EXPERT SYSTEM OF GENARATIVE CAPP SYSTEM IN FUNCTION CUTTING SPEED

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Abstract

In this paper will be show model for expert system process planning with minimum cost per piece in function to cutting speed. The numbers variants depends of resource by manufactured system, machine labour and overhead rate and tools. The optimization model will be use in generative CAPP system for rotation parts. The Mathematically model devolpment for minimum cost per piece, which have all parameters of process planning. For determining machining and manufacturing tims importing for maximum profit, what is leading aim all manufacturing of industry. The optimal of cutting speed determining which to receive maximum profit. The maximum profit introducing combination of criterion minimum cost per piece variant process planning and criterion optimal of cutting speed.

Keywords: Expert system; generative CAPP; process planning.

1. Introduction

The manufacturing industry has been pushed to adopt more effective and efficient production strategies to meet the challenge of shorter life cycle, higher quality, lower cost, wider variety of customer demands [1]. This increased emphasis on achieving highly adaptive manufacturing to reduce manufacturing costs and to better utilize manufacturing capacity has led to a critical focus on agile manufacturing as a strategy to achieve these goals. In manufacturing, process planning is the task that transforms the design information into the manufacturing processes and determines the operation sequence.

CAPP considered a crucial link between Computer -Aided Design (CAD) and Computer -Aided Manufacturing (CAM) [2]. Research of over 30 years in CAPP has resulted in a wealth of knowledge on CAPP and many experimental and commercial CAPP systems have been developed as a result. Computer-assisted process planning was originated in the 1960s (Niebel 1965) and since has been a very active area of research and development. During the late 1970s, the science of computer-aided process planning (CAPP) evolved into two basic approaches: variant or generative process planning (Chang 1998). Modern approaches toward CAPP include using case-based reasoning. [3]

In this paper proposed of methodology show on figure 1, which is start by geometric information about part using basic features. Target make all alternative variants process planning, as organized by sequence phase, scheduled and operations, this technological to steps different.

The module developed for searching basic mechanical features (groove revolution, slot, thread, plane, cylinder cone outer, cylinder cone inner, etc.) must have two conditions, the first condition is all features to be simple, and make together complex features defined rotation part. The second condition had defined features by every simple features to be individual.

Fig. 1. Assignment of alternative processes and operations

2. An object- oriented knowledge representation scheme

Whole part consideration, searching from plans simple features which made complex rotation part, with their individual informations possible define process and commission technology for resumption destitute operations for to do any assignment basic features. stage enactive all features, all process and operations which can to be applicable for make with acceptable declaration quality.

We propose an appropriate knowledge representation scheme which attempts to address various facets of the process planning task. We recommend object-oriented common attributes and/or their values from higher level objects. Taxonomies of features, processes, machines and tools exist in the semantic network. Inheritance is used to infer attributes and behaviour of more specific object. (Hang-Wai, L.; & Hon-Yuen, T.) a number of represent manufacturing capabilities and reasoning in process planning. Now we will explain some of these taxonomies and relations in more detail.

Fig. 2. The process planning semantic network

3. Minimum cost per piece

The average cost per piece to produce a work piece consists of the following costs: nonproductive cost per piece, machining time cost per piece, tool changing cost per piece and tooling cost per piece. Mathematically, this can be expressed as equality (1).

$$c_1 = c_o t_1 + c_o t_c + c_o t_a \left(\frac{t_{ac}}{T} \right) + c_a \left(\frac{t_{ac}}{T} \right) \quad (1)$$

Upon partially differentiating c_1 with respect to v , equating to zero, and solving, we obtain the minimum unit cost cutting speed ($v_{\min}$) as follows equality (2).

$$\frac{\partial c_u}{\partial v} = 0 \quad (2)$$

Upon partially differentiating c_1 with respect to v , equation to zero, equating to zero, and solving for v , we obtain showed on equality (3).

$$v_{oj} = \sum_{j=1}^{i_p} \frac{C}{\left[\left(\frac{1}{n} - 1 \right) \left(\frac{c_o \cdot t_{aj} + c_a}{c_o} \right) \right]^n} \quad (3)$$

Optimization mathematically systems, this can be expressed as systems of equality (4).

