acquisition and processing;
- positioning and testing subsystem of the subassembly “ankle-foot for external lower limb prosthesis”;
- sub-system for simulating the wear of the hip stent;
- sub-stent wear simulation subsystem;
- system of thermostating and recirculation solutions for in vivo condition simulations.



**The main technical characteristics of the system:**

- static and dynamic axial-torsional loading for loads of up to  $\pm 15$  kN and  $\pm 100$  Nm;
- form of load curves: sinusoidal, rectangular, triangular, ramp, with maintenance at the preselected value, with frequencies up to 100 Hz;
- automatic movement of the work head;
- servo-hydraulic drive system;
- software for the testing machine control;
- software for data acquisition and processing;
- functional software for testing;
- basin with recirculation system and heating solution for in vivo condition simulations.

**Services offered:**

- ankle-foot subassembly testing according to standard SR EN ISO 22675;
- hortic endoprosthesis wear test according to ISO 14242 standard;
- testing of knee endoprostheses according to ISO 14243-1;
- wear tests, according to standardized or beneficiary methods.

**B. INSTRON 8872 universal test equipment**

The equipment has as accessories:

- fatigue test system of the tibial component of knee prostheses;
- basin with recirculation system and heating solution for in vivo condition simulation.

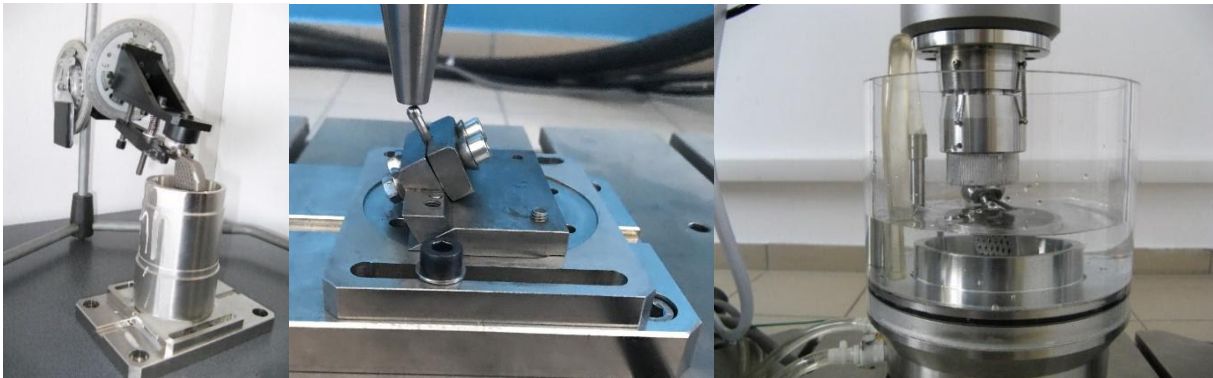
**The main technical characteristics of the equipment:**

- loading force: from 2 N to 10 kN;
- working speed: from 0.005 to 60.000 mm / min;
- working temperature: from -70 ° C to 250 ° C;
- maximum working frequency: 100 Hz;
- form of loading curves: sinusoidal, triangular, trapezoidal, rectangular, saw etc.



**Services offered:**

- testing implantable and non-implantable medical devices for orthopedic surgery (*fatigue testing of knee joint components according to ISO 14879:2000; fatigue testing of hip joint components according to ISO 7206*);
- testing of the instruments used in orthopedic surgery;
- testing of implants and related instruments used in maxillofacial surgery (*Fatigue testing of dental implants, according to SR EN ISO 14801*).



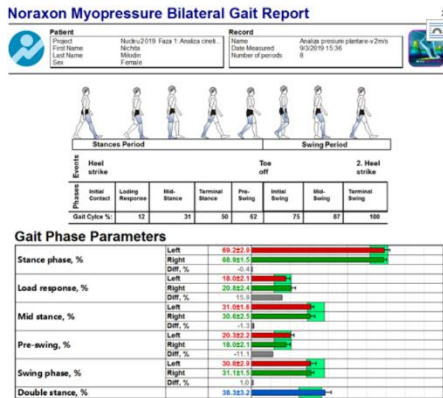
**4. Gait analysis and simulation system**

It is dedicated to biomechanical studies in order to evaluate and simulate gait. Biomechanical studies are performed using component subsystems, which ensure the acquisition of motion data, simulation, modeling in real time, through sensors to determine the forces of the lower limb in bipedal position, walking or running, movements, speeds and accelerations from the joints of the body.

Continuous movement analysis is necessary in medicine for diagnosis and objective documentation of rehabilitation processes. This is especially important after surgery, neural dysfunction, long-term illness, rehabilitation, physical therapy, prosthesis use, stroke, sports injuries and in various other areas.

The motion analysis and simulation system consists of the following subsystems:

- A. Sensorized conveyor belt type plantar pressure measuring subsystem;
- B. Integrated subsystem for tracking, motion acquisition, simulation, real-time modeling;
- C. Integrated optical (noncontact) subsystem, intended for dynamic and static 3D coordinate measurements.



**Beneficiary:**

- Institutions / centers of research, development, innovation in the medical fields;
- Producers of dental implants in the country and abroad.

**FURTHER INFORMATION:**

E-mail: [laborator\\_biomecatronica@yahoo.com](mailto:laborator_biomecatronica@yahoo.com);

PhD Student Eng. Nicoleta-Mirela Popa, (<https://www.linkedin.com/in/nicoleta-mirela-popa/>);

Infrastructure direct public link: <https://erris.gov.ro/biolab>.

## AUTONOMOUS ROBOTIC SYSTEMS FOR WASTE MANAGEMENT IN THE CONTEXT OF SMART CITY

The SIRAMAND project is supported by a grant of the Romanian Ministry of Research and Innovation, CCCDI – UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0086 / contract no. 22 PCCDI /2018, within PNCDI III.

### PRESENTATION

The aim of the complex project is to strengthen the scientific and technical competences and collaborative skills already existing among the partners of the consortium from different research environments within an relevant up to date theme, namely the management of waste left in public spaces such as parks, streets or sidewalks. Although the emphasis is put on educating the population for the purpose of voluntary waste sorting in containers for plastic, metal, glass, paper / cardboard, it is observed that even in the most advanced societies the necessity to raise such waste daily using a large number of sanitation workers did not disappear.

The SIRAMAND project aims to provide robotic collecting and sorting solutions for different types of waste, in line with the anticipated developments of the smart city concept.

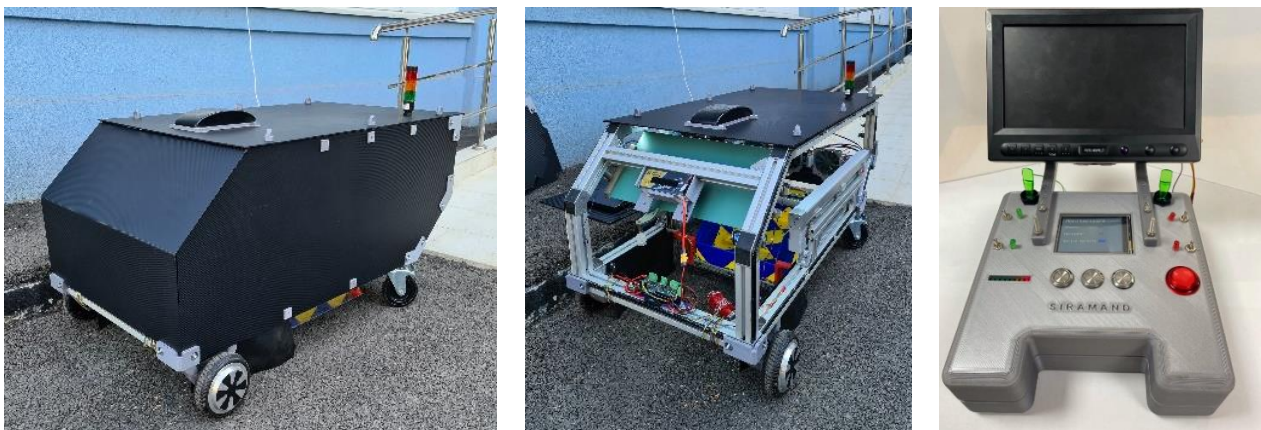


Figure 1 – Autonomous robotic systems for waste management - SIRAMAND

### TECHNICAL FEATURES

- Overall size:  $\approx 1200 \times 800 \times 900$  mm
- Lipo Battery Pack: Capacity-10 000 mAh, Voltage - 22.2V, Discharge Rate - 25C, Configuration: 4S1P / 14.8V / 4 cells;
- Power Supply wheel drive: 24VCC;
- Speed limit: 5km/h;
- Working pressure range of the vacuum pump: -70KPA -220KPA;
- Waste collector volume: 30 liters;
- Size/weight of the collected waste: maximum 160x350 mm/1,2Kg;
- Ultrasonic sensors to avoid obstacles (animals - humans)
- Camera: image sensor - 1/3" SONY Super HAD II CCD

- Trajectory planning is done on maps imported by iNav from GoogleMaps; Waypoints are placed at user-selected intervals. In case the robot has to make a turn, it is recommended that the resolution of the points describing that turn on the map be significantly higher compared to the points placed in a straight line (Figure 2). After the points are placed on the map the robot can perform his tasks autonomously.



Figure 2 - Waypoints on map

- The navigation, emergency stop and arming command is performed via the remote monitoring and control module (Figure 3).

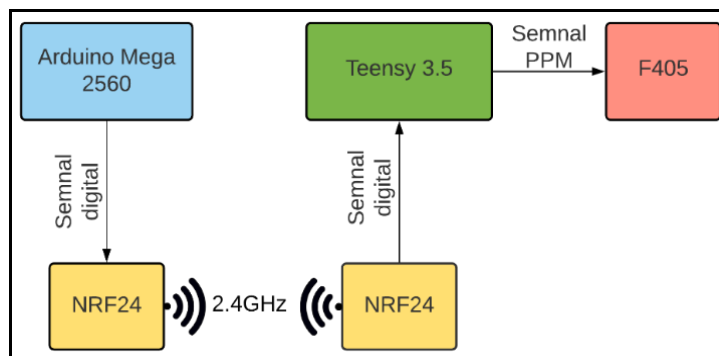


Figure 3 - Block diagram of remote monitoring and control modules

#### APPLICABILITY

Autonomous robotic systems for selective waste collection in public spaces.

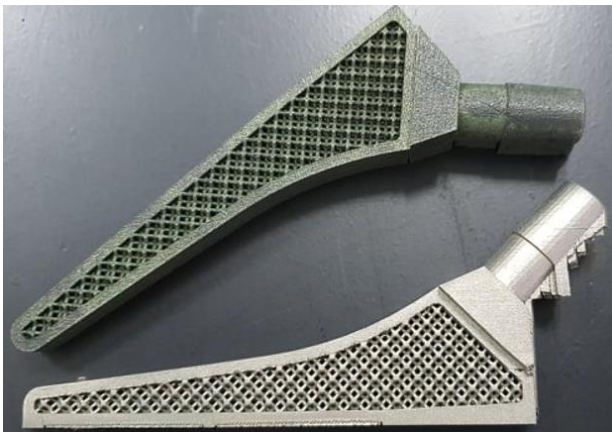
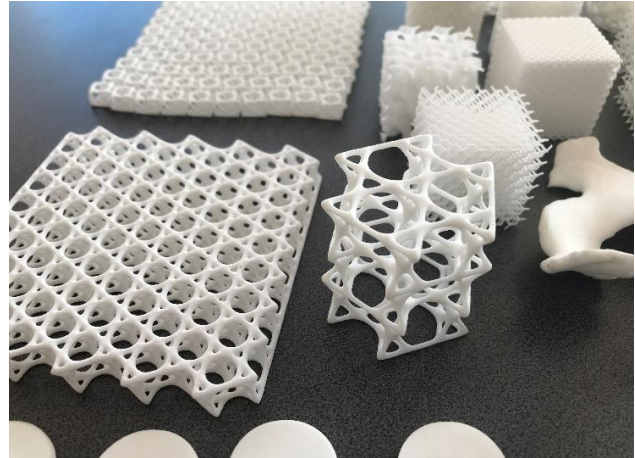
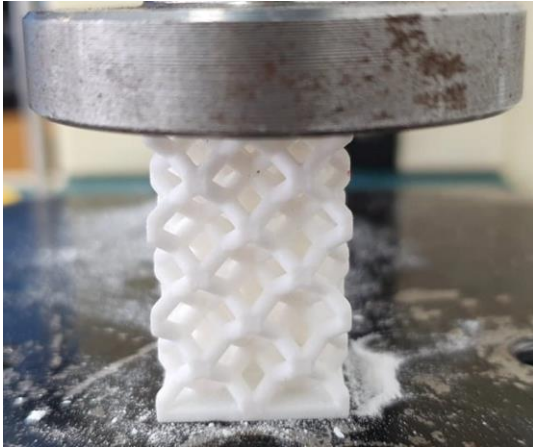
#### BENEFICIARY:

Public and private institutions.

#### FURTHER INFORMATION

Project manager: Dr. Ing. Mihai Margaritescu  
e-mail: [mihai.margaritescu@gmail.com](mailto:mihai.margaritescu@gmail.com)

## IMPLEMENTING ADDITIVE TECHNOLOGIES IN ORDER TO MANUFACTURE COMPLEX AND OVERLOADED COMPONENTS - DIGITECH



### PRODUCT OVERVIEW

Additive manufacturing is an emerging technology that promises to revolutionize global production and will have a major impact in many areas. In Romania, this technology is just at its beginning and has great growth potential. However, considering additive technology's uncommon qualities, there has been encountered significant challenges in determining the optimal methods of characterization and evaluation of the final components, as well as in validating and accepting these technologies in certain fields that are generating additional technical conditions: medical, automotive, aerospace etc.

### OBJECTIVES

The objectives are to manage experimental researches regarding the evaluation and validation of additive technology of laser sintering / melting and the adaptability of processing parameters to the specific requirements of manufacturing and testing the complex and overburdened components:

**In medicine**, for easy manufacturing of complex, anatomic-adaptive, lighter and more resistant implantable structures designed for 3D prostheses of harsh human tissues, with the possibility of improving the technology and therefore extending the application in the field of human organs bio-prototyping;

**In the automotive industry**, for manufacturing finished products designed to customize each car and its spare parts, with the possibility of extending the application to almost entirely manufacture cars from lightweight and durable materials. Also, a methodology will be developed with the purpose of optimizing the design process of complex products for the automotive industry by using artificial intelligence and modelling;

**In the aerospace industry**, for manufacturing complex components, mechanical and thermal overloaded: compressor and/or turbine blades, injectors, structural elements etc.

**Results obtained:**

- “Compression behaviour of PA2200 lattice structures”, Nichita Larisa MILODIN, Cristian DOBROMIRESCU, Mihai TUTOVEANU, Nicoleta Mirela POPA, Flavia-Petruța Georgiana ARTIMON, Journal: International Journal of Mechatronics and Applied Mechanics eISSN 2559-6497, 2021, DOI: [dx.doi.org/10.17683/ijomam](https://doi.org/10.17683/ijomam) – published article;
- “Compression testing of PA2200 additive manufactured lattice structures”, Nichita Larisa MILODIN, Nicoleta Mirela POPA, Mihai TUTOVEANU, Flavia-Petruța-Georgiana ARTIMON, International Conference on Reliable Systems Engineering (ICoRSE), Volume 305, ISSN 2367-3370, 2021, <https://doi.org/10.1007/978-3-030-83368-8> – ISI Proceedings;
- “Compliant positioning system with 6 DoF for high precision medical standing applications”, Mihai TUTOVEANU, Nichita Larisa MILODIN, Nicoleta Mirela POPA Flavia-Petruța-Georgiana ARTIMON, International Conference on Reliable Systems Engineering (ICoRSE), Volume 305, ISSN 2367-3370, 2021, <https://doi.org/10.1007/978-3-030-83368-8> – ISI Proceedings;
- “Femoral component with lattice beam celular structures made by SLS form biocompatible metal powders”, Nicoleta Mirela POPA, Nichita Larisa MILODIN, Mihai TUTOVEANU, Flavia-Petruța-Georgiana ARTIMON, Eminent authority: OSIM, Status: Application submitted, Application number: A100725, 2020 – Patent.



Indexed in:





**«MECHATRONIC MICRO AND  
NANOTECHNOLOGIES» R&D  
DEPARTMENT**

## The MECHATRONIC MICRO AND NANOTECHNOLOGIES» R&D DEPARTMENT

**offers professional solutions and services:**

- √ **Researches in the field of processes specific to chipping** (dynamics, kinematics, tribology):
  - Special chipping tools and high productivity tools;
  - Tools with the active part made up of tough materials (CMS, cermets, ceramic);
  - Tools with the active part made up of extra-tough materials (NCB diamond, diamond poly-crystals):
- √ **Mechatronics** technologies;
- √ Design and execution for:
  - Special chipping tools and high productivity tools;
  - Tools and subassemblies of tools;
  - Tools and subassemblies of tools and tool support assemblies for the extractive industry and the wood industry, the industry of civil engineering;
- √ Tool support assemblies and dedicated accessories for motor vehicles – theme tools;
- √ Matrices;
- √ Complex laboratory devices;
- √ Dedicated theme installations and tools used in precision mechanics and mechatronics;
- √ Special micro technologies and nanotechnologies.

## **MICRO/ NANOMETRIC COATINGS FOR IMPROVING THE FUNCTIONAL CHARACTERISTICS OF MECHATRONIC COMPONENTS STRUCTURES" IN NUCLEU PROGRAM "ENGINEERING OF INTELLIGENT MECHATRONICS AND CYBER-MECHATRONIC SYSTEMS / IMISC-M**

### **PRODUCT OVERVIEW**

#### **Study: Technical study**

The project "Micro/ nanometric coatings for improving the functional characteristics of mechatronic components structures" has as main objective the achievement of researches regarding intelligent materials tribology.

General objective of the project is to investigate and to use materials for coatings of metallic parts of friction couplings used in mechatronic applications (high-precision gears in miniaturized constructions, high precision bearings, components of mechatronic equipment for measuring, positioning and adjustment: raceways, guides, grippers, etc., components for biomedical devices, MEMS & NEMS) in order to increase their lifetime. Of the many materials from which mechatronic components are done, in the framework of this project, micro/ nanostructured thin films were deposited on steel substrates, which can improve their quality.

In order to develop this objective it was necessary to achieve a technical study, which was the basis for future experimental studies. It is a field that is consistent with objective 4 of NUCLEU program "Engineering of intelligent mechatronics and cyber-mechatronic systems/ IMISC-M". Thus, the main area of interest in the project is materials science, which deals mainly with the acquisition of knowledge regarding the internal structure of materials, physical properties, and materials processing to obtain required performances in different fields of application. For example, researches on materials used in mechatronics are directed to the study of their surface properties, and the stresses to which they are subjected to.

The types of structures used at the deposition methods and characterization techniques of thin films have been analysed. Criteria by which are chosen materials for coating, and used deposition techniques: physical and chemical methods are also described.

Academic researches, of companies and performed in specialized institutes have broadened and the area of used materials/ alloys: metals (e.g. Ti, Ta and Au), ferrous alloys containing Cr, alloys based on Co - Mo - Ni - Mn - Zr - Sn - W and alloys based on Ti - Al - V - Nb - Ta - Zr, etc.

Nationally, experiments regarding deposition of titanium thin films were developed at the ICEM and INCDMFS in the years 1980-1987 and completed with technologies assimilated in manufacturing at IMF Bucharest and FS Rasnov.

Concerns regarding development of procedures and conducting experimental researches for characterization of micro- and nanostructured films, used for biomedical applications were developed also at INCDMTM.

To characterize structurally and physico-mechanically thin films obtained and applied for improvement of mechatronic components different technologies, which are presented in the same study, are used.

End of this study presents the main technical variants possible for implementation of the work; timetable of the project and describes the content and phasing of planned activities.



Atomic Force Microscope, NT-MDT NanoLaboratory NTEGRA Probe.

1 - basic unit; 2 - measuring probe; 3 - vibration isolation system; 4 - viewing optical system.

