

What is <<ADAPTRONICS >>?

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Abstract. *The scientific work deals with the new concept called ADAPTRONICS, implemented by INCD-Mecatronics & Measurement Technique and expressed by innovative and multi-disciplinary technological engineering, by the advanced science, by the hyper-advanced high-tech field, by active technology applicable structurally, by the mix of new structures and products, by the technical dialogue between research – development – innovation – commercial application and by the active exchange of experiences and new information transfer.*

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1. INTRODUCTION:WHAT IS ADAPTRONICS?

ADAPTRONICS: is the innovative and multi-disciplinary technological engineering technology gathering and integrating new knowledge in fundamental structural mechatronics, generative integronics, materials science and engineering, architecture of actuators and sensors, as well as measurement and automatic control technology and software engineering.

➤ is the **advanced science** that facilitates high-performance of mechatronic, integronic and high-tech systems, as well as the competitive development of new, innovative products, restoring the relevance of most efficient business areas;

➤ is the **hyper-advanced field** that complements innovative developments and potentially needed upgrades and improvements in smart technologies appropriate and necessary on national and international markets and cybernetic and computer-based industries.

➤ is the **integrating high-tech vector** for the strategic industries such as mechatronics industry, aerospace, automotive, medical technology, measuring and control technology, intelligent measurement engineering, mechanical and process engineering, handling engineering and production automation.

➤ is the **innovative science** with significant enrollment is domestic, European and international markets, has a strong inter-relation between science and business and will need to continue advancing actively in the development of future technology.

➤ is the **vanguard of the high-tech** field supporting technology transfer and product intensive enforcement and innovative technologies and industrial operation, leading to economic growth and high levels of labor employment.

➤ is the **key technology for the future** and is increasingly becoming an international platform of knowledge and new knowledge ensuring the development and use of technical-economic integration of research results, development and innovation.

➤ is the **active structural applicable technology** in all industries, opening up completely new

possibilities for developing innovative, intelligent materials of new architectures of sensors and actuators and new driving components.

➤ is the **mix of structures and products** that can be used to change the operations and requirements of the environment.

➤ is the **new design** of mechanical, mechatronic and integronic systems using performance-enhancing potential of technical-technological products and extensive product profiles and high-tech systems.

➤ is the **new technology central** to the implementation of competitive products to meet growing and changing demands of modern products and systems, combined with low development time and greater flexibility.

➤ is the **technical dialogue** between research, technological development and innovation, and commercial application of **the active exchange of experiences and knowledge transfer** solutions with the latest products and systems components and adaptronic structures as current trends in this new field.

2. HISTORY OF ADAPTRONICS

ADAPTRONICS was created as a high-tech field as a science, as well as a technological engineering, ten years ago, to meet the new requirements and conditions imposed to new products and services, combined with reduced time for creating - making – developing, more flexibility, higher accuracy and a considerably lower price.

This new hyper-intelligent field was created and designed by the most developed companies from Germany, Japan and the U.S., by incorporating innovative new complex, automated and intelligent features, the most appropriate ways for integrated control technology and changing structural properties of future products and systems that have become adaptronic and are used to change the operating and environmental requirements.

Future adaptronic products and systems actively and intelligently control vibration, noise and distortion,

recover and monitor and influence of structures of any kind.

In ADAPTRONICS, there is a co-operation between different essential disciplines and technical and technological experts in science and industry, oriented to more efficient applications and interactions.

During this period of over ten years, of development of ADAPTRONICS, excellence adaptronic developments have been highlighted part in the Research Programme “Fraunhofer” – Germany; some of them are:

- **Adaptive and intelligent systems engineering;**
- **Hybrid actuator engineering;**
- **Engineering amortization systems** based on electro-rheological effect;
- **“Inchworm” and inertial piezoelectric actuators engineering;**
- **Engineering of new materials** for actuators and sensors;
- **Engineering of adaptronic applications** for the architecture and components of signal processors with adaptable control;
- **Engineering of development** of piezo-hydraulic pumps for applications in the industry of the automobile;
- **Engineering of numerical modeling** of the behaviour of the dynamic transfer of a magneto-rheological fluid;
- **Engineering of adaptronic control** of sound and vibrations;
- **Engineering of integration** of sensor-actuator for static and cvasi-static forces control;
- **Engineering of adaptable methods** for optimizing the performance of very excitable serial structures;
- **Engineering of multi-layer actuators** for lead-free piezo-ceramic development;
- **Active control technology** for vibrations in applications of mechanical engineering;
- **Engineering of active amortization** through optimal robust control technique;
- **Engineering of hybrid** micro-production systems driven by piezo-electrical actuators for flexible production
- **Engineering of modeling and designing** piezo-electrical valves
- **Engineering of piezoelectric active and passive control** of vibrations and noise.