$$\begin{aligned} c_{1f1} &= c_o \left[\frac{t_{ps}}{N_0} + t_{ss} + \left(t_p + \frac{L}{1000v_{ph}} \right) i_p \right] + \sum_{j=1}^{i_p} \left[c_o \left(\frac{\pi D_j l}{1000v_{cj} f} \right) + c_o \left(\frac{\pi D_j l}{1000v_{cj} f} \right) \left(\frac{v_{cj}}{C} \right)^{\frac{1}{n}} t_a + c_a \left(\frac{\pi D_j l}{1000v_{cj} f} \right) \left(\frac{v_{cj}}{C} \right)^{\frac{1}{n}} \right] \\ c_{1f2} &= c_o \left[\frac{t_{ps}}{N_0} + t_{ss} + \left(t_p + \frac{L}{1000v_{ph}} \right) i_p \right] + \sum_{j=1}^{i_p} \left[c_o \left(\frac{\pi D_j l}{1000v_{cj} f} \right) + c_o \left(\frac{\pi D_j l}{1000v_{cj} f} \right) \left(\frac{v_{cj}}{C} \right)^{\frac{1}{n}} t_a + c_a \left(\frac{\pi D_j l}{1000v_{cj} f} \right) \left(\frac{v_{cj}}{C} \right)^{\frac{1}{n}} \right] \\ c_{1fn} &= c_o \left[\frac{t_{ps}}{N_0} + t_{ss} + \left(t_p + \frac{L}{1000v_{ph}} \right) i_p \right] + \sum_{j=1}^{i_p} \left[c_o \left(\frac{\pi D_j l}{1000v_{cj} f} \right) + c_o \left(\frac{\pi D_j l}{1000v_{cj} f} \right) \left(\frac{v_{cj}}{C} \right)^{\frac{1}{n}} t_a + c_a \left(\frac{\pi D_j l}{1000v_{cj} f} \right) \left(\frac{v_{cj}}{C} \right)^{\frac{1}{n}} \right] \end{aligned} \quad (4)$$

The minimum cost per piece for one operation in process planning are representation sums all phases consisted in operation as inform of equality (5)

$$c_{1o} = \sum_{i=1}^f c_{1if} \quad (5)$$

4. Example of part

Showed on figure 3 testing rotation part for given mathematically of module. They correspond to the following types:

- Groove revolution: GRO1, GRO2.
- Slot: SLO1, SLO2, SLO3.
- Thread: THR1.
- Plane: OD1, OD3, OD5, OD7, OD10.
- Cylinder cone outer: OD2, OD4, OD6, OD8, OD9.
- Cylinder cone inner: HO1.

The production media for which the process plan is developed consisting of a group of machines–tool and fixtures that provide support for conventional machining processes. The capacities established for these manufacturing systems are the usual ones for standard quality.

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Np	

Alat	
ID Alata	
Cpl	5,450
Zpl	3,000
Nppl	2,000
Cd	1,520
n	0,200
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Fig. 3. Example Expert System for generative CAPP system

Figure 3. shows the expert system for generative CAPP systems for rotating parts, using the method of object oriented programming.

Fig. 4. *Drawing model with features*

Using CAD software in this paper is Solid Works as an example of the rotation parts on figure 3 [5]. Graph of function for minimum cost per piece for all possible variants process planning shown in figure 4.

Fig. 5. Graph of function for minimum cost per piece for cutting

Shown on figure 5 testing for testing rotation part, we get for all possible variants for process planning in function cutting speed and minimum cost per piece and number workpieces.

Fig. 6. Shown all possible variants

On graph showed function for minimum cost per piece for different machining regime possible variants process planning shown in figure 6 [7].

Fig. 7. The considered variant 1-4.

On the table I: showed minimum cost per piece for variants with different machining regime in function of number workpieces and given coefficient rate of dependent [7].

number workpieces	V1	V4	k
	28,83	34,27	0,16
3	12,95	16,17	0,20
5	9,84	12,28	0,20
10	7,51	9,37	0,20
15	6,73	8,4	0,20
20	6,34	7,91	0,20
35	5,84	7,29	0,20
50	5,64	7,04	0,20
75	5,49	6,84	0,20
100	5,41	6,75	0,20
250	5,27	6,57	0,20
400	5,24	6,53	0,20
500	5,22	6,51	0,20
800	5,21	6,49	0,20
1000	5,2	6,48	0,20
> 3000	5,18	6,46	0,20

Table 1. Achieving coefficient rate of dependent

On figure 7 rate variant 1 and variant 4, in function on numbers workpieces, we can conclusion to there mathematically dependence which is declare through coefficient showed on equality (6).

$$k = \frac{c_1 - c_4}{c_4} \quad (6)$$

Fig. 8. The coefficient dependence between variants.

5. Conclusion

In this paper proposed an expert system suitable for generative the process plan of machining parts. It is a proposal in which the peripheral processes needed for these parts are taken into account and they enable the development of alternative process plans.

The process plans offered by the system constitute all of the alternatives for the sequence of phases, guaranteed by a high degree of optimization with regard to cost and number of phases. These alternatives explicitly include feasible alternatives for machines and, tools for operations (depending on the type of machine for each phase).

These characteristics are largely based on the methodology proposed, the functional structure, the use of general information models and the general functional procedures. All these factors working together give the system its qualities. The development of the CAPP expert system based on this proposal has demonstrated the system's feasibility and its optimal qualities.

The target is connecting CAD and CAM system to realization flow over information's by design of product then to its manufacturing. The development of the CAPP system based on this proposal has demonstrated the system's feasibility and efficient.

The process plans offered in CAPP system alternative variants, which are composed of sequence and phases. The optimization of the process variant depends of the minimal cost per peace and optimal speed of cutting.

5. References

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