### **STUDY: Laboratory studies and researches I: structural characterization**

The result of the second stage of the present project consisted of an experimental study, achieved as a result of some structural characterizations of samples studied in the project.

It is about the Ti, Cr, Al thin layers and Ti/ Al multilayer obtained by the electron beam evaporation deposition process on four types of steel: OLC45, Ru1, C120 and OSC. The deposited layers had thickness of 50 nm (Cr and Al), 100 nm (Ti), and Ti / Al multilayer had 100 nm (the thickness of each layer is 50 nm).

These samples were then characterized using atomic force microscopy and laser measurement of surfaces microgeometry.

It was observed that all the deposited layers have uniformity resulting from the deposition process, but, at the microscopic level, all seem to have not a very flat surface. Also, in the images obtained from the microscopic analysis of samples, was possible to observe the complete bonding between coating and substrate.

Following microscopic observations, to better characterize the layers, scans were performed using atomic force microscopy, which allows the characterization of surfaces up to the nanometer level. After scanning area of  $50 \times 50 \mu\text{m}$  from the different films deposited on various substrates, were analysed different topographic parameters (e.g. roughness, surface skewness, coefficient of kurtosis), which provides information on distribution of deposited layer. In this way it could be done the detailed characterization of the structure of films with different thickness deposited on various substrates. The roughness was used as an indicator of deterioration of deposited layer to obtain information on the variation in height from one point to another. Surface skewness assesses the asymmetry degree of a distribution and characterizes, together with coefficient of kurtosis, the distribution form. From measurements taken it was observed that there are some average values, minimum and maximum, of parameters obtained for thin films deposited depending on the substrate.

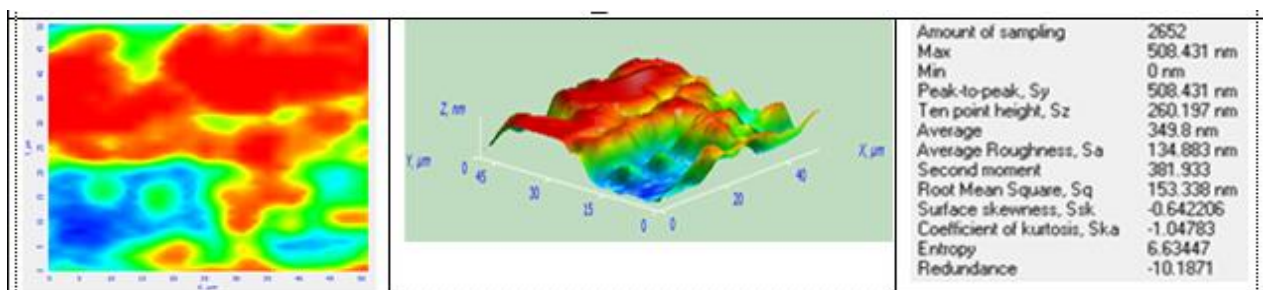
After analysing the average values of roughness of the deposited layers, it was observed that on the OSC type steel substrate are deposited layers with the most uniform surface. Titanium has the most uniform surface and from the thin films with thickness of 50 nm aluminium is evenly deposited on this type of substrate steel. From the measurements made it was noticed that from all steel types used as substrate, the titanium has the lowest roughness value, followed by

aluminium and then chrome. The final conclusion was that were obtained layers increasingly uniform starting from chrome, aluminium and titanium. The multilayer Ti/ Al had the slightest roughness when deposited on steel substrate type C120 and the highest value of roughness when it was deposited on the steel substrate type OSC.

The average values of the surface skewness in all three types of layers deposited on the four substrates have values very close to zero, most of below 0.1 resulting that they have a symmetrical distribution. The only exception is the multilayer Ti/ Al, which has a positive surface skewness index, over 1, so it is a deposit with asymmetrical distribution to the right.

The analysis of kurtosis coefficient of the studied samples showed a platycurtic distribution (curve is flatter) of all thin films deposited on all four substrates. The exception is the Ti film with thickness of 100 nm, which has a leptocurtic distribution (height curve is higher than the normal one).

Similar results to those from AFM analysis were obtained realizing the structural characterization using the laser measuring system for microgeometry surfaces. The same surfaces with low uniformity at micro level, but with a roughness level of nm were observed.



100 nm thick titanium layer deposited on steel substrate type C120.

#### TARGETED BENEFICIARIES:

- Users:
  - mechanical components manufacturers;
  - specialized departments in higher education;
  - specialized testing laboratories;
  - INFLPR, IMT, ICPE-CA, etc.
- Producers: ITMAMIRO, TEHNOROM, TEHNOMED.

#### FURTHER INFORMATION:

PhD. Physicist Laura Liliana Badita; e-mail: [badita\\_l@yahoo.com](mailto:badita_l@yahoo.com)

## NANOTECHNOLOGICAL MEASURING SYSTEM



### PRODUCT OVERVIEW

Nanotechnological measurement system is designed to calibrate devices and nanotechnology. Adaptive system is designed to be used both in the production of organized nanosystems as nanosensors and accurate transducers.

The system is equipped with two robots, displacement systems and precision laser measurement systems, opto-electronics and atomic force microscope.

### TECHNICAL FEATURES:

- AFM resolution: 0.2 nm
- Laser measurement resolution: 1 nm
- Optoelectronic measurement resolution: 10 nm

### APPLICABILITY:

The system can be used to calibrate the equipment and systems for nanotechnology production.

### TECHNOLOGY TRANSFER:

Center of Excellence in Nanotechnology

### BENEFICIARY:

Innovative SMEs in the field of micro and nanotechnology

**FURTHER INFORMATION:** Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)

## DISTANCE LASER MEASUREMENT SYSTEM FOR NANOSATELLITES



### PRODUCT OVERVIEW:

It is a laser distance measuring system up to 1000 m. Measurement system will be used as a component of the nanosatellites measurements system required to maintain flight formation. The laser measuring system is based on time of flight method of a laser beam reflected on a target.

### TECHNICAL FEATURES:

- Measuring domain: 0.066 m – 1000m
- Accuracy:  $\pm 3$ mm
- Resolution: 1mm
- Measuring rate: 200 meas./sec.

### APPLICABILITY:

Highly precise measurements of distance

### TECHNOLOGY TRANSFER:

The product is usable in companies producing high-tech products, R&D institutes, technical universities, including aerospace domain.

### BENEFICIARY:

Institute of Space Science

### FURTHER INFORMATION:

PhD Eng. Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)

## **CERMISO CENTER - RESEARCH CENTER FOR INTELLIGENT MECHATRONIC SYSTEMS USED FOR SECURING OBJECTIVES AND INTERVENTION**

CERMISO is a center research facility for the optimization of Autonomous Intelligent Airborne Minisystem with direct applications in safety and security objectives and intervention in case of disasters in areas difficult to reach. The Cermiso Center is a work in progress in INCDMTM Bucharest, that will optimally concentrate and use, the high-level scientific and technical potential of the institute. The center is equipped with state-of-the-art equipment for manufacturing and machining airborne prototypes.

Basically center activity will be conducted on the following CD guidelines:

- Autonomous intelligent mechatronic systems integration in the security space and the environment.
- Airborne autonomous intelligent mechatronic systems Optimization
- Secure data transmission technology
- Developing micro multisensory systems controlled by artificial intelligence.
- The development of artificial intelligence for automatic data processing in order to prevent disasters and accidents.
- Developing solutions and anti-hacking security algorithms for autonomous airborne systems.
- Hardware and software solutions to optimize energy consumption and increase endurance and autonomy of airborne mechatronic systems.

### ***Proposed objectives:***

- The implication of the INCDMTM research centre in European projects especially H2020;
- The attainment of the capacity to develop partnerships with economic agents interested in thematic research and construction of functional models or prototypes in the project field;
- The attainment of the capacity to develop partnerships with universities, engaging students in educational activities and attracting young researchers from among the latter by providing the research centre with demonstration, testing or research equipment;
- INCDMTM affiliation by means of the research centre to the new European platforms.

Results will be made available to companies having manufacture and production possibilities for Autonomous Intelligent Airborne Minisystem equipment type, considering that there are all the necessary conditions to obtain ultra-high performance equipment in our country. In this moment in Romania there is no such equipment, in study or in the research stage. The range of use of Autonomous Intelligent Airborne Minisystem type is extremely broad, covering all the major existing fields just by a reconfigurable modular concept per task/intended use as it is addressed in the CERMISO concept.

## MECHATRONICS EQUIPMENTS FROM CERMISO LABORATORIES



HORIZONTAL 5-AXIS MACHINING CENTER



LASER METAL 3 D SINTERING



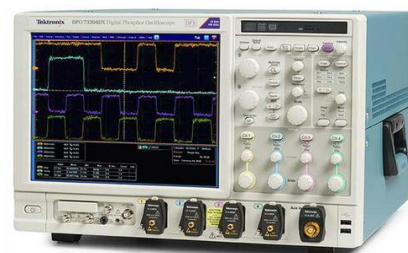
ELECTRODE EROSION MACHINE



WIRE EDM PROTOTYPING



HIGH DIGITAL TIG WELDING MACHINE



OSCILLOSCOPE EQUIPMENT MAKINO

## LASER METAL SINTERING PROTOTYPING EQUIPMENT - SHINING 3D EP M250 3D PRINTER



### Product overview:

The equipment is using the Metal Powder Bed Fusion technology, which is also known as Selective Laser Melting.

Using the fiber laser can directly melt alloy metal powder layer by layer to produce high performance metal parts directly. A large variety of metal material can be used, including Titanium Alloy, Aluminium Alloy, Nickel Alloy, Maraging Steel, Stainless Steel, Cobalt Chrome, Copper Alloy.

### TECHNICAL FEATURES:

- Print volume: 250 x 250 x 300 mm
- Thickness of the print layer: 0.02 - 0.1 mm
- Minimum print detail size: X, Y, Z = 100 microns
- Accuracy: 60 microns
- Repeatability positioning X, Y: 50 microns
- Repeatability Z position: +/- 0.005 mm
- Material: Titanium Alloy, Aluminium Alloy, Nickel Alloy, Maraging Steel, Stainless Steel, Cobalt Chrome, Copper Alloy
- Laser source power: 500 W
- Scanning speed: 8m / s
- Preheating: 200<sup>0</sup> C

### APPLICABILITY:

The EP-M250 prototyping equipment is suitable for a wide range of applications in the aerospace, biomedical, automotive, research and development projects, etc.

**BENEFICIARY:** INCDMTM - Bucharest.

**FURTHER INFORMATION:** PhD Eng. Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)

## HORIZONTAL 5-AXIS MACHINING CENTER MAKINO D200Z



### **Product overview:**

Makino 5-axis horizontal machining centers provide unprecedented levels of productivity and accuracy in the most complex, full 5-axis machining applications.

The ultra-high-accuracy rotary axes and superior motion-control systems eliminate compound errors and maximize accuracy while improving speed and productivity reducing part cycle times.

### **TECHNICAL FEATURES:**

- X-axis stroke: 350 mm
- Y-axis stroke: 300 mm
- Z axis stroke: 250 mm
- Distance from the table surface to the front of the main shaft: 160 - 410 mm
- B axis (mass inclination): 180<sup>0</sup>
- C-axis (mass rotation): 360<sup>0</sup>
- Table diameter: 300 mm
- Payload: 75 kg
- Maximum piece dimensions (Diameter x height): 300 x 200 mm (with limitations)
- Speed range: 100 - 30,000 rpm
- Fast feed (X, Y, Z): 60,000 mm / min
- Working advance (X, Y, Z): 60,000 mm / min

- Rapid Advance (B / C): 36,000 / 54.000<sup>0</sup> / min
- Working advance (B / C): 27,000 / 54.000<sup>0</sup> / min
- Positioning accuracy:
- XYZ axes: ± 0.0015 mm
- Axis B: ± 2.0 sec
- C axis: ± 2.0 sec
- repeatability:
- XYZ axis: ± 0.0010 mm
- Axis B: ± 2.0 sec
- C axis: ± 1.0 sec

**APPLICABILITY:**

Any type of machining applications despite it's geometric complexity. The quipment is suitable for a wide range of applications in the aerospace, biomedical, automotive, research and development projects, etc.

**BENEFICIARY:** INCDMTM - Bucharest.

**FURTHER INFORMATION:** PhD Eng. Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)

## MAKINO EDAF2 - SINKER EDM

### Product overview:

The EDAF2 sinker EDM machine offers an ideal mix of high-speed machining, high accuracy and surface finish capability to efficiently tackle any job.

The EDAF2 has a flexible machine design that utilizes a stationary worktable with a programmable rise-and-fall work tank. The solid electrode erosion machine Makino benefit from the revolutionary Hyper-I Control system that represents a radical change in operational efficiency and offers operators an identical, powerful and easy-to-use interface.



### TECHNICAL FEATURES:

- Working range on XYZ axes: 350 x 250 x 250 mm
- The dimensions of the table: 550 x 350 mm
- X / Y / Z axis positioning accuracy:  $\pm 0.002$ mm
- Surface roughness quality:  $\leq 1.0 \mu\text{m}$
- Automatic tool changer (electrode): 4 tools
- High precision linear rulers:  $0.5 \mu\text{m}$

### APPLICABILITY:

The EDAF2 sinker EDM machine offers an ideal mix of high-speed machining, high accuracy and surface finish capability to efficiently tackle any job in regard to solid electrode erosion machining technology. The equipment is suitable for a wide range of applications in the aerospace, biomedical, automotive, research and development projects, etc.

**BENEFICIARY:** INCDMTM - Bucharest.

**FURTHER INFORMATION:** PhD Eng. Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)

## MAKINO U6 H.E.A.T - WIRE EDM

### Product overview:

The U6 H.E.A.T. Wire EDM machine provides an ideal mix of speed, accuracy, and surface finish capability with larger travels to tackle the most demanding applications with new levels of user-friendliness and efficiency. Makino's Hyper i control delivers intuitive and familiar touch Pinch/Swipe/Drag operations similar to smartphones and tablets to the U6 H.E.A.T. machine. The Hyper i control utilizes a straightforward 3-Step operation process of Program/Setup/Run, and this efficient and user-friendly interface is used for all Makino Wire and RAM EDM machines. U6 H.E.A.T reduce the single largest expenses in operating a wire EDM machine.



### TECHNICAL FEATURES:

- Working range on XYZ axes: 280x250x280 mm
- The dimensions of the table: 600 x 400 mm
- Thread: copper wire and brass wire
- XYZ axis positioning accuracy: 0.0015 mm
- Repeatability:  $\pm 0.001$ mm
- CNC axis programming: simultaneous control of the 4 axes
- Surface quality processed (roughness): 0.005 mm

### APPLICABILITY:

The U6 H.E.A.T. contains a robust machining conditions library that has been developed to provide an optimal mix of Speed, Accuracy, Surface Finish, and Low Wire Consumption for both sealed and poor flush applications. It can be used for any type machining process where wire EDM technology is necessary. The equipment is suitable for a wide range of applications in the aerospace, biomedical, automotive, research and development projects, etc.

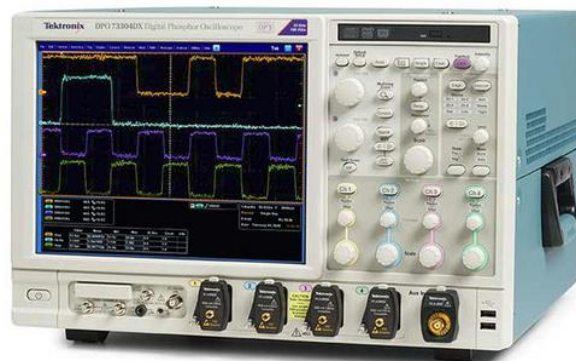
**BENEFICIARY:** INCDMTM - Bucharest.

**FURTHER INFORMATION:** PhD Eng. Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)

## TEKTRONICS DPO70404C - OSCILLOSCOPE

### Product overview:

The DPO70404C is a 4GHz, 4 Channel digital oscilloscope from Tektronix. Measure voltage or current signals over time in an electronic circuit or component to display amplitude, frequency and rise times, etc. Applications include troubleshooting, production test, and design.



### TECHNICAL FEATURES:

- 25 GS/s Real-time Sample Rate
- Up to 125 Megasamples Record Length with MultiView Zoom™ Feature for Quick Navigation (31 MS standard)
- Fastest Waveform Capture Rate with >300,000 wfms/s Maximum per Channel
- Digital Serial Analyzer Models with Dedicated Configuration for High Speed Serial Design and Compliance Testing
- Enhanced Bandwidth to the Probe Tip Extended to Support Multiple Bandwidth Steps for Advanced Signal Integrity.
- Pinpoint® Triggering, with over 1400 Combinations to Address Virtually Any Triggering Situation
- Unique Serial Pattern Triggering up to 3.125 Gb/s and 8b/10b Standard Protocol Triggering for Isolation of Pattern-dependent Effects
- Serial Data Analysis and Compliance for PCI Express, Serial ATA, FB-DIMM, SAS, Fibre Channel, IEEE1394b, RapidIO, XAUI, HDMI, DVI, Ethernet, USB 2.0
- Most Popular Jitter and Timing Measurement and Analysis Package
- 12.1" Largest XGA Touch Screen Display in the Industry
- MyScope® Custom Windows Enhance Productivity
- Right-Mouse-Click Menus for Exceptional Efficiency
- Microsoft Windows 10 Enterprise IoT Edition

### APPLICABILITY:

- Design verification including signal integrity, jitter, and timing analysis
- Design characterization for high-speed, sophisticated designs
- Certification testing of serial data streams for industry standards

- Memory bus analysis and debug
- Prototype turn-on and power supply verification
- Research and investigation of transient phenomena
- Production testing of complex systems
- Spectral analysis of transient or wide-bandwidth RF signals

The equipment is suitable for a wide range of hardware applications in the aerospace, biomedical, automotive, research and development projects, etc.

**BENEFICIARY:** INCDMTM - Bucharest.

**FURTHER INFORMATION:** PhD Eng. Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)

## REHM TIGER 230 DC - HIGH DIGITAL TIG WELDING MACHINE

### Product overview:

The REHM - TIGER welding equipment delivers first-class quality, a perfect seam look and the rework is significantly reduced. All these benefits you get in conjunction with a mobility that is second to none. With a maximum weight of 7.9 kg is the lightest TIG unit in the REHM welding equipment class.

Welding in the assembly and maintenance area is much more demanding, especially when the mobility and handling of the device that is one of the most important requirements in practice. Thanks to a new, intuitive operating concept, the TIGER offers maximum safety in the selection of welding parameters and thus a high degree of user-friendliness. The digital display also makes it easy for a less experienced welder to make the right setting safely and quickly.



### TECHNICAL FEATURES:

- Setting range TIG [A] 4-230
- Duty cycle (ED) at I<sub>max</sub>. (10 min.) At 40 ° C TIG [%] 40
- Power connection [V] 1 x 230
- Mains frequency [Hz] 50/60
- Hedging (sluggish) [A] 16
- Burner cooling gas / water \*
- Degree of protection IP 23 S
- Power factor [cos phi] 0.98
- Power consumption at I<sub>max</sub>. [kVA] 6.1
- Insulation class F
- Weight [kg] 7.5
- Dimension (LxWxH) [mm] 480 x 160 x 320

### APPLICABILITY:

The mobile solution for all welding tasks that occur daily in the craft industry. It does not matter if you want to process stainless steel, aluminum, steel, copper or titanium in different material thicknesses.

The equipment is suitable for a wide range of welding applications in the aerospace, biomedical, automotive, research and development projects, etc.

**BENEFICIARY:** INCDMTM - Bucharest.

**FURTHER INFORMATION:** PhD Eng. Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)

## ADVANCED BLUETOOTH SYSTEM FOR MEASURING AND PRESETTING TOOLS - TOOL PRESET EZSET

### PRODUCT OVERVIEW

Preparing your tools correctly pays off. Precisely measured tools and optimized machine and tool lives mean at least a 15% increase in productivity in your manufacturing processes. EZset tool presetting devices amortize quickly. They are easy to operate, small on costs, and big on performance.

