Interdisciplinary mechatronics systems analysis in the perspective of a performance vocational education

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Abstract: The interdisciplinary study of mechatronics systems comes to facilitate and expand the opportunities for interaction, networking and collaboration between teachers, students and others who are either involved or interested in developing the new vocational education perspectives. The knowledge society will recognise the organic link between the learning citizen, the learning organisation and the learning territory as an open system of learning that embraces formal and informal, professional and cultural learning in the same dynamic. According with these conditions we start to develop precision mechanics and mechatronics systems study for promote the development of the reflective capabilities of the students, giving greater responsibility for managing their own learning and preparing for important aspects of work-based on learning.

Keywords: Vocational education, mechatronics, systems, analysis, interdisciplinary.

1 Introduction
Mechatronics is the result of evolution reasonable technological development. The genesis of mechatronics is the interdisciplinary area relating to mechanical engineering, electrical and electronic engineering, and computer science (fig.1). This technology has produced many new products and provided powerful ways of improving the efficiency of the products we use in our daily life.

In the next stage by integrating microprocessors in electromechanical structures, and thus they are smart enough to mechatronics.

Interdisciplinary analysis requires integration of knowledge from the disciplines being brought to bear on an issue. Disciplinary knowledge, concepts, tools, and rules of investigation are considered, contrasted, and combined in such a way that the resulting understanding is greater than simply the sum of its disciplinary parts [1].

2 Interdisciplinary aspects
Many engineering problems can be formulated, attacked, and solved using the mechatronic paradigm. Mechatronics deals with benchmarking and emerging problems in integrated electrical–mechanical–computer engineering, science, and technologies.

Mechatronic systems can be subdivided into [2]:
• Mechatronic systems;
• Mechatronic machines;
• Mechatronic vehicles;
• Precision mechatronics;
• Micro mechatronics.
Mechatronics technology put the spotlight the issue of information which is part-giving season in relation to material and energy. This position of the information is motivated by these arguments:

- provide information meeting the spiritual needs of man;
- only new information increases the value added of all things;
- information means culture.

The synergistic combination of precision mechanical engineering, electronic control and systems thinking in the design of products and manufacturing processes is the essence of the mechatronic concept.

Modern engineering encompasses diverse multidisciplinary areas. Therefore, there is a critical need to identify new directions in research and engineering education addressing, pursuing, and implementing new meaningful and pioneering research initiatives and designing the engineering curriculum.

By integrating various disciplines and tools, mechatronics provides multidisciplinary leadership and supports the current gradual changes in academia and industry.

Academic endeavors in order to provide training for specialists in accordance with the requirements of new technology led to the shaping of mechatronic principles in education.

Mechatronics is an important part of modern confluent engineering due to integration, interaction, interpretation, relevance, and systematization features. Efficient and effective means to assess the current trends in modern engineering with assessments analysis and outcome prediction can be approached through the mechatronic paradigm [1].

Mechatronic systems provide:
- versatility;
- flexibility;
- shareholders the opportunity to distance;
- continuous evolution due to dynamic market demands;
- imitation of nature-adaptability.

Providing effective solutions to promote interdisciplinary, mechatronics has become support moves to encourage initiative and creativity.

The multidisciplinary mechatronic research and educational activities, combined with the variety of active student learning processes and synergetic teaching styles, will produce a level of overall student accomplishments that is greater than the achievements which can be produced by refining the conventional electrical, computer, and mechanical engineering curricula [9].

The objectives of the mechatronic high education are to teach the new generation of students and engineers, as well as to assist industry and government in the development of high-performance electromechanical systems augmenting conventional engineering curriculum with an ever-expanding electro mechanics core (fig.2).

Mechatronics is the interdisciplinary laboratories for materializing the principles of "education through practice", "education through research".

Located at the intersection of fields of science with peak performance in implementing new technologies, mechatronics approach and systems engineering concepts micro and nano sensing and actuation systems, composite materials and suitable for implementation in cellular or atomic scale, cell structure and neural network, which prefigure the concepts of nanoelectronics systems capable of producing future nano-processors, new concepts of artificial intelligence on adaptability, ability to reason, capacity training, intelligent, expert systems and neuro-fuzzy, etc.

For mechatronics engineering practice, philosophy marked leap from traditional engineering, sequential or simultaneous engineering competition.

In recent years, mechatronics is defined simply: science intelligent machines. More recently approaches for renewal in education and research
highlight the issue of mechatronics as: educational environment in the Information Society environment that integrated design and manufacturing background which has developed the concept design for control.

In the literature have become established, in other areas of expansion: hydronic, pneutronics, termotronics, autotronics, precision farming.

Integrronics is science and systems integration processes hiperintegrate, as the human body. The personality of an individual not depends on the width of horizon and the richness of his knowledge, but of how he organizes and integrates them, integration is more important than volume and richness of his knowledge.

