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CONTRIBUTION TO THE MECHATRONIC CONCEPTION OF THE AUTOMAT DIMENSIONAL INSPECTION SYSTEMS

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ABSTRACT
An inspection system involves the measurements, tests, and gauges applied to certain characteristics in regards to an object or activity. The results are usually compared to specified requirements and standards for determining whether the item or activity is in line with these targets. An automatic dimensional inspection system combines the core aspects of mechatronics (system modelling, simulation, sensors, actuation, real-time computer interfacing, and control) with practical industrial applications.
The integrated mechatronics design methodology is a powerful rapid system development tool that can be used for the development of optimised, flexible automation technologies and systems. This paper proposes an alternative design methodology, integrated mechatronics, which could be used for the rapid, cost-effective development of automated systems. The application of the integrated mechatronics design approach in the development of an automated dimensional inspection system is presented.
Keywords: Dimensional inspection, mechatronics, flexibility, automatisation.

1. INTRODUCTION
Evolution and intelligence are the major known tools in producing a beneficial response to anything that may happen to a living creature. They help the creature survive in most situations, expected and unexpected.
Many modern technological products result from integrating mechanical, electrical and computer systems. This combination of technologies is known as mechatronic systems engineering and such mechatronic systems are found in numerous applications.

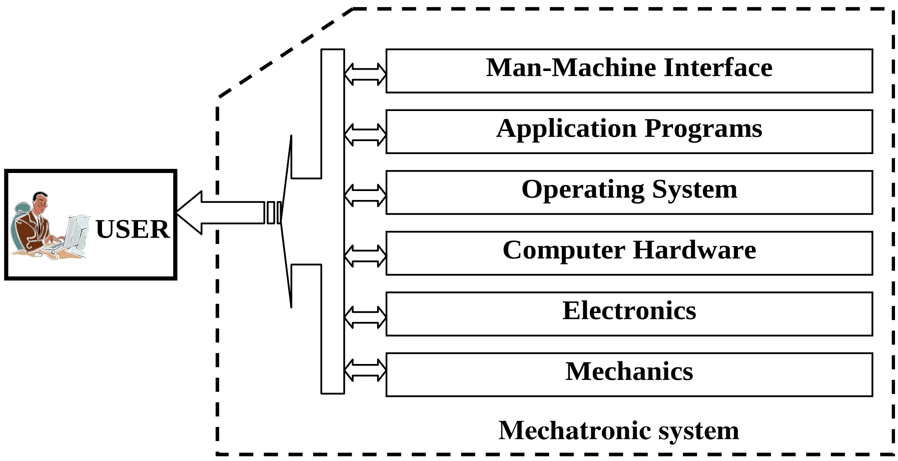


Figure 1. Components of a mechatronic system.

Mechatronics comprises today almost any field of instrumentation, from optical and medical technology through to domestic appliances, metrology, automatic control engineering, office automation and systems engineering. An Automated mechatronic system is capable of handling materials and energy, communicating with its environment and is characterised by self-regulation, which enables it to respond to predictable changes in its environment in a pre-programmed fashion. A typical type of problem in Mechatronics combines precision mechanics, optics, electro-mechanics, electronics, data processing and applied computer science and requires a very high standard of precision, reliability and miniaturization.

Generally speaking, a mechatronic system consists of several layers (fig. 1), where each layer is able to perform correctly only when the underlying one is behaving correctly, too. The number of interfaces between layers leads to an explosion of the overall complexity of the system, thus rendering the development error prone, and the testing extremely difficult.

2 THEORETICAL CONSIDERATIONS

In order to optimise an automatic inspection system it is necessary to treat the entire sub-system in an integrative way during the design process. In the world, remarkable preoccupations were achieved in the field of the development and optimisation of the parts handle and in the field of the mechanical characteristic correlation of the automation.

Issuing from the results obtained in the world in this field, the author propose him selves to study the parts' behaviour in automat inspection system modulus, and to determine new methods to increase productivity and dynamic performances these systems utilised in bearing production and inspection.

In this paper are being approached a few aspects concerning the dynamic and static behaviour of automatic systems for bearings rings control with the aim of achieving the best structures from the efficiency point of view. The research objectives have been underlined within the frame of solving a specific problem raised in the field of machine manufacturing industry for dimensional control productivity improvement characteristics and performances.

