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DEVELOPMENT OF NEW CLASSIFICATION METHODS FOR CAPP SYSTEMS

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ABSTRACT
The paper deals with new classification methods in Computer Aided Process Planning (CAPP) systems which extend the possibility of engineering part classification. New developed methods of classification – selective and dynamic classifications will be introduced and described in the paper.
Keywords: CAPP**,** process planning, dynamic and selective classification

1. INTRODUCTION
The process planning systems are important tools for increasing of efficiency and profit. One question is very relevant – is possible to achieve by current methods and means of the process planning the increasing the flexibility and time performance? Accordingly it is needful to find new tools and advanced methods for solving of the process planning task in the modern enterprise.
Engineering activities realised before manufacturing are very important in term of influencing of total production cost. The process planning activities as the main engineering activities are critical production cost factors. Therefore there is a big meaning to deal and interest with process planning activities.

2. PRODUCT CLASSIFICATION AND CLASSIFICATION SYSTEMS
There are two basic approaches for creation and processing of process plan based on computer support and advanced planning methods. The first approach is based on *Group Technology* (GT) utilizing *the variant method or the variant process planning*), the second approach is the exact mathematical principle based on modelling of part, manufacturing knowledge and process plan (*generative method or generative process planning*). The two approaches are generally different. In the first approach - *GT based approach* - a planner retrieves the plan for similar components using coding and classifications of parts. In the GT CAPP systems human retrieves the plan for similar components using coding and classifications of parts. The process planner edits the retrieved plan to create a variant to suit the specific requirements of the component being planned. Variant process planning implements a coding and classification scheme by which a process plan for a previously planned part is retrieved.
The majority of CAPP systems based on GT are intended for manufacture process planning. It is sufficient for the manufacturing process to create a classification system that will be simply fulfilled. There is no need for frequent changing the number of groups, or for changing the localisation of individual engineering parts in individual groups.
Therefore, it is possible to consider these classification systems as static classification systems. It is needful to create classification system for concrete factory according analysis of range of manufactured products (portfolio) before utilising of GT CAPP system. The period for creation of classification system for factory is time demanding process and depends on concrete range of manufactured products [1, 2].

3. SELECTIVE CLASSIFICATION

Sometimes it is problem to determine and to classify new engineering part to the individual groups. Each of group is characterised by interval of geometrical, material and qualitative (tolerances, roughness) properties. It doesn't mean that there is no similarity between new part and some group. Question is the following: What is level of similarity and how to determine the similarity among parts?

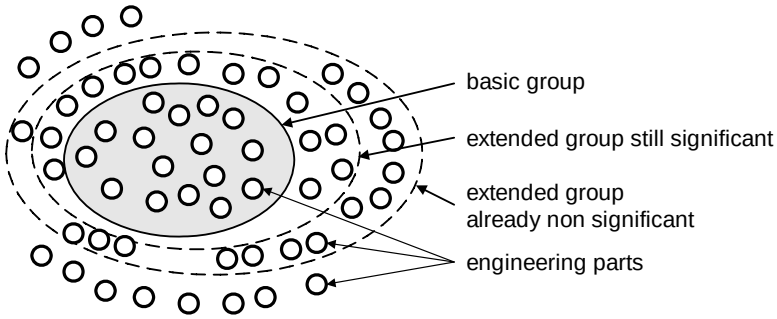

Figure 1. Principle of selective classification

Interval of geometrical, material and qualitative properties determine the number of engineering parts classified into the group and at the same time the level of similarity in framework of the group. If it is extended the interval for material properties or for tolerances, more parts will be classified into the group.

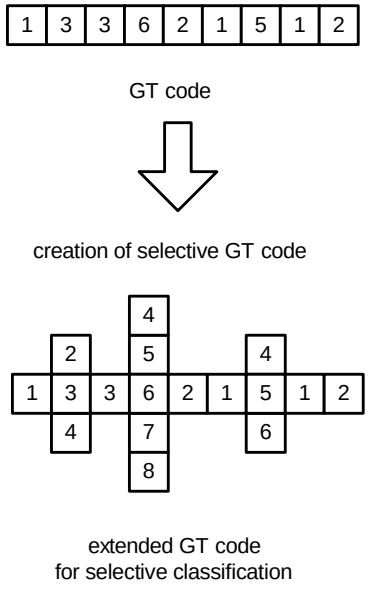

Figure 2. Extension of GT code for selective classification consideration

The process for selective classification of new engineering part is the following:

- Finding the most similar group for new engineering part,
- If there is no similarity between new part and GT representative pf the group, it is possible to extend individual properties (e.g. tolerances) characterizing the group, till the similarity between new part and GT representative is finding (Fig.1),

- If the group is determined, it is necessary to valuate whether the similarity has still technological meaning. For example if interval for total length is too big, all classified parts from the group need not have the same clamping. Too big interval of shapes also causes problems in editing of process plan.

