MECHATRONICS AND MICRO-MECHATRONICS CONCEPTS FOR INTELLIGENT SYSTEMS AND FOR ADVANCED ROBOTICS, WITH APPLICATIONS FOR TECHNOLOGICAL AND MEASUREMENT AND CONTROL PROCESSES

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Abstract – The paper presents new mechatronics concepts and solutions for intelligent equipments and for advanced robotics with applications of measurement and control in technological and metrological processes from various HIGH-TECH environments, for assuring quality levels of the industrial products, marks and technologies. Intelligent equipments and for advanced robotics, presented in the paper, identify mechatronics systems / micro-systems as parts of assemblies by experimental simulation and by behavioral determination that are based on signals measured and parameters of mathematical and physical models. Structures and micro-structures of intelligent equipments and for advanced robotics are created based on the destination of the application that takes into account the type of the process or product of the mark/product, in terms of geometrical and precision characteristics, of nature and properties of the materials used, of technical and technological parameters and of process accessibility in process. Each intelligent equipments and for advanced robotics has determined conceptual and functional, the structure of the elements and mechatronics micro-systems, in terms of informatisation of the measurement and integrated control process and technological process, using new mechatronics structures with micro-movements functions, micro-positioning and automate micro-measurements, with syntheses, coordination, command, control and decision in expert system.

In the paper are presented various types of intelligent equipments and of advanced robotics, for dynamic and static applications for measurement, checking and integrated control processes and for industrial and technological processes. In the paper are presented, the architecture of sensors/transducers in the value chain of mechatronics systems, electronic and informatics unit for information, control and diagnostic, micro-mechanics micro-systems, micro-systems of dynamic control for process supervising and software packages for measurement, integrated and decisional control.

Keywords – micro-mecatronic concepts; intelligent systems; advanced robotics; control and measurement process.

Regarding integration of mechatronic and micro-mechatronic concepts

Integration of mechatronic and micro-mechatronic concepts in intelligent equipments and advanced robotics develops their applications in measurement processes and metrological control and in performant technological processes for assuring and controlling quality level and especially precision level, at HIGH-TECH industrial products.

The general concept of intelligent equipments and advanced robotics, brings into the structure and functional chart, systems and sub-systems MEMS and MECHATRONIC/ MICROMECHATRONIC as main parts of ensembles, identified by experimental and behavioral structure simulation, functioning and maintenance and by results of measured signals and mathematical and physical models, but also through destination of applications which will take into account the process or product type from geometrical and precision characteristics, of nature and properties of the materials used, of technical and technological parameters and of process accessibility methods.

The general and innovative concept of intelligent equipments and advanced robotics, is realized
considering elements structure, components and functional compatibility, that enter in automatization and informatization chart of the ensemble, and depending on micro-movements obtaining, micro-positionings and micro-measurements in coordination, command, control and decision in expert matrix matrix.

Thus, the concept of intelligent equipments and advanced robotics, integrates the architecture of sensors and micro-sensors in value chain of signal generation and information transfer, actuators and micro-actuators architecture in mobility chain of ensemble, architecture of electronic and micro-electronic units in signals processing chain, controllers architecture in command chain and coordination process automated and informatized, architecture of process computers in driving process (technological, measurement and control, decisional) and architecture of software packages in movement chain, measurement, integrated and decisional control, commands, coordination, driving, results visualization results, static status monitoring and dynamic status etc.

In intelligent equipment or in advanced robotics, is considered, with important role and compatible functioning and maintenance, architecture of actuators and micro-actuators.

- Regarding actuators / micro-actuators for intelligent equipments and advanced robotics

In general, in intelligent equipments concepts and advanced robotics are used actuators / micro-actuators on various types of auxiliary energy, as: electrical energy, fluidic energy, chemical energy and thermal energy.

The command devices of actuators / micro-actuators don’t action continuous but only for short period of time with a high precision in positioning which fulfill the following requests:

- reversible functioning in two directions;
- high capability at loading / super-loading,
- high resolution for a precise positioning;
- good static transfer properties;
- fast dynamical properties;
- high degree of longitudinal speed and rotation speed;
- high force generation;
- adequate interfaces at variable transformation of the signal.

