Brand: «SMART MECATRON»

SERVICES OFFER

of

«BIOLAB » BIOMECHATRONICS LABORATORY

from

INCDMTM - Bucharest

2015 Bucharest, Romania
BIOLAB Objectives

Main Objective

The main objective of BIOLAB is contributing to the increase of economic competitiveness on the medium and long term, by increasing the quality and efficiency of research - development activities of national institutions that will provide efficient services to the public healthcare units, by featuring the most modern equipment 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 bio-mechatronics in the innovative economic activity, based on knowledge & emergence in the development region of Bucharest-Ilfov region, and in the European Research Area (ERA).

Specific Objective

BIOLAB aims to achieve the following specific objectives:

- increasing the capacity of research - development - innovation of INCDMTM Bucharest through infrastructure development and attracting young and highly qualified staff;
- strengthening the knowledge supply and research health services conducted by the beneficiary research institute;
- stimulating technology transfer based on the cooperation of the R&D Institute and the businesses;
- stimulation of innovation demand of enterprises;
- supporting the 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 4th floor.

BIOLAB includes:

1. Software and hardware for 3D reconstruction from CT medical images and design.
3. High-tech bio-mechatronic systems for complex load testing equipment and applications in conditions similar to those in vivo.
4. System analysis and simulation work.
1. SOFTWARE AND HARDWARE EQUIPMENTS FOR 3D RECONSTRUCTION FROM MEDICAL AND DESIGN IMAGES

1.1 MIMICS Software for Anatomical Reconstruction of items in Medical Images

➢ *The Main Technical Characteristics Of the Program:*

- It allows medical image segmentation in order to reconstruct anatomical areas;
- Carries out analysis and measurements for understanding anatomy and pathology and medical device compatibility check;
- Simulating surgical procedures;
- It features a design-modeling module;
- It prepares models designed for Finite Element Analysis;
- It facilitates anatomical reverse engineering.

*Software graphical interface*
1.2 Graphical Interactive Design Software and Advanced Finite Element Analysis

The Main Technical Characteristics Of the Program:

- Three-dimensional parametric modeling of parts;
- Three-dimensional parametric modeling of assemblies;
- Automatic generation of drawings for parts and assemblies;
- Project Management;
- Analysis and Finite Element Simulation for static calculation;
- Environmental impact analysis for parts;
- Design analysis from the point of view of costs and their reporting;
- Capabilities for analysis and simulation;
- Static computing, dynamic computing, non-linear computing, vibration computing, buckling computing, thermal computing, fatigue computing shock resistance computing, load optimization computing and cyclical load optimization, and pressure vials computing.

 Finite Element Analisys for Hip Prosthesis
2. MECHATRONIC EQUIPMENT FOR THE ADVANCED TECHNOLOGY OF SELECTIVE LASER SINTERING

2.1 EOSINT 270 M Dual Mode Equipment

BIOLAB, by acquiring *EOSINT 270M Dual Mode*, has implemented an advanced technology for prototyping and making complex parts from metal powders by selective laser sintering.
The Main Technical Characteristics of the equipment:

- Exposure area: max. 250 x 250 mm
- Exposure height: max. 215 mm
- Shutter speed: max. 7000 mm / s (any piece can be made in a few hours; once the command is given this machine requires no supervision).
- Laser beam diameter: 100-500 micrometres
- Speed of the positioning powder coating layer arm: 40 - 500 mm / s
- Specialized software for rapid prototyping:
  - EOS RP-Tools (single non-expiring licence)
  - EOS PSW offline (single non-expiring licence)
  - Materialise Magics RP v.10 licensed version with additional module SG
  - EOSTYLE

Offered Services:

- Manufacturing models and prototypes for implantable biomedical products;
- Manufacturing functional prototypes for the automotive and aerospace industry;
- High quality and durability molds;
- Design and static and dynamic testing of implants and other mechanical parts for the industry;
- Realization of complex geometries, impossible to be made by other metal processing proceedings.
2.1 EOS FORMIGA P110 Equipment for Processing Through Sintering of Plastics

The system for processing by laser sintering of plastics for medical applications consists of:

- equipment for processing by laser sintering powders of plastics;
- Command and control software equipment;
- Part post-processing accessories and powder management for their reuse and machine cleaning:
  - Processing site vacuum cleaner;
  - Powder sieving;
  - Powder mixer.