Theoretical studies consist of mathematical models and methods for technical systems optimisation. Mathematical tools are of ever-increasing importance in control- system analysis. In optimisation of transport and feeding systems, numerical methods are indicated to be used. By using the classical mathematics optimisation in the cases of feeding and transport systems as an optimal problem, a few problems can be proved: -the optimisation criterion is closed; -it can not be used when the optimisation criterion is “bi” or “multi” variables function; - the operating conditions are not used; - in linear optimisation the Lagrange multiplier method, (which is a mathematical method) can not solve the optimisation problem.

Concisely stated, the optimal problem in cases of transport and feeding systems reduces to the problem of finding the optimal operational factors as an optimal transport and feeding strategy that optimises an index of performance, cost index, criterion subject to various imposed constraints [1].

In such circumstances, there have been underlined a series of methods to improve the performances of automat inspection systems used in the bearing and assembling component production.

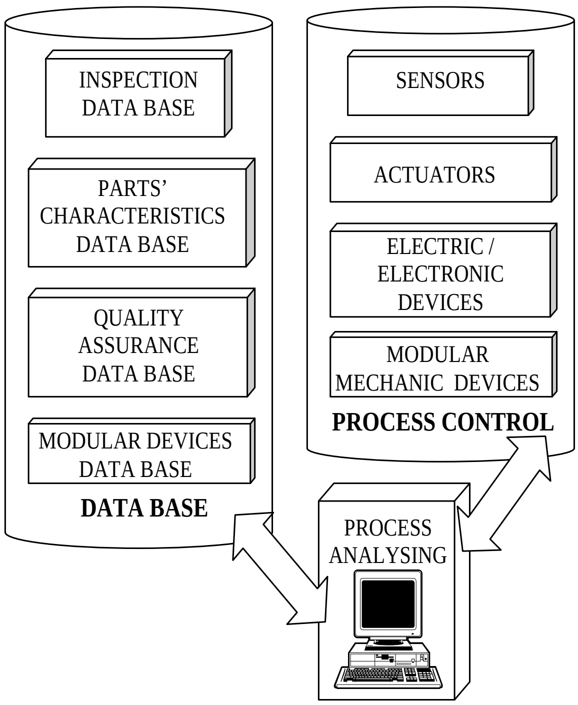
Considering the theoretical results, the authors have perfected a new testing plant to realise the static and dynamic characteristics' correlation with the specific functional characteristics and to determine the main and the most important optimal working parameters.

3 EXPERIMENTAL CONSIDERATIONS

Considering the theoretical analysis, the author gives emphasis to the influence factors that can determine the optimised structure realisation [2]. Some of the most important factors are:

- the holding elements rotative speed;
- the tank rake;
- the parts’ dimensional characteristics;
- the pats’ features of constructions;
- the parts' quality coefficient;
- the holding elements dimensional characteristics;
- the holding elements features of constructions;
- the looping unit mechanical characteristics.

Considering the theoretical analyses, the authors contrived a new testing plant to generate optimise feeding and transport systems.



