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RESEARCHES CONCERNING THE USAGE OF THE GROUP TECHNOLOGY CONCEPT IN THE MODULAR DESIGN AND OPTIMISATION OF THE BEARINGS AUTOMATIC DIMENSIONAL INSPECTION SYSTEMS

Cristea Luciana
Fine Mechanics and Mechatronics Department
TRANSILVANIA University of Brasov
Romania

Repanovici Angela
Fine Mechanics and Mechatronics Department
TRANSILVANIA University of Brasov
Romania

ABSTRACT
The quality assurance achieved in our country special results in the field of devices used in the automatic dimensional control of the parts. The currently used automatic drive systems are manufactured for concrete service and are equipped with elementary components. Special attention is dedicated to the analyses of dimensional control technology and product characteristics in order to segment the parts into homogenous groups of products with similarly technological characteristics based on concept of group technology. The author aimed at the implementation of the newest designing and analysis methods, essential in quality setting and assurance in the automotive industry.
Keywords: Inspection, modular structure, flexibility, group technology and automatisation.

1. INTRODUCTION
Quality inspection, through all its forms, stands for an integrant part, absolutely necessary, of production, with a view to its being rendered effective and modern. Lately, especially in car building, there have been concentrated numerous elements of novelty. These aspects are enhanced both in point of the immediate efficiency through the mechanization and automation of quality inspection, and in point of prospect, as the automation of quality inspection stands for one of the key conditions for the technological modernization of the fabrication fluxes. One characteristic of the current systems of automatic inspection of the production is the necessity of accomplishment, which refers both to utility programmes, to the manner of solving them, and to the data, respectively to their correctness, accuracy and strict succession in time. The systems of high complexity cannot however meet such a requirement but at high costs. For the near future, there is advocated the development of the systems that might ensure satisfying solutions and that might adapt to the modifications of a procedural nature, imposed by the evolution of the respective set of problems. Due to the common characteristic of all applications of this type, that of being based on an objective and factual knowledge of the field of use, these systems have been named expert systems.

2 THEORETICAL CONSIDERATIONS
The adoption of a quality strategy means the adoption of new means of management of the activity, of some practical rules of conduct, implies the definition of the actions that are to be undertaken, all of them in compliance with the general objectives and principles. In the framework of quality

management, the variables to be measured are either quantitative, or qualitative and there is necessary the adoption of specific techniques and instruments. The means of fabrication will have to possess the quality of adaptability to the requirements imposed by the different series of products which will change during the process of fabrication. The increase in the degree of adaptability in the case of the automatic fabrication systems imposes ensuring the conditions so that these systems might successively generate (materialize) different work possibilities, within a spectrum of potential possibilities, through the modification of the structure or without the help of auxiliary devices.

The adequate principle implies that the structure elaborated for the automatic system of fabrication should be adequate to the maximum both from the technical and from the economic point of view, to the accomplishment of the assembly of operations imposed by the previously established adaptability level. The principle of the dynamic design takes into account the fact that for ensuring an increased flexibility of the fabrication automatic system, the component subsystems will have to modify in time, with reference to the specific of every fabrication operation it carries out. Reaching an optimum between the universality and the specialization may be obtained when designing the system, only by taking into consideration a certain fabrication task, accurately defined and adequately analysed, in order to capture the similitude the stability in time of all afferent operations. Conferring the flexibility characteristic to an automatic fabrication system returns to the formation of a variable structure adapted to the variation of the fabrication tasks, based on modular and functionally integrated subassemblies, as well as on the aptitude of being programmed. The method of group technologies well answers such a desideratum, applied in structuring the fabrication and control technologies.

The idea of group technologies has been initially substantiated and developed for the processes of metal cutting, however subsequently the principle extended upon other fabrication processes, too, playing an essential part for the functioning of the flexible fabrication systems.

Starting from the model of the group technologies, there has been passed over to the identification and particularization of every piece in point of the process of automated measuring, resorting to four matrices whose elements take only two values, 0 and 1, in the framework of the logic true/false: an F matrix corresponding to the geometrical configuration of the piece, two matrices M_1 and M_2 which reflect the geometrical parameters measured on two perpendicular planes and an A matrix for the differences in form which are calculated through the application of the two measuring matrices upon the indicated measurement modulus.