By comparison with the systems theory and cybernetics, which studies the ready formats systems, integrronics analyzes how systems are set up and developed. In this context, mechatronics can be regarded as an integrronics vision technology.

The problem of integration is essential in mechatronics. In carrying out different products and systems, specific solutions must be found to integrate components: mechanical-electronic-informatics. Integrronics highlight new solutions integration as: genetic integration, integration by addiction, integration by choice. In this regard it is important to understand that integration is a natural process in nature. For this nature has created forms and structures that favors integration. Mechatronics opened unsuspected horizons in all fields, because the synergistic stimulation.

3 Mechatronics education – practical aspects

The impact of mechatronics technology exceeds the economic sphere, the essential social, cultural and others. This explains the keen interest in the EU countries to launch initiatives and develop special programs for this area. Approaches strengthen the belief that the information society, cultural relevance depends on the performance, technology [5]. It is envisaged that the future of technological development in Romania will increasingly call upon and depend on mechatronics expertise to provide equipment and specialised skills that will not only add value to the finished products, but do it quickly, accurately, economically and in large volumes. Those involved in learning and training are looking for tools to transform the learning experience, enable learners to become autonomous and enjoy a truly personalized development path.

The primary emphasis is placed on enhancement and improvement in student knowledge, learning, critical thinking, depth, breadth, results interpretation, integration and application of knowledge, motivation, commitment, creativity, enthusiasm, and confidence. These can be achieved through the new mechatronic curriculum development and implementation.

Mechatronics interdisciplinary high education will perform fundamental and applied activities by:
• integrating electromagnetic, electro mechanics, power electronics, ICs, and control;
• devising advanced design, analysis, and optimization simulation and analytic tools and capabilities through development of specialized computer-aided-design software;
• developing actuation-sensing-control hardware;
• devising advanced paradigms, concepts, and technologies;
• supporting research, internship, and cooperative multidisciplinary education programs for undergraduate and graduate students.

Mechatronic curriculum design includes development of goals and objectives, programs of study and curriculum guides, courses, laboratories, textbooks, instructional materials, manuals, experiments, instructional sequences, material delivery techniques, visualization and demonstration approaches, and other supplemental materials to accomplish a wide range of educational and research goals [3].

Following the overseas trends where mechatronics education is firmly established, the more educated the work force, the greater will be the demand for mechatronics education [6].

The computer technology enhances the need for mechatronic professionals, as it involves specific integration of mechanical, electrical and software engineering.

The structure of the Mechatronic programme at the Transylvania University of Brasov fully integrates theory and practice and ensures an interdisciplinary approach. The education philosophy will ensure not only demand for our graduates but provide the mutually vital links with industry by way of collaborative research, consultancies, provision of industry scholarships.

Close links with industry are considered especially important for an engineering discipline in general and Mechatronic Engineering in particular. The School of Mechatronic Engineering has a lot of connections with companies with mechatronic links.

Interdisciplinary design and analysis demand from people trained in traditional disciplines to learn appreciating different perspectives, views, ideas,
and approaches from other disciplines. Mechatronics curriculum should emphasize a balance of the content between technology, methodology and knowledge of theoretical science. The degree programme should not focus only on the design process and building up practical skills and neglect the potential role of the scientific issues along with the associated theories. [4]

Mechatronic systems such as robots, cameras and automobile, which integrate the various disciplines, make good topics to illustrate the value of an interdisciplinary approach.

The goal mechatronic education in UTBv (fig.2) is to obtain engineers who are educated in the theories, principles and applications of Mechatronics while improving their competencies in innovative thinking, communication skills, teamwork, leadership, and project management [7]. According with these aspects in our activities we intend to assure:

- The gradual training of our students in order to face effectively the requests of the labour market trough: developing the students’ cognitive capacities based on up-to date knowledge taught and assessed in a modern and effective way, developing the students’ team working skills as a base of an efficient further social and professional integration, developing the students’ effective self assessment skills by using a transparent and formative assessment system.
- The developing of competencies for users, providers, administrators and policy makers.
- The running of a quality educational process management.
- The developing of an intrinsic motivation for the profession of our students.
- The developing of an effective research activity of teaching staff and with and for students.
- The development of an effective co-operation with other faculties and universities from Romania and from abroad.
- The developing of high quality in-service training programs for pre-university teachers.

4 Conclusion
Recent approaches to mechatronic systems use signal processing in the lower levels, such as damping, control of motions, or simple supervision. Digital information processing, however, allows for the solution of many tasks, like adaptive control, learning control, supervision with fault diagnosis, decisions for maintenance or even redundancy actions, economic optimization, and coordination. The tasks of the higher levels are sometimes summarized as “process management.”

The mechatronics curricula attempts to bring real world experiences for the student and part of this include integrating various engineering disciplines.

References: