

GENERATING MODEL OF MANUFACTURING TASKS FOR FLEXIBLE MANUFACTURING SYSTEMS

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Abstract: In this paper the simulation model for real manufacturing items is drawn up, the “Shafts” program having on its grounds the generalized analytical model of the manufacturing charge conceived in paper [2]. This program offers applications in designing flexible manufacturing systems for processing round shafts; a field was specialty literature doesn't offer information. The “Shafts” program was realized in Visual C++ programming language. By decomposing simulation a simulating program was developed. The program is drawn up for the most complex item, were by annulling geometrical-functional features, any more simple, real item, component part of any item family of the manufacturing charge may be obtained.

1. INTRODUCTION

The basic element staying on the grounds of designing a flexible manufacturing system is represented by the current manufacturing charge featured by a prevalent typology. Consequently, the first stage in designing any of the flexible manufacturing system consists in the analysis of the manufacturing charge.

Flexible manufacturing systems (FMS) are adapted to the manufacturing charge. There is no “general” FMS, but only adapted FMS to the peculiarities of an item class or family – in this analyzed case, the flexible manufacturing system for round shafts processing. Laying on the grounds of flexible manufacturing systems designing for processing round shafts the generalized manufacturing charge S_aF_{ag} was fixed before, on grounds of the typological nucleus, which includes the whole typology of possible items belonging to an item class, family or variant, limited by constrictions to an imposed field, within paper [2]. The stages as below were **covered**:

- The ***synthesis method of the current manufacturing charge*** was drawn up by the analysis and mathematical formalization of the items features (round shafts)
- On grounds of the ***generalized analytic and global synthesis model of the manufacturing charge*** for designing any flexible system for the round shafts processing, ***generalized item models***, hypothetical and representative items for the family (F) or variant (V) of particular real items R_k , [2] were drawn up. The generalized item includes all constructive-geometrical elements of the multitude of real, factual items of the represented family or variant. These constructive-geometric components were ordered in a logic and natural sequence, according to [2]. In this manner six types of generalized item models were drawn up, [2] laying on the grounds of configuring and sizing the flexible manufacturing system for processing round shafts:
 - The model of generalized item of compact, typical, asymmetrical, external configured round shafts family (FAC | p | T_i | A_s | e);
 - The model of generalized item of round gap shafts family (FAC | G | T_i | A_s | CO | e | i);
 - The model of generalized item of polygonal/ conic round shafts (FAC | P | T_i | CO | A_t | A_s | e | i);
 - The model of generalized item of axles and spindles family (FAO | p | T_i | A_s);
 - The model of generalized item of threaded shafts family (FAF | p | T_i | A_s);
 - The model of generalized item of spherical shafts family (FASF | p | A_t | A_s | e | i).

Within this paper *the data basis for the synthesis of geometrical configuration*, consisting of drawings and symbols (notations) corresponding to the matrix elements of the before presented mathematical model shall be drawn up [2].

Each item family, variant represents an ordered literary-numeric (alphanumeric) ordered sequence. Each symbol of the ordered sequence has in the data basis a corresponding graph: drawing, distinct and univocal geometric figure, according to paper [2].

The totality of constrictions (conditions and restrictions) afferent to all families of the accordingly class were written, which also shall be introduced in the data basis, beside of the corresponding symbol.

The data basis so constituted contains the elementary geometrical components of the manufacturing charge, accordingly to the symbols of the mathematical model matrix former drawn up [2].

2. DESCRIPTION OF USING THE SIMULATION PROGRAM

In view of the generalized manufacturing charge computer simulation an “assembling” program is drawn up, which has to associate different data basis figures, expressing the symbols of the ordered sequences, [2].

The program converts the alphanumeric ordered sequence in a succession, joining of geometric figures respecting this ordered sequence. By the running on computer of this program, more item families of the same class, in different variants shall be obtained. These variants may be real or theoretical. From an item family the more complex variant is chosen, generally theoretical, hypothetical, fictive, including all the accordingly family’s features, all the geometrical elements of all variants belonging to the accordingly item family.

The computer program was realized in the *Visual C++ programming language* [1, 3] and has on its grounds the *logic chart* in Figure 1.

A **data basis** – BD was conceived, containing the sizes and features of all the elements belonging to all former, in paper [2] fixed round shaft families (assigned functions – f_{ij} of the characteristic logic function’s geometrical constructive elements of the item multitude).

The **main stages** of using the program are as below:

By means of the decision bloc <option> user may automatically select, at any time, from the data basis, from the six generalized items, the generalized shaft family he wants to use.

The two windows are visualized on the screen (Figure 2):

- The **generalized shaft window**, named “**generalized shaft**” comprising generalized items for the six round shafts family types;
- The **real shaft window**, named “**client shaft**” which may be automatically generated from the generalized item.