The four matrices have the following significations: F matrix – presence geometrical form/absence, matrices M_1 and M_2 – measuring a geometric parameter/cancelling of measurement, a matrix – calculation of a certain geometrical deviation/acceptance of the values measured under the form in which they were determined, under numerical form. If the elements of the form matrix type F are determined only by the geometrical configuration of the piece, taking into consideration the external shape, the interior shape, the dull edges or the significant connections as cone-shaped surfaces, respectively caps, the measurement matrices M_1 and M_2 are determined by the geometrical parameters whose value has to be determined, in one or two measuring planes, according to the complexity of the required results. They directly influence the disposal of feelers in the probes. In the case of the revolution pieces, it is possible for the feelers to be disposed in a single plan, even if the measurement matrix M_2 indicates likewise the second. The latter may be accomplished by maintaining the probes firm and by rotating the piece with 90° in view of the second measurement. Generally speaking, the parallelepiped pieces imply the direct materialization of the measurement planes, through disposing the feelers in the probe, as the greater dimension of the diagonal as compared to two parallel measurement faces makes the rotation of the piece impossible in the measuring station, with out the withdrawal of the feelers.

3 EXPERIMENTAL CONSIDERATIONS

The four matrices which characterize the measurement process are established upon groups of related pieces, with a view to their efficient use, and in order to remain at a reasonable number of lines. There cannot be encoded through the same matrix pieces which are extremely different from the dimensional point of view or in point of their shape. The representation matrices would be characterized in these cases by a much too complicated shape and it would be extremely difficult to handle them. As the measurement matrices are reflected in the configuration of the probe, this one would be particularly complex in order to cover a very large dimensional interval and a great number of geometrical configurations. For these reasons, there are chosen groups of related pieces in point of shape and dimensions which are attached the characteristic matrices. Such a group may be considered as being formed by the pieces in the constituency of the bearings. In the case of the group of pieces taken into consideration, the ring of the cardanic bearing is the main piece. Taking into consideration the shape of the external and internal surfaces, there is determined the F matrix. There are added the corresponding lines of the cap of the ellipsoid roller and of the third surface cone-shaped roller.

The measurement matrix M_1 comprises the elements necessary for the determination of two external diameters, placed at an already known distance on the longitudinal axis with a view to obtaining the external taper, two interior diameters with a view to determining the interior taper, a diameter of the external channel, a lineal distance which is the value of the thickness of the inferior wall, a distance which represents the placement of the channel and other two distances which are represented by the height of the piece in two diametrically opposed points, with a view to determining the axial beat.

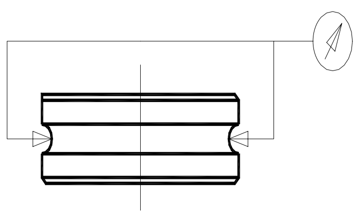
The measurement matrix M_2 comprises the elements which mean the determination in a perpendicular plane on the former, of an external diameter which, associated to the previous one, leads to finding the external radial beat, by analogy an internal diameter in the second plane, with a view to calculating the internal radial beat and two heights on a diameter perpendicular on the internal one, with a view to the subsequent determination of the maximum axial beat.

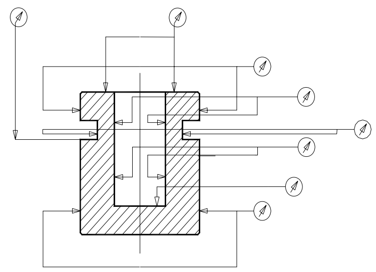
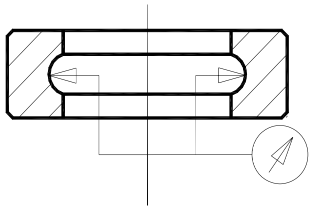
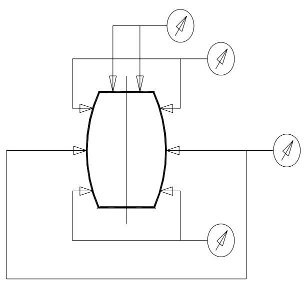
The elements of the matrix A, which are on 1 logic are characterized by the logical value true and they indicate mathematical operations, applied between the elements of the matrices B and C, on the same line, in the case of determining the radial beat and axial beat, and extended on two lines in order to obtain the taper. The elements of the D matrix equal to 0 are characterized by the logical value false and they leave the elements of the measuring matrices in the numerical value determined by measurement. There should be noted that taking into consideration a configuration of the measurement matrices M_1 and M_2, the numerical results corresponding to them may be left under this form or processed so as to determine some geometrical deviations, according to the value of 0 logic or 1 logic of the deviation matrix.

