

THE INNOVATIVE VECTORS "MECHATRONICS AND INTEGRONICS" IN EDUCATION, TRAINING AND VIABILITY ON THE LABOUR MARKET

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I. INOVATIVE VECTORS <<MECHATRONICS & INTEGRONICS>>, SUPPORT IN EDUCATION, TRAINING OF EXCELLENCE AND LABOR MARKET VIABILITY

- The MECHATRONICS integrating innovative concept vector (Fig. 1) is essentially the synergy of complex engineering structures in a combination and mix integration of precision mechanics engineering / micro-nanoengineering, electronics engineering / micro-nanoengineering and computer engineering / micro-nanoengineering, all this in a architectural construction with intelligent materials engineering / micro-nanoengineering, intelligent systems engineering / micro-nanoengineering, bio/systems engineering / micro-nanoengineering etc. and evolving in a vision of the new generation of innovative global vector «Mechatronics (M) – MicroMechatronics (μ M) – NanoMechatronics (nM)».

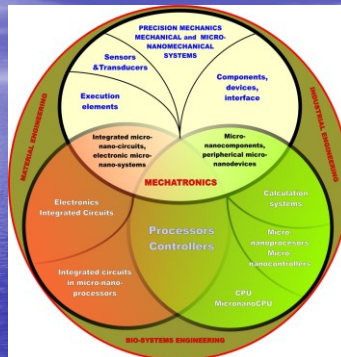


Figure 1: Integrative concept of the innovative vector
<<Mechatronics >>

- The innovative vector of hyper-integrator concept INTEGRONICS (Fig. 2) represents "perspective / vision of Mechatronics in a hyper-integration to the human body and human knowledge, in a completely integrated Mix-Engineering structure and in a highly integrated systemic concept", summarizing the constructive – functional – decisional solutions similar to intellectual state behavior and expression, physical-moral-socio-human, etc. and evolving in a vision of new generation of innovative global vector «Integrionics (I) – MicroIntegrionics (μ I) – NanoIntegrionics (nI)».
- Regarding its aim, mechatronics – micro-mechatronics – nano-mechatronics, is an inter-disciplinary engineering and a science from the perspective of engineering / micro-nano-engineering that serves to the advanced intelligent control of hybrid systems, and as a science is an interdisciplinary compendium from the various fields of technical and technological engineering.
- In its evolution, as and interdisciplinary science, Mechatronics, is used in all the fields of human life, improving the quality of the human life.

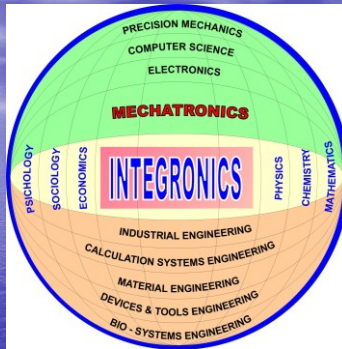


Figure 2: Integrative concept of the innovative vector
<<Integronics>>

- In research, Mechatronics – Micro-Mechatronics – Nano-Mechatronics cover a high degree of application areas, such as:
 - ✓ Competitive products;
 - ✓ Intelligent instrumentation;
 - ✓ Intelligent fabrication;
 - ✓ Integration between computer and intelligent processors;
 - ✓ Intelligent control of high-tech process devices and equipments;
 - ✓ Permanent innovation of mechatronics / micro-mechatronics / nano-mechatronics.
- The nominalization of the term μ MECHATRONICS or nMECHATRONICS, has been sustained by mixed realizations, by their simultaneous appealing and participation but most of all through the resulting mix and the encouraging effect obtained by the realization, application and development of the advanced field of „MECHATRONICS“.

- Appealing to the applicative potential of the „high-tech“ technologies and products, but most of all, to the synergistic integration of mechanical engineering / micro-nano-engineering with other fields such as electronics, calculus technique and computer science in the design / fabrication of intelligent systems, the field of MECHATRONICS - μ MECHATRONICS - nMECHATRONICS, nowadays a multidisciplinary field deriving from the constituent disciplines, with autoadaptability, flexibility and high speed and reaction, is characterized like a new philosophy of concepts and of design of technical and technological micro-based on the fundamental concept of high complexity, with a high degree of integration and expanded artificial intelligence.
- The new concept of MECHATRONICS, μ MECHATRONICS and nMECHATRONICS has the following objectives:
 - The perfecting and the modernizing of high-tech processes / products;
 - The integration of components with updated soft;