The process for finding the similarity between new engineering part and individual groups based on extended properties of groups with respect on technological meaning is titled as *selective classification*. The process planner determines in the system some property (tolerance, dimension, roughness, length, etc.) and after extension of property interval he explores if there is some similarity between new part and the group.
On the beginning the process planner creates GT code according. System tries to find the same GT code of individual groups. If there is no correspondence, some of property is extended while there is match of GT code of new part with some extended GT code of some group. Naturally the meaning of extension of GT code have to be in accordance with technological meaning of property extension.
The developed selective classification method was implemented in the commercial CAPP systems for rapid production cost valuation.

4. DYNAMIC CLASSIFICATION

However there is a big demand to utilise the GT also for other technologies and not only for machining process planning. As the characteristic of non-cutting technologies (such as forging and casting) are different as cutting technologies, there is need to take other view on utilisation of GT in this area [1, 2]. As the static classification system is not suitable for process planning of non-cutting operations, therefore there is a concept design of dynamic classification system oriented especially for non-cutting technologies.

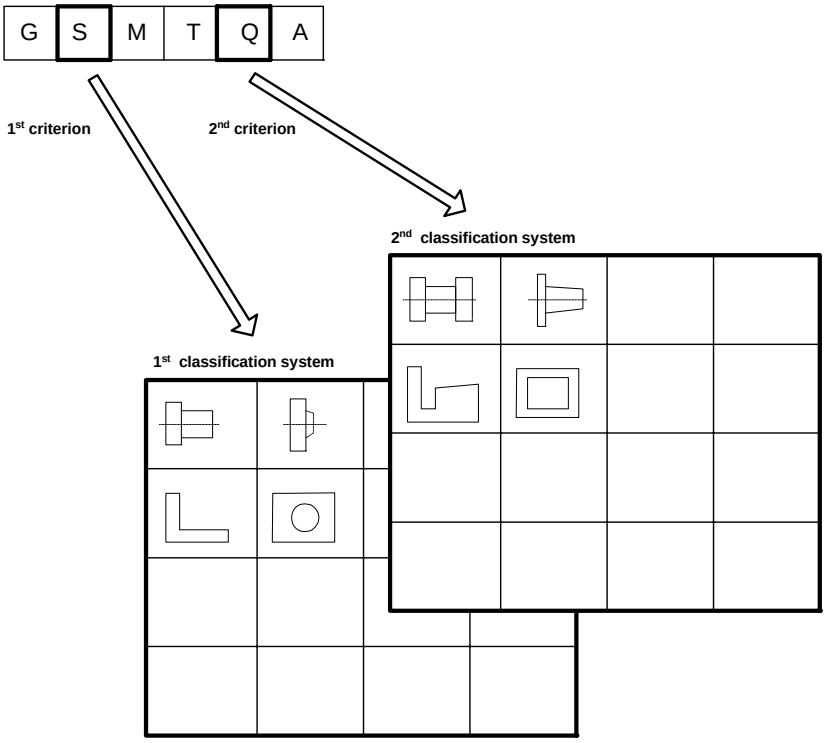

Figure 3. Considered product parameter and its influence on classification

The dynamic classification is based on *flexible classification system* [7, 8] The engineering parts are *dynamic grouped* to the individual groups according to classification intention (Fig.3). For example the engineering parts will be dynamic grouped to the family groups according the total costs or operational total times, number of produced parts, series, tolerances, etc..
The parts are flexible and dynamic grouped according selected criterions. It is still appropriate to utilise the visual classification as it is very simple and effective method however with flexible possibility the grouping the parts according actual demands.

5. CONCLUSION

The classification systems that more precisely reflect flexible demand of production are needed. The dynamic classification has been used to categorize product properties according actual demand. During past years, the classification systems in CAPP systems utilized only static classification. The static classification system does not reflect important changes in the factory. The disadvantages of the current CAPP systems based on GT lie in their static classification systems, which are not suitable for flexible and quickly reorganization of parts to the individual groups.
A new approach consists of applying methods, which enable the selective and dynamic grouping of the engineering parts in the individual groups according to selected criterions (e.g. cost, precision, equipment, level of automation, etc.). The dynamic classification system includes a flexible classification system that generates a detailed and comprehensive knowledge catalogues based on the actual criterions used in the input.

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