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SYSTEMIC APROACH ELEMENTS OF THE ACCURACY CHARACTERISTIC OF THE ELASTIC TECHNOLOGICAL SYSTEM

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Abstract*: The technological cutting system is represented by the tool-machine, the piece – half-finished good and the devices for catching the piece – half-finished good and the cutting tool on the tool-machine. this system presents an assembly of characteristics, mainly: the functional, the accuracy, the thermal, the static and the dynamical functions. The analytical and experimental analyses of these characteristics imply the mathematical modelling of the mechanisms that lead to the parameters' errors of these characteristics. Therefore, the distinguishing of the elastic technological system functional chart is important.*
Keywords: *cutting technological system, elastic technological system, functional characteristics, cutting process.*

1. INTRODUCTION

The technological system is a development made of a limited number of production means or technological equipments [1], [2]. Its` main reason is to accomplish a certain preparation process by means of a preparation proceeding upon a semi manufactured article. Under a functional look, the structure of the technological process keeps its' self unchanged no matter what type preparation it is used. From a systemically point of view, the assembly is structured and dynamical [3]. The characteristic of being a structured assembly is determined by the fact that among the production means there are established functional links that occur from the working tasks of each equipment deriving from the basic function of the system. The dynamical character occurs from the fact that the preparation procedure modifies in time its' functional, static, dynamical etc. characteristics. In the mechanical by cutting preparation domain, the technological system is called the technological cutting system [4], [2]. This system if made of the fallowing subsystems:

- tool-machine MU that unsure the main cutting movement and the secondary advance movement;
- device D (D_p) for the semi manufactured article positioning and fixing (piece that is worked upon), on the tool-machine;
- semi manufactured article P;
- device D (D_s) for the positioning and fixing the cutting tool on the tool-machine;
- -edged tool S;
- dimensional measures measuring and checking means MMV of both the semi manufactured article that is worked upon and the tool-machine adjustment.

The first five subsystems are considered being main subsystems. They form the elastic technological system MUDPS [5], [1]. The last subsystem is the auxiliary subsystem. The arrangement of mentioned subsystems is presented in figure 1, in the functional purpose order of the cutting process [3].
According to the arrangement positioning of the component subsystems, there are different categories on technological cutting systems.
The technological cutting system it is defined through functional characteristics that may be divided in two categories: 1. general characteristics; 2. exploitation characteristics [2], [4].
In the first category there can be mentioned [2], [4]:

- the main subsystems that are functionally subordinated so that to unsure the generating by cutting upon the faces of the piece according to the execution drawing of the piece;

• the complexity of the cutting technological system. It is determined by the complexity grade of the piece, that results from the functional purpose and from the its' working conditions;

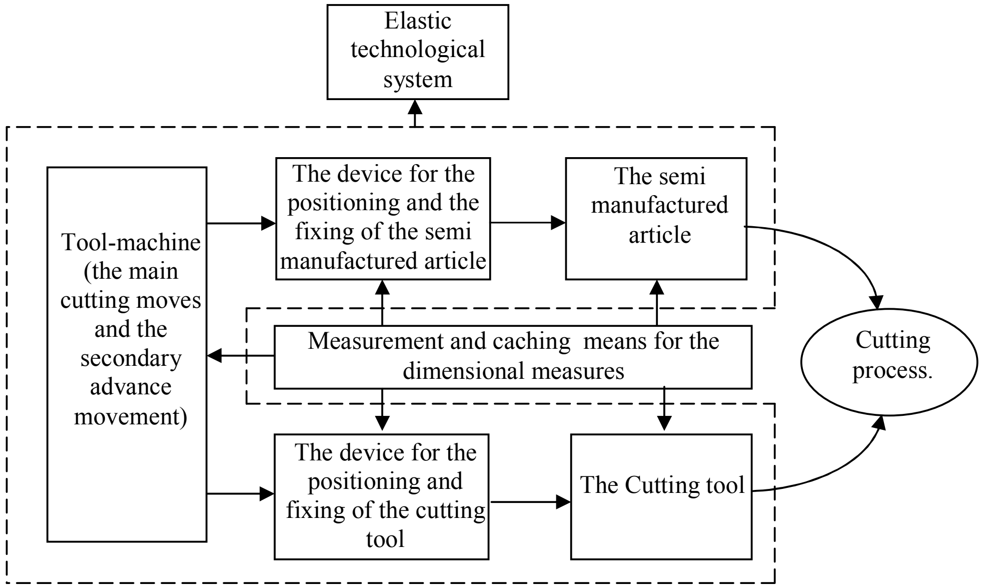

Figure 1: The technological cutting system

• it has the capacity to ensure the parameters adjustment of the cutting process to their optimal values under a technical and economical point of view.