- The creation of new inter-disciplinal techniques, such as micro-nanoinformatics, micro- and nano-metrics;
- The creation and the carrying out of intelligent informatic machines / equipments, oriented towards “human behavior” simulation;
- The development of the multi-disciplinal engineering, together with material engineering, micro - and nano-material engineering, bio-system engineering.
- To maintain contact with mechatronics, μ mechatronics & nmechatronics must develop technical interfaces, compatible and appropriate stage. Development techniques, technologies and materials, means addressing the technical components used and integrated intelligent system, such as:

- technique of system concept, microsystem & nanosystem;
- technique of design and simulation;
- technique of testing and diagnosis;
- technique of processing / micro-nanoprocessing signal and information;
- technique of technology / microtechnology & nanotechnology;
- technology of standardization;
- microtechnique & nanotechnique technology;
- physical optics & microoptics technology;
- materials / micronanomaterials technology;
- etc.
- The integrative concept mechatronics, μ mechatronics & nmechatronics is supported by "reception" of MEMS&NEMS mechatronic/ μ -nanomechatronic products, and technical integration methods used support emerging areas.

II. Matrix of conceptual structure of the advanced field: Mechatronics (M) - μ Mechatronics (μ M) - nMechatronics (nM)

- The new MECHATRONICS & MICROMECHATRONICS field (Gheorghe, 2003) is expressed mainly by the integration of the micro-systems, of the micro-sensors, of the micro-actuators, of the micro-controllers and of the micro-processors and secondly, by the designing methodology, that goes beyond the conventional procedure to the mechatronic / μ -mechatronic procedure, a shift of mind in the modeling the simulation and the optimization of any "product" or "system".
- The new concept MECHATRONICS – MECHATRONICS – nMECHATRONICS [4], [6], [8] uses the new principles, such as programmability, the possibility of interactive communication, self-adjustment, self-diagnosis and self-learning, aimed at integration and synergy of organic high-tech products

- The theoretic bases of the mechatronic and micro mechatronic construction appeals at concepts, principles and ways of integrating elements and components, at dedicated and specialized software, at the management of permanent development and last but not least at the interface of the field with the other type of engineering and bio engineering.
- The philosophy of MECHATRONICS – μ MECHATRONICS - nMECHATRONICS involves the field, not only as an integrative science with a multi-disciplinary nature together with a mathematical modeling of the processes and of the products, but also as the science of flexible generating of movements and interactions with the environment.
- The philosophy of the field of MECHATRONICS – μ MECHATRONICS - nMECHATRONICS encompasses concrete data, syntheses and expression data, according to the European / international norms and standards, such as:
 - a) compatibility;
 - b) for the synergy of elements / components and of the assemble;
 - c) for the structure of the micro system: micro actuators / nano actuators, micro sensors / nano sensors, electronic micro components, A / D and D / A conversion, microprocessors / nano processors conversions, interfaces with the process, systems / micro interfaces, information processing and the control of the micro system;

- The diagram of the sub fields encompasses the following:
 - a) applications in (micro chemistry, endoscopies, diagnosis μ robots);
 - b) effects of the control (applications, hybrid design)
 - c) The diagram of the basic technology encompasses: new materials, material evaluation methods, assessments (function / trust evaluation).
- The concept, the terminology, the philosophy and the structure of the descriptor thesaurus of MECHATRONICS – μ MECHATRONICS - nMECHATRONICS, each or all together, contribute to the development of the terminological dimension in the logic of the receptors of the measuring / verification and setting measures.
- The concept of integrating mechatronics - μ mechatronics - nmechatronic is aided by the "reception" of mechatronic / μ mechatronic products and the methods of technical integration used to aid the new emerging fields.
- Matrix with systems / micro-systems in the mechatronic and micro-mechatronic field realized at The National Institute for Research and Development for Mechatronics and Measuring Technique – Bucharest, Romania (fig. 3).



Figure 3: Integrative concept of the innovative vector
<<Mechatronics >>

- Matrix Structure:
 - Tightness control and case mark installation
 - Water volume contour calibration system;
 - Intelligent machine for cog rows checking;
 - Hostile environment intervention robot;
 - Time and speed testing laboratory;
 - System for the control of the axis of reverse moving;
 - Brain surgery robot;
 - Devices for recovery after multiple-traumatism;
 - Crankshaft control mechatronic system;
 - Lengths calibration laboratory;
 - Shock and diameter control mechatronic equipment;
 - Axial play intelligent control system;
 - Thin layers preparing device.
- Matrix with systems / micro-systems in the mechatronics - micro-naomechatronics and micro-nanorobotics field realized at The National Institute for Research and Development for Mechatronics and Measuring Technique – Bucharest, Romania (fig. 4)



Figure 4: Systems / micro-systems in the micro-mechatronic field

- The MECHATRONICS – μ MECHATRONICS - nMECHATRONICS Field has the following elementary and systemic matrix as shown in figure 5.
- The most important role of the MECHATRONICS – μ MECHATRONICS – nMECHATRONICS field is found: in the launching and the development of environmental protection, in medicine, in bio technologies, in office equipments / micro equipments, in sound board, in consumer electronic devices, in automations and informatics, in telecommunications, in metrology, in the system for transmitting the "measuring unit" of the "0" and "1" degree in computer technology, in industrial production technology, in robotics, informatics, in product and process engineering, in competition engineering etc.

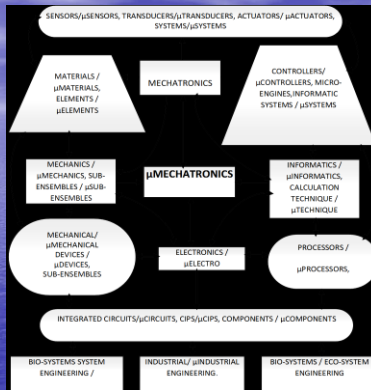


Figure 5

III. Conceptual structure of the advanced field Integronics (I) – Micro-Integronics (μI) – Nano-Integronics (nI)

- If in the beginning, the bases were those of **MECATRONICS - μMECHATRONICS - nMECHATRONICS**, that focused on micro-optics-electro-mechanical and micro-production techniques using technological micro-devices and micro-equipments together with the micro-mechanical and the tribological testing of the materials and of the components and that continued with the integration between electronics and micro-electronics and, afterwards, between informatics and micro-informatics, which culminated with the actual emergence of both the field and the concept of **INTEGRONICS - μMECHATRONICS - nMECHATRONICS**.
- Recent worldwide research work also shows that micro-mechatronics and system architecture introduce the new field and concept of **INTEGRONICS & μINTEGRONICS**, [1], [3], [6] together with micro- and nano-materials, process micro-equipments, micro-transducers and integrating micro-systems, within the international science and culture.

- In this new field and concept of **INTEGRONICS & μINTEGRONICS**, the key role is played by:
 - a) **μactuators and nano-actuators** defined within the European scientific concept as acting micro-nano-units with a dimensional value starting from 1 micron and with a multi-complex, multi-compatible and multi-applicable functioning principle;
 - b) **Technological μdevices and nano-devices** defined as micro-units obtained by using micro- and nano-mechanics in the micro-production processes with micro-burden depending capabilities functioning;
 - c) Ultimate **μhardware** developed;
 - d) Ultimate **μprocessing**, based on the most recent scientific discoveries;
 - e) **μmaterials and nano materials** discovered and approached in the present;
 - f) **Intelligent and new generation μcontrollers**;
 - g) **Intelligent and new generation μcomponents**

- h) **μsensors and nano-sensors**, defined within the European scientific concept as the interface between the environment and the control element and representing the "vital organ" for real and artificial system and plying the role of "anatomical elements corresponding to several senses" and being, at the same time, "the nervous system" with intelligent approaches that have or will take place;
- i) **μefactuators**, defined within the European scientific concept as "**final elements**" that are to carry out several functions, either / or in sequence or simultaneously;
- j) **Intelligent electronic μunits**, defined within the European scientific concept as "**intelligent micro-elements**" with a great number of parameters, of physical values, chemical values, biological values and reciprocal and effect influences, etc. (of interface **μMECHATRONICS - nMECHATRONICS** registering / measuring / display / digital display / complete and complex processing, etc) of mathematical / parametric / statistical / economical / social / psychological etc. calculation;

- **μinformatics**, defined within the European scientific concept as a vector-like / structural / informational infrastructure;
- **μmechatronics and mechatronics**, defined within the European scientific concept;
- Measuring / control **μsystems**;
- Adaptable, flexible and special **μsoftware**;
- Thermal / radiant / mechanical / magnetic / chemical / biological **effects micro-transducer μsystems**;
- **Supervising μsystems**, with close / open loop command;
- **Measuring / control μinstruments / μinstallations and equipments**;
- Adaptable, flexible and special **software** for integronics and μintegrconics, defined and standardized according to European and international standards;
- **Social / psychological / economical and financial behavior within technical and technological environments description software**;
- **Ultimate bio-tronics / nano-micro-biotronics etc.**;
- **μlogical-informatics and μlogical-informatics**, with ultimate generations of structure;
- **etc.**;

- **The philosophy of INTEGRONICS - μ INTEGRONICS** - **nINTEGRONICS** refers to the **carrying out / development and scientific orientation of INTEGRONICS / μ INTEGRONICS / nINTEGRONICS at the boundary between several sciences or mixes of sciences for real and physical modeling of human / environmental / animal functions and activities in order to ensure experiments and their implementation and use in the technique and technology of the industrial environments of tomorrow.**
- **The descriptor thesaurus INTEGRONICS – μINTEGRONICS nINTEGRONICS, refers to the area of the specific terms dictionary for this new field in the III Millennium, with references to the newly proposed to be introduced and used by the future informatic society, refers to the area of specific databanks and data bases of INTEGRONICS – μINTEGRONICS – nINTEGRONICS, with references to the notions, explanations and definitions used by this new field and refers to the area if products / technologies and tasks defined as INTEGRONICS – μINTEGRONICS – nINTEGRONICS, respectively integrconic and integrconized products / technologies and services.**

- **The concept, the terminology, the philosophy and the descriptor thesaurus INTEGRONICS - μ INTEGRONICS - nINTEGRONICS** contribute each or all together as an assembly to the acknowledgement of the "integrconic / μintegrconic system", integrated / integrconized into the Romanian scientific technical and technologic culture.
- This knowledge of the integrconic / μintegrconic system assumes the following evaluation matrices:
- the structural and functional matrix;
- the matrix of the application fields with their specific;
- This knowledge of the integrconic / μintegrconic system through matrix evaluation shows a "relative knowledge" and not an "absolute" or "total knowledge" since any knowledge encompasses generally a certain accuracy and total inclusion degree.
- In the aid of the matrix evaluation, a procedural system assessment is also useful. This covers, mainly, the following:

- identified relations that characterize the measures of the integrconic system;
- the checking, by computer simulation and experiments, of the identified and established relations within the integrconic system;
- the identification and the establishing of the relations that exist between the considered integrconic system and the other component or non-component systems, through the exchange of mass, energy and information by these systems;
- the identification and the establishing of the physical or of the mathematical model used in the integrconic system, in its direct relationship with the external environment, but also in its relationship with the internal environment, in relation with its compounding systems;
- the identification and the establishing of the input measures (xi), of the output measures(xe) and of the disturbing measures (xp), respectively the measures that cause the effect and the perturbation measures;
- the identification of the free regime of the integrconic / μintegrconic system through the function that expresses the timely variation of input measure (multi-variables);

- the identification of the relation between the input measures and the output measure of the integronic / μ integronic system, according to which the characterization of the concentrated and / or distributed parameters is done, according to which the identification of the multi-variables of the input and the output system is done. The identification of the variations of the input and of the output measures variations is done and this is corroborated with the identification of the behavior of the integronic / μ integronic system behavior, as a varied or as an in-varied system or as a deterministic stochastic system;
- the identification of the quality and of the quantity assessment of the measure that characterizes the entire integronic system;
- the identification of the main investigation tools, starting with modeling engineering and continuing with mathematical, electronic and informatic modeling;

- the projecting of the integronic / μ integronic system standardization, in order to "develop the human size" of integronics / μ integronics as a warranty of the virtual negative consequences of the technical component;
- design of the standardisation of the integronic / μ integronic system with the view to „develop humanization" of integronics / μ integronics, as a warranty of avoiding virtual negative consequences of the technical component;
- Also, the concept, the terminology, the philosophy and the descriptive thesaurus of INTEGRONICS & μ INTEGRONICS, altogether or each of them, can characterize integronic / μ integronic, mix-integronic and eco-integronic / μ integronic systems.

- Starting from the definition of the integronic / μ integronic system as an integrated / integronized ensemble of technical mechatronic / μ mhecatronic, electronic / μ electronic, informatic / μ informatic, precision devices / μ precision mechanic devices, etc., of industrial engineering systems / μ systems - calculation systems / micro-systems, materials / nano-materials, devices / micro-devices, tools / micro-tools, bio-systems / μ bio-systems, etc., economic systems, psychological and sociological systems, etc., inter-bound through inter-relation and inter-dependency synergetic and adaptable, friendly connection and vectorial connection, interfacing and integrating, distributive and multi-reproducible knowledge and information dissemination, internal and external environment behavior monitoring forms, elements and functions in order to ensure the understanding of the functioning and of the friendly behavior towards human beings and existing environments; this integration and multi-integration on a macro scale of all systems into an integronic system carries out, in fact, a new integronic / μ integronic information processing and perceptive formation global concept that corresponds functionally, socially, culturally and scientifically to any virtual situation and can be described using a qualitative matrix able of establishing certain corresponding and competitive levels of the situation.

- In the assessed synthesis, INTEGRONICS & μ INTEGRONICS represent a poli-science that with multiple valences in virtually all cultures and whose integronic product is the multi-vector-like result and stays for a summon of scientific, technical, psychological, social and economical results with solutions that cover friendly all the application needed in the society of tomorrow.
- **Matrix with systems / micro-systems in the micro-mechatronic field** realized at The National Institute for Research and Development for Mechatronics and Measuring Technique – Bucharest, Romania (fig. 6).
- **The μ INTEGRONICS Field**
- The " μ INTEGRONICS" field [1], [2], [8] comprises integronic μ systems, transformed and synthesized constructively and functionally, promoted and realized in a friendly and vector-like connection concept.
- The μ INTEGRONICS Flow chart (Figure 10) depicts the most representative related fields such as the μ mechatronic, μ robotic, etc., field.
- **The μ n INTEGRONICS field** encompasses the following elementary flow chart and system shown here in fig. 7.



Figure 6

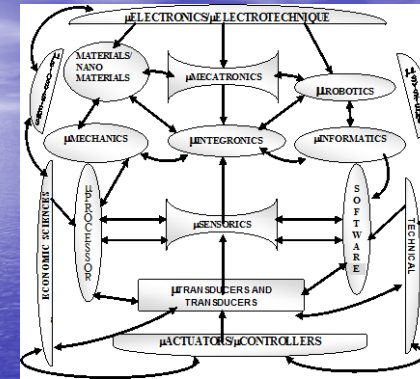


Figure 7

IV. Intelligent Mechatronic Systems / Micro-Systems mecatronice realized by INCD – MECHATRONICS and INTELLIGENT MEASUREMENT TECHNIQUE

- 4.1 Intelligent mechatronic micro-system for micro-dimensional and micro-angular measurements and for micro-nano-positioning (fig. 8)



Figure 8

Technical parameters:

resolution: $10 \div 100$ nm; 0,1 seconds; counting error: ± 1 bit; display capability: 8+1.

- 4.2 Electronic micro-equipment for the analysis of walking and determining caloric use during walking (fig. 9)



Figure 9

Technical parameters: sensors: haptic resistive; system for signal conditioning; data acquisition system: PC+ A / D converter + cycle multiplier with 2 channels; dedicated software

V. Integronic Ultraprecise Measuring Systems / Equipments by INCD – MECHATRONICS and INTELLIGENT MEASUREMENT TECHNIQUE

- 4.3 Intelligent mechatronic equipment for checking tightness in the auto mark: „coupler and differential carter“ (fig. 10)



Figure 10
Technical and functional parameters:

Functioning cycle: automated
Supply pressure: 5÷6 bar
Test pressure: 0,2 bar
Automated measuring type: differences in pressure
Wastage level over time: 15 cm³/min
Cycle time: 45 seconds

- 4.4 Intelligent control integronic for diameters and axial levels <<vibrochen >>



Figure 11
Technical and functional characteristics:

Measuring cycle time: max. 50 sec.;
Display resolution: 0,1 μm;
Measurement transducers: 24 pieces/ZDB103 /lap ±1 mm;
Industrial calculator: CMZ 200 ETAMIC / 220 V.c.a/50 Hz;
Work programmes: OS: Windows / Measuring Programme -INCDMTM Bucharest;

CONCLUSIONS

- The innovative vectors MECHATRONICS and INTEGRONICS contribute in a new systemic, unitary and integrative view and with a new generative conception to the integration of fundamental knowledge and scientific researches, to the building and development of intelligent solutions with multiple possibilities for integration into the intelligent and automated industry and for Education, Excellence Training and Viability on the labour market.

THANK YOU FOR YOUR
KIND ATTENTION!