THE USAGE OF DIMENSIONS CHAINS IN ESTABLISHING THE OPTIMAL VARIANCE IN THE TECHNOLOGICAL PROCESS OF A PIECE

RĂDULESCU Constanţa[1], CÎRŢÎNĂ Liviu Marius[2], LUCA Liliana[3]
[1,2,3]University ,,Constantin Brâncuşi" Tg-Jiu
e-mail: radulescu@utgjiu.ro ; liliana@utgjiu.ro

Key words: technological dimensions chain; tolerance.
Abstract: In determining the optimal sequence of processing a piece (eg a tree in steps) will have to take into account the tolerances and deviations that occur in the order of size chains. Thus, to determine the optimal sequence of processing the tree in steps, it can be used the Bellman's algorithm. For simplifying the construction of Bellman's algorithm it may be taken into account that the same system of linear dimensions provides the optimal order of shifting for cutting instrument (lathe knife) and changing the length of the other steps of the tree. To determine the optimal sequence for processing the tree will first need to study aspects of tree-sized chain solution.

1.INTRODUCTION

A very high influence on the optimal variant election of the technological process of executing a piece has the determination and the correct solving of dimensions chains. Depending on the depth of cut, but also on the intermediate tolerances that are made for each element of the chain in part, it can be chosen the optimum technological process of execution of a piece. Methods for optimization of technological process variation, depending on the formed dimensions chain are: dynamic programming method, method using Bellman's algorithm and graphical method. In determining the optimal processing sequence of a piece (eg a tree in steps) will have to take into account the tolerances and deviations that occur in the order of sized chains.

2. THE USAGE OF DIMENSIONS CHAINS IN ESTABLISHING THE OPTIMAL VARIANCE IN THE TECHNOLOGICAL PROCESS

To determine the optimal sequence of processing the tree in steps we can use Bellman's algorithm. Using Bellman's algorithm for optimal sequence of the tree in steps, at accurate processing operations is related to respecting linear dimensions. In such cases, when the linear dimensions data affect the processing sequence of the tree in steps, it should be considered the boundaries of the vainly movement of cutting tools. In general, the number of possible variants of succession of the tree in steps processing may be equal to **n!**, where n is the number of tree steps.

To find the optimal variant of processing sequence of stepped shaft, at first, it will be determined the base edge, with the side that can process all the shaft steps to the section (step) with the maximum diameter (note the left extreme with p and right extreme with q). For simplification of Bellman's algorithm construction, it may be taken into account that the same system of linear dimensions has already set the optimum travel order for cutting tool (lathe tool) and changing the length of others steps. Cutting tool path motion if it were possible to process steps according to the order 1,2,3 ,..., p.

This is not always possible, since **deviations** are encountered, occurring **in the order of dimension chains**. To determine the optimal sequence for processing the tree will first need to study **aspects of solving the stepped shaft dimension chain.**