➢ The Main Technical Characteristics of the Program:

- Workload: at least 200 x 200 x 300 mm;
- Working gas: nitrogen from the embedded generator with connection to external compressed air source;
- Laser type: CO₂;
- Laser power: at least 30 W;
- Optics: F-theta lenses;
- Scanning process speed: 5m / s with digital data transfer from the scanner;
- Layer thickness: 0.06 ÷ 0.12 mm;
- Processed materials: bio-compatible plastic powder, resistant to repeated sterilization, and plastics for medical applications in other fields such as aerospace and automotive;
- Command and control software for the equipment;
- Exposure parameters change, depending on the material, increasing productivity, decreasing costs and improving the quality of the parts;
- Realization of porous structures on certain part areas.
Offered Services:

- Manufacturing of concept models, and functional prototypes;
- Manufacturing medical models for simulating complex processes such as planning cranial and maxillo-facial surgery, and orthopedic surgery;
- Manufacturing models for providing training and learning for students;
- Manufacturing anatomical elements such as crowns, disposable drill guides, orthoses and even functional prostheses for limps;
- Manufacturing fracture immobilization systems;
- Manufacturing prosthetic elements which realistically reproduce the shape and dimensions (e.g. for nose, ear);
- Creating tools, instruments, and parts of medical devices;
- Realization of complex geometries.

Various medical models for planning and simulations of surgery
3. HIGH-TECH EQUIPMENT FOR TESTING AND COMPLEX BIO-MECHATRONIC LOAD TESTING OF BIO-MECHATRONIC SYSTEMS IS CONDITIONS SIMILAR TO THOSE “IN VIVO”

3.1 MTS - BIONIX Wear Test System

The wear test implants and prosthetic components consists of:

- Multiaxial testing machine with the following components:
  - Loading stand;
  - Hydraulic driving system;
  - Command and control system;
  - Computational system (PC).

- Dedicated programs (software) testing for machine control, data acquisition and processing;

- Sub-positioning system and subassembly testing for "external ankle-foot prosthesis for lower limb";

- Sub-system for simulation for hip prosthesis wear;

- Sub-system for simulation of knee endoprostheses wear;

- Thermostat and solution recirculation sub-system for in vivo conditions simulation.
"External ankle-foot prosthesis for lower limb" subassembly testing

Hip prosthesis wear simulation

Knee endoprosthesis wear simulation

➢ The Main Technical Characteristics of the Program:

- Static and dynamic loading in the axial torsion for loads of up to ± 15 kn and ± 100 Nm;
- Load curves shape: sine, triangular, ramp maintaining at the pre-selected with frequencies up to 100Hz;
- Automatic movement of tool head;
- Servo-hydraulic drive system;
- Machine control software system testing;
- Software for data acquisition and processing;
- Multifunction test software;
- Recirculation tank and heating simulation solution system for in vivo conditions.

➢ Offered Services:

- Ankle foot subassembly test - according to EN ISO 22675 standard SR;
- Hip endoprosthesis wear test - according to ISO standard 14242;
- Knee endoprosthesis wear testing - according to ISO 14243-1 standard;
- Standardized wear or implants testing methods upon beneficiary request.
3.2 **HOUSFIELD Static Test Equipment type H10KT**

- **The Main Technical Characteristics of the Program:**
  - Working / approaching speed: from 0.001 mm / min to 500 mm / min, with increments of 0.01 mm / min;
  - Working force: from 0.1 N to 10000 N, with increments of 0.1 N;
  - Speed of return to start position: from 0.001 mm / min to 500 mm / min;
  - Maximum vertical stroke: 1100 mm, without load and mounted fixtures;
  - Distance between columns: 400 mm;
  - Force cell easily interchangeable: 250 N, and 10,000 N;
  - Force measurement accuracy: 0.5% of the applied force;
  - Force reading rate of 200 times / sec;
  - Vertical displacement precision: ± 0,0001 mm;
  - Driving speed precision: 0,005%
Offered Services:

- Tensile test: according to EN ISO 6892-1 - metallic materials.
- Compression test: STAS 1552: 87 – metals testing.
3.3 INSTRON 8872 Universal Testing Equipment

The equipment features the following accessories:

- Fatigue test system of the tibial component of the knee prosthesis;
- Recirculation tank and heating system simulation solution for in vivo conditions.

The Main Technical Characteristics of the Program:

- Load force: from 2 N to ±10 kN;
- Speed range: from 0,005 to 60 000 mm / min;
- Working temperature: from -70 °C to 250 °C;
- Maximum operating frequency: 100 Hz;
- Load curves shape: sine curve, triangular curve, trapezoidal curve, rectangular curve, saw-like curve, and so on
Offered services:

- Testing implantable medical devices and implantable orthopedic surgery medical devices;
- Testing tools used in orthopedic surgery;
- Testing implants and instrumentation used in maxillo-facial surgery.

Fatigue testing of components of knee joint, according to ISO 14879: 2000

Fatigue testing of hip joint components, according to ISO 7206

Fatigue testing of dental implants, according to EN ISO 14801
The gait analysis and simulation system is dedicated to the study of biomechanics in order to assess and simulate gait. Biomechanical studies are performed using the sub-component that provides movement data acquisition, simulation, and real-time modeling via sensors to determine the forces in the lower limp in erect position, either walking or running, the displacements, velocities and accelerations in the joints of the body.