Acting button “**outlining**”, the program shall automatically generate in the “*generalized shaft*” window:

- The family selected (example, family 1 – round gap shafts, Figure 2);
- The code bare corresponding to the assigned functions to the elementary geometric components of the data basis items made according to [2] and maintaining the same notations.

For example, radial-axial bearing section – f_{ra} ; polygonal section – f_{tp} ; shrinking thread – f_{fs} ; key transmission – f_{pn} ; belt canal – f_{cc} ; grooved section – f_{can} ; spacing section – f_{td} ; teeth – f_{Rd} ; flange – f_{FI} ; a.s.o.).

2.1 The logic chart of the program

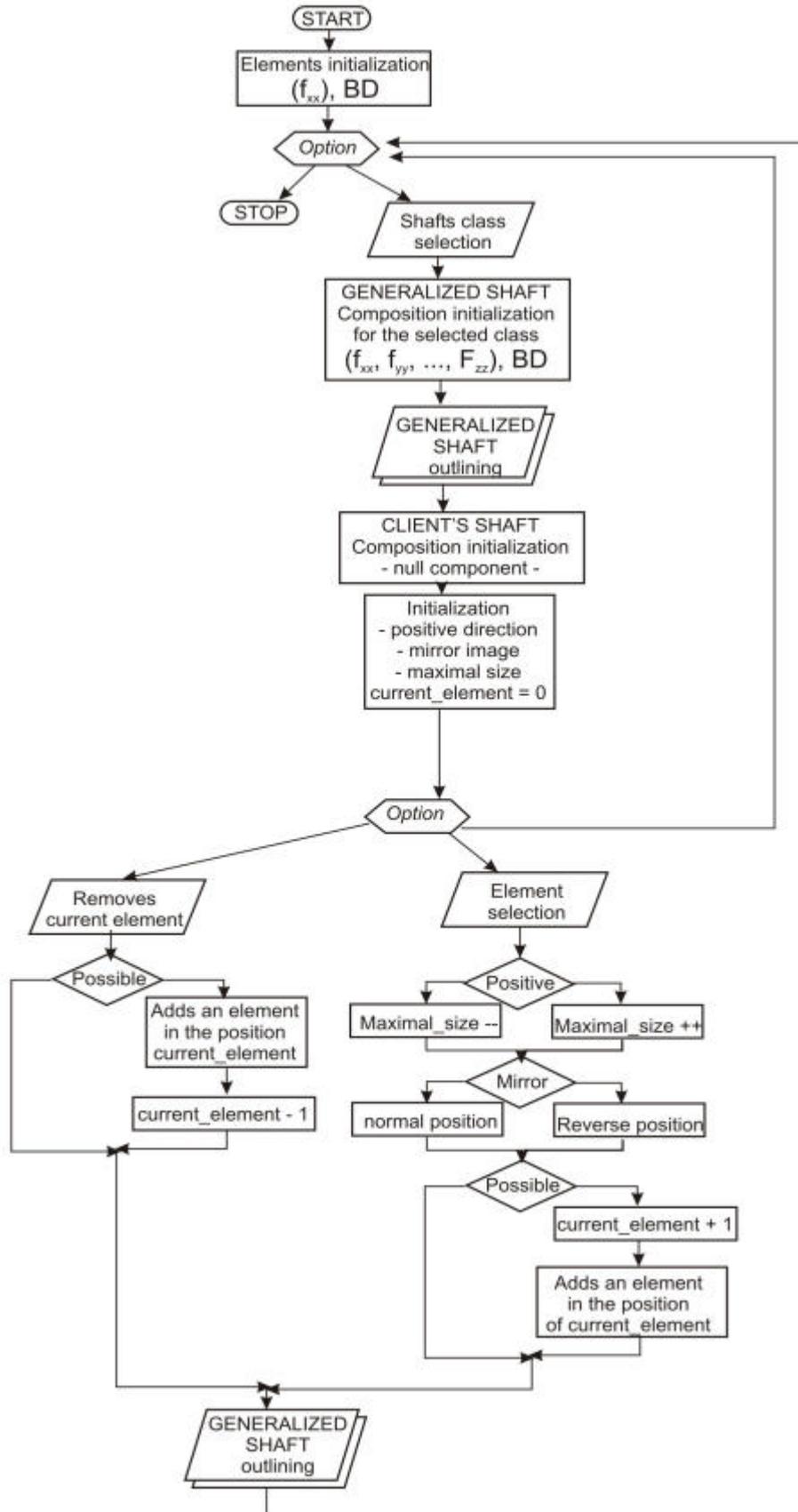


Fig. 1. The logic chart of the program

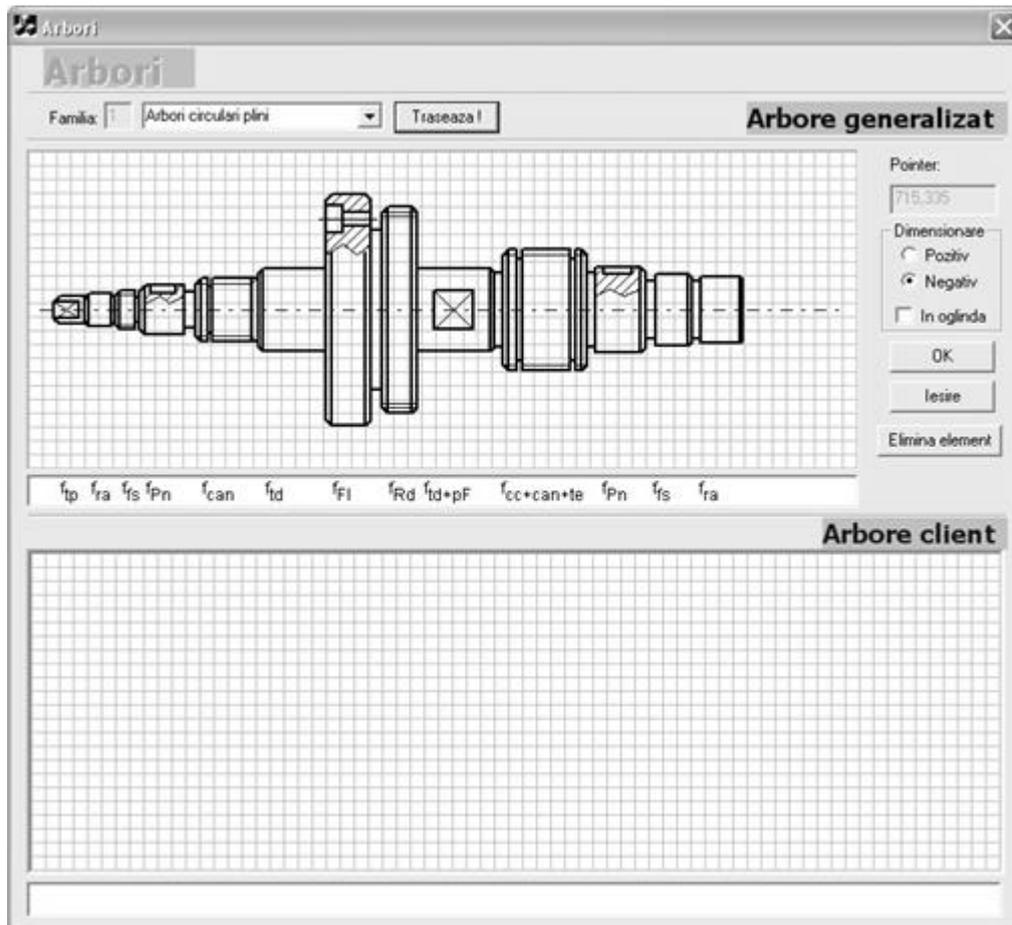


Fig. 2. The family selected (family 1 – round gap shafts) in the “generalized shaft” window

From the generalized item any real item type, represented by a model graph as the ordered sequence determined by the assigned functions to some elementary geometric figures from the data basis (f_{ij}) may be obtained.

Generation of real shaft, also called client shaft is made in the window “client shaft”. Initialization of the client shaft elements is made by selecting the current element of the “generalized shaft” window, so as it is shown in the Figure 3.

Buttons as below could be activated:

- “Positive” – if diameter of the next element has to be grown;
- “**Negative**” – if the diameter of the next element has to be reduced;
- “**Mirrored**” – for mirroring, such as:
 - *False*: the element shall be insert in the position described in the data basis BD (normal position),
 - *True*: the element shall be insert in reverse position (mirrored compared to the vertical axle).

The current element indicates the position an element shall be inserted in the “Client shaft” window, that means in the real item of the manufacturing charge.

The current element of the client shaft can also be eliminated by acting the “**element eliminating**” button.

From the figures as below (Figure 4) some application windows were extracted, for exemplifying the construction of any real item type resulted from the generalized items of round shaft families included in the used program’s data basis.

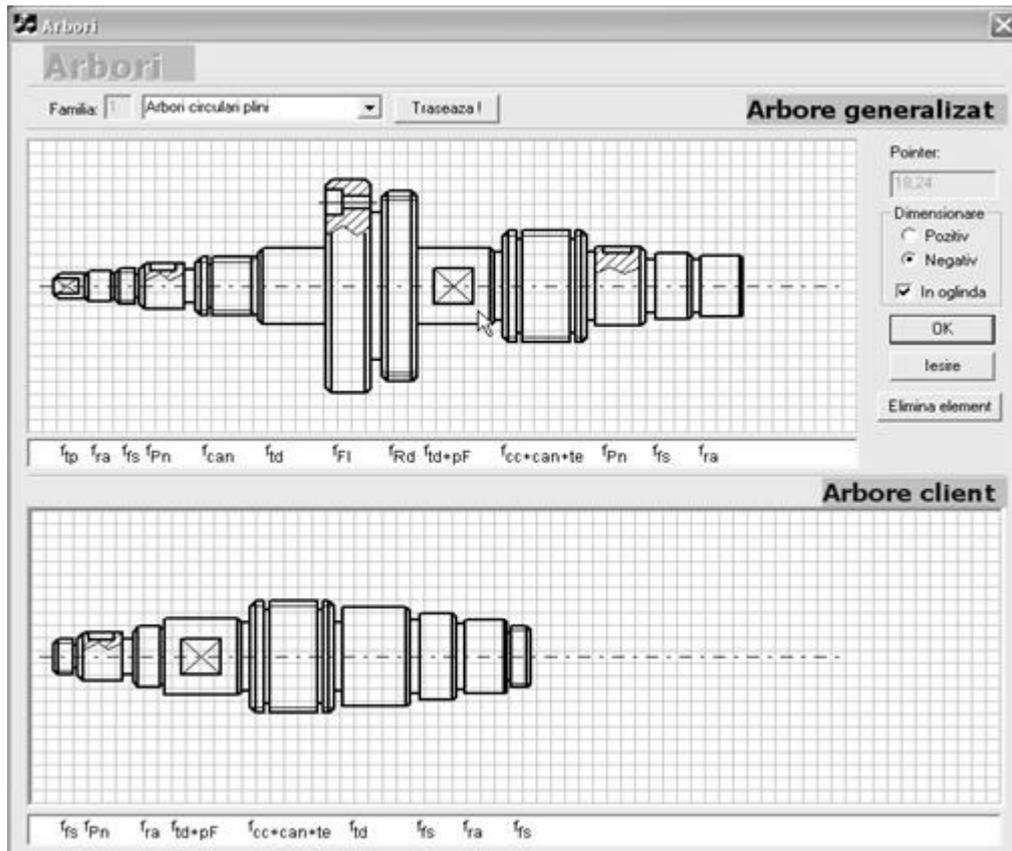


Fig. 3. Initialization of the client shaft

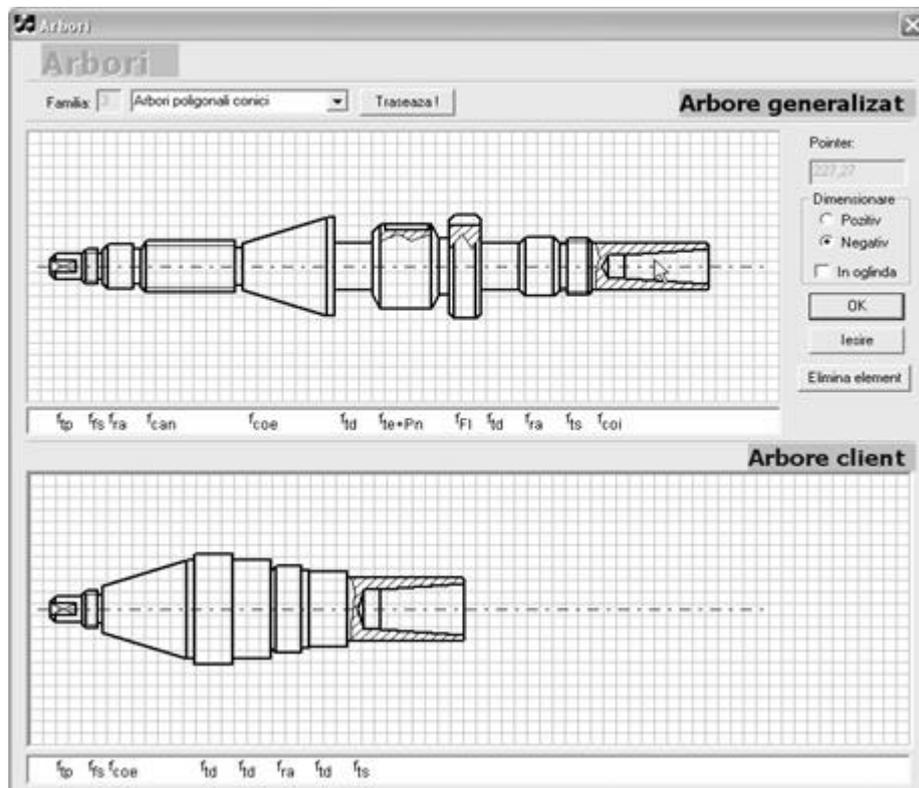


Fig. 4. Application window – conic round shafts family