In the second category there are the fallowing characteristics:

- technological characteristics;
- precision characteristics;
- thermal characteristics;
- dynamical and statical characteristics.

It is to be noticed that each of the mentioned characteristics are defined through quantative parameters.

2. TECHNICAL REQUIREMENTS

The elastic technological system has as its main function the accomplishment of the relative movement between the preparing piece and the cutting tool that determines the generating by the cutting process of a certain prepared surface. In essence, the mechanical components and elements of the elastic technological system may be included in the next subsystems[7],[8]:

• the elastic subsystem of the piece S^p (that is worked upon). It is formed of pieces (the semi manufactured article) to be prepared, the caching device of this on the tool-machine and the subassemblies of the tool-machine that contribute to the creation of the piece –semi manufactured article movements through the cutting process;

• the elastic subsystem of the cutting tool S^{Sc}. It is formed of the cutting tool, the fixing device of the tool and the subassemblies of the tool-machine that contributes to the creation of the tool movements through the surface generating process of the piece;

• the generating system SG of the tool-machine. This system contains [7] the entire mechanical elements of the system MUDPS. Their relative position and movement accomplish the given trajectory of the cutting tool movement in report to the preparing tool. According to the positioning and the number of both the preparing semi manufactured article and cutting tools, the structure of the generating system may have different representations, shown in figure 2.[8].

Both the analytical and experimental analyses of the technological elastic system's functional characteristics can be made by considering the system as being represented as an open frame [6], [1]. At the ends of this frame the cutting tool and the piece – semi manufactured article are placed.

Attaching to this frame a still reference system XYZ or mobile reference systems connected to the cutting tool XsYsZs or to the piece - semi manufactured article XpYpZp, the mechanisms that lead to the forming of the functional characteristics' errors of the system, may be mathematically modelled.

These errors forming mechanism has at its' bases the functional chart of the cutting technological process, as it is presented in figure 3 [9], [10], [11].

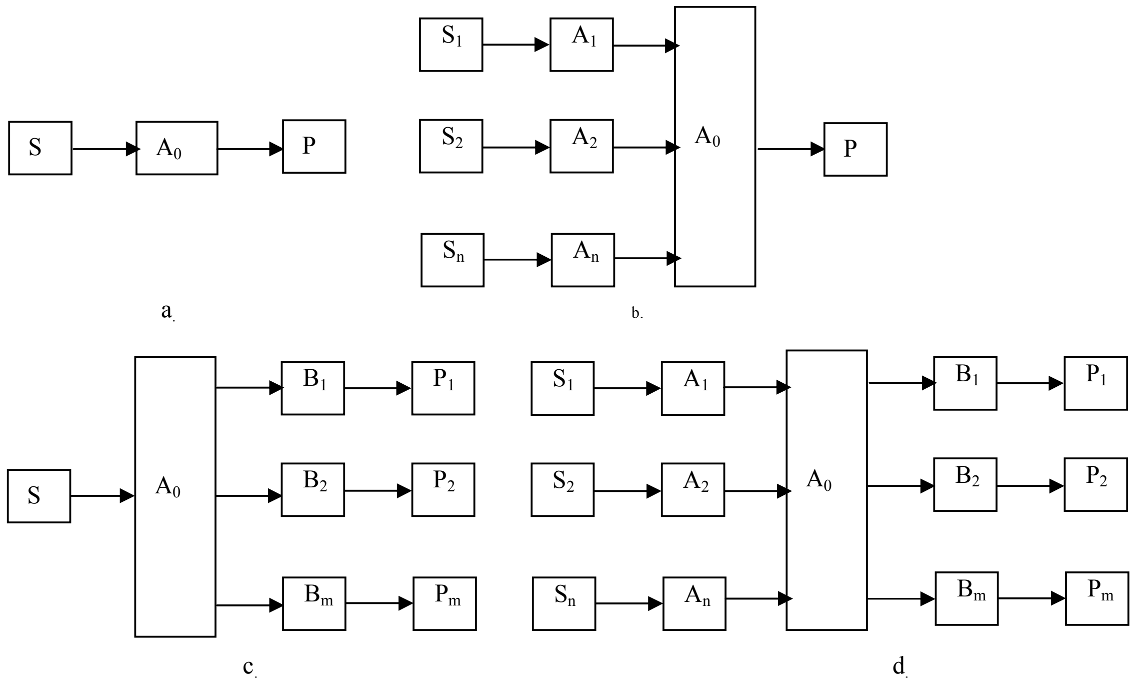

Figure 2 The structure of the machine-tool's generating system**.**a. in chain; b. several tools; c. one single tool having more positions; d. parallel aranjament;; S_1, S_2,…S_n -cutting tools;; P_1, P_2, …P_m – semi manufactured article; A_0 – the general component of the system SG; A_1, A_2, …A_n- the elements of the system SG connected to the cutting tool; B_1, B_2, …B_m - elements of the system SG connected to the semi manufactured article

In this chart, it is shown the fact that the entrance measures presents deviations to which the factors belonging to the environment are associated.