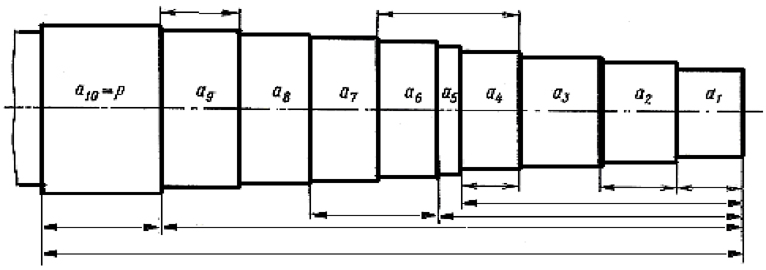


Fig. 1. The scheme of the stepped shaft dimensions chain

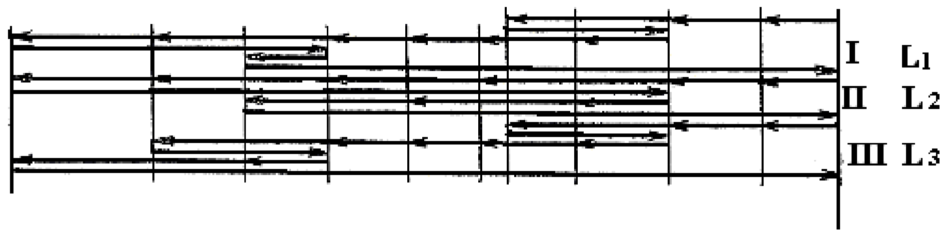


Fig.2. The cutting tool motion path at processing the stepped shaft

The scheme of dimension chains is shown in Figure 1 and in Fig.2 is shown the travel path of the cutting tool at stepped shaft processing. Checking correctness is done as in Fig.2. Depending on comparative variations, we consider the processing order:

- I : a_1, a_2, a_4, a_3, a_5, a_6, a_7, a_9, p, a_8;
- II: a_1, a_2, a_4, a_5, a_7, a_9, p, a_3, a_6;
- III: a_1, a_2, a_4, a_3, a_5, a_6, a_7, a_8, p.

Travel path length of each cutting tool for each variant is determined by the relationship:

$$L_1 = 2l_p + 2(l_3 + l_4 + l_8) \quad (1)$$

$$L_2 = 2l_p + 2(l_3 + l_4 + l_5 + l_6 + l_7 + l_8) \quad (2)$$

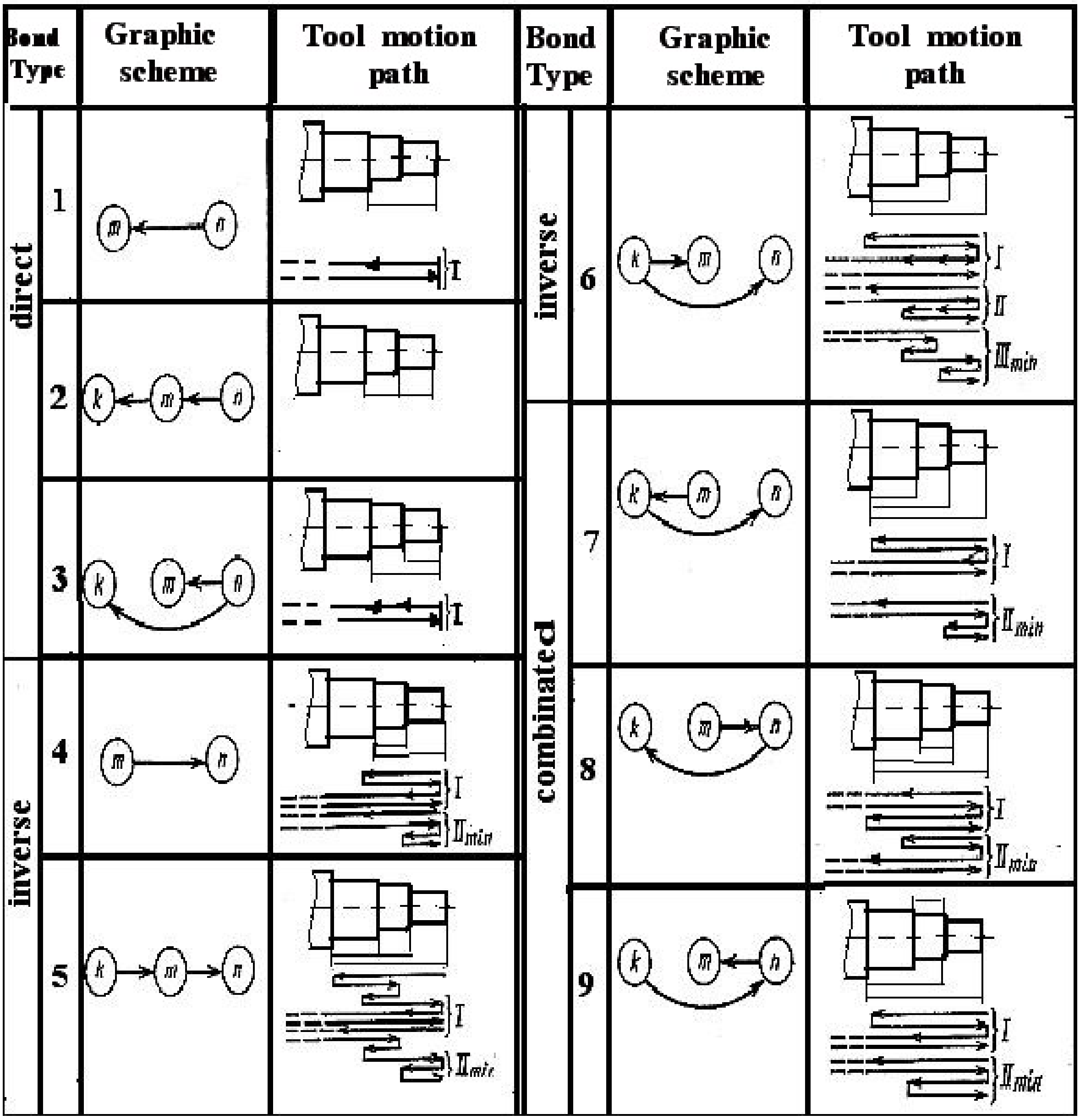
$$L_3 = 2l_p + 2(l_3 + l_4 + l_8 + l_9) \quad (3)$$