The micro-actuators are based on any of the basis physical effects, as: electro-magnetism, thermal elongation, piezo-electricity, electro-narrowing and magneto-narrowing.

Micro-actuators, together with the circuit control, are forming so called MEMS (micro-electric-mechanical systems).

In general, all the actuators / micro-actuators are influenced by the effects similar unwanted, and the mechanism and command micro-electronic circuit must develop as an “actuator mecatronic integrated systems”.

- Regarding actuators / micro-actuators as components of intelligent equipments and advanced robotics

In situation of application with actuators / micro-actuators, as part of mechatronic systems, interface with intelligent equipments and advanced robotics, becomes the most important component, because it refers to all properties that allows or obstruct integration of an actuator / micro-actuator in a complete system, as:

- input-output behavior;
- auxiliary power type;
- integration of the actuator / micro-actuator and of processes;
- integrated functionality and intelligence degree;
- increasing technical-scientific confidence;

Intelligent actuators / micro-actuators, resulted in developed concepts, can offer other functions, as:

- adaptable non-linear command;
- detection of errors based on parametric estimation;
- error diagnostic;
- optimal energy and control strategy;

Increasing technical-scientific confidence can be approached by parametric perfection and by improved design and respectively by maintenance of program type or scheme type, which can distinguish the degradation phases, respectively functioning failure, safety failure and silence failure.

Integration of intelligent equipments and advanced robotics

The intelligent equipments and advanced robotics, have been realized and implemented by the National Institute of Research and Development for Precision Mechanics, and also in some high-tech level companies (for example S.C. Automobile Renault-Dacia, Pitești).

An example of advanced robotics, is “the concept of mecatronic micro-robot of measurement and dimensional integrated control with micro-detector with Laser fascicle”, used in metrological measurement processes, in micro-technological processes from integrating industry of precision mechanics and mechatronics and showed in the following figure:
- Equipment mechatronic micro-robot of measurement and dimensional control

The constructive mechatronic solutions of the equipment and means of sensors / transducers architecture integration are presented in the following figure:

Constructive solutions and architecture integration for sensors / transducers and actuators – Mechatronic micro-robot equipment
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Functional chart of mecatronic micro-robot of measurement and dimensional integrated control is showed in the following figure:

START

DOCUMENTATION OF EXECUTION AND CONTROL
ex. execution drawing

Utilization of control software packages:
- is established the piece reference system
- there are determined the surfaces, the distances and the angles that must be controlled
- there are calculated the movement trajectories of measurement indicators
- there are determined the points from the software in which there are made changes of indicators and data gathering.

Is automatically built the commands file in ISO 6983 format, which defines the diminishing trajectories and auxiliary functions

The control trajectories are tested on peripheral equipment

IS THE TRAJECTORY CORRECTED?

CHECKING PHRASE BY PHRASE OF THE PROGRAM IN AUTOMATE REGIME, WITH THE CORRESPONDING ADVANCE ON A PIECE FROM THE LOT

IS THE TRAJECTORY CORRECT AND WITHOUT THE DANGER OF COLLISION WITH THE PIECE?

Both files ARE SAVED – source and ISO code

IS STARTING THE CONTROL IN AUTOMATE REGIME OF PIECES LOT

STOP

3. Experimental data and results regarding intelligent equipments and advanced robotics

- Regarding applications and comparison areas of actuators / micro-actuators that can be used at intelligent equipments and advanced robotics

From the laboratory experimentations can be synthesize diagrams that realize comparisons between different actuators as: electrical micro-engines and step by step micro-engines, microelectromagnets, piezoelectric micro-actuators, pneumatic and hydraulic micro-cylinders etc.

So, in the following figure, there is synthesized the maximum speed of the micro-actuators and
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So, in the following figure is synthesized positioning time for controlled response operating.

Regarding measurement of deviation from the roundness and/or from the surface micro-geometry

In the following figure, there are presented the results of roundness measurement and from surface micro-geometry, by an intelligent equipment for converting circular displacement with Laser...
4. **Conclusions**

In perspective, intelligent equipments technique and advanced robotics, develops the methods and methodologies of safety and controlling high quality level of industrial products and of technological manufacturing processes, contributing in this way to increasing competitiveness on national, European and international level.

5. **References**