In the case of the cardanic ring taken into consideration, the elements of the A matrix have the significations: $d_1=1$ - there is determined the external radial beat: $d_1=b_1-c_1$; $d_2=0$ - the diameter of the external channel is left under the initial form, characterized by an absolute value; $d_3=1$ – there is determined the external taper $d_3 = arctg\frac{b_3-b_1}{2x}$, x being the distance between the two measurement points; $d_4=1$ - there is determined the interior radial beat: $d_3=b_3-c_3$; $d_5=1$ – there is determined the interior taper $d_5 = arctg\frac{b_5-b_4}{2y}$, y being the distance between the two measurement points; $d_6=0$ –the thickness of the inferior wall is left under the initial form, characterized by the absolute value; $d_7=1$ – there is determined the axial beat on one direction $d_7=b_7-c_7$; $d_8=1$ - there is determined the axial beat on a direction perpendicular on the former; $d_7=b_7-c_7$; there is kept the higher value max (d_7, d_8); $d_9=0$ – the distance to the external channel is left under the initial form, characterized by the absolute value

In Table 1 there is presented the constituency of the four matrices for the family of pieces which constitute bearing elements.

Table 1. Structure of the matrices F, M_1, M_2 and A for the family of pieces which constitute bearing elements.

Type of piece	Scheme of measurement	Form matrix **F**	Measurement matrix in the plane 1- **M1**	Measurement matrix in the plane 2 - **M2**	Matrix of the form deviations **A**
Interior ring		$\begin{bmatrix}1\\1\\0\\0\\0\\1\\1\end{bmatrix}$	$\begin{bmatrix}1\\0\\0\\0\\0\\0\\0\\0\\0\end{bmatrix}$	$\begin{bmatrix}1\\0\\0\\0\\0\\0\\0\\0\\0\end{bmatrix}$	$\begin{bmatrix}1\\0\\0\\0\\0\\0\\0\\0\\0\end{bmatrix}$

Cardanic ring		$\begin{bmatrix}1\\1\\1\\1\\0\\1\\0\end{bmatrix}$	$\begin{bmatrix}1\\1\\1\\1\\1\\1\\1\\1\\1\end{bmatrix}$	$\begin{bmatrix}1\\0\\0\\1\\0\\0\\1\\1\\0\end{bmatrix}$	$\begin{bmatrix}1\\0\\1\\1\\1\\0\\1\\1\\0\end{bmatrix}$
External ring		$\begin{bmatrix}1\\1\\0\\1\\0\\1\\1\end{bmatrix}$	$\begin{bmatrix}0\\0\\0\\1\\0\\0\\0\\0\\0\end{bmatrix}$	$\begin{bmatrix}0\\0\\0\\1\\0\\0\\0\\0\\0\end{bmatrix}$	$\begin{bmatrix}0\\0\\0\\1\\0\\0\\0\\0\\0\end{bmatrix}$
Barrel-shaped roller		$\begin{bmatrix}0\\0\\0\\0\\0\\0\\1\end{bmatrix}$	$\begin{bmatrix}1\\1\\1\\0\\0\\0\\1\\1\\0\end{bmatrix}$	$\begin{bmatrix}1\\1\\1\\0\\0\\0\\1\\1\\0\end{bmatrix}$	$\begin{bmatrix}1\\1\\1\\0\\0\\0\\1\\1\\0\end{bmatrix}$

4 CONCLUSIONS

Under the conditions in which a particular importance is attached to ensuring the product quality, in point of technical control, there have been outlined the directions for the application and for the generalization of the modern methods of quality analysis and control, of dynamic reorientation towards the retechnologization with immediate and important effects upon the increase in the fabrication accuracy, upon the diminution of the dispersion, upon the reduction in work and energy consumption and upon the fundamental modification of the attribute of control, from taking note to taking prevention measures.

In the bearing production, performing a complete control, of high precision and productivity, stands for an essential characteristic, constitutes an essential characteristic, an indispensable factor of the scientific management of the fabrication process, as well as in maintaining and rising the product quality at a level corresponding to the requirements.

Through the research carried out, there has been aimed at a particularly modern approach of the automatic control systems and at the implementation of the latest methods of measurement and analysis necessary for setting and ensuring the quality of bearings as essential mechanical elements in the framework of automotive industry.

5. REFERENCES

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