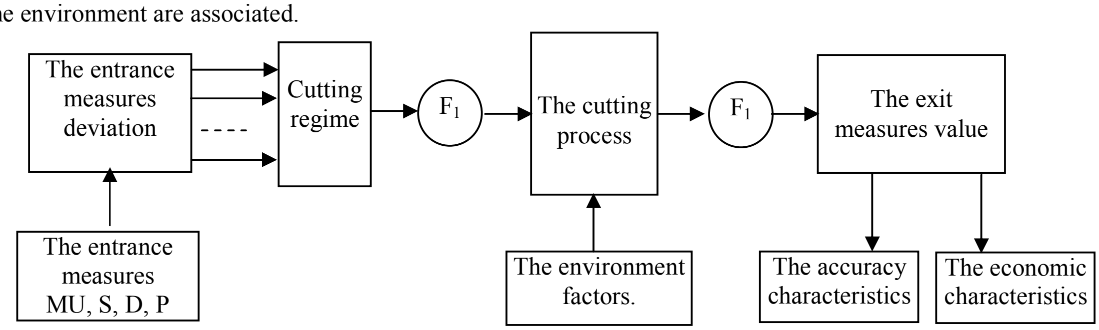

Figure 3 The scheme oh the cutting process. F_1, F_2 – fixing functions

Through the cutting process structural chart, as it is shown in figure 3 [10] [11], the entrance measures of any cutting method are represented by the system's components MUDPS and the exit measures are represented by two complex characteristics: accuracy characteristics represented by the dimensional accuracy, the form accuracy, the positions accuracy and the prepared piece surfaces quality; economical characteristics represented by productivity, the piece's execution cost, the cutting tool cost and the cutting tool durability. It also may be mentioned that the cutting regime represents a fixing parameter of the entrance measures influence upon the cutting process mechanism's development.

Regarding the representation of the system MUDPS as an open frame [12] [10], it may be noticed that the mathematical model for the evaluation of the system's MUDPS accuracy characteristics has the general representation [12]:

$$\{\delta\} = f\ (\{Z\}, \{C\}). \tag{1}$$

In which: $\{\delta\}$ represents the deviation vector of the prepared surface piece accuracy characteristics;

$\{Z\}$-.the vector of the factors that influence the system's MUDPS accuracy characteristic;

$\{C\}$- the vector for the given constants.

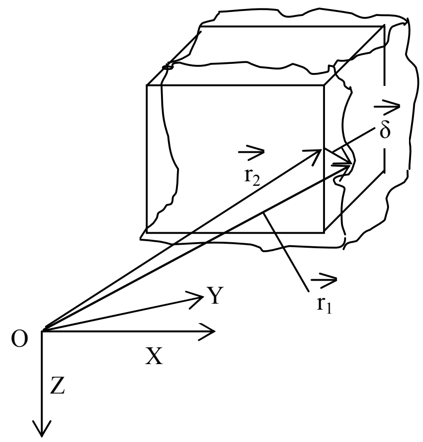

Figura 4 The calculus scheme of vector δ

The mathematical model (1) allows [12] the quantative evaluation of the influence degree that one or more factors of the technological process have the accuracy characteristics of the elastic system. Measure δ may be represented as being the difference (Fig. 4) [12]:

$$\{\delta\} = \{\, | \, r_2 - r_1 | \,\}. \qquad (2)$$

in which r_1 and r_2 represents the theoretical and real vector radiuses of a point positioned on the prepared piece surface.
The relations 1 and 2 are extremely useful in the stage of projecting the technological elastic system.

3. CONCLUSION

To analyse the accuracy characteristics of the system MUDPS implies a systemic approach of the influence factors. Therefore, the systemic representation of the cutting process is necessary. This way, the identification of the entrance, exit and state measures that define the preparing process within the system MUDPS is allowed. The entrance factors shows themselves through two categories of factors: force and heat factors. The mathematical model that is used for estimating the accuracy characteristics of the system MUDPS systemically groups the influence factors.

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