Mould&Die NC computer-aided Tool of Selection

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Introduction

NC machining tool path generation and tool selection, including the two key issues. Before a problem in the past 20 years has been wide-ranging and in-depth study, Many algorithms for the development of CAD / CAM system has been applied in the business. Most CAM systems to the user input parameters with automatic tool path. Comparatively speaking, the quality, efficiency and optimization tool of choice is far from mature. Currently no commercial CAM system optimization tool can provide decision support tools. it is difficult to achieve automatic CAD / CAM integrated. Tools typically include tools and tool type size. In general, usually for a processing tool targeting a variety of different processing tasks as well as the completion of a tool. Therefore, considering only meet the basic requirements of the tool selection process is relatively easy, particularly for the holes, ducts, etc. typical geometric features. But in reality, and we usually choose the optimal tool goals, such as the most efficient cutting, processing time at least, the lowest manufacturing cost, and the longest life expectancy, and so on tool selection is a complex optimization problems. For example, die parts, complex geometric shapes (usually free surface and Island) Tool choices affect the geometric constraints in CAD model can not explicit that it is necessary to design appropriate extraction algorithm, choose the appropriate tools and tool specifications portfolio to improve the efficiency and quality of NC is not an easy task.

NC general cavity with the processing methods, including extensive and usually, semi-finishing and finishing processes. Snag is the

principle of maximum extent possible the efficient removal of excess metal and therefore wish to opt for large size of the tool, But cutter size is too large, might not lead to an increase in processing volume; the main task is getting extensive and semi-finished stage left; finished the main components of the size and surface quality assurance. Taking into account the current election entirely by the computer automatically knife there are still certain difficulties, therefore, in our development of the computer-aided tool selection (Computer Aided Tool Selection, CATS) system, based on the users to provide a decision-support tool, roughing, semi-finishing and finishing. the real decision-making power is left to users, and to bring into full play the advantages of computer.

1.System structure.

CATS system for CAD model input, output types of tools, tool specifications Milling depth, feed, Spindle Speed (Speed) and the processing time of six parameters (Figure 1). Tool types of options, including decision-support tool, tool selection decision-support tool for roughing. tool selection decision-support tool for semi-finishing and finishing tool selection decision-making tools.

Figure 1 computer-aided tool selection of input and output

Given extensive and important position in the cavity (usually 5-10 times finishing time). snag when the system is automatically optimized

combination of functional tool to enhance overall processing efficiency. In addition to the above decision-making tools, the system also has a detailed standardized tools to detect, According to the recommendation of processing parameters and the size and type of tool to assess the function of processing time. Tool choice of the final total returns generated (Figure 2). Tool System data and knowledge are all in support of the background database.

$$\min t = \sum_{i=1}^{n} t_i = \sum_{i=1}^{n} \frac{v_i}{\mathrm{MRR}_i} = \sum_{i=1}^{n} \frac{\sum_{j=1}^{m} a_j c_{ij}}{\mathrm{MRR}_i}$$

Figure 2 CAD tool selection and the basic function modules

2 key technology and algorithms

1) Tools for choice

According die NC practice, the tool generally consists of Milling Cutter peace. Fillet cutter and the cutter ball three. Based tool diameter D, the radius r, r = 0 when the crew cutter. 0<R tools can be divided into the overall style and framed chip. Tipped for the ceremony, the key is to select material blades, blade materials are determined by three factors : the workpiece material, Machine tool fixture and the stability of the cantilever. Workpiece material will be processed into steel, stainless steel, cast iron, nonferrous metals, materials and other hard-to-cut materials and hardware six. Stability jig into the well, less than three grades. Cantilever Tool cantilevered into short and long cantilever two, the system automatically inducted blade material under specific circumstances. WALTER Tool knowledge comes from the decision-making manuals, system users to choose the first interactive tool types. Tipped Tools of the rule-based Automated Reasoning blades suitable material. For example, if the workpiece material as "steel", the stability of the fixture good tool for short cantilever cantilever. Blade material will be WAP25.

2) Portfolio Optimization Tool snag

The objective is to maximize the cavity snag in the removal of excess metal, used Ping Cutter and take all the layers. Therefore, the 3D die roughing process is actually a series of 2.5D die for processing. Optimization Tool Tool Group's goal is to find a combination that will enable it to the highest removal efficiency of most metals. The basic approach is as follows : Portfolio Optimization Tool

A. To do a certain step in the direction perpendicular to the feed cavity search plane and entities intersect, the formation search layer.

B. Deadline for submission of outline obtained.

C. Calculation link between or outside of critical distance between the islands, the choice of tools to influence the geometric constraint, the algorithm shown in figure 3.