Time-wasting fine adjustments are a thing of the past. The dynamic cross-hairs move to the tool cutting edges, and automatically measures the entire camera image. Results are precise no matter the user, as well as repeatable and reliable. Three in one! Quickly measure, preset, and inspect tools – directly beside your CNC machines.

### TEHNIICAL FEATURES:



- Operating system: Windows 7 64-bit multilingual
  - Permitted for ambient temperatures up to 50 °C
  - Manufactured according to CE regulations (Europe) and FCC class B (USA)
  - Fast and shock-resistant solid state disk (SSD)
  - One-button" data backup for each backup on a USB storage device
  - Dimensions: approx. 33 x 27 cm (17" visible screen diagonal)
  - Screen type: Widescreen flat-panel display (4:3)
  - Maximum viewing angle: 178° vertical / 175° horizontal
  - Screen type and surface: Hard coating (3H), anti-glare
  - Optimal resolution: 1,280 x 1,024 pixels at 60 Hz
- Contrast ratio: 1000:1 (standard)
  - Brightness: 350 cd/m<sup>2</sup> (standard)
  - Response time: 5 ms
  - Color support: 16.7 million colors
  - Background lighting: LED
  - Temperature during operation 0 to 50 °C (32 to 122 °F)
  - Temperature when not operating, during storage and shipping: -20 to 60 °C (-4 to 140 °F)
  - Humidity during operation: 10 to 80 % (non-condensing)
  - Humidity when not operating, during storage and shipping: 5 to 90 % (non-condensing)

### APPLICABILITY:

The EZset Tool Preset equipment is suitable for a wide range of cutting tools used in factories and production plants through metal processing, research and development centers equipped with microproduction sections, production and microproduction sections, etc.

**BENEFICIARY:** INCDMTM - BUCHAREST

**FURTHER INFORMATION:** PhD Eng. Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)

## EQUIPMENT STANDARD AND POLYGON STANDARD - TAYLOR HOBSON TRIANGLE ULTRASPEC 300

### PRODUCT OVERVIEW

Taylor Hobson Autocollimators – developments of the renowned Hilger and Watts products – are sensitive optical instruments designed for the accurate measurement of small angular displacements. Taylor Hobson Autocollimators are used in conjunction with reflecting mirrors or surfaces for the accurate measurement of small angular deviations from a datum angle.



The main advantages of Taylor Hobson autocollimators are:

- High accuracy & wide range angle measurement
- Easy to set up and operate
- Calibration traceable to international standards
- Choice of Visual or Electronic systems
- Wide range of accessories and levels

### TEHNIICAL FEATURES:

- Wide measurement range (1800 seconds)
- High accuracy (0.2 seconds)
- Simultaneous dual axis operation and display
- Laser sighting aid for easy set-up
- Simple touch-screen operation
- Clear software with full electro optics applications package

Applications include:

- Simultaneous 2 axis straightness measurement
- Alignment of optical systems
- Flatness measurement
- Lens centration
- Angles of optical components and prisms
- Checking, setting & measurement of angular indexing heads and tables

### APPLICABILITY:

Used extensively in workshop, tool rooms, inspection departments and quality control laboratories throughout the world.

**BENEFICIARY:** INCDMTM - BUCHAREST

**FURTHER INFORMATION:** PhD Eng. Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)

## MECHATRONICS EQUIPMENTS FROM CERTIM LABORATORIES



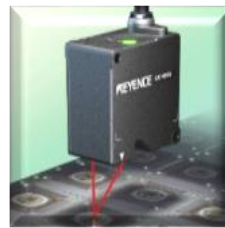
3D Automatic Laser Calibration System –  
ETALON Laser Tracer



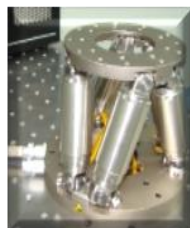
Atomic force microscope - A.P.E. Research  
A100



NANOMETROLOGY FEATURES



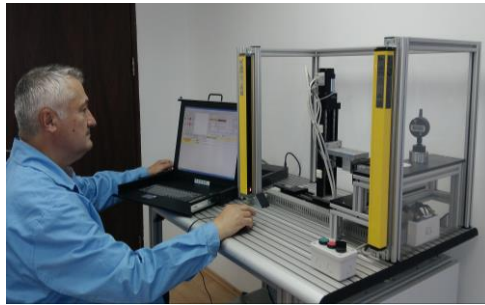
ULTRARAPID LASER MEASUREMENT



COMPLEX MEASUREMENT AND POSITIONIN

**FURTHER INFORMATION:** PhD Eng. Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)

## FLEXIBLE POSITIONING MICROMECHATRONIC SYSTEM, INTEGRATED INTO TECHNOLOGICAL PLATFORMS



### OVERVIEW:

The flexible positioning micromechatronic system is a modular construction and contains the following main parts:

- a worktable
- two electric linear axis model M403- 8PD of the Physik Instrumente company
- electric gripper LEHZ 32K2-22 and connections with controller
- industrial computer National Instruments PXI 8106
- electric panel
- temperature sensor
- inductive sensor
- optical barriers
- the positioning micromechatronic is electronically performed using linear gauges.

### TECHNICAL FEATURES:

- worktable 1250x780x750 (mm)
- travel ranges from 0 to 200 mm on x and z axis
- carry up to 200 N and push/pull up to 50 N
- accuracy of the positioning:  $\pm 0,00025$  mm;
- electrical supply: 220 V.c.a./50 Hz; (15V- CC motors, 24V- gripper and controllers)
- automatic loading and downloading of the work piece;

### APPLICABILITY:

- Highly precise position for measuring.
- Mechatronic innovative system characterization of surfaces in complex vector space size, temperature
- Intelligent mechatronic system for determining the measurement of global constants in optical systems with complex software algorithms.
- System calibration inductive displacement sensors and pneumo-electric sensors.

**TECHNOLOGY TRANSFER:** The product is for companies producing high-tech products, R & D institutes, technical universities.

**BENEFICIARY:** Privat companies, R & D institutes, technical universities.

**FURTHER INFORMATION:** PhD Eng. Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)

## METALLOGRAPHIC SAMPLE PREPARATION LABORATORY

Program: Institutional Development -“Institutional development of INCDMTM to increase capacity and performance to support excellence in research and development - short- and medium-term innovation”, contract no. 5 PFE/16.10.2018

The laboratory aims to prepare metallographic samples in order to perform structural metallographic analyzes. Cutting the samples is done so as not to produce changes in the structure of the material by abundant cooling of the cutting disc.

The embedding of the metallographic samples is made in reusable silicone glasses, the embedding material being a resin and hardener composition.

Sanding is performed on abrasive paper of various granulations and polishing on felt with alumina or diamond solution.

### OVERVIEW:

The following equipment was purchased:

#### Metallographic sample cutting equipment MECATOME T202

The equipment is a compact and robust precision manual micro-cutting machine. With a large working area, it can cut with the highest precision a wide range of materials, from the hardest to the softest. Its powerful engine allows it to work at high and constant torque over the entire speed range 100 to 4000 RPM.



#### Technical features:

Power 960 W

Type of cut-off wheels: Resinoid and diamond  
Cut-off wheel size range: From  $\varnothing$  75 to  $\varnothing$  200 mm

Rotation speed :From 100 to 4000 RPM

Arbor size: 12,7 mm

Cutting mode: Manual or by gravity (weight / counter-weight)

X axis range :100mm X-axis movement of the sample carrier arm

Holder Sample:carrier arm accepts a wide variety of holders

### Pressure embedding equipment for metallographic samples



#### Technical features:

Volume 4.5 liters  
Working pressure 2 bar  
Enclosure dimensions: Height 70 mm, Diameter 220mm  
Ensures good filling of gaps for porous materials  
Reduces resin shrinkage

### Polishing equipment for metallographic samples MECATECH 250 SPI



#### Technical features:

- Aluminum tray with diameter: 250mm
- Rotation speed: 20–700 rpm
- Motor with automatic torque compensation: 750 W
- Automatic grinding head with individual pressure - speed 20 - 150rpm
- rotation in both directions
- motor power: 180 W
- two 200 cc tanks for polishing substances
- pressing force on the piece: 0.1 - 5 daN

**APPLICABILITY:** The equipments has applicability to the characterization of metallic materials from a structural point of view.

**BENEFICIARY:** Metallography laboratories, research and development projects

**FURTHER INFORMATION:** PhD Eng. Zapciu Aurel, e-mail: [zapciu.aurel@yahoo.com](mailto:zapciu.aurel@yahoo.com)



**STRATEGY & MARKETING  
DEPARTMENT**

## **The Strategy & Marketing Department performs**

the following activities:

### 1. Elaboration of specific Strategies and Reports:

- a. Development Strategies
- b. Drafting the development strategy of the Institute
- c. Drafting the annual activity report of the Institute

### 2. Promotional activities:

a. Promotional activities oriented on increasing the visibility and notoriety of the institute, including the organization and logistical management of conferences, workshops, fairs and exhibitions

b. Organizing the annual conference named the "International Conference on Reliable Systems Engineering -IcorSE"

### 3. Editing Publications via "CEFIN Publishing House"

- a. Editing and publishing "International Journal of Mechatronics and Applied Mechanics"
- b. Editing and publishing technical books
- c. Editing and publishing scientific bulletins

### 4. Initiation and development of specific Partnerships and Projects

a. Continuous development and optimal management of databases with potential partners in the country and abroad

b. Support for engaging in competitions and subsequently implementing European projects

- c. Specialized translations

## Strategy & Marketing in INCDMTM

INCDMTM's marketing strategy refers to the development of specific activities and the use of a range of dedicated tools to facilitate the fulfillment of the objectives formulated by the board of directors and the executive management in the strategic documents of the organization.

The marketing strategy envisages the accommodation of the assumed objectives with the material, financial, and human resources that can be mobilized by the Institute, taking into account also the impact elements of the external environment that exert a major influence. These refer primarily to the technological challenges that emerge at a relatively fast pace at the international level in the fields of interest to the Institute.

The main purpose of the marketing activities is to materialize in partnerships with various organizations, including private companies, with the view to facilitate the implementation of innovations and results of the work of INCDMTM research teams. Also, the increase of the Institute's notoriety in its areas of expertise - at both national and international level, through the participation of researchers in specialized conferences and the publication of specific papers - is another important objective of INCDMTM, and which is pursued especially through the Department of «Strategy & Marketing».

INCDMTM's promotion policy is achieved by adapting and combining the use of the main tools used to promote the organization's image - advertising, public relations, direct marketing, dedicated events, participation in fairs and exhibitions - in order to increase the Institute's audience and notoriety in its areas of niche expertise, as well as to facilitate the conclusion of representative partnerships:

- Communication - through its own regularly updated website - via which site visitors can become familiar with the areas of expertise of INCDMTM, its main existing partnerships, as well as with the areas of interest for the Institute, its major current achievements and projects and even its specialized papers - published by researchers who belong to the organization - in the fields of interest of the Institute.
- The organization of dedicated specialized events is an important vector in order to achieve long-term strategic objectives, representing a real pivot for the marketing activity of the Institute. Thus, INCDMTM organizes an annual technical-scientific conference - **The International Conference on Reliable Systems Engineering - ICoRSE - as of 2021** , an event that, in addition to its well-defined scientific objectives, offers an essential opportunity to promote the Institute in existing partners, but above all it creates opportunities for the initiation of new partnerships.
- Promotion of important specialized works of the Institute's own researchers through **Cefin Publishing House** , that issues publications with an important role in boosting the visibility of INCDMTM in the scientific niche areas where the focus of the research activity of the Institute lies.
- The management of media appearances and press relations is carried out mainly through press releases aimed at either popularizing achievements within the Institute or organizing specialized conferences / seminars, from this perspective press conferences being a tool to be employed only in relation with major events;
- The use of the newsletters to reach a target audience periodically (quarterly or half-yearly) as a tool via which the main informative novelty elements that promote the activities and major achievements of the institute are circulated;
- The use of both electronic (brochures, catalogs) and physical promotional materials (roll-ups, banners).



The National Institute of Research and Development in Mechatronics and Measurement Technique organized, between 9 and 10 September 2021, the first edition of "ICORSE" International Conference - International Conference on Reliable Systems Engineering.

The event facilitated the interaction and exchange of experience and good practices between experts in universities, research institutes and business representatives in 12 countries in Europe, North America, and Asia.

The Conference Proceedings was published by the prestigious "Springer" publishing house in the 'Lecture Notes' collection of the 'Networks and Systems' book series and is indexed in "Scopus" international database.

## Scope

The aim of the conference was to bring together actors in the public and private research and development scene in as many countries as possible, both from academia and industry, the fields of mechatronics, but also related ones, so that they would have the opportunity to assert themselves and promote the latest results of their work. Last but not least, by organizing this event, The National Institute of Research and Development in Mechatronics and Measurement Technique offered its own employees an opportunity for having a successful career and establishing contacts with researchers in other countries, in order to lay the foundations for outstanding collaborations.

## CONFERENCE ORGANIZERS:



National Institute of Research and Development in Mechatronics and Measurement Technique, Bucharest – Romania



Relay Center of Technological Transfer and Consultancy

Event organized  
UNDER THE AEGIS OF THE:



MINISTRY OF RESEARCH,  
INNOVATION AND DIGITIZATION

CO-ORGANIZERS:



University „Concordia” Montreal,  
Canada



Institute for Water Education–  
UNESCO – IHE, Delft, Olanda



Academy of Technical Sciences of  
Romania



**We welcome all interested persons to visit [www.icorseng.eu](http://www.icorseng.eu) for more information on the next edition of ICORSE, that will take place on 8 and 9 September 2022.**

**Please join us on Zoom as we host the second edition.**

## Dissemination and Publications

The Strategy, Marketing Department contributes to the disseminating of the institute results by designing and producing posters, ads, flyers, brochures, DVDs for all the scientific events organized by the institute.

The Strategy, Marketing Department also deals with editing the scientific publications, namely scientific books, catalogues, reports and **the scientific journal**. Since 2017, the former *Romanian Review Precision Mechanics, Optics and Mechatronics* will become the International Journal of Mechatronics and Applied Mechanics

*International Journal of Mechatronics and Applied Mechanics* is a publication dedicated to the global advancements of mechatronics and applied mechanics research, development and innovation, providing researchers and practitioners with the occasion to publish papers of excellent theoretical value on applied research. It provides rapid publishing deadlines and it constitutes a place for academics and scholars where they can exchange meaningful information and productive ideas associated with these domains.

The *journal* provides its readers with critically peer-reviewed, carefully selected articles about advances in the fields of mechatronics and applied mechanics.

### Scientific publications



Papers published in *IJOMAM* bring an intellectual approach to knowledge, experience and learning. Moreover, these works establish an obvious connection between professors, researchers and highly qualified experts in the approached fields as papers appeal to a wide range of audiences interested in Mechatronics and Applied Mechanics all around the world.

Topics cover two main areas: Mechatronics and Applied Mechanics. Each main topic is structured in 4 sub-areas (8 fields of research for the journal), each with an Associate Editor assigned:

- *Under the Mechatronics topic:*

- Robotics and Automation
- Measurement Systems and Image Processing
- Mechatronic Systems and Manufacturing Processes
- Electronics and Cyber-Physical Systems

- *Under the Applied Mechanics topic:*

- Materials Science,
- Structural Mechanics,
- Fluid Mechanics,
- Technology of Measurement and Instrumentation.

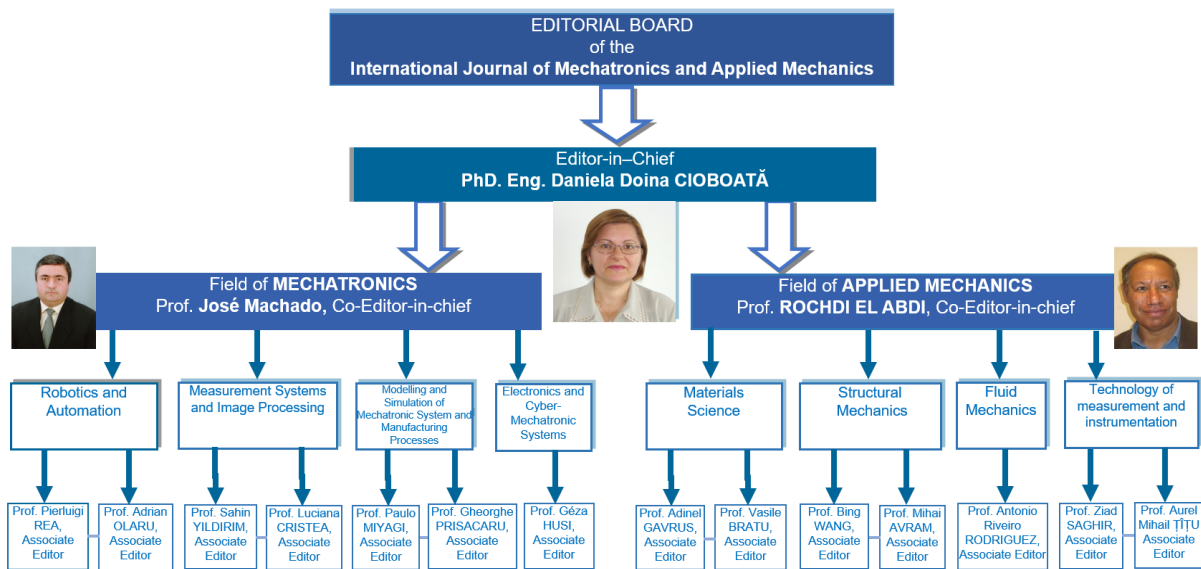
International Journal of Mechatronics and Applied Mechanics is a peer-reviewed, open-access journal, published twice a year, in July and November, and is included in **EBSCO**, **SCOPUS**, **ProQuest** and **Ei Compendex** international databases (IDB).

## International Journal of Mechatronics and Applied Mechanics



If you have any questions on the submission and reviewing process, please contact the Editorial Team at [incdmtm@incdmtm.ro](mailto:incdmtm@incdmtm.ro)

For more information please access journal Website: <http://ijomam.com>



Please, visit our website: [www.ijomam.com](http://www.ijomam.com)

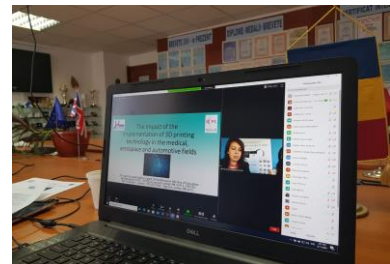
## Event management

Event management is also an important tool for the institute's marketing and communication activity. The marketing team effort helps researchers to benefit from promotional events as a way to communicate with current and potential partners.



### Our **STRENGTHS** are:

- We have a young, dynamic team with experience in organizing national and international events
- We have a strong relationships with our partners
- We are reliable
- We have an well developed system for registration, abstracts and papers collection, communication with participants
- We are friendly and open to suggestions



### What we **DO BEST** (from our previous experience):

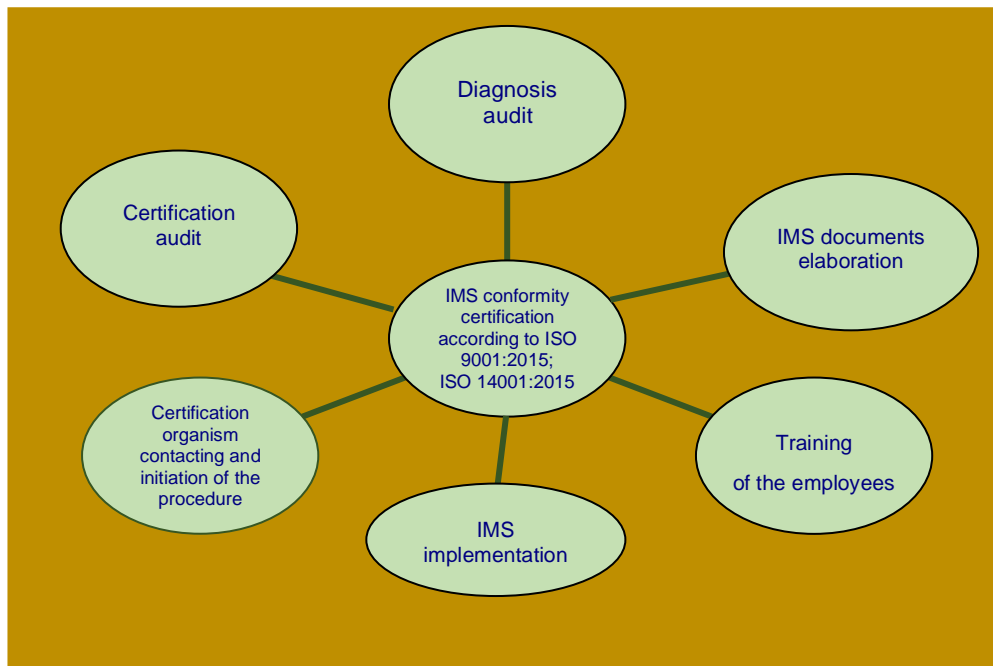
- International and National Conferences
- Symposia
- Thematic workshops
- Ad hoc groups for international exchanges
- Meetings
- Projects meetings and events
- Laboratory visits
- Detachments for European collaborations
- Management of individual participants for conferences.





**«INTEGRATED MANAGEMENT»  
DEPARTMENT**

## INTEGRATED MANAGEMENT SYSTEM (IMS) CERTIFICATION IN FIVE STEPS



### TECHNICAL AND FUNCTIONAL FEATURES:

- ◇ Duration until obtaining the certification – 5 months
- ◇ Assistance during the certification audit
- ◇ Internal audit services and assistance during availability of the certificates
- ◇ National and international recognition of certificates

### APPLICABILITY:

- ◇ **Competitive advantage:** certified firms confirm the development of new businesses.
- ◇ **Increase in the demand by clients:** certified firms report an increase in the demand from clients, and, automatically an increase in business.
- ◇ **Business protection:** firms that are not certified have declared that they have lost clients who have preferred certified organizations. They have found out when losing contracts is already too late.
- ◇ **Cost reduction:** through efficiency, continuous improvement, loss diminishing, key control of processes.
- ◇ **The competition is certifying:** in many fields, concurrent are certified or are being certified. The more you wait before doing it, the bigger will the competition advantage be.
- ◇ **New prospects:** certified firms want to have certified business partners.
- ◇ **You will be qualified for the participation in public acquisitions.**
- ◇ **Increase in credibility:** Your businesses can increase dramatically, taking into account that many firms only work with certified firms.

**CAPITALIZATION AND TECHNOLOGY TRANSFER:** Carmen Finat; [carmen.finat@incdmtm.ro](mailto:carmen.finat@incdmtm.ro)

## THE RESEARCH IN INTEGRATED MANAGEMENT DEPARTMENT HAS AS PRIMARY FIELDS OF EXPERTISE

- 👍 Execution of research – development projects focused on quality management and environment issues;
  - 👍 Methodological coordination of the certified laboratories of INCDMTM;
  - 👍 Development and implementing of quality management or integrated systems for: organizations, trial labs, management systems certifying entities, product certifying entities, inspection entities;
  - 👍 Internal and external audits of the quality management system;
- Standardization**, standard development, attending in Technical Standardization Committees;

### Research objectives of the CCMI personnel:

- attending participation in competitions through project C – D proposals;
- execution of C – D projects
- elaboration and editing of technical and scientific materials designed for presentation and informing purposes.
- Participation in development of scientific standards for the departments tied of expertise.

The CMI personnel abilities for:

- ↪ The completion of all activities assigned to CMI, with the regard for the specific conditions and terms subsequent from the procedure which documents the quality manage system;
- ↪ Identifying and registering any and all problems concerning processes, products and for the integrated quality management system;
- ↪ Annual management analysis;
- ↪ Initialization and conduction on Internal Audit Programs;
- ↪ Identifying of professional training needs inside the CMI ;
- ↪ Follow up of the training activities and training evaluation participation in INCDMTM;
- ↪ Participation in the analysis of bids, orders and contracts;
- ↪ Involvement in the assessment and selection activity of subcontractors;
- ↪ Timely elaboration at a scientific level of all the works assigned to CMI;
- ↪ Projects elaboration concerning the main activity field of CCMI and the department's personnel.

The concerning domains of CMI are part of the interest domain set of INCDMTM and are based on the following fundamental management principles:

- ❖ Clients explicit and implicit needs satisfaction;
- ❖ Quality level assessment opposed to the degree of correspondence with the client's needs;
- ❖ Prevention, as an economic solution for the improvement of the integrated quality management system;
- ❖ Planning of the activities / processes of INCDMTM;

- ❖ Perfecting internal communication in INCDMTM;
- ❖ Promoting a quality based value system.

The main objectives of CMI are:

- ↪ **Continuous improvement of the integrated quality management system implemented in INCDMTM and keeping conformity with the referred standard SR EN ISO 9001: 2015 and SR EN ISO 14001: 2015 ;**
- ↪ **Project proposals participation** at the National and International Research – Development Innovation Programs;
- ↪ **Maintaining the certifications of the laboratories placed under the legal authority oh INCDMTM according to the conditions of the referral SR EN ISO / CEI 17025**

**CMI is enabled and competent to deal with the development of the following third party works:**

Ensuring a high level of competitiveness for the organizations / trial labs by giving assistance with the integrated quality management system for:

- technical and administrative assessment, identification of processes / sub processes of the organization, development of the establishment based on the processes existing in the lab / organization, by taking into consideration of all the conditions and norms concerning quality and quality management;
- ensuring the good functioning of the organization's processes according to the requested standard conditions of document elaboration;
- ensuring the success of developing integrated quality management system through an appropriate documentation of the processes from the organizations/labs, through the development of quality management system / integrated management system;
- development of an adequate management system documentation of the processes/ sub processes and activities that take place in the organization, in accordance with the organizational culture, with its objectives the services / products it provides, with the referral standards and / or other legal / normative requirements.
- ensuring the success of quality management system, implementation, maintenance and continuous, improvement inside organizations / trial labs by providing consulting and / or technical assistance.

#### **Main areas of interest of the CMI in the standardization domain**

In full accordance with the national policy of standardization, CMI participates at the assimilation of European standard process by assigning a representative of CMI in the Technical Standardization Committee.

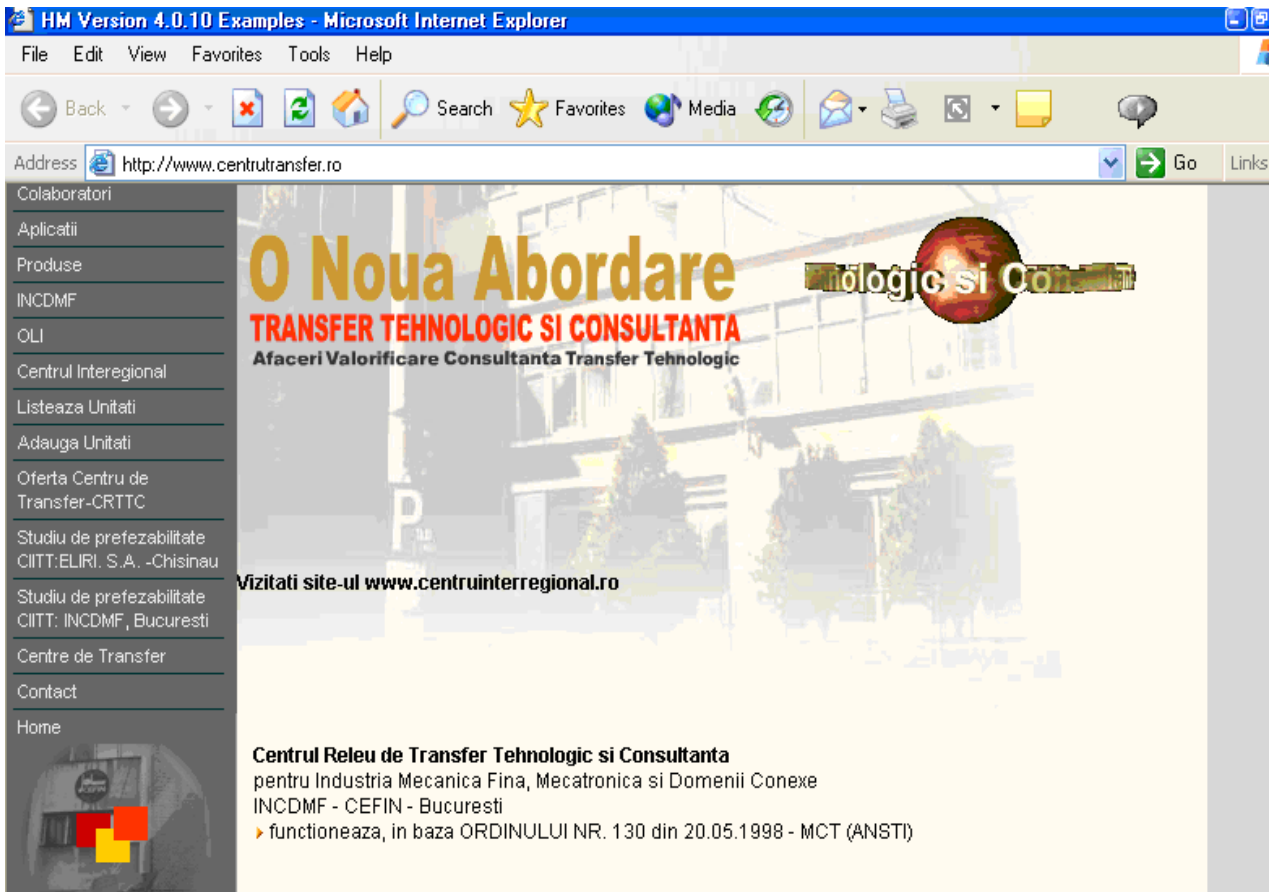
Also from the standardization point of view, CMI has responsibilities in ensuring a human interface with the consequent department of ASRO and in maintaining a standardization data base in INCDMTM.



**THE RELAY CENTRE FOR  
TECHNOLOGY TRANSFER AND  
CONSULTANCY**

## RELAY CENTRE FOR TECHNOLOGY TRANSFER AND CONSULTANCY

- **Authorized, MENCS**
- **Accredited ISO 9001/ 2001**



[www.centrutransfer.ro](http://www.centrutransfer.ro)

## **RELAY CENTER OF TECHNOLOGICAL TRANSFER AND CONSULTANCY**

### **•CRTTC•**

#### **THE FUNDAMENTAL OBJECTIVE AND THE OPTIONS OF STRATEGY RELEVANT THROUGH Relay Center of Technological Transfer and Consultancy – CRTTC**

**[A] The fundamental objective in the medium term:**

(1) creation by TECHNOLOGICAL TRANSFER of some sub-sectors of fine mechanics, optics and mechatronics for a functioning market, compatible with the EU principles, rules, mechanisms, institutions and policies;

(2) shaping the convergence of technological transfer activities, based both on evaluation of resources and opportunities, and on national and international context;

(3) support the imperative to conclude the transition of TECHNOLOGICAL TRANSFER to market economy in the field of industrial fine mechanics, optics and mechatronics as well as preparation of the accession of industries Fine mechanics, optics and mechatronics in industrial fields related EU;

**[B] Options of the corresponding strategy of basic objective options aim to create conditions for:**

(1) providing specific industry sectors increased proportion of fine mechanics, optics and mechatronics based on technology transfer and increase investment rate, both through a significant participation of national capital and by attracting external resources;

(2) further measures to stabilize the specific sub-industry of fine mechanics, optics and mechatronics through support for technology transfer for the domain and policies to ensure the budget deficits incurred and the dynamic quasi-fiscal deficit reduction in the specific industry;

(3) the promotion and integration of technology transfer and coherent policies are compatible with EU mechanisms, aimed at "adjusting" fine structural mechanic, optics and mechatronics, development and modernization of specific sub-area, revitalization and upgrading of sub-sectors and that some businesses related sub, supporting implementation of information technology in the automation industry and specifically by his computerization of other industrial sectors of developing the national strategy;

(4) providing an optimal environment TRANSFER OF TECHNOLOGY AND BUSINESS, specific market area based on the development of market competition, by reducing costs and easing the tax burden and promoting specific measures to stimulate small and medium enterprises;

(5) modernization and development of technology transfer and industrial services and other specific fields to best meet the needs and requirements of the internal market (and external), and approaching the standards the EU countries;

(6) increasing technology transfer and the remodelling of the structure of industrial production capacity and the related field of fine mechanics, optics and mechatronics, including the development and fostering cooperation with EU partners, including entities related to technology transfer infrastructure, amid consolidation operation market economy, it real infrastructure of a competitive environment and the renewal of SMEs with potential competitiveness;

(7) sequence selection process for resizing and operators in the field of fine mechanics,

optics and mechatronics, engaged in restructuring and economic recovery by absorption of the most effective technology transfer of R & D results;

(8) developing the technology transfer consultancy and training, entrepreneurial training and business in centre field-specific relay transfer of fine mechanics, optics and mechatronics, which facilitates the provision of useful services for SMEs;

(9) improving project management research and development-innovation and technology transfer and capacity development to generate scientific and technological knowledge in the field of fine mechanics, optics and mechatronics, in order to reduce disparities in technology, information infrastructure development, application of standard procedures for assessing of operations and personnel, developing the capacity to disseminate scientific knowledge and technology infrastructure transfer extension and marketing services, industry liaison offices, business centres and centres of excellence;

(10) developing capacity of the innovation in the economic environment, by developing the field of fine mechanics, optics and mechatronics, and that the technological transfer of results in this priority area.

**MISSION:**

- 1. Awareness of companies in the industry, the necessity and importance of technology transfer;**
- 2. Constant involvement Relay Technology Transfer Center and Consultants share the results of RDI technology transfer.**

**FURTHER INFORMATION:**

Drd. Eng. Iulian Ilie, Manager  
Phone: +4021.252.30.68/361  
e-mail: [iuliancefin@yahoo.com](mailto:iuliancefin@yahoo.com)



**BENCHMARKING NETWORK**

## **BENCHMARKING STUDY CONCERNING TO CAPITALIZATION OF RESEARCH RESULTS FROM INCDMTM ECONOMIC AGENTS OF MECHATRONICS**

### **Program Nucleu nr.pr 16210601**

The project aims as its final stage, through a benchmarking study to develop a mechanism and tools to ensure a better exploitation of research results developed by INCDMTM. SWOT analysis to INCDMTM emphasizes the fact that the Institute has the potential scientific and organizational capacity to develop effective work of capitalizing on technologies/products/services/ knowledge and has a series of specific points of transfer activities: Benchmarking, industrial property, marketing, creating spin-off and start-up.

### **Overview:**

Valorisation results of public research in Firms, represent a problem of major state policies, the rapidity with which to make a transfer of product/technology/process/service and technical performance and economic that such transfer provides them depending and competitiveness of firms that take.

Development companies by the Transfer of results and Innovation, is a concept that we find in all policies developed by the EU. In the last FP5-FP7 programs the problem of transfer results occupying an important place, more accentuated in the current Horizon 2020 Program.

The interest of States for capitalizing result of public research to industry is justified by the fact that from year to year research funding grow (already the EU average exceeded 2% of GDP) and return these funds to the budget must be reflected in the economic effects that bring assimilation of these products / technologies and services in the benefit of society. That is why, Technology Transfer (TT) be the subject of careful analysis in the EU states, in order to find the most appropriate policies, mechanisms and tools to motivate the transfer of knowledge and results, stimulating both the beneficiary of a patent or object transfer as well as also the one to take it over; TT and the last beneficiary, should not be left alone, but need financial support, legislation in this effort. The capitalization of patent and industrial property right there have different ways of treatment in European countries and US, the US practice instituted once the Bayh Doyle law application and validated by favourable economic results being acquired by the Europeans. Granting institution holding patent rights to itself commercialize patent, creating these institutions specialized bodies with TT and having one means that the inventor cannot have boosted activity. Appeared Centre for Technology Transfer in Universities and Institutions, Industry Liaison Offices, Agencies. INCDMTM has a great experience, succeeding previous years transferring research results its economic agents important and has the potential to develop this activity, make this institute a leadership in the promotion of results in research, increasing technical advantages in Institut or the product to which transfer. Technology, service, his experience - concentrated into a guide - can have a high degree of multiplier.

In establishing this guide will be addressed TT mechanisms, instruments should be created to support this activity the patent licensor licensee knowledge and on - barriers that delayed reporting of research valorisation, possible indicators for evaluating the effectiveness, establishing some solid relations, long-term relationships between the research environment and industry / economic.

Equally, the experience gained in this project and the results may represent a useful contribution to solving a problem of global concern, in the European programs the problem of technology transfer - see ROP program that has a whole division in that finding the problematic - calls finding the most appropriate models for Technology transfer, transfer mechanisms and tools.

## Development of innovative high-tech enterprises, result of the innovation process and transfer of research results

Industrial development of the company in the last few decades, more strongly highlighted the importance of innovation and the application of research results. European policies have endeavored to favor innovation by creating a favorable environment conducive to the increasing of labor productivity, economic growth, create jobs and wealth.

Innovation and strong support they formed the basis of creating a huge volume of knowledge, great efforts being made to transfer these results to the industry, lifting its technical level. Increasing sums being spent were allocated from year to year research statistics showing that countries that invest the most in research, benefits the strong industrial development that are based on outcome scientific transfer.

Statistics show explosive growth of innovative SMEs - those companies who use high-tech technology transfers, representing the EU Member economy around 50%, with significant contributions to GDP. There is a high tendency of increasing the percentage of innovative SMEs, those enterprises characterized by sustained policies of assimilation of high-tech products.

Mechatronics through the synthesis of high technology made in various fields, leading to the development of high-tech products intended for leading industries: automotive industry, aerospace, robotics, medical devices industry. This stands out by the high number of companies that address EU27, variety of supply and added value of the products.

In EUROSTAT 2015 appears eloquently the preoccupation of countries to innovation appeal for increasing the number of innovative enterprises. In Table 2 shows proportion of innovative enterprises to EU countries. The European average innovative enterprises of all existing enterprises is 48.9%. Above this average are situated Germany, Ireland, Italy, Sweden, Spain, France, Finland, the Netherlands, Greece; below 25%, there are only three countries: Bulgaria, Poland, Romania.

The proportion of innovative enterprises of all those existing in a country EU-28 is given in Figure 1.

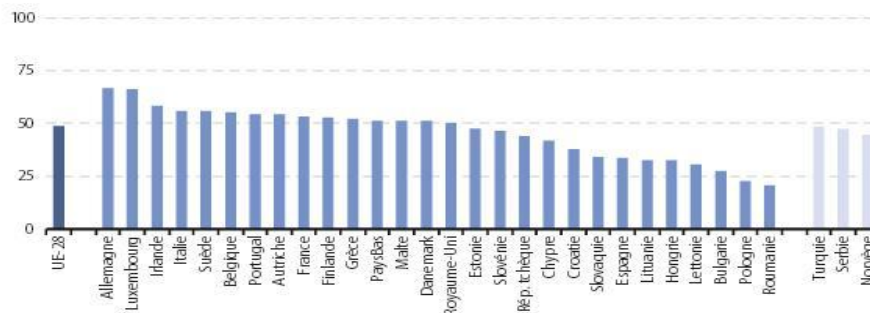


Figure 1. Proportion of innovative enterprises of all those existing in the EU 28

The activity of innovation in a company is not only the assimilation of new products or implementation of new technologies and processes but also to organize activities aimed at enterprise, new ways to do marketing.

Some important findings resulting from this table:

- The allocation of adequate funds for research explains the economic development of these countries (the first part of the table) compared with countries in the second group of table;
- The industry participate significantly to establishing the fund research compared to the second group, consisting of countries that passed after 1990 to a market economy are not yet

consolidated economic to support research, the State is required to take this effort with reduced resources, though granted more as the industry, but funds are insufficient;

- Insufficient financing for research are a cause of transfer less research results together and that the industrial structure of Romania has changed substantially since 1990, with the disappearance of some industrial units strong, new ones - in training and without financial resources - an industry where the largest share of industrial output is achieved in multinational companies who use little to local research results even though they may be competitive as a solution;
- Romania have been identified a number of companies working in Mechatronics, selecting from amongst those who may become potential partners in the development of technological transfers. This selection was made after considering that turnover exceeding 10 million may suggest that the company has some potential financial or human resources to be interested in a possible technology transfer. Since the economic crisis of recent years has collected data and developments that turnover of selected companies made during the years 2006-2014. It noted that data was drawn from official documents sent by companies to the Chambers of Commerce or Chamber of Commerce Bucharest, in their synthesis done by collectively Project;
- From CAEN code analysis, has revealed that Mechatronics is covered mainly by Divisions 26 computers industry, electronic and optical products and optical equipment industry Divisions 27. The paper presents the subdivisions of these Divisions families of products being produced. Benchmarking study done on these divisions provide important data regarding the turnover of the 27 EU countries, value added, salary costs, the type of companies and their contributions to the formation of indicators, labor productivity, employment, the trend of specialization. Comparing the data submitted by Romania to EUROSTAT with the data communicated by with other European countries, made benchmarking analysis suggests the directions of Romania Mechatronics industry through technological transfers can find "niches" that would ensure a competitive participation in international markets.

For the first time in the country will develop a benchmarking study that addresses economic agents and mechatronic profile that will result mainly raising their competitiveness

Also will introduce a new concept in the activities of of economic agents with profile mechatronic namely: commercialization the research results from institute.

**Project manager:** Dr.ing. Diana Mura Badea

E-mail: [dianamura@yahoo.com](mailto:dianamura@yahoo.com)



**“CE–MECATRON” - CENTRE FOR  
PROFESSIONAL COMPETENCES IN  
MECHATRONICS EVALUATION “CF–  
MECATRON” - CENTRE FOR  
PROFESSIONAL TRAINING IN  
MECHATRONICS**

## **“CE–MECATRON”- CENTRE FOR PROFESSIONAL COMPETENCES IN MECHATRONICS EVALUATION**

*[With National Authorization from CNFPA]*

- Organizes evaluation for:  
MECHATRONICS:
  - technician
  - engineer
  
- Ensures for the candidates the proper PROFESSIONAL COMPETENCES EVALUATION and the access to their Specific Resources.
- Issues CERTIFICATES/ DIPLOMAS recognised nationally
  - TARGET GROUP: any person of minimum 18 years of age, with experience in the field
  - REQUIREMENTS FOR THE TARGET GROUP REPRESENTATIVES: graduates from high school with / without high school diploma and / or vocational school graduation diploma

## **“CF–MECATRON” - CENTRE FOR PROFESSIONAL TRAINING IN MECHATRONICS**

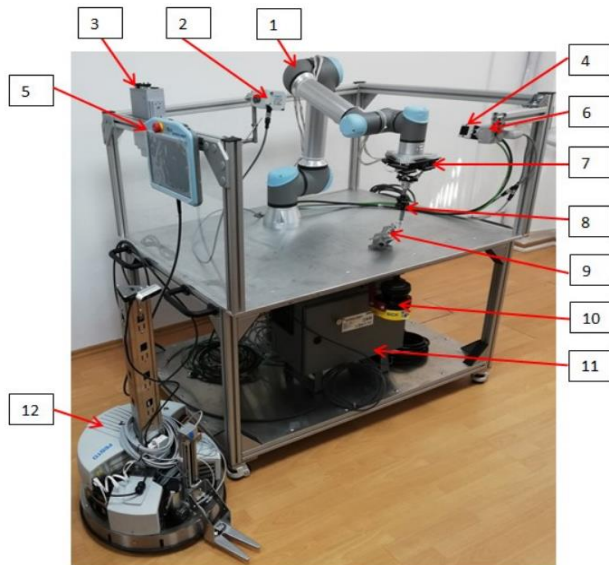
*[With National Authorization from CNFPA with the following series: BNR-0004768]*

- Organizes training for:  
MECHATRONICS:
    - technician
    - engineer
  - Ensures for the candidates the proper PROFESSIONAL TRAINING and the access to their Specific Resources
  - The PROFESSIONAL TRAINING courses ensure:
    - ✓ Labour redistribution
    - ✓ Acquiring new skills for:
      - people seeking employment
      - persons employed in the entities and organizations
      - People interested in the labour market
    - ✓ Review of training programs in accordance with the law
      - The TRAINER course ensures:
    - ✓ Becoming TRAINER, for:
      - persons who have acquired skills of informal trainer (by self-study, at work,, from introductory or short courses) and want official certification
      - persons interested in obtaining the status of qualified Trainer
- Target group requirements: people with higher education or equivalent.



**CYBER-MECHATRONICS  
RESEARCH LABORATORY**

## “COBOTIC” TYPE SMART MULTI-APPLICATION ROBOTIC PLATFORM WITH REMOTE CONTROL AND ULTRA-ACCURATE MEASUREMENT CAPABILITY FOR DIGITAL INDUSTRY 4.0



- iv. UR5e collaborative robot
- v. Smart color sensor
- vi. Smart component identification video system
- vii. Smart camera
- viii. Touch-screen panel
- ix. Axis of rotation
- x. High accuracy hexapodal robot
- xi. Ultra-precise probe
- xii. Measuring part
- xiii. Security sensor
- xiv. Electronic control controller
- xv. ROBOTINO mobile collaborative robotic system

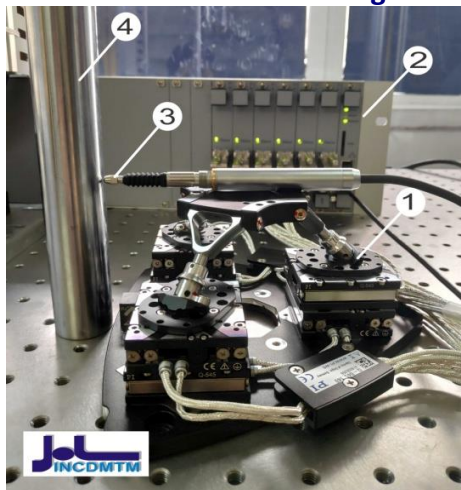
### OVERVIEW:

- The collaborative robotic platform integrates two robotic systems (1) and (7) ensures 11 degrees of mobility along with managing the positioning - with nanometric precision - of the final effector, respectively an ultra-precise probe transducer (8). The orientation of the probe throughout the general workspace is achieved with the positioning accuracy of the universal robot combined with the very high-resolution positioning (of the order of  $\pm 7$  mm) achieved by the hexapodal robotic subsystem (7).
- The smart multi-application platform type "Cobot" allows remote control of cyber mix-mechatronic platforms type "Cobot multi-application" by bidirectional data transmission and implementation of remote control, telemonitoring and teleservice functions through cyberspace - in the Remote Control and Teleservice Center - using specialized programming and visualization software.
- An autonomous mobile robot "Robotino" (12) - to which a smart forklift system is attached - performs various functions based on the reconfigurable software that manages the supply of parts (of the measuring stand or used in the smart control process).
- The smart measuring / control stand is a rigid table on which several functional subassemblies are positioned on two levels by means of clamping. The lower level is the robot controller (11) and the electrical and electronic circuit box. At the upper level is the Universal Robot (1) and also here is fixed the measuring part (9) or the part subjected to a smart control process. The upper level also restricts the effective working area of the robot.
- The smart component identification video system (3) allows the automatic identification of parts or bores as well as their indexing / counting.
- The IP camera (4) allows remote viewing of the workspace with HD image quality, and it allows the automatic realization of smart video inspection and image capture functions.
- A (removable) display (5) is provided with a touch-screen with which it is possible to program and store the system variables of the collaborative robot (1). During automatic or remote-

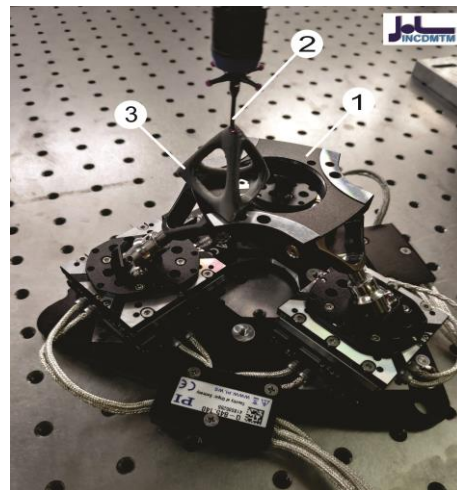
control work, various pieces of information on the status of the entire system, measurement results, etc. can be displayed on the screen.

- The measuring / controlled part is fixed on the rigid table stand (9). The “supply” of the system with parts / work objects is done, depending on the application, either automatically - with the robotic system endowed with Forklift “Robotino” - (12) or manually, by the human operator.
- The connection of the cobotic system with the higher level of command and communication (cyberspace) is made through the controller (11).

### High accuracy hexapodal robot



- Legend:
- 1-Movement platform with six degrees of freedom
  - 2- Kinematic controller
  - 3- Linear Transducer
  - 4- Measured piece



- Legend:
- 1-Movement platform with six degrees of freedom
  - 2- Ultra-precise stylus 3D
  - 3-Plastic prototype powder coating subjected to the ultra-precise measurement process

### TECHNICAL FEATURES

The mixed-mechatronic cobotic system with serial-parallel structure for ultra-precise measurement and dimensional control used in the laboratory and the digitized industry 4.0 allows obtaining the following performances:

- fine, ultra-precise repeatability of the final effector: X, Y **7nm**, Z **20nm**;
- repeatability of the global positioning: 0.1mm;
- resolution of the axis of rotation of the final effector:  $\theta_X, \theta_Y, \theta_Z$  **0.9  $\mu$ rad**;
- fine repeatability, ultra-precise at the rotation of the final effector:  $\theta_X \pm$  **20  $\mu$ rad**;
- fine repeatability, ultra-precise at the rotation of the final effector:  $\theta_Y \pm$  **10  $\mu$ rad**;
- fine repeatability, ultra-precise at the rotation of the final effector:  $\theta_Z \pm$  **6  $\mu$ rad**;
- effective global workspace radius: 500mm;
- working space for ultra-precise fine displacement: X, Y  $\pm$  **7mm**;
- working space for ultra-precise fine movement: Z  $\pm$  **5 mm**;
- temperature of the working environment: **0  $\div$  50  $^{\circ}$  C**;
- power consumption: **150W**;
- Collaborative functions: **15 advanced safety functions** approved by TÜV NORD and tested according to standard **EN ISO 13849: 2008 PL d**;

**APPLICABILITY:**

The robotic platform can be used by public and private smart production companies in the field of high-tech Research Laboratories in Institutes and Universities.

**TECHNOLOGY TRANSFER:** Center of Excellence in Cyber Mix-Mechatronics

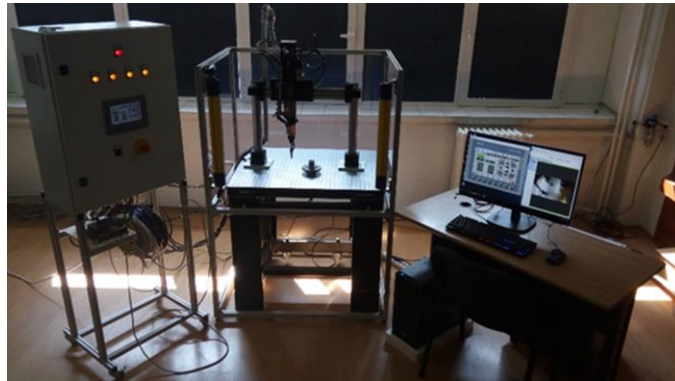
**BENEFICIARY:**

- Innovative SMEs in the field of micro and nanotechnology
- Institutions / centers of research, development, innovation in the Cyber Mix-Mechatronic fields;

**FURTHER INFORMATION:** PhD. Eng Iulian Ilie

Tel. 021.252.30.68/69, Fax. 021.252.34.37, e-mail: iuliancefin@yahoo.com

## EXPERIMENTAL MODEL OF MECHATRONIC AND ADAPTRONIC AND CYBER-MECHATRONIC AND CYBER-ADAPTRONIC SYSTEM



### OVERVIEW:

Within the framework of the Project PN 16210201 "Research on the Design and Making of Virtual and Physical Mechatronic and Adaptronic and Cyber-Mechatronic and Cyber-Adaptronic Models for Laboratory and Industry Work" we have developed an Experimental Model with the following technical features:

- horizontal X axis: made in a structure defined by the nominal stroke (measuring range) of 200 mm and the gauge of the axis of 510 mm, the nominal force of 205 N (and the maximum permissible force of 500 N), 1 linear motor, 1 absolute encoded with high precision and repeatability, 1 controller;
- horizontal Y axis: made in a structure defined by the nominal stroke (measuring range) of 100 mm and the gauge of the axis of 310 mm, the nominal force of 120 N (and the maximum permissible force of 250 N), 1 linear motor, 1 absolute encoded with high precision and repeatability, 1 controller;
- horizontal Z axis: made in a structure defined by the nominal stroke (measuring range) of 100 mm and the gauge of the axis of 100 mm, by the (maximum) nominal force of 115N, 1 linear motor, 1 break, 1 absolute encoded with high precision and repeatability, 1 controller;
- rotating electric axis  $\phi$  with 1 controller, made in a structure defined by: torque: 0.4 / 1.2 (Nm); maximum rotation speed: 600 (1/min.); moment of inertia: 500 (Kgmm<sup>2</sup>); repeatability accuracy: 0,01 (°); operating pressure: 6 (bar); mass: 1.2 (Kg); temperature: 10/40 (° C); circuit voltage: 530 (V); Current: 1 (A); electronic control: external; encoder system: absolute encoder.
  - "micro gripper" subassembly,
  - "smart (ultraprecise) 3D probe" subassembly.

**APLICABILITY:** automotive industry, electronic and mechatronic industry, aerospace industry and so on.

**FURTHER INFORMATION:** PhD. Eng Iulian Ilie

Tel. 021.252.30.68/69, Fax. 021.252.34.37, e-mail: iuliancefin@yahoo.com



**ACCREDITED TESTING  
LABORATORIES**

## LENGTH TESTING LABORATORY – LIL

### OVERVIEW:

The **Length Testing Laboratory** is a laboratory accredited by RENAR according to SR EN ISO/CEI 17025:2005 (accreditation certificate no. LI 783) for the following tests:

- Dimensional and shape errors determination of the limitative plain cylindrical gauges;
- Callipers indication errors determination;
- Micrometers indication errors determination;
- Analogical and digital dial gauges indication errors determination;
- Pneumatic comparators indication errors determination;
- Linear and angular, shape and position dimensional errors determination;
- Vickers hardness test

For these tests, the Length Testing Laboratory uses performing measurement equipments:

### TECHNICAL FEATURES:



#### Machine to measure in 3 coordinates MH-3D TESA – Switzerland MICRO-HITE 350

##### *Technical features:*

- Accuracy:  $(0,002+3L/1000)$  mm
- measurement range: 350 mm
- rezolution: 0,001 mm.

##### *Applications:*

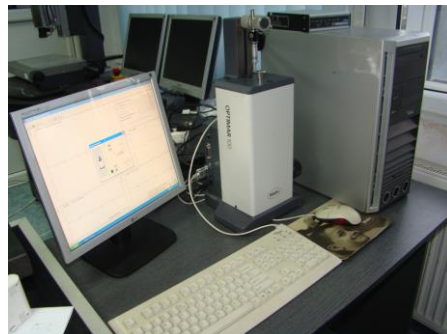
Determination of linear and angular dimension deviations, deviations of shape and position

#### Calibrated comparators and transducers OPTIMAR 100 MAHR Germany

- Accuracy:  $(0,2+L/100)$   $\mu\text{m}$ ,  
L = measuring length ( mm)
- measurement range: 100 mm
- rezolution: 0,02  $\mu\text{m}$

##### *Applications:*

Dial gauges and inductive probes calibration





**3D measuring machine with CNC, type LEITZ-REFERENCE 600**

**Technical features:**

- Accuracy:  $0,9 + L/350 \mu\text{m}$ ,  
L = measuring length (mm)
- Measurement range X/Y/Z: 1000/700/560 mm
- Resolution:  $0.05 \mu\text{m}$

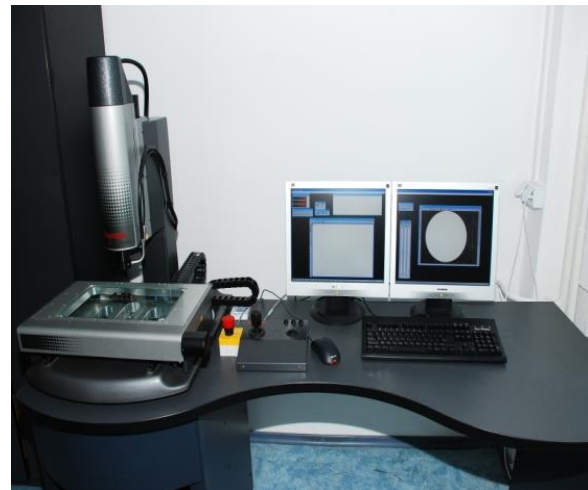
**Applications:** linear and angular measurements, geometrical tolerances control

**Universal measuring microscope with digital display, type STARRETT GALILEO QC-5000**

**Technical features:**

- Accuracy: X,Y :  $(1.9 + 5L/1000) \mu\text{m}$ ;  
Z:  $(2.5 + 5L/1000) \mu\text{m}$ ; L = measuring length (mm)
- Measurement range: X/Y/Z: 300 / 150 / 140 mm
- Resolution:  $0.1 \mu\text{m}$
- CNC system and VISIO unit

**Applications:** linear and angular measurements, surfaces positional tolerances control



**CNC surface and contour tester RONCORDER EC 2500-KOSAKA**

**Technical features:**

- Rotational accuracy:  
 $0,02 \mu\text{m} + 0.0003 \mu\text{m}/\text{mm}$
- Rotary table with automatic centring and tilting
- Resolution:  $0.001 \mu\text{m}$

**Applications:** control of surfaces form





**CNC surface roughness tester IND 120-Taylor Hobson**

***Technical features:***

- Resolution (Z): 16nm/1mm;  
3 nm/0.2 mm;
- Accuracy X, Z: 0.5 $\mu$ m

***Applications:*** measurements of surface roughness and contour

**Universal Length Measuring Machine DMS – 680**

***Technical features:***

Resolution: 0.1  $\mu$ m

Accuracy: 0.5  $\mu$ m

Measurement range: absolute 100mm;  
differential: 680 mm

***Applications:*** dimensional and shape errors determination of the limitative plain cylindrical gauges, micrometers and dial gauges indication errors determination.



## MEASUREMENT AND CALIBRATION LASER INTERFEROMETER SYSTEM RENISHAW XL- 80



### **Technical features:**

#### **Linear measurement:**

- Resolution: 0.001  $\mu\text{m}$
- Accuracy : 0.5 ppm
- Linear measurement range: 0-80 m

#### **Flatness:**

- Resolution: 0.01  $\mu\text{m}$
- Accuracy: 0.6% of calculated flatness
- Flatness measurement range: 1.5 mm

#### **Angular measurement:**

- Resolution: 0.1  $\mu\text{m}/\text{m}$  (0.01 arc sec.)
- Accuracy: 0.2% of calculated angle
- Angular measurement range: 10

#### **Straightness:**

- Resolution: Short range: 0.01  $\mu\text{m}$ ;  
Long range: 0.1  $\mu\text{m}$
- Accuracy:  
Short range: 0.5% of displayed value  
Long range: 2.5% of displayed value
- Straightness measurement range: 2.5 mm

#### **Squareness:**

- Resolution: 0,01  $\mu\text{m}/\text{m}$
- Accuracy: 0.5% of displayed value
- Measurement range: 3/M mm/m, M= measurement distance in meters of the longest axis



**Applications:** 3D measuring machines and length measuring machines calibration, high level direct measurements

### **OPTIMAR 100 Test Instrument**

#### **Technical features:**

- Resolution: 0.02  $\mu\text{m}$
- Accuracy: 0.2 + L/100  $\mu\text{m}$ ; L = measuring length ( mm)
- Measurement range: 100 mm

**Applications:** dial gauges and inductive probes calibration



### Height Gauge MICRO-HITE 350

#### **Technical features:**

- Resolution: 1  $\mu\text{m}$
- Accuracy:  $2 + 3 L/1000 \mu\text{m}$
- Measurement range: 350 mm

**Applications:** dimensional errors determination for terminal sizes, height and length calibers and standards



### Hardness Tester 251VRS-AFFRI

#### **Technical features:**

- Resolution: 0.1 HV-HB-HR
- Digital display
- Automatic conversion different scales: Rockwell, Brinell, Vickers

**Applications:** Rockwell, Brinell, Vickers hardness measurement

#### **CAPITALIZATION AND TECHNOLOGICAL TRANSFER:**

- Measurements within some research projects or on contract basis with beneficiaries from the automotive industry, aeronautics, etc.

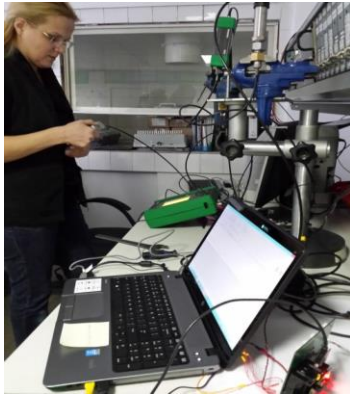
#### **BENEFICIARIES:**

- SC Autochassis International
- SC Automobile Dacia
- SC Renault Mecanique Roumanie
- Research institutes and universities laboratories
- SC Gruppo Italiano Imballage SRL
- SC Plastic Legno Romania SRL

#### **FURTHER INFORMATION:**

Eng. Henriette Arabagian, chief of the Length Testing Laboratory -LIL ;  
Phone:: 021-252.30.68/331, 323; E-mail: [laborator\\_tm1@yahoo.com](mailto:laborator_tm1@yahoo.com)

## PRESSURES TEMPERATURES CALIRATION LABORATORY LE-PRESSURES



### OVERVIEW:

Calibration laboratory - LE 009 operates under the legal responsibility of INCDMTM- Bucharest, organized as a National Research & Development Institute, internationally accredited with «A+». As part of INCDMTM - Bucharest, LE was founded in 1990 as a "Testing Laboratory, in the field of testing and metrological metering of pressure, temperature, becoming in 2012 the «Pressures, Temperatures» Calibration Laboratory. The field of activity of the Calibration Laboratory – LE is relative pressure measurement of fluids and gases.

### TECHNICAL AND FUNCTIONAL CHARACTERISTICS:

Objectives:

- Calibration Laboratory - LE is responsible for maintaining traceability standards of equipment by regular calibrations relative to standards of other national and international institutes on metrology: INM- Bucharest and / or FINAS. Accredited by ilac-MRA;
- Management, maintenance, development, preservation, conservation and maintenance of standards and of the measuring endowment of the laboratory;
- Participation in interlaboratory comparison schemes with the purpose of maintaining the measurement capability of the laboratory;
- Maintaining and continuous improvement of the Quality Management System in laboratory.

Principles of Calibration Laboratory - LE:

- Independence – the staff of the laboratory is not subject to any internal or external pressure in terms of taking decisions on calibrations results;
- Trust – technical competence, growth of the competitiveness of the personnel, integrity of the laboratory is only few targets for winning and maintaining trust;
- Privacy – application of policies and procedures in accordance with the Quality Management System implemented within the laboratory, which ensures protection of information and property rights of clients;
- Responsibility – awareness of the personnel on the importance calibration activity and insurance of a qualities the best of these services;
- Quality - development, implementation, maintenance and improving of the effectiveness of the quality system.

**APPLICABILITY AREAS:**

Calibration Laboratory - LE in the field of pressure measurements is Accredited by RENAR with the Accreditation Certificate No: LE-009 of 05.02.2013, in accordance with EN ISO / IEC 17025: 2005 and is competent to perform calibration activities in accordance with the Annexes to the certificate, updated on 02/02/2017 by RENAR through the Accreditation certificate no. 009 / LE.

Measurement capabilities: Calibration Laboratory - LE can perform calibrations permanently, at the premises, according to the Accreditation certificate No: 009 / LE from 02/02/2017

**CAPITALIZATION AND TECHNOLOGY TRANSFER:**

Calibration Laboratory - LE provides services in the following measurement intervals accredited for the measured size - relative pressure:

1. Transducers and Pressure transmission with voltage or current output;
2. Manometers, vacuum gage and vacuum metre with indication analogue or Digital.

The staff in the calibration laboratory - LE deals with the execution of calibrations and will not, under any circumstances, perform specific serve activities to the devices handed over for performing calibration.

The equipment in the laboratory are operated by the management personnel and by the technical personnel with high expertise. The instructions for use and maintenance of equipment (including user manuals of the manufacturer) are available in the laboratory for use by the staff of the laboratory.

The calibration certificates issued by calibration Laboratory – LE are according to EN ISO / IEC 17025: 2005 and meet all applicable standards and requirements of the Accreditation Association RENAR.

In the calibration process are used updated documents such as:

- RENAR policies;
- EA Documents - European Co-operation for Accreditation;
- EURAMET Documents - European Association of National Metrology Institute;
- ISO Documents - International Organization for Standardization;
- Documents according to the Quality Management System implemented by the Laboratory.

**BENEFICIARIES:** Calibration Laboratory – LE are oriented to all the beneficiaries in Romania and abroad who have the means to measure the pressure

**FURTHER INFORMATIONS:**

Eng. Valentina Bajenaru, PhD , E-mail: [incdmtm@incdmtm.ro](mailto:incdmtm@incdmtm.ro) / [valibajenaru@yahoo.com](mailto:valibajenaru@yahoo.com)



**RESEARCH-INNOVATION  
LABORATORIES**

**OPERATING UNDER INTELIGENT MEASUREMENT MECHATRONICS  
DEPARTMENT**

**LABORATORY OF INTEGRATED CONTROL MECHATRONIC SYSTEMS**

**ACTIVITY FIELD**

Founded together with the Institute, this department has carried out thousands of research and development works for our major beneficiaries consisting in a wide range of products, from the simplest of them (gauges, mechanical devices, pneumatic buffers and rings and so on) to the most complex of them (tightness checking machines, tappet selecting machine, machine for pressing spindle to the tappet lever etc.).

The laboratory benefits from the modern calculus technique and specialized design software tools. The specialists of the laboratory have participated and participate continuously to the rising of the level of training by attending training courses.

We are a leading supplier of plants, machinery, equipment and unique devices for controlling the auto parts for Dacia Groupe Renault cars.

By capitalizing the results of research together with the other laboratories of the Institute (Laboratories MMI4, MMI3 and MMI2) and in collaboration with renowned companies (Festo, ATEQ, Siemens, Bosch, Parker, Mitutoyo, Mahr, Tesa, Tox-Pressotechknic etc.) we managed the development of both domestically and internationally competitive works.

Some of our achievements were exhibited in national and international Exhibitions and awarded various prizes and recognitions.

Sphere of activity:

- 1) Research projects under national and international programs
- 2) On demand design:
  - √ Mechanical and electronic dimensional control devices
  - √ Machines, equipment and computing devices for dimensional control
  - √ Installations, equipment, pneumatic parts for dimensional control
  - √ Machines and equipment for checking tightness
  - √ Machines, installations and mounting devices
  - √ T-NT gages
- 3) Technical Studies
- 4) Control Technologies

## PRECISION MEASUREMENTS AND SMART CONTROL LABORATORY

### ACTIVITY FIELD

In accordance with the provisions contained in the Science and Technology thematic areas (according to FP7) in the Draft of the Decision of the European Commission on FP7 - EC COM (2005) 119 final:

1. Activities of applied research and precompetitive development, dissemination, technology transfer and capitalization of research findings
  - 3.1.3 Embedded systems, computing and control
  - 3.1.4 Software, network security and interdependence
  - 3.2.4 Smart infrastructures following the development of infrastructures that are more efficient, more robust in everyday use and resistant to failure
  - Mobility 3.3.1: intelligent transportation systems and vehicles; safe, comfortable and efficient transportation of people and goods
  - 3.3.3 Fabrication: rapid and adaptive design; production and delivery of goods with high adaptation to customer requirements; digital and virtual production; modelling, simulation, presentation, miniaturized and integrated products
  - 4.3 New productions
  - 4.4 Integration of technologies for industrial applications integrating new knowledge and technologies, nanomaterials and production processes and cross-sectoral applications
  - 6.1 Environment and health
  - 7.2 safety and security in transport

### PRODUCTS:

- Control equipment for deviations of form and position
- Equipment for controlling gears
- Equipment for active control
- Roughness control devices
- Profile projectors
- Instruments for measuring profiles
- Machine for tool presetting
- Instruments and equipment for inspection of auto-mechanical, electronized / informatized parts:
  - √ complex installations for torque control, pressure and crankshaft clearance
  - √ computing systems with axle gearbox control
  - √ installation for collector verification
  - √ control equipment for pinion blows to the gearbox
  - √ noise control equipment
  - √ control for fork devices
  - √ disc brake control devices
  - √ hub control device
- Machinery and devices for threads control
- Devices for automatic measurement and sorting.

## COMPLEX SYSTEMS AND AUTOMATION CONTROL LABORATORY

### ACTIVITY FIELD

#### 1. Basic and applied research activities on:

► Measurement and dimensional control systems:

- Equipment for measuring non-contact probes using optical, laser and ultrasound tools
- 3D measuring techniques and systems
- Automatic movement and spatial positioning for measuring complex profiles
- Miniaturized probing systems
- Equipment for laser flow control

► Automatic control and command systems:

- Specific control systems for image acquisition in precision mechanics, electronics, medicine, biology and biotechnology
- Metallographic determination system for materials' microstructure
- Computerized analysis systems of the *in vitro* development vegetal hybrids
- "Embedded" systems for on demand themes
- Error prevention techniques and systems for complex fabrication processes

#### 2. Activities of design, commissioning, technical assistance, consulting for the automotive industry:

- Dynamic cabinets for assisting operators on assembly lines
- Automation systems for assembly and control posts

### PRODUCTS:

- Portable devices for determining electrical charges of surfaces
  - Portable devices for barcode acquisitions
  - Dynamic cabinet systems for rapid identification of marks
  - On demand Automation Systems with proprietary PLC, or PLC developed by: Siemens, Moeller, Schneider
  - Control systems for stepper motors
  - Electronic systems equipped with Atmel microcontrollers
  - Small portal Coordinate Measuring Machines
  - Laser equipment and computer system for the certification of final measures
  - Equipment for computer analysis using video-electronical feeling
  - Discrete feelers with switches, optical feelers
  - Electronic rotary tables, dividing heads with digital display and interface for PC
  - Dividing heads with transducer, digital display and interface for PC.

## ENVIRONMENTAL ENGINEERING SYSTEMS AND RENEWABLE ENERGY LABORATORY

In this laboratory, we have developed several innovative systems:

**System of diagnostics passenger wagons:** The diagnosis system is a computerized system, redundant, aiming to detect a defect, the place where it occurs, the way it can be eliminated and how to memorize the event.

**Organic airtight vacuum toilets for passenger cars – Ecotoaleta:** The vacuum toilet system is a compact, automated, low water consumption and based on an electro-pneumatic system, which meets the requirements in passenger trains using European standards on hygiene and environmental protection.

**System of specific investigations on tough composite materials:** The system on investigation of hard metal powders is made for physical measurements of particulates, which directly influences the quality of finished products obtained by sintering.

**Alcohol meter:** The alcohol meter is a device for determining alcohol production and is part of the flow meter drum category that makes direct measurement of fluid flow and discontinuity.

**Flow meter with digital display for stands for testing hydraulic pumps:** The meter uses a variable time base and a turbine flow transducer, which allows the use of six variants depending on the measuring range.

**Thermal mass flow meter:** Thermal mass flow meter measures the flow of industrial gases based on the principle of hot wire anemometry.

**V-Cone Flow Meter for industrial liquids:** The device is part of flowmeters with constant section measuring, no moving parts, which measure the indirect flow of industrial liquids.

**Transmission system unit based on GPS signal - MASTER CLOCK:** The master clock displays the universal time information (hour, minute, second) or date (day, month, year) and allows local time to be compared to the Universal Time (Greenwich).

**Litermeter:** The Litermeter is a system of measuring the fuel consumption of trucks and buses equipped with diesel engines.

**Command and control system of heat treatment furnaces:** The product is a system of command and control program with temperatures in small capacity electric furnaces for heat treatment laboratories.

**Portable tachometer:** The tachometer is an opto-electronic device with non-contact measurement whose operating principle is generating a light spot projected on the direction of a reflector (brand) mounted on the rotating part.

**Transmitter for measurement and control:** The transmitter is a unified signal device based on galvanic separation, dedicated for measurement and control appliances from domestic production in order to increase automation of measurement processes.

**Simple door intercom for passenger wagons:** Simple doors and intercommunication doors are electro-pneumatic systems that drive the doors of the cars of passenger wagons.

## SMART TERMOTECHNICAL MEASUREMENTS LABORATORY

### **Field of activity:**

- research on systems, equipment, methods and technologies in the field of measurement pressures, temperatures and level;
- advanced research and applied research permanently connected to requirements of the Internal Market and European and international trends in the field;
- development and integrated approach for making use of sustainable directions of new research and related activities in the field of water resources;
- analysis and synthesis of the factors having effect on the competitiveness, effectiveness and performance, and superiority of SMEs on their competition market;
- developing strategies aimed at improving output performance, increasing efficiency, providing a high quality of service based on benchmarking;
- studies, analyses and forecasts;
- performing research and developing applied innovation technologies, that has both a technical / economic viable point of view as well as an environmentally friendly one;
- organizing, supervising and performing demonstrative projects and pilot projects to promote the above technologies;
- implementing research results into commercial projects in the private sector and those of local authorities, professional associations, etc.;
- offering services and technical consulting in the form of specialized know-how and information for third parties;
- experiments, testing equipment and systems in the field;
- offering advice in the areas of pressure, temperature, level and in the national policy, strategy and planning of these fields;
- disseminating the results of research in the field of expertise and offering viable information meant for supporting the interested investors interested and organizations;
- organizing and / or participating in technical and scientific seminars, educational programmes, specialized training, meetings and so on;
- attracting and preparing of workforce using the newest technologies of simulations to educate technicians quickly, which would allow for practice in secure environments and would ensure reduction of errors;
- participating in scientific and technological clusters, competitiveness poles and excellence virtual knowledge platforms, eco-innovation platforms;
- participating and elaborating in research-development projects and in national or European programmes as a coordinator and / or a partner.

### **Research infrastructure**

- **Autonomous modular system for monitoring atmospheric conditions**  
(Intell. IRS31 Road sensor; VS20-UMB Visibility sensor; UMB ISOCON converter; Schnehohensensor SHM30; Luftdrucksensor air press. P; UMB Analog transmitter; Netzteil / net adapter 24V / 4A Surge arrester; Überspannungsschutz VENTUS; Visibility calibration kit);
- **Noise measurement system and accessories**  
(Source; Amp; Sonometer; Plate Tone Soft Dirac, Cable Sound triaxial lemo 3.5 mm jack connector 3m cable from your sound card type in 2239; cable connecting plate-amplifier Tripod for. Source;

Tripod for. Sonometer; box for. transport and storage);

- TOSHIBA TLP-X-200 Projector;
- 3 / PD1 BEIRFELD Gauges;
- MMV Gauge type 250; (MMV compensated)
- BUDENBERG gauge; (70bar);
- M2200 Gauge with piston and heights, model: BL2H 1200, measuring range (1 ... 1200) bar;
- Pressure calibrator kit type PC6-0700-CH; + Sical Soft (SI pressure);
- Temperature calibrator with dry bulk (-50 .... + 150) °C with Kit Quartz accessories (GIUSANI);
- PTX 620 Pomp of vacuum / pressure; 1,6bar abs .;
- Tektronix oscilloscope;
- Pressure transmitter (0 ... 20) bar abs. D10 type, with EasyCom and EasyCut Light software and RS323 cable and serial-USB converter (with digital output);
- DPI TIP-800 Pressure calibrator (GE Druck);
- Set of 6 digital pressure gauges;
- Set of 7 pressure transducers;
- FLUKE 8846A Digital multimeter;
- 603 TLP source of DC (0-30 V; 0-5 A; 60-60 V; 0-3A);
- Power source 115, 230Vac, output: 2x24x10,3A, 1x12V10 A PS3010;
- Set of transducers for pressure and temperature, with display
- RML6 LAUDA liquid thermostat;
- Vacuum pump (KNF type ANDC 24V N 828);
- Thermohygrographic;
- Stopwatch;
- Data acquisition NI USB-6210, code 779675-01;
- Desktop PC, Laptop, Windows 7.10; Office; Professional SolidWorks 2015, SolidWorks; Simulation Professional 2015; AutoCAD LT 2006 Commercial, Labview PDS, En, Windows; printers; scanner.



## Results

Analyses, studies, new products, methods, technologies, experimentation, systems, equipment and robots in the areas of laboratory, strategies, methods of applied benchmarking, IT applications, projects in the field of technology transfer, articles, papers presented at scientific events, organizing and participating in workshops, scientific events.

### **Projects**

1. Advanced pneumatic systems for robotic actuating and other industrial applications based on the development of new types of proportional mechatronic servodistributors
2. Creating a benchmarking network aiming at using strategic benchmarking, performance and process benchmarking aiming to complement the economic reform, and to enhance commerce for small and medium enterprises / BENCHMARK
3. Development of IT platforms for characterizing the potential of the field of precision mechanics, mechatronics, automation, and optimization in order to increase competitiveness of specific activities - developing a collaborative environment / IPCPMMA
4. The use of smart grids for on-line monitoring of the quality of electrical networks
5. Compared analysis of law and financial institutions and instruments for the evaluation of transfer and exploitation of results
6. GRID-BENCHMARKING resource centre for analysis, evaluation, processing data, in order to increase competitiveness of organizations to achieve high performance / GRID - BENCHMARK
7. Smart autonomous mechatronic equipment for the disposal of deposits of snow on secondary driveways in the urban environment / UACUZ
8. Prospective study on the implementation of Benchmarking in Romania / ST BR
9. Development capacity to keep the transfer and commercialization of research results in institutes and research centres applied to the ROMANIA - implement a pilot model for specialized departments
10. Wide network of sensors for water use - WIDESENS. Technology transfer to SMEs - FP7 Program
11. NUCLEU Programme: Benchmarking study on the exploitation of research results of INCDMTM in the businesses of mechatronics
12. Technology transfer and assistance for the implementation of research findings in the area of replacement of CFC coolants with cooling ecological use of laser cutting machines
13. NUCLEU Programme: Study on intelligent systems for measuring thermo-technical parameters in residential buildings
14. NUCLEU Programme: Support-study for defining the national strategy in the production of mechatronics equipment for measurement, control, pressure and temperature control
15. NUCLEU Programme: System m of hall sensors measuring the fluid level
16. NUCLEU Programme: Methods and systems for high precision measurement and control of the level of technical fluids
17. Technological methods and procedures for the realization of sound absorbing and soundproof areas for protection of populated areas against the noise produced by trucks on highways
18. Autonomous modular system for monitoring of atmospheric conditions on inland road transport (temperature, barometric pressure, fog, ice, snow, wind, precipitations)

### **Services offered in the fields of activity**

- fundamental research;
- research for gaining new knowledge and competences for developing new products, processes or services or for a significant improvement in existing products, process or services, development of laboratory prototypes;
- development of new or improved products, processes and services, defining, planning and conceptual documentation of new products, processed and services;
- prototyping, demonstration, creating pilot projects for testing and validation of new or improved products, processes or services in environments representative for real functioning conditions;
- transmission of information, experience and best practices, as well as cooperation for promoting innovation;

- implementation of a new or substantially improved in practice of the product, service or process;
- placing a new or substantially improved product or service in the economic cycle;
- dissemination of information, providing consultancy, transmission of knowledge acquisition of specific devices and equipment in order to introduce to the economic cycle the results of research, converted into commercial products and services;
- exploitation of research results.

### **Perspectives**

- excellence research in order to obtain advanced scientific and technological results;
- integration in national and European / international networks;
- national and international research proposals financed from private and / or public funding;
- approach and development of other directions and advanced themes;
- realization of transfer technological of the results of research in the economic environment;
- development of the advanced field of increase of energy efficiency by smart management of the building;
- development of the advanced field of water resources;
- development of the high-tech field of interactive IT products for the protection of the environment and of non-conventional energies;
- development of the smart field of promoting renewable energy resources;
- strategy for the Danube region;
- Parametrized diagnosis, environmental parameters monitoring: water, air and soil;

### **FURTHER INFORMATIONS:**

Eng. Dumitru VLAD, PhD, Phone +40212523068; e-mail: [didivlad2006@yahoo.com](mailto:didivlad2006@yahoo.com)

**OPERATING UNDER BIOMEDICAL MECAHTRONICS AND ROBOTICS  
DEPARTMENT**

**BIOLAB LABORATORY**

**Overall objective**

The overall objective of BIOLAB is the contribution to growth of economic competitiveness on the medium and long term by increasing the quality and efficiency of the activities of research - development of national institutes, which will ensure efficient services for units of public health by equipping with modern tools, rehabilitation software and the creation of new modern research laboratories.

BIOLAB will support the integration of research - development – innovation in INCDMTM Bucharest, in the field of biomechatronics, in an economic innovative, knowledge-based activity which is emerging in the Development Region of Bucharest-Ilfov and in the European research area (ERA).

**Specific objectives**

BIOLAB has the following specific objectives:

- ▶ increasing the capacity of research - development – innovation of INCDMTM Bucharest by developing the infrastructures and attracting young and highly qualified specialists;
- ▶ strengthening of knowledge supply and service of medical research done by the beneficiary - a research institute;
- ▶ stimulate technology transfer based on the cooperation between the institute and R&D companies;
- ▶ stimulation of innovation demand of enterprises;
- ▶ supporting training and development of high-tech companies.

**BIOLAB Presentation**

BIOLAB is located in the building of the National Institute of Research Development in Mechatronics and Measurement Technique (INCDMTM), at the 4<sup>th</sup> floor.

**BIOLAB includes:**

1. Software and hardware for 3D reconstruction of medical images and CT design.
2. Mechatronic equipment for advanced technologies of selective laser sintering.
3. High-tech equipment for testing and controlling of complex biomechatronic systems under stress in conditions similar to those “in vivo”.
4. Gait Analysis and Simulation System.

## LABORATORY OF SMART SYSTEMS. DATA ACQUISITION AND ROBOTICS

### Activity Field

The laboratory is focused on the research and development of aims to research and development of robotic systems with non-industrial applications: inspection robots, investigation robots, intervention robots, sampling robots, robotic systems with serial parallel or mixed kinematics, with virtual applications in medicine.

Another activity of MBR 2 is the building of LabVIEW applications in data acquisition from various sensors (temperature, humidity, acceleration, etc.), processing and interpretation.

### Features

**1. Specialized data acquisition equipment, including computer system, National Instruments 6035 data acquisition plate, LabVIEW 6i Base Package Software, with the following characteristics:**

- 16 analogue inputs
- Sampling rate: 200 000 samples / sec.
- ADC resolution: 16 bits

**2. Motion control equipment, which includes computer system, NI PCI-7356 motion control board, UMI-7774 and UMI-7772 motor control interfaces, LabVIEW Full Development System 8.2 software, with the following characteristics:**

- 6-axis motion
- Each axis can be configured for step-by-step or servo command
- Windows XP
- Compatible software: Visual Basic, C, C ++
- Recommended software: LabVIEW
- Driver software (included): NI-Motion
- Interface for 4 axes

**3. Calculation system + software for computer aided design - SolidWorks PREMIUM OFFICE 2020- Create fast and accurate designs, including 3D models and 2D drawings of complex parts and assemblies**

**4. 3D Printer - Prusa i3 MK3S with the following technical parameters:**



Fused deposition modelling (FDM) techniques are used for prototyping, rapid manufacturing and we have the capability to create complex parts using 3d design software SolidWorks.

Build Volume: 25×21×21 cm (9.84"×8.3"×8.3")

Layer height: 0.05 - 0.4 mm

Supported materials: Wide range of thermoplastics, including PLA, PETG, ASA, ABS, PC (Polycarbonate), CPE, PVA/BVOH, PVB, HIPS, PP (Polypropylene), Flex, nGen, Nylon, Carbon filled, Woodfill and other filled materials.

**5. Data Acquisition Plate "High - Performance Multifunction DAQ for USB M Series 16-Bit, 16 Analog Inputs - NI 6229", 2 pieces:**

- Analog Inputs: 16
- Resolution: 16 bits
- Sampling rate: 250 000 samples / sec.
- Analog outputs: 4
- Analog outputs Resolution: 16 bits
- Sampling rate analogue outputs: 833 000 samples / sec.
- Category:  $\pm 10$  V
- Digital I / O: 48
- Operating system: Windows Vista, XP, 2000
- Recommended Software: LabVIEW

**6. Control equipment for robotic system, including:**

- Customer Platform with NI PXI power supply-1031
- Industrial Computer NI PXI - 8106
- Motion Controller NI PXI -7356 6-Axes, with the following characteristics:
  - 6-axis motion
  - Step-by-step or servo command configurable for each axis
  - Compatible software: LabVIEW, Visual Basic, C, C ++
  - PID cycle period: 62.5 to 500 ms / cycle
  - Servo control of output voltage:  $\pm 10$  V, 16-bit (0.000305 V / LSB)
  - Analogue outputs: resolution 8, 16-bit,  $\pm 10$  V DC
- Control interface UMI-7764, with the following characteristics:
  - Interface for 4 axes
  - Isolation of signals
  - 24 VI / O
- Professional Development System LabVIEW 8.6 software

## BIOSENSORS AND BIOMATERIALS INVESTIGATION MICROSYSTEMS LABORATORY

The Laboratory of Biosensors and Biomaterials Investigation Microsystems - MBR 3 is located in the building of the National Research-Development Institute for Mechatronics and Measurement Technology - Bucharest, 4<sup>th</sup> floor.

### Research areas / objectives

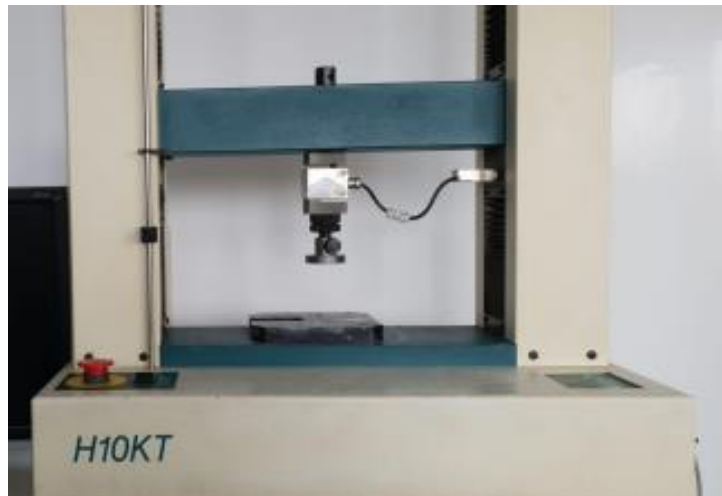
The laboratory researches, designs and tests prototypes and parts for a wide range of parts and medical devices, prosthetic elements for orthopedics and traumatology.

### MBR 3 includes:

1. *Software and hardware for research and design (SolidWorks Premium, Solidworks Simulation, Mimics Innovation Suite etc.);*
2. *Equipment for testing and testing at mechanical stress (HOUNSFIELD type H10KT);*

### The main technical characteristics of the system:

- working speed / approach: from 0.001 mm/min to 500 mm/min, in increments of mm/min;
- working force: from 0.1 N to 10000 N, in 0.1 N increments;
- return speed in the initial position: from 0.001 mm/min to 500 mm/min;
- maximum vertical stroke: 1100 mm, without sample and mounting devices installed;
- distance between columns: 400 mm;
- easily interchangeable force cells: 250 N and 10,000 N;
- force measurement accuracy: 0.5% of the value of the applied force;
- force reading rate of 200 times / sec;
- vertical movement accuracy:  $\pm 0.0001$  mm;
- travel speed accuracy: 0.005%.



### Services offered:

- Tensile test: SR EN ISO 6892-1 - Metallic Materials;
- Compression test: STAS 1552: 87 - Metal tests;
- Bending test: STAS 1660: 1980 - Metals testing.



### 3. *Metallographic analysis equipment.*

#### A. Nikon - Eclipse MA100

##### **The main technical characteristics of the system:**

- XY working stroke of 50 x 50 mm;
- Maximum workpiece weight of 5 Kg;
- Maximum image magnification 100 x.

##### **Services offered:**

Metallurgy, metal processing, surface examination, cast iron nodularity and composition analysis, grain size, telescopic optics etc.

#### B. Mitutoyo 176-809A

##### **The main technical characteristics of the system:**

- XY work table stroke of 100 x 50 mm;
- Work table size: 240 x 152 mm;
- Maximum workpiece weight of 5 Kg;
- Maximum workpiece height of 107 mm;
- Maximum image magnification 30 x.

##### **Services offered:**

Metallurgy, metal processing, dimensional control, etc.



#### **BENEFICIARY:**

- Institutions / centers of research, development, innovation in the medical fields;
- Producers of dental implants in the country and abroad.

#### **FURTHER INFORMATION:**

E-mail: [laborator\\_biomecatronica@yahoo.com](mailto:laborator_biomecatronica@yahoo.com);

Drd. Eng. Flavia-Petruța-Georgiana Stochioiu (<https://www.linkedin.com/in/flavia-artimon/>);

Infrastructure direct public link: <https://eeris.eu/ERIF-2000-000Y-0168>.

## RAPID PROTOTYPING LABORATORY

### LRP presentation

It is based on rapid prototyping equipment by selective sintering with laser, for metal and plastic powders.

It produces parts and prototypes for research, development and innovation activities and provides design, execution and consulting services for plastic / metal prototypes for external orders. The geometries approached can be complex in nature, created directly in CAD files, then reproduced with high accuracy and high resolution, with a surface quality and mechanical properties similar to those obtained by applying conventional technology.

### Research areas / objectives

Currently, LRP is part of the Digi-CENTER network (<https://www.incdmtm.ro/digitech/>), a partnership between several research institutions and universities, which aims to:

- to support activities to promote additive technologies;
- to create a technological platform that allows companies access to advanced manufacturing technologies;
- to allow the transfer of scientific results to the economic and industrial environment;
- to offer new perspectives for the field of health, in particular for cranio-maxillofacial and orthopedic surgery;
- to offer internships for students of engineering universities and to allow the active use of additive technology in the education and training process.

### The Additive Manufacturing (AM) technology

Additive manufacturing is the common name for the "layer by layer" processing technology, using virtual 3D models.

The basic principle of the laser sintering process consists of melting of layers of the raw powders using a CO<sub>2</sub> laser, adding each layer on top of the melted previous layers. During this process, the powder is briefly heated above the melting point by exposure with the laser beam. A solid, 3D part is produced layer by layer by this heating and then subsequent cooling process.

Selective laser sintering uses a wide range of materials: aluminum alloys, corrosion-resistant steel, titanium and cobalt alloys, plastic polymers, in order to obtain products with high geometric complexity and high physical-mechanical properties for fields such as: medical and automotive.

**LRP includes:**

**1. Additive manufacturing services by selective laser sintering with plastic powder – EOS FORMIGA P110**

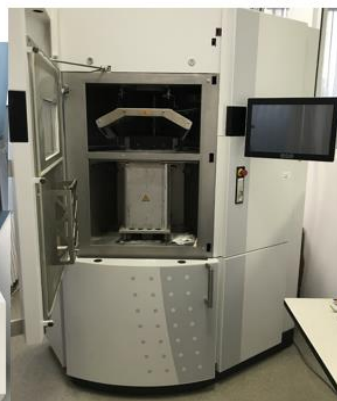
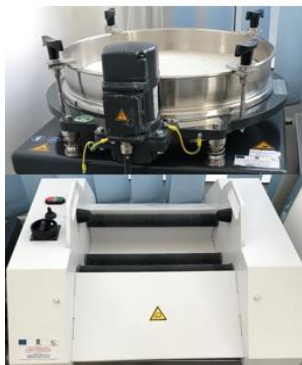


**The main technical characteristics of the equipment:**

- Building volume: 200 mm(X) x 250 mm(Y) x 330 mm(Z);
- Layer thickness (depending in material): from 0,06 mm to 0,12 mm;
- Laser type: CO<sub>2</sub>;
- Laser power: 30 W;
- Scan speed during building process: up to 5 m/s;
- Building rate: up to 1,2 l/h;
- Power supply: 16 A;
- Power consumption: typical 3 kW, maximum 5 kW;

**Plastic additive manufacturing – Tehnological process**

Powder preparation



Post-processing

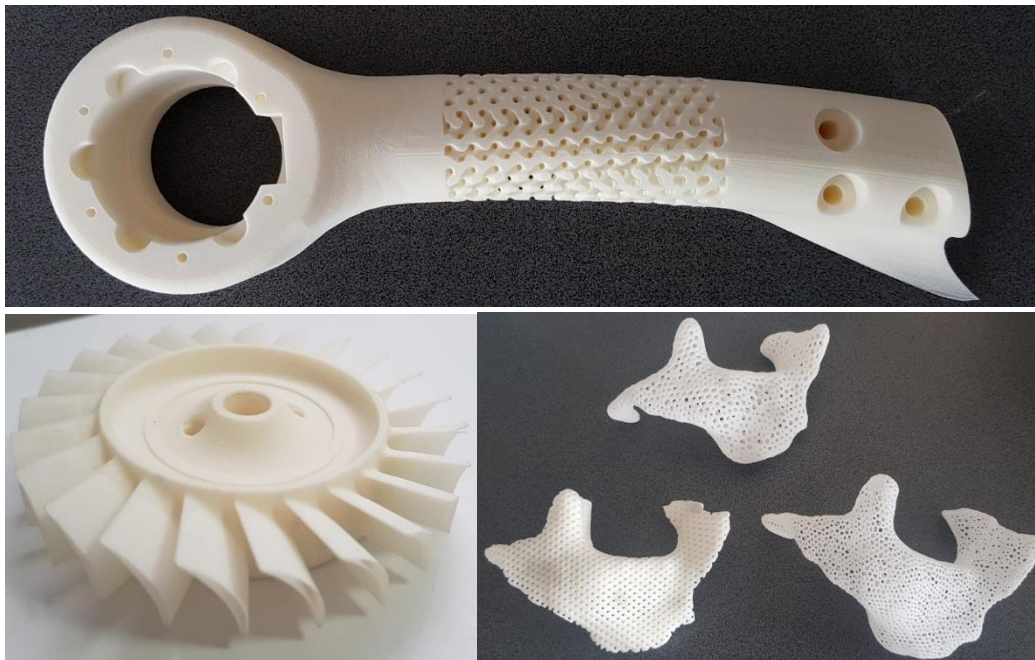
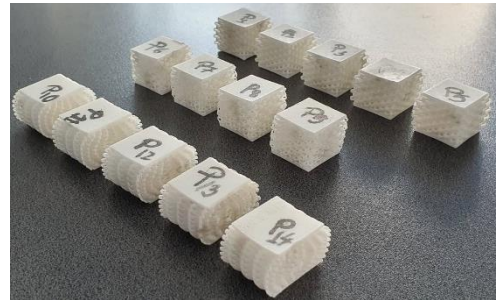


Moreover, the laser sintering processing system for plastics includes accessories for post-processing parts and powder management in order to reuse them and to clean the machine:

- a post surface processing device;
- a vacuum cleaner for removing all the debris left in the processing chamber;
- a powder screening sieve;
- a powder mixer.

**APPLICABILITY:**

- Processing of complex and personalized components for applications in the fields: medical and automotive, but also in other fields;
- Processing experimental models for complex surgical procedures that require geometrical precision and pre-surgical equipment;
- Testing the functionality and the design of mobile assemblies before manufacturing them from other more expensive and demanding materials;
- Processing prototypes of verifying new, innovative solutions.



**BENEFICIARY:**

- Institutions/centers for research, development, innovation in the medical and automotive fields;
- Medical pre-surgical equipment in clinics and hospitals that perform traumatology interventions;
- Production of prototypes in the automotive and medical fields.

## **2. Additive manufacturing services by selective laser sintering with metal powder – EOSINT 270 M Dual Mode**

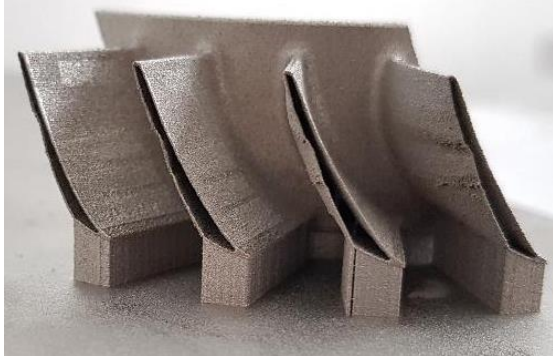
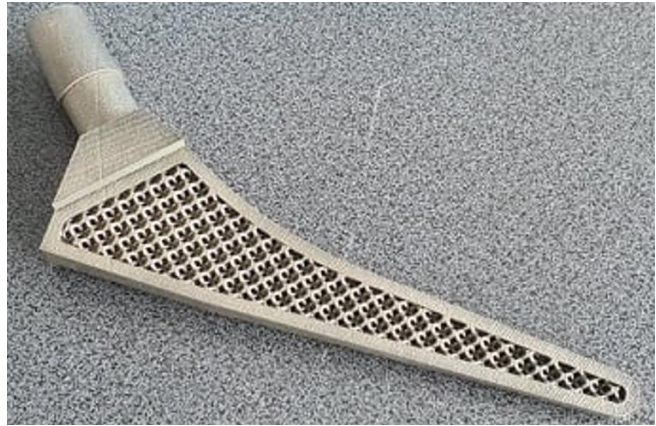
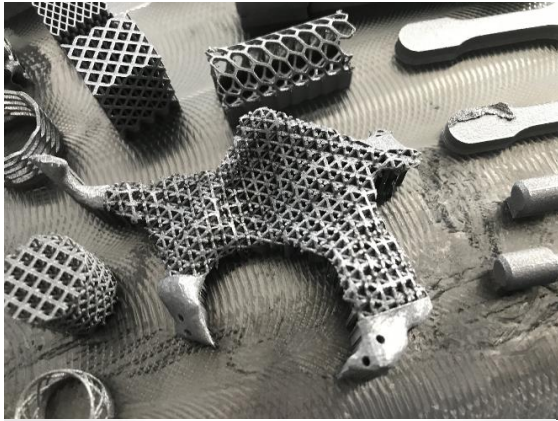
### **The main technical characteristics of the equipment:**

- Effective building volume (including building platform): 250 mm(X) x 250 mm(Y) x (215 mm Z);
- Building speed (material-dependent): from 2 to 20 mm<sup>3</sup>/s;
- Layer thickness (material-dependent): from 20 to 100 µm;
- Laser power: 200 W;
- Scanning speed: up to 7 m/s;
- Variable focus diameter: from 100 to 500 µm.
- Power supply: 32 A;
- Power consumption: maximum 5,5 kW;
- Nitrogen generator: standard;
- Compressed air supply: 20 m<sup>3</sup>/h.



### **APPLICABILITY:**

Processing of complex, personalized and overloaded components for applications in the fields: medical, aerospace and automotive, but also in other fields.



**BENEFICIARY:**

Centers and institutions of research, development and innovation in the medical, aerospace and automotive fields,

Orthopedics and traumatology clinics for hard tissue (bone) surgery,

Aerospace and automotive production.

**FURTHER INFORMATION:**

E-mail: [laborator\\_biomecatronica@yahoo.com](mailto:laborator_biomecatronica@yahoo.com);

Drd. Eng. Mihai Tutoveanu (<https://www.linkedin.com/in/mihai-tutoveanu/>);

Infrastructure direct public link: <https://erris.gov.ro/biolab>.