Continuous gait analysis is required in medicine for diagnostic purposes and objective documentation in rehabilitation processes. This is particularly important after surgery, neural dysfunction, long-term illnesses, rehabilitation, physical therapy, use of prostheses, stroke, sports injuries, and in various other fields.

The gait analysis and simulation system is made of the following sub-systems:

1.1 Sub-system of plantar pressure measurement type sensorised conveyor;

1.2 Sub-system of integrated tracking, gait acquisition, simulation, and real time modeling;

1.3 Integrated optical sub-system (non-contact) for 3D coordinate measurement in dynamic and static regime

4.1 Sub-system of plantar pressure measurement type sensorised conveyor

Components:

- Conveyor band with pressure sensors;
- Software for acquisition, analysis, processing, storing and displaying data from the podiatric measurement system;
- Wireless motion sensors for detecting both fast and slow gait;
- Accessories: Signal Acquisition System; Data Recording System; Sensor Limp Attachment System, and so on
The Main Technical Characteristics of the Sub-System:

- Load capacity: 250 kg
- Active area: 1500 x 500 mm;
- Number of sensors: 5,000 pcs;
- Sensor measuring range: 1-120 N/cm²;
- Running speed: adjustable from 0 km/h to 19 km/h;
- Sampling rate: 100 Hz.

Offered Services:

- Recording static measurements: displaying of body weight on 4 quadrants and display of the center of gravity;
- Creating and recording dynamic measurements: walking and running measurement; measuring foot and plant dimensions; automatic detection of the left and right foot; measurement in the two directions of the plate (along and across the band); displaying the dynamic pressures and pressure center line; display in the following modes: 2D, 3D, synchronized, pulse or roll off;
- Calculations foot size, drawing the pressure / time and force / time plots for each zone of the foot; displaying foot axes and spatial and-temporal parameters; establishing references; analyzing motion (rotation, balance, flexion-extension, load, pressure centers, etc.); 3D dynamic sizing; Dupont model for use in 5 segments for assessing neuromotor problems.
4.2 Sub-system of integrated tracking, gait acquisition, simulation, and *real time* modeling

This sub-system allows a detailed analysis and comparison of positions and movements, 3D view graphic representations of models and biomechanical parameters of movement, and motion analysis provided to facilitate understanding.

- **The Main Technical Characteristics of the Sub-System:**
  - Automatic tracking of markers or recognition of a model (pattern matching);
  - Data processing and analysis of 2D / 3D data in real-time or off-line;
  - 6 pcs - video cameras with a working speed of 100 fps and a resolution of 2MP, with a scalability from 500 fps for 1 sq.m. up to 1,900 fps at 0.3MP, with the cables required;
  - Synchronous video and diagrams data viewing, with the possibility of synchronization software;
  - Automatic video identification and tracking, semi-automatic or manual markers placed on an active or passive subject (without use of infrared markers) with the possibility of using marker color and color recognition;
  - Automatic identification and tracking without markers, only on the basis of video patterns;
  - Identification and correction of errors by tracking individual frames or groups of frames without the need to rebuild the entire acquisition process;
  - 2D reconstruction of a simple segment for each camera model for understanding the optical movement from different perspectives;
  - Real-time capture reflective markers on videos with direct calculation and display of 2D data as graphs;
  - Synchronous of data viewing video and diagrams;
- Simultaneous recording and tracking with cameras;
- 3D calibration;
- Automatic, semi-automatic and manual tracking based on markers and automatic tracking, without markers, based on a model;
- 3D inverse kinematics analysis for calculation of joint centers, of joint angles, and so on;
- Sampling rate: 100 Hz.

### 4.3 Integrated optical sub-system (non-contact) for 3D coordinate measurement in dynamic and static regime

The analysis and simulation system using an integrated (non-contact) optical subsystem also allows ensuring an analysis of the motion of prosthetic/endoprosthetic elements mounted on test equipment such as: deformation (torsion, bending, displacements, etc.), velocities, accelerations, and vibration. Thus, based on the correlation of digital images, the system helps understanding the deformation and movement of the implant at the interface with the mounting system or plastic mold which simulates the bone. The measurement results can be used to validate numerical simulations.

#### The Main Technical Characteristics of the Sub-system:

- Generation and analysis of 3D coordinate measurement marked on the subject for the study of human gait kinematics;
- Optical sensors for dynamic 3D analysis;
- System control and data acquisition sensors;
- Computing (PC) image processing system;
- Calibration standard;
- Image Processing Software for static and dynamic measurements.
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