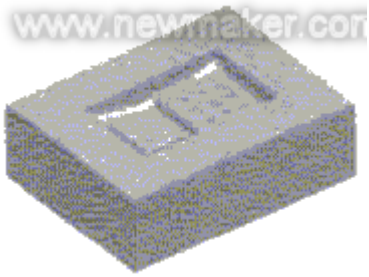


Figure 3 key demand from the algorithm.

D. Under this principle (the distance between adjacent key difference is less than a given threshold) level of the search for a merger Plane processing and identify viable tool sets, forming layers.

E. Each layer processing tool used to determine that the combination of the tool cavity.

F. According to the recommended processing tool parameters (cutting speed, feed rate and depth of milling), material removal rate calculation.

G. According to the actual removal of the layer processing volume, the processing time is calculated for each layer processing.

H. Calculate the total processing time and residual volume cavity.

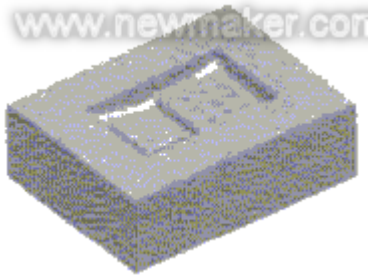
I. The overall composition of this group processing efficiency assessment tool.

J. A~i repeated until the optimal combination of the tool. If time goal that the processing time t required for the entire cavity tool to optimize the combination of the shortest. Based on the above methodology, we can establish the following formal optimization model.

$$\min t = \sum_{i=1}^{n} t_i = \sum_{i=1}^{n} \frac{v_i}{\mathrm{MRR}_i} = \sum_{i=1}^{n} \frac{\sum_{j=1}^{m} a_j c_{ij}}{\mathrm{MRR}_i}$$

MRRi=(dicij)×(Nfz) (X cross-sectional area of cutting feed rate)

$$Q = \frac{t}{(V-\Delta V)/V} \times \frac{\Delta V}{V} = \frac{t \cdot \Delta V/V}{1-\Delta V/V} = \frac{tk}{1-k}$$



Where : n-layer processing cavity volume; M-layer processing each of the milling cutter number; l-processing layer in the search each layer volume; q-layer processing every tool possible number; h-cavity depth; cij -i time processing layer j Milling depth; aj - j cutting area of the base layer; vi -i processing volume ;MRRi -i milling layer, layer of material removal; di -i layer processing tool diameter; -i processing layer dip viable tool set; rik -i processing layer k ;e1 search of the key distance-control layer with a constant search; e2 - residual volume control constants; V-cavity volume ;DV - residual volume; N-spindle speed; f-cutter feed per tooth; z-cutter teeth.

Plane taking into account the different steps in the search process will produce different levels, resulting in the processing time and residual volume, So sometimes, even though total processing time shorter, but more

likely to residual volume. This shows that the target of a separate optimization of processing time are not necessarily science. Therefore, the coefficient of efficiency of the concept, considering the processing time and the residual volume, the processing time is shorter. less residual volume, the higher the efficiency coefficient. Possession : On a middle-processing unit volume reflects the time factor, k =DV/V percentage of residual volume. Thus, the efficiency coefficient defined as q = 1/ Q.

3) Semi-finished Tool Selection

The main purpose is to remove semi-finished roughing the residue level contour shape. For the complete removal of height, depth milling the surface must be greater than the distance between each level of x components. Algorithm steps are as follows :

Step 1 model will have two parts from the adjacent section and the corresponding surface contour length;

Step 2 calculation of the average length profile;

Step 3 calculating height width;

Step 4 Calculation of the corner to level the surface of the parts to distance x law;

Step 5 Repeat steps from 1 to 4 steps, each step of the decision Milling depth;

Step 6 curve of the diameter D, D=x/0.6 Tools manual or recommended by experience;

Step 7 x greater than the minimum depth of choice milling cutter.

4) finished Tool Selection

The basic principle is : finishing tool selection tool radius R size smaller than the smallest curvature radius r surface parts. General admission R = (0.8~0.9) r. The following steps :

$$Q=\frac{t}{(V-\Delta V)/V}\times\frac{\Delta V}{V}=\frac{t*\Delta V/V}{1-\Delta V/V}=\frac{tk}{1-k}$$

Step 1 algorithm model from the smallest radius of curvature parts entities; Step 2 retrieved from the database tool cutter radius less than the radius of curvature calculation for all tool;

Step 3 select the best tools to meet these requirements;

Step 4 : If all the tools than the smallest radius of curvature. Minimum recommended as a tool of choice.

3 implementation of the system and examples

CATS system in the C language environment UG/OPEN API was developed. Background for the Oracle 8i database using ODBC programming and database communications between UG. All the data and knowledