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MECHATRONIC POSITIONING DEVICES SYSTEMATIC DESIGN MANAGEMENT

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Abstract: *Designing mechanical systems in a mechatronics vision involves ensuring conditions consistency related to the mechanical structuring of the system, introducing electronic elements and applying the information "of interest".*
Currently there are no systematic design techniques that ensure functional consistency between these components.
This paper presents, for the first time, using the coordinates of an appropriate management, the techniques needed to design mobile systems in the current view that specialists accepts as "mechatronics vision".
. ***Key words:*** *positioning systems, design, mechatronics*

1. INTRODUCTION

Continuous development of the knowledge process involves identifying the steps required of it, of the mechatronics vision by answering challenging questions as: what is it, how does it behave, why is it needed, what models does it involve and what impact does it have on the way products are designed. The development of designing and producing new products has an integrative character permanently open and continuous, because multidisciplinary knowledge, which consist the basis of the explanation of how the knowledge economy works, presents itself a permanently open character.

2. VARIANTS OF APPROACHING THE DESIGN OF COMPLEX TECHNICAL SYSTEMS

Designing in a mechatronics vision, leads to solving five design problems of the mobile mechanical systems:

1. The process of designing mobile mechanical systems is slow if it involves positioning in a series the design of mechanical, electronic and informatics components
2. In the context of optimization, considering the communication between project team members as a challenging variable.
3. Testing the axes control methods requires more test data on real mobile mechanical system that may be risky.
4. Proper sizing of the actuators, respectively, of the motor elements, is complex in the context of the three categories of items series design in the mechatronic product.
5. The control techniques of the initial PID are difficult to set or determine

A simple mechanical structure designed in the traditional design version (Figure 1) has the attribute of a final intermediate phase. The sequence of the stages of designing a complex technical system followes independently the design of a suitable electrical structure. And using the same vision in traditional, sequential design, follow the information structure (hardware-software) design stages, as well as the operation and control system.

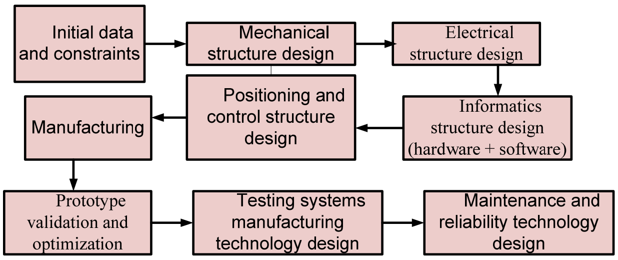

Fig. 1. Structural diagram of a traditional sequential design

In terms of efficiency, however, such a drafting and design approach is disadvantageous because of the inherent delays and unexpected costs on each sequence separately.

In the context of a design in mechatronics vision, this disadvantage is solved because the design of the mechanical structure, the electrical structure and the informatics structure, and the command/control structure are done in parallel at the same time (Figure 2). The results completed in about the same time create the possibility of manufacturing a virtual prototype before engineers begin the actual manufacturing of the complex technical system or the prototype of this system.

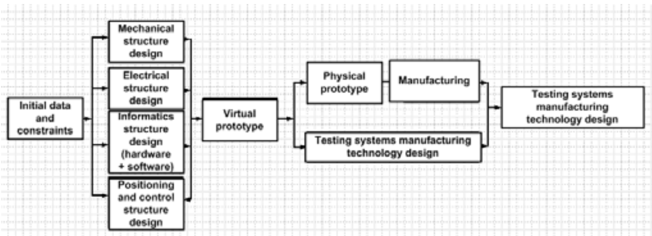

Fig. 2. Structural diagram of a design in mechatronics integrating vision [104]

A technical system prototype virtually developed is a 3D model computer-aided interacting with a system control simulation to view and test all system's components movements. Through this virtual prototype stage, design teams can test and continuously improve both the structures (mechanical, electrical, informatics) and the design of these systems before manufacturing any physical component of the technical system.

3. COMPLEX TECHNICAL SYSTEMS DRAFTING AND DESIGN STRUCTURAL MODEL

This model aims to list the steps to follow when conducting operations of drafting complex technical systems in a continuous interrelation between the structural elements of these systems and external factors that influence the positions of elements in the structure of these systems.

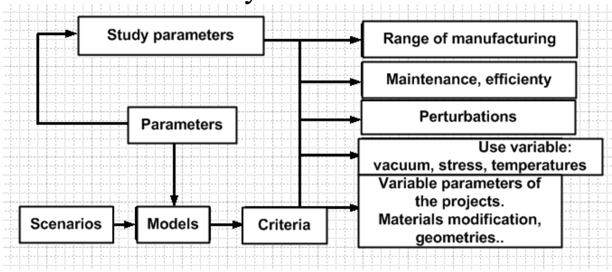

Fig. 3. Study parameters of complex technical systems

Figure 3 shows the study parameters of complex technical systems whose design and manufacturing purposes were well-defined. These parameters determine the efficiency of the model that will have to have a final behaviour scenario subjected the final utility of the complex technical system. These parameters are determined in the range of manufacturing of the technical systems, isolating the technical systems from perturbations, defining usage variants of the complex technical systems, determining the optimization variables needed in the design stage of optimization models, respectively determining the reliability criteria of complex technical systems.

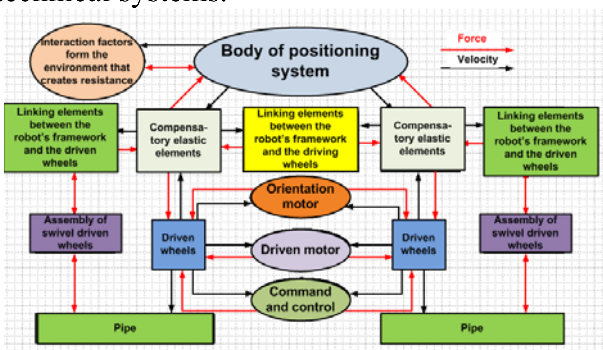

Fig. 4. Study parameters of complex technical systems

The positioning model design was done in accordance with the structural model from figure 4. This model highlights the mechanical structure which is defined by linking elements between the positioning system's elements, the compensation elastic elements, the engine elements, respectively the leading elements of the positioning system. The electrical structure of the positioning system is determined by the driving and guidance engines of the positioning system, as well as the command and control system of the elements' positions in the structure of the positioning system. The software and hardware structure is suggested by the signals that are based on kinematic parameters (speed) and dynamic parameters (force) that interact between mechanical and electrical components of the positioning system's structure. Note that this positioning system is always under the impact of some interaction factors from the environment, factors that generally create resistance, and which tend to disturb the metrological characteristics of the developed positioning system. If the control information source is the weld cord on a cylindrical pipe, then the used conceptual model is actually the one in Fig. 4. Every component of the model has a physical correspondent in the developed positioning system.

4. THE POSITIONING SYSTEMS IN AN INTEGRATED VISION

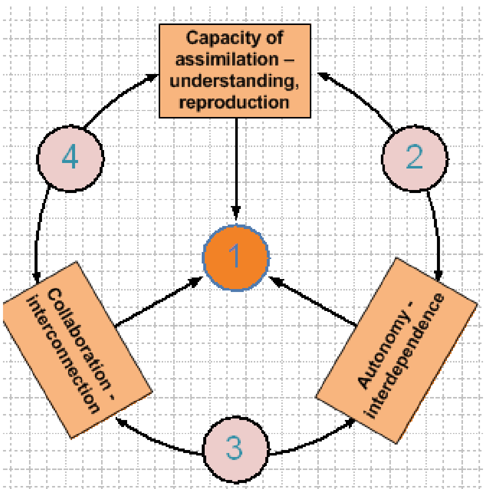

Fig. 5. Agent types- 1.Intelligent agents 2.Non-collaborative agents (with learning competences)3. Collaborative agents (with autonomy competences)4. Collaborative agents (with learning competencies)

Robotics is a field of mechatronics. It represents the part of mechatronics that deals with humanoid operations research and is at the border of mechanics with computer science, electrical engineering, electronics and computer systems, thermo-technics hydraulics.

The internal architecture of a robotic positioning system has five major systems, each belonging to a domain of classical technique: the mechanical support and joints system (rotation and translation couplings), the driving system (hydraulic, pneumatic, electric or mixed), the transmission of the movement system, the sensory system (internal and external) and decision-making system for controlling and programming the robot.

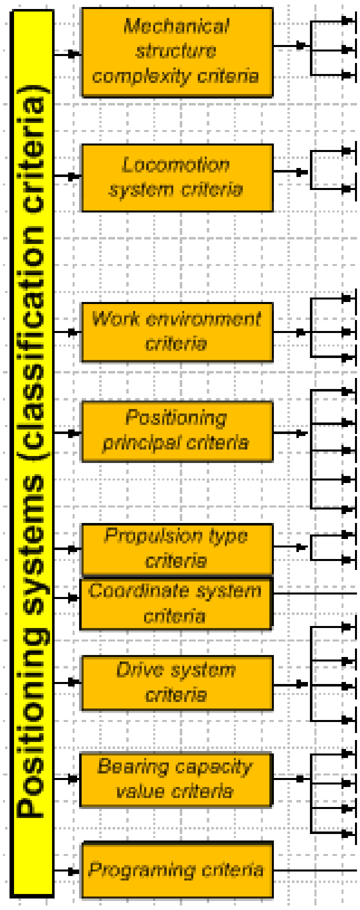

Fig. 6. Schematic classification of positioning systems based on certain criteria

Given the positioning systems characteristics above summarized (Figure 6) the interdependence between robotics and NDT methods is given by the need to position the control and measuring apparatus of the measuring size, in order to ensure the best precision and sometimes to eliminate any danger for the human user to be affected by the harmful effects of possible test methods. All NDT methods require to some extent a positioning process to determining the defects or measures needed to be found as accurately as possible.

5. CONCLUSION

The most common positioning systems used in this stage are divided into different types of mobile robots. The contribution consists in presenting these criteria and effective classification of the positioning systems based on these criteria.

This research details models of existing positioning systems are particularly highlighted the constructive technical and metrological characteristics that define each time obtaining positions as close to those required.

6. REFERENCES

[1] Craciun, S., Ardelean, I., Csibi, V.. *Considerations Regarding of Mechatronics Systems for Positioning in Non-Destructive Testing*, COMEFIM 10, Bucureşti, 2011

[2] Craciun, S., *Name of the article in italics "Contribuții privind îmbunătățirea sistemelor de poziționare utilizate în controlul nedistructiv"- Teză de doctorat,* Editura Tehnica, 2011

[3] www.ndtautomation.com

[4] www.ndt.ro

[5] www.sherpa-eng.com

Managementul proiectării sistematice a mijloacelor mecatronice de poziționare

Rezumat: Proiectarea sistemelor mecanice în viziune mecatronică presupune asigurarea unei concordanțe de condiții legate de structurarea mecanică a sistemului, introducerea elementelor electronice şi aplicarea informației „de interes". In prezent nu există sistematizate tehnici de proiectare care să asigure o concordanță funcțională între aceste componente. Lucrarea prezintă în premieră, în coordonatele unui management adecvat, tehnici de proiectare a sistemelor mobile în viziunea actuală pe care specialiştii o acceptă sub denumirea de „viziune mecatronică".

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