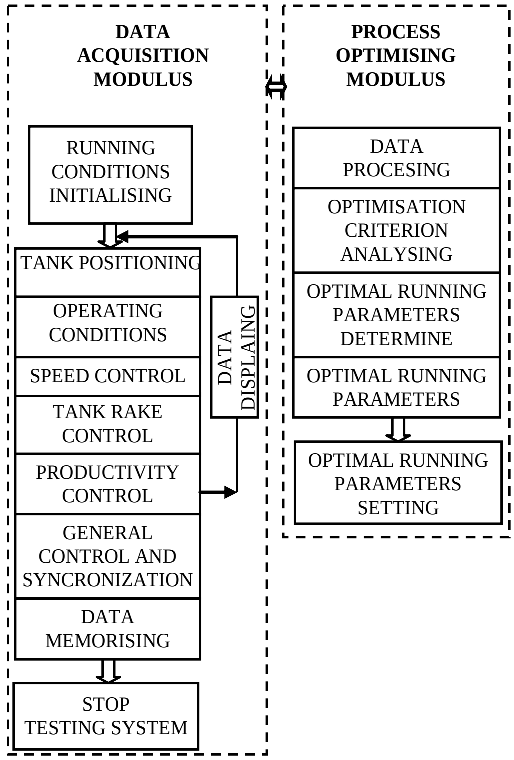
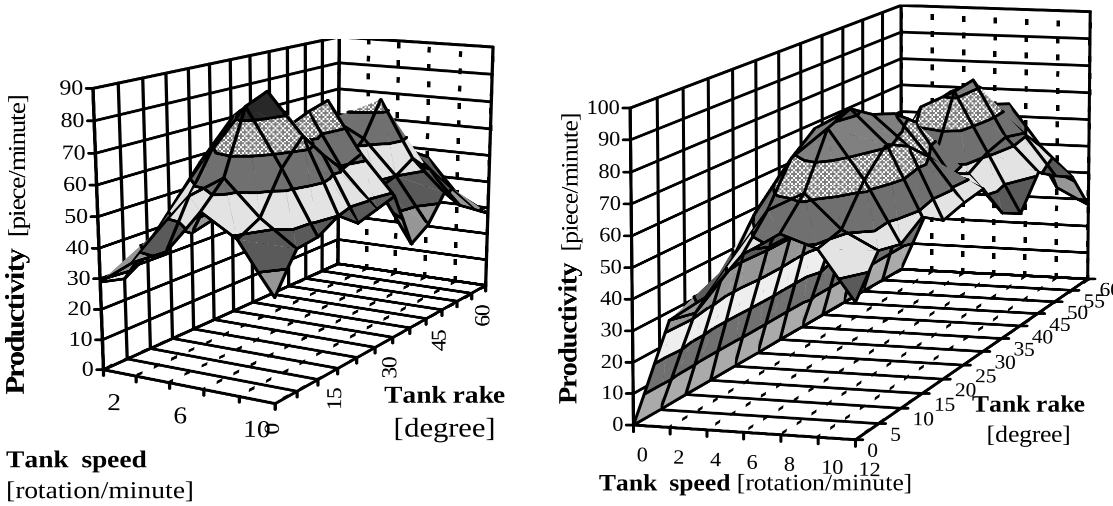


Figure 2. Testing plant low-chart.

Figure. 3. General structure of the testing plant routine.

In order to analyse the correlation of the static and dynamic characteristics and the specific functional conditions, the authors devised and realised an original testing plant (figure 2.). The testing plant reproduces the mechanical structure of some topes of feeding and transport systems in varied operating characteristics (hooked disks, carved disks and catch pin disks). The computer traces the whole process of deposition, catching, handling, transport and exhaust of the parts from the tank, analysing the necessary information and signals from the sensors and generates the decisions on the optimised conditions of the feeding system.
The handling, catching and transporting elements must turn round with a rotation speed with a variation range between 1 and 18 rotations per minute. The tank rake must vary between 0 and 90 degrees, namely from horizontal position to vertical position. The primary data that will be processed by the computer are: the speed of the manipulation elements, the tank rake, the time, the working productivity and the part characteristics (shape, dimensions, appearance and material, inspection characteristics). The general structure of the testing plant routine is presented in figure 3.
The primary data that will be processed by the computer are the speed of the manipulation elements, the tank rake, the time, the working productivity and the part's characteristics (shape, dimensions, appearance and material). The computer processes the information about the experiment and presents the optimal parameters of the inspection systems analysed.
Figure 4,a presents an example of a chart generated inside the experimental process for the tapered rollers. The chart underlines the tank rake and the speed values for which the analysed system has a maximal range for productivity.
Figure 4,b presents an example of a chart generated inside the experimental process for the spherical parts. It also presents the correlation among the static, dynamic behaviour and the specific functional characteristics.
Analysing this chart, the author can remark the tank rakes and the speeds that assure a high productivity for each of part types. The main purpose of this research is to generate optimised feeding,

transport, proportioning, measuring and alignment systems for more mechanical efficiency. The computer processes all the information, testes the analysed system and sets the working parameters to obtain an optimised mechanical system.



a) b)

Figure 4. Experimental chart

4 CONCLUSIONS

All these studies are very important in the field of precision mechanics and mechatronics systems. The main purpose of this research is to generate optimised feeding and transport systems for more mechanical efficiency.

This method provide an automatic optimised process for dimensional inspection as well as an important data base for selecting the optimal working parameters that can assure the most efficient mechanical structure used in automation of dimensional control systems.

This method provides an automatic process control as well as a data base for the select on of the working parameters that can assure the most efficient.

In the near future models of the micro inspection will be added to the methodology. This will enable optimisation of all vital parts of the structure of a mechatronic module. Later on, dynamic properties and controller design will be included into the methodology, which will allow for integrated design and optimisation of structure and control properties.

5. REFERENCES

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