3. DEVELOPMENT AND EXTENSION OF ADAPTRONICS IN GERMANY

ADAPTRONICS, as advanced high-tech field, was developed and extended in Germany, by:

- **Centre of Competence in Mechatronics / Adaptronics** in the Fraunhofer Platform, for the technological area on vibration control and structure analysis, renewable energies and its monitoring and new actuators, for the area of competences on experimental analyses, numerical simulation and

modeling, design and prototyping, system integration and control engineering and rehabilitation and evaluation of systems and for technical offers on approaching measurement projects, feasibility and consultancy studies and concepts of development and implementation;

- **Multifunctional Ceramics Division** – for sensors, actuators and new materials production, with applications in the automotive industry, in the medical field and so on.

- **ERAS GmbH Centre**, for production engineering and consultancy in the area of technological sensors, driving components and measurement and control adaptable technologies;

- **Fludican GmbH Centre**, for production in the field of actuators, automated technologies and semi-active systems;

- **Fraunhofer Adaptronic Association**, with co-operations with 11 Institutes, for the area of competences in the field of materials, sensors and new actuators, experimental and numerical analysis, control and electronic engineering and production technologies engineering;

- **PI Ceramic GmbH**, with production in the area of sensors, actuators, automated technologies and new materials;

- **High Private School “Gottingen” of the University of Applied Sciences**, with occupations in «Master Adaptronics»

- **Rhein-Main Adaptronik e. V**, with concerns in technological networks in the field of sensors, actuators, automation and structural technologies, research, new materials, control and measurement technologies and R&D in businesses;

- **Schenck RoTec GmbH**, with production in the field of control and measurement technologies;

- **SWIFT GmbH**, with production in the area of measuring and control technologies;

4. CREATION, DEVELOPMENT AND EXTENSION OF ADAPTRONICS

ADAPTRONICS, as advanced high-tech engineering, was created and developed in Romania at the National Institute of Research and Development in Mechatronics and Measurement Technique, by establishing in 2010 an “Adaptronics Centre”, with the following technological area:

- **Intelligent mechatronic systems for integrated measurement and control** for the automotive industry:

- (a) **for molded marks for automotives** – for tightness checking;

- (b) **for processed marks for automotives** – for dimensional checking (dimensional errors, shape errors, position errors, and so on)

- **intelligent mechatronic systems for technological and micro-technological processes;**

- **intelligent mechatronic systems** for the medical and the biomedical field;
- **mechano-electrical micro-systems (MEMS) and mechano-electrical nano-systems (NEMS)** ;
- **intelligent mechatronic systems** for the automation of natural gases distribution and control process;
- **intelligent mechatronic systems** for micro-nano-positioning and micro-nano-measurement;
- etc.

The concept of ADAPTRONICS, created and developed in the CENTRE OF ADAPTRONICS in the National Institute of Research and Development in Mechatronics and Measurement Technique is based upon:

- **the mix-integrative conception of new constructive and technological** micro-mechatronic, electro-technical, electronic and computer-based solutions, adaptive to the already known solutions, with the view of modernizing and improving performances of products and systems capable of changing their structure and functions;
- **the conception of adapting new complex functions in addition and adaptation**, for the ensemble of pre-existing mechatronic products and systems, capable to transform into new products and systems, called “adaptronic”;
- **the conception of modernizing and improving mechatronic systems** and products by adding and adapting with new integrative solutions for elements and newly discovered components and with newly generated principles and functions;
- **the conception of developing the lifecycles** of mechatronic products and systems adapted in a constructive manner, functionally and at decision level with new innovative and generative parts that create improvements and modernizations of ensembles capable of changes of changes of properties and structures of product and system components;
- **the structural – innovative conception** to change the operating type and requirements of the working environment in which the mechatronic products and systems used in processes and processing exist;
- **the innovative conception** of integrating new design, modeling and simulation methods, with the view to obtain new mechatronic products and systems, called “adaptronic” products and systems, with reduced developing time, greater flexibility, much lower price, increased ergonomics, with much better operability, increased maintainability and greater life duration;
- **the concept of ADAPTRONICS** is depicted as innovative scheme:



Figure 1. The concept of ADAPTRONICS

5. CONCLUSIONS

ADAPTRONICS is a new concept, is a new technology, is an integrative science, is a hyper-advanced high-tech field, is an innovative technological engineering and a multi-interdisciplinary engineering, is an vanguard, is a key technology for the future, is a mix of structures of products and new products, is a structural active applicable technology, is an innovative science, is an integrative high-tech vector, is a technical-technological dialogue between commercial research – development – innovation - application and is an active exchange of experience and transfer of new knowledge.

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