**OPERATING UNDER MECHATRONIC MICRO – AND NANO - TECHNOLOGIES  
DEPARTMENT**

**PROCESS MICRO AND NANOTECHNOLOGIES LABORATORY**



**Field of activity**

- Engineering of systems and micro-systems of conventional and non-conventional processing: Analysis and diagnosis of process; Dedicated technological logistics developed in computerized systems / micro-systems for computerized processing, monitoring, management and transfer; Equipment/systems for checking and testing the process and the end of the technological process; Approaches to the processing, industrial applications, laser
- New materials: Research applications of composite materials with nano structures / micrometre; Research for processing technologies and use of new materials with special characteristics; Methods and equipment for investigation, characterization and processing new materials investigated;
- Nanotechnologies: Studies and analyses of evaluating the potential uptake of new research areas such as micro- and nano-dimensions and micro- and nano-structure; Forecasting immediate and future directions on the development of micro and nano-mechatronic systems, and especially micro- / nano-sensors and micro- / nano-actuators; Development of specific methods and procedures for characterization and evaluation.
- Forecast studies, strategies: Market studies; Sectoral development strategies; Forecasts on sector development.
- Studies / analyses of frictional systems: Analysis of specific tribo-systems for chipping and micro-chipping of metallic and non-metallic materials using hard and super hard composite structures; Study of the effects induced to the tribo-system by varying technological parameters according to categories of processes; Developing methods and testing procedures complementary to those practiced in the EU; Structural and operational characterization of wear-resistant coatings.

In the department, there is the Centre of Excellence called "Logistics and transfer for hard and super hard materials ", which operates as a network of scientific connections bringing together specialists from INCDMTM, institutions of higher learning, research institutes and private companies in the field of research.

The main strategic directions deriving from preliminary strategic directions include: The formation of a multidisciplinary extended core, with a higher potential of elaboration, promoting and developing sustainable projects that are also compatible with current requirements of internal and external market research; Development of a material base for research aligned to the scientific European and international requirements; Further development of associative activities, partnership with internal and external research entities, respectively, SMEs with innovative vocation and appetite for research and development.

## CERTIM LABORATORY

### Overall objective

CERTIM's overall objective is to contribute to increasing levels of economic competitiveness by increasing the quality and efficiency of activities of research – development in research institutes and SMEs will ensure efficient services for businesses by equipping with modern equipment, tools, software and the creation of new and modern research laboratories. CERTIM will support the integration of research, development and innovation of INCDMTM Bucharest for the smart laser-based measurement as an innovative economic activity, based on knowledge and intelligent techniques in the Region of Development Bucharest - Ilfov and in the European research area (ERA).

CERTIM has the following specific objectives:

- ▶ increasing the capacity of research - development – innovation of INCDMTM Bucharest by developing the infrastructures and attracting young and highly qualified specialists;
- ▶ strengthening of knowledge supply and service of medical research done by the beneficiary – a research institute;
- ▶ stimulate technology transfer based on the cooperation between the institute and R&D companies;
- ▶ stimulation of innovation demand of enterprises;
- ▶ supporting training and development of high-tech companies.

*Scope of services:*

- ▶ In metrological and industrial laboratories;
- ▶ In technical and technological manufacturing;
- ▶ In other specialized and related fields.

2015 Bucharest, Romania

### CERTIM Overview

CERTIM is located in the building of the National Institute of Research Development in Mechatronics and Measurement Technique (INCDMTM) as a clean room space. CERTIM contains four operational laboratories:

- LABORATORY OF NANOMETROLOGY;
- LABORATORY OF COMPLEX MEASUREMENT AND POSITIONING;
- LABORATORY OF ULTRA-FAST LASER MEASUREMENT;
- LABORATORY FOR ADDITIVE PROCESSING AND PROMOTION.

Technical characteristics of the cleanroom:

Standard: ISO 14644 (USA- FS-209 D)

Class 10000 - ISO7

Useable Space: 59 m<sup>2</sup>.

Environment conditions:

- humidity (%): 45 ± 10;
- relative pressure, Pa: 25 ± 5, between the clean room and outdoor;
- temperature ° C: 20 ± 1 0C

- speed air circulation; in accordance with the parameters of standard class clean room, but no less than 0.25 m / s.
- noise level - 42dB  $\pm$  3dB.
- lighting: light boxes, in accordance with the parameters of standard class clean room (500 W)
- emergency lighting for escape autonomous systems (one hour of autonomy).





**2021 SCIENTIFIC OUTCOMES**

## RESEARCH PROJECTS 2021

• NATIONAL/ INTERNATIONAL PROJECTS 2021			
Contract No.	Project name	Manager	Beneficiary
<b>„NUCLEU”</b>			
PN 16 21 01 01	The collaborative heterogeneous system of inspection and intervention in the disaster affected area	MARGARITESCU Mihai	MCI
PN 16 21 01 02	Innovative solution for monitoring and testing soil and arable land using cyber-intelligent equipment to create the agricultural agricultural direction	ILIE Iulian	MCI
PN 16 21 01 03	Research regarding the development of integrated cells, flexible, with a high degree of adaptability, based on cyber-mechatronic principles, for transport, handling, inspection and control in the manufacture of components with high-risk potential in the automotive industry, in the context of Industry 4.0	CIOBOATA Daniela	MCI
PN 16 21 01 04	Researches regarding the identification and implementation of modern and efficient solutions for ensuring the functional autonomy of the mechatronic equipment of measurement and control and their integration in the industrial and non-industrial cyber-space	SOREA Sorin	MCI
PN 16 21 02 01	Interdisciplinary research on the conception and realization of a multi-application intelligent robotic platform of type “COBOT” of ultra-precise telemetering and telecontrol for the Digitalized Industry (4.0)	Anghel Constantin	MCI
PN 16 21 03 01	Researches regarding the realization of a non-contact calibration system of the special processes of production and control designed by eco-design	Angelescu Dorin	MCI
PN 16 21 04 01	Complex researches for the realization, characterization and evaluation of the applicative capacity of the deposition of micro-nanostructured layers destined to the biocompatible components	BADITA Liliana	MCI
PN 16 21 05 01	Applications of cryogenics and ultrasound in medical recovery	BAJENARU Valentina	MCI
PN 16 21 05 02	Rehabilitation and assistance of people with locomotor disabilities with the help of integrated intelligent biomechatronic systems	STOCHIOIU Artimon Flavia	MCI
<b>PROGRAMME: “PARTNERSHIP IN PRIORITY AREAS”</b>			
22 PCCDI	Autonomous Robotic Systems for Waste Management in the Smart City Context – SIRAMAND	Margaritescu Mihai	UEFISCDI

RESULTS OF RESEARCH, DEVELOPMENT & INNOVATION – 2021

77 PCCDI	Implementing additive technologies in order to manufacture complex and overloaded components	CIOBOATA Daniela	UEFISCDI
159 POC	Research Center for Intelligent Mechatronic Systems Used for Securing Objectives and Intervention - CERMISO	Popan George	MCI
85 POC	Knowledge Transfer Partnerships to Increase Competitiveness of the Automotive and Parts Industry and Enhance Traffic Safety – KTAutoComp	Cioboată Daniela	MCI
323/340002 POC	Support Center for international RDI projects in the field of Mechatronics and Cyber-MixMechronics, SMIS code 2014+ :108119	Cioboata Daniela	MCI
<b>PARTNERSHIPS</b>			
307 POCA	Strengthening the institutional capacity of the Ministry of Research and Innovation through optimizing the decision-making processes in the field of R&D and innovation – SIPOCA 393	Gheorghe Gh.	MCI
ERASMUS	Improving Skills and Competences in Order to Stimulate the Eco-Innovation in the Automotive Industry – DRIVEN, ERASMUS +	Diana Badea	Erasmus + Programme -UE

**PAPERS PUBLISHED IN MAGAZINES / SCIENTIFIC JOURNALS IN 2021**

Alexandru Gal, Alexandra-Cătălina Ciocîrlan, **Mihai Margaritescu**, "State Machine-Based Hybrid Position/Force Control Architecture for a Waste Management Mobile Robot with 5DOF Manipulator", Applied Sciences 11(9):4222, May 2021, DOI:10.3390/app11094222, indexed WoS, Impact Factor: 2.679 (2020)

Constantin Stochioiu, Horia-Miron Gheorghiu, **Flavia Stochioiu**, "Visco-elastoplastic Characterization of a Flax-fiber Reinforced Biocomposite", Journal: Materiale Plastice, Nr. 58(1):78-84, April 2021, DOI:10.37358/MP.21.1.5447, indexed WoS, Impact factor: 0.593 (2020)

Moldovan Catalin, Cosma, Cosmin, **Milodin Nichita-Larisa**, Teusan Christina, Berce Petru, Balc Nicoale, "Finite Element Analyses of 3D Printed Composite Robot Component", Acta Technica Napocensis Series-Applied Mathematics Mechanics and Engineering, 2021, Vol. 64, Issue 1, Page 141-152, ISSN1221-5872, indexed WoS

**Badita Liliana-Laura**, Florescu Virgil, Tiganesteanu Constantin, Capitanu Lucian, "Modularity of total hip prosthesis and its tribological implications", Industrial Lubrication And Tribology, ISSN: 0036-8792, DOI10.1108/ILT-06-2021-0219, indexed WoS, Impact factor: 1.297 (2020)

**Daniela Doina Cioboata**, Mihai Selagea, Silvia Savencu, Radu Mihail Udrea, Mircea Virgil Udrea, **Dănuț Iulian Stanciu**, Valentin Șerban Popescu, "Optimization of pulsed laser based metal cleaning proce", International Journal of Mechatronics and Applied Mechanics, 2021, Issue 9, pag. 71-75, CEFIN Publishing House, indexed in BDI: Sopus, EiCompendex, EBSCO and Proquest.

**Alexandru Stan, Diana Maria Cotorobai**, "Centroid and planar rotation calculus using parallel computational geometry for regular shaped objects", International Journal of Mechatronics and Applied Mechanics, 2021, Issue 9, pag. 186-191, CEFIN Publishing House, indexed in BDI: Sopus, EiCompendex, EBSCO and Proquest.

**Nichita-Larisa Milodin, Nicoleta-Mirela Popa, Mihai Tutoveanu and Flavia-Petruța-Georgiana Artimon**, "Compression behaviour of PA2200 lattice structures", International Journal of Mechatronics and Applied Mechanics, 2021, Issue 9, pag. 192-200, CEFIN Publishing House, indexed in BDI: Sopus, EiCompendex, EBSCO and Proquest.

**Alexandru Stan, Mihai Mărgăritescu, Ana Maria Eulampia Rolea, Andrei Cristian Dinu, Victor-Marin Zafiu, Diana Maria Cotorobai** "Construction and control of an autonomous mobile robot for urban waste collection", International Journal of Mechatronics and Applied Mechanics, 2021, Issue 10, vol.1, pag. 24-31, CEFIN Publishing House, indexed in BDI: Sopus, EiCompendex, EBSCO and Proquest.

**Diana Mura Badea, Dumitru Vlad, Valentina Daniela Bajenaru, Simona Elena Istrateanu**, "Analysis of ultrasound generation methods and systems used in physiotherapy", International Journal of Mechatronics and Applied Mechanics, 2021, Issue 10, vol.1, pag. 80-86, CEFIN Publishing House, indexed in BDI: Sopus, EiCompendex, EBSCO and Proquest.

**Gheorghe Silviu Ionut, Negrea Catalin Stefan, Robert Mangher, Vlad Mangher**, "The New INCDMTM Research Center for Intelligent Mechatronic Systems used for Securing Objectives and Intervention", International Journal of Mechatronics and Applied Mechanics, 2021, Issue 10, vol.1, pag. 146-153, CEFIN Publishing House, indexed in BDI: Sopus, EiCompendex, EBSCO and Proquest.

**Gheorghe Silviu Ionut, Negrea Catalin Stefan, Angelescu Dorin, Robert Mangher, Vlad Mangher**, "Universal Eco Environmental Drone Ionizer Equipment for Drones using Vertical Propellers", International Journal of Mechatronics and Applied Mechanics, 2021, Issue 10, vol.1, pag. 175-180, CEFIN Publishing House, indexed in BDI: Sopus, EiCompendex, EBSCO and Proquest.

**Cioboată Daniela, Pătrașcu Ion, Stanciu Dănuț, Logofătu Cristian, Nicolae Nicușor**, "Automated Robotic Inspection Cells for Quality Control", International Journal of Mechatronics and Applied Mechanics, 2021, Issue 10, vol.2, pag. 7-15, CEFIN Publishing House, indexed in BDI: Sopus, EiCompendex, EBSCO and Proquest.

**Badea Sorin Ionuț**, "Analysis of Current Methods for Leakage Part Detection", International Journal of Mechatronics and Applied Mechanics, 2021, Issue 10, vol.2, pag. 112-118, CEFIN Publishing House, indexed in BDI: Sopus, EiCompendex, EBSCO and Proquest.

Daniel Chiriță, **Simona Istrateanu, Gheorghe I. Gheorghe, Valentina Băjenaru**, "Aspects Related to Current Recycling Methods and Trends in Implementing the Principles of the Circular Economy for Lithium-Ion Batteries", International Journal of Mechatronics and Applied Mechanics, 2021, Issue 10, vol.2, pag. 137-144, CEFIN Publishing House, indexed in BDI: Sopus, EiCompendex, EBSCO and Proquest.

**Dănuț-Iulian Stanciu, Gheorghe Ion Gheorghe, Doina-Daniela Cioboată**, "Master Error Elimination in Forced Gear Engagement Testing Machine using Harmonic Analysis Through Fast Fourier Transform", International Journal of Mechatronics and Applied Mechanics, 2021, Issue 10, vol.2, pag. 238-247, CEFIN Publishing House, indexed in BDI: Sopus, EiCompendex, EBSCO and Proquest.

**Mihai Tutoveanu, Nichita Larisa Milodin, Nicoleta Mirela Popa, Flavia Stochioiu and Constantin-Daniel Comeagă**, "Compliant Positioning System with 6 DOF for High Precision Medical Standing Applications", In book: International Conference on Reliable Systems Engineering (ICoRSE) - 2021 (pp.182-197), indexed in SpringerLink, DOI:10.1007/978-3-030-83368-8\_18

**Nichita-Larisa Milodin, Nicoleta-Mirela Popa, Mihai Tutoveanu, Flavia-Petruta-Georgiana Artimon**, "Compression Testing of PA2200 Additive Manufactured Lattice Structures", International Conference on Reliable Systems Engineering (ICoRSE) – 2021, Vol. 305, pp 304-315, DOI: 10.1007/978-3-030-83368-8\_30, indexed Springer Link, Lecture Notes in Networks and Systems.

**Daniela Doina Cioboata**, Mircea Udrea, Mihai Selagea, **Danut Iulian Stanciu**, Silvia Savencu, Radu Mihail Udrea, **Cristian Logofatu**, "Pulsed Fiber Laser Surfaces Micro-processing - Optimization and Applications", International Conference on Reliable Systems Engineering (ICoRSE) – 2021, Vol. 305, pp 349-362, DOI: 10.1007/978-3-030-83368-8\_34, indexed Springer Link, Lecture Notes in Networks and Systems

**Andrei Cristian Dinu, Paul-Nicolae Ancuța, Victor-Marin Zafiu**, "Communication and Control Algorithms for a Heterogenous Multi-agent System", International Conference on Reliable Systems Engineering (ICoRSE) – 2021, Vol. 305, pp 223-228, DOI: 10.1007/978-3-030-83368-8\_22, indexed Springer Link, Lecture Notes in Networks and Systems

**Victor-Marin Zafiu, Diana-Maria Cotorobai, Ana Maria Eulampia Rolea, Andrei Cristian Dinu**, "Flexural Test of 3D Printed Mecanum Rollers", International Conference on Reliable Systems Engineering (ICoRSE) – 2021, Vol. 305, pp 296-303, DOI: 10.1007/978-3-030-83368-8\_26, indexed Springer Link, Lecture Notes in Networks and Systems

**Paul-Nicolae Ancuța, Sorin Sorea**, "Intelligent Network for Measuring Natural Environment Parameters", International Conference on Reliable Systems Engineering (ICoRSE) – 2021, Vol. 305, pp 266-277, DOI: 10.1007/978-3-030-83368-8\_29, indexed Springer Link, Lecture Notes in Networks and Systems

**Flavia Stochioiu**, Constantin Stochioiu, H M Gheorghiu, Iuliana Sima, "Experimental characterisation of a flax fibre - epoxy resin composite", IOP Conference Series Materials Science and Engineering 1018:012004, January 2021, DOI:10.1088/1757-899X/1018/1/012004

**Cioboată Daniela Doina**, Minciunescu Paul, **Stanciu Dănuț**, Neacșu Irina, Matei Silviu Ștefan, Neacșu Mihăiță Gabriel, " Design, Modelling and Performance Evaluation of a Brushless DC Motor for a Vehicle Electronic Power Steering System", Revista: Electrotehnica, Electronica, Automatica: EEA; Bucharest Vol. 69, Iss.3, (Jul-Sep 2021): pag. 5-13. DOI:10.46904/eea.21.69.3.1108001

Gheorghe Gheorghe, **Badea Sorin-Ionut, Iulian Ilie**, Despa Veronica, "Is Romania Ready for the Development of Smart Industry 4.0?", Conference Proceedings ICIENG 2021, Innovations in Industrial Engineering, pp 293-304, Part of the Lecture Notes in Mechanical Engineering, book series (LNME), DOI: 10.1007/978-3-030-78170-5\_26

Gheorghe Gheorghe, **Badea Sorin-Ionut, Iulian Ilie**, Despa Veronica, "Original Constructive Solutions for the Development of Industry 4.0 in Romania", Conference Proceedings ICIE 2021, Innovations in Industrial Engineering, pp 270-284, Part of the Lecture Notes in Mechanical Engineering, book series (LNME), DOI: 10.1007/978-3-030-79168-1\_25

**Cristian Radu Badea**, Octavian Donțu, Gheorghe I. Gheorghe, "Using the method of determining the variation of the length of the stretched chord, as a means of monitoring the postural changes of the athletes spine", U.P.B. Scientific Bulletin, Seria D ,Vol. 83, Nr.3, Pages 55 – 70, 2021, ISSN 1454-2358, indexată Scopus, Compendex.

**Flavia-Petruța-Georgiana ARTIMON**, Constantin STOCHIOIU, Gheorghe POPAN, "Thermal influence on positioning error and position repeatability of a machining center axes", U.P.B. Sci. Bull., Series D, Vol. 83, Iss. 2, 2021, Pages: 181-188, ISSN 1454-2358, indexată Scopus, Compendex.

**SCIENTIFIC JOURNALS - 2021**

International Journal of Mechatronics and Applied Mechanics, 2021, Issue 9, CEFIN Publishing House, ISSN: 2559-4397, indexed BDI: Scopus, EBSCO, Proquest and EiCompendex.

International Journal of Mechatronics and Applied Mechanics, 2021, Issue 10, CEFIN Publishing House, ISSN: 2559-4397, indexed BDI: Scopus, EBSCO, Proquest and EiCompendex.

**GRANTED PATENTS - 2021**

<b>No.</b>	<b>INVENTION</b>	<b>INVENTOR</b>
B.I. 129948/ 29.01.2021	Mechanical hygostat with lamellar electrical contact	Codrut Darie, Florin Ontanu
B.I.132678/ 26.02.2021	4D Mechatronic-Mixmecatronic control system in the laboratory and in industry	Gheorghe Gheorghe, Ilie Iulian, Anghel Constantin
B.I. 132505/ 29.10.2021	System for Measuring the Driving Moment of A Hydraulic Gear Pump	Vasile Iulian, Paul Nicolae Ancuța

**ISSN 2068-6498**



6-8 Pantelimon Road, 2nd District,  
021631 - Bucharest, ROMANIA  
Phone: +4021. 252.30.68/69;  
Fax: +4021. 252.34.37;  
E-mail: [incdmtm@incdmtm.ro](mailto:incdmtm@incdmtm.ro), [marketing@incdmtm.ro](mailto:marketing@incdmtm.ro)  
[www.incdmtm.ro](http://www.incdmtm.ro)