Here: $L_2 > L_1$ for the size: $2(l_5 + l_6 + l_7)$

$L_3 > L_1$ for the size: $2l_9$

We observed from the obtained relations that $L_2 > L_3 > L_1$, for different values of the various steps of the shaft. Changing any step length does not affect the relations obtained. This assumption is valid for any system of linear dimensions circuits.

Table 1. Graphic scheme and trajectory of movement of cutting tools in various combinations.



Thus, any dimensions chain can take the form of direct and reverse links between shaft steps. It will be possible to study successively the whole appearance of dimensions chains of 1, 4, 8 and 9 aspect. For each aspect of the links it will be studied the number of versions of the tool motion. To reduce the travel path of the knife, steps with links from 1 and 8 aspect will be processed at the knife movement from the edge to the largest diameter section, and connection steps with the 4 and 9 aspect at the back race of the cutting tool.

In this way, we could represent the minimum path building rules:

1. Travel path of the knife can be presented as a combination of two successive numbers of the stepped shaft:

$$k = \langle T_p 1, T_p 2 \rangle ;$$

2. Elements of the first sequence will be the number of steps with links to 1 and 8 aspect, and the normal order of succession - the increasing order of numbers from 0 to p:

$$T_p 1 = \langle 0,1,2,3,...,n_i, p \rangle ;$$

3. Elements of the second sequences will be the number of shaft steps with the links from 4 and 9 aspect, and their normal order of succession - the descending order of numbers from p to 0:

$$T_p 2 = \langle P-1, P-2,...,0 \rangle ;$$

4. The failure of normal order succession of numbers results in links [TP1] with aspect 8 and [Tp2] with aspect 9.

3.CONCLUSIONS.

In determining **the optimal processing sequence of a piece** of shaft type were taken into consideration:

- the **tolerances and deviations** that occur in the order of the formed **dimension chain**;
- when the **linear dimensions affect the processing sequence** of a piece, it will have to take into **account the movements in gap of cutting tools**;
- it must be **determined the basic edge** which represents the **surface** to which it is possible to **process all the gear part (shaft)**, from the lowest rung to its biggest rung.
- **the variants of the technological process** were **established according to the order of the piece processing steps** and to the **displacement path length of the cutting tool**.

4. REFERENCES

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