THE OPTIMIZATION OF MECHATRONIC SYSTEMS USED IN DIMENSIONAL CONTROL

Alexandru Constantinescu, Gheorghe I. Gheorghe

The National Institute of Research and Development in Mechatronics and Measurement Technique

Abstract. In different areas in the manufacturing processes the optimization is an important component by allowing the choice and application of economic and technological optimal solution leading to more efficient systems and decreased manufacturing costs and increase of productivity. Prioritizing characteristics the optimization can be achieved both in economic terms and in mechanical terms by limiting the current needs of the production flow of the system and in the same time it is necessary to know the parts that makes the machine systems to achieve efficient optimization with the desired effect. Efficient use of energy, the speed optimization work, and the system adaptation for a better accuracy and repeatability, etc, can mean the machine optimization for a better use. Mechatronic systems generally aim to maximize the optimization components from both technically and economically perspective, making use from reduced cost of execution and a maximization of operations that can be performed with this in a relatively short time. Mechatronic systems optimization can mean an improvement and increase efficiency of a machine which is integrated in the production flow so that the numbers of reported rejected parts to be significantly lower.

Keywords: optimization, productivity, mechatronic systems

1. INTRODUCTION

One of the important component in the manufacturing process is optimization and can be done both from the point of the economically and mechanical view by prioritizing characteristics of system and by limiting the current needs of the production flow, at the same time it is necessary to know the components that make up machine systems in order to achieve efficient optimization with the desired effect.

Mechatronic systems generally follow optimization within its components by more efficient use of energy, a better flexibility speed work, an adaptation of the system to have a better accuracy and repeatability, etc., both from the point of the technically and economically benefiting from reduced cost of execution and maximization of operations that can be performed with this in a relatively short time.

Mechatronic systems in various fields are optimized by choosing and applying economic and technological optimal solution leading to a more efficient, improve and increase of the efficiency of embedded systems in the production flow and the decreased manufacturing costs through reduced number of parts declared reject and increase productivity.

2. THE OPTIMIZATION OF THE MECHATRONIC SYSTEMS FOR CONTROL

Mechatronic systems optimization for control involves the development of part classification and ordering their according to their importance so as to obtain modular and adaptive systems for flexible manufacturing processes.

The main elements that characterize a control system and dimensional measurement are represented by clamping system, the centering system parts in relation to an absolute coordinate system and measurement system.

The clamping system involves catching piece so it will not move in any direction and allow measuring and centering. The clamping of the part is performed by pressing clamps with toggle clamps, pneumatic pressure, vacuum and by magnetic field, etc.

In figure 1 is shown a fastening system that consists of a plate and adjustable modular elements on which a part is fixed for measurement.

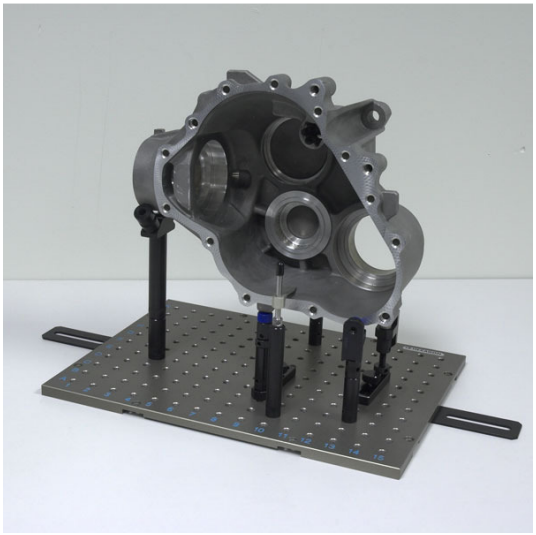

Figure 1. Fastening system

Centering system consists of adaptive measurement modules to determine the distance between the reference part elements to the measuring system of the machine. The main elements of the reference are represented by the surfaces and the holes from to which the measurement will be made, these constituts points, axes, and planes of reference.

Measurement system consists of elements positioning to element which is measuring and the measuring element. Currently on the market are sold kits of fastening systems (positioning) by different companies producing measuring systems depending on the complexity of the parts for that is intended to be controlled number of content elements is varied.

Positioning kits can be of several types:

- mechanical positioning kits;
- magnetic positioning kits;
- vacuum kits positioning;
- freezing positioning kits.

Mechanical positioning kits represent a set of elements (clamps, wedges, screws, etc.) that is combines to orientate and catch a piece so it can be controlled without changing the placement. Company "CMM Fixture" markets fastening systems (figure 2), which consists of different elements that allow catching pieces, divided into three categories according to complexity: bronze kit, silver kit and gold kit.

Figure 2. Mechanical fastening kit – CMM Fixture

Magnetic positioning kits use electromagnets to create a magnetic field to fix orientation the piece so as to allow its measurement in from one single pitch. Company "Spreitzer" sells plates and universal electromagnetic catching pieces of varying sizes (figure 3).

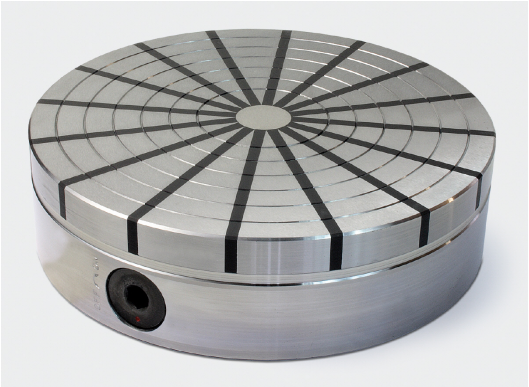

Figure 3. Universal magnetic mounting – „SPREITZER"

Positioning kits with vacuum use a pump to create vacuum between piece and the table, so piece to be positioned.

AMF company manufactures and sells vacuum clamping systems (figure 4) that uses suction points for to guide the piece so that it can be processed, measured, etc.

Figure 4. Vacuum clamping plate – AMF

Kits positioning by freezing (Figure 5) is achieved by using a wet bed which is cooled with compressed air after the piece is set fixing the piece.

Company „Spreitzer" manufactures and markets fastening systems through freezing which uses a wet bed on wich sits the piece, after which it is cooled with compressed air.

Figure 5. Freezing plate for fixing

The centering system involves the use of sensors that can be positioned so that they can measure the distance from the reference elements of the piece and the reference system.

To achieve a measurement and an dimensional control this system centering must use sensors and precise positioning elements.

The defining of elements centering requires identification of points, axes and planes to which the measuring system will control piece by reporting to a common reference system with the centering system.

Mainly to achieve a measurement of parts is necessary to define a plan and two axes that are perpendicular to that plane.

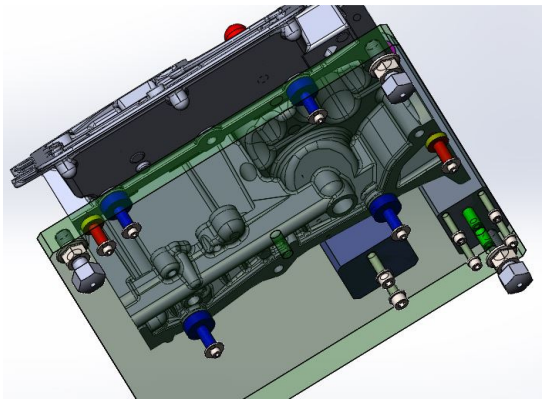

Figure 6. Fixing system for parts

Figure 6 presents a special fastening system developed for one type of piece that consists of a plan generated from the surface of three blue dowels and two other red which generates two perpendicular axes on the plan. The piece is set on the plan generated by blue dowel, are fixing on the red dowel and is caught trough toggle clamp eleminand any possible way to move the piece during the measurement.
The measurement system is used to control certain allowances from the centering system, having a common point of reference to which dimensional control is realized. Positioning elements are represented by translational and rotational axes which have a very good accuracy in rapport with the speed.

3. CONCLUSIONS

The characteristics required wich have to be fulfill by the measuring system are accuracy and repeatability of the sensors and of the positioning elements to which in addition is added to the latter the speed work, response time and a small size.
All these features of measurement system converge for achieving an spatial mechatronic system for dimensional modular and adaptive control.
Optimal configuration of mechatronic systems for measurement and dimensional control is achieved through subsystems and by ensuring the modular and adaptive features of the fixture subsystem as well to measurement subsystem.

4. REFERENCES

References sourced via the world wide web:
[1] http://metrology.zeiss.com/industrial-metrology/en_us/products/accessories/fixture-systems.html

[2]http://www.hitechmetrology.com.au/products/142/index.html?id=386

[3]http://www.cmm-fixturing.co.uk/cmm-fixture-kits/cmm-fixture-kits.html

[4]http://www.spreitzer.de/englisch/productranges/standardproducts/freezing-clamping-technology/index.html

[5]http://www.amf.de/application/amf_app000002?SID=1255077257&ACTIONxSETVAL%28%27artlist.htm%27,APGxNODENR:183060,USERxEBENE2:No.%207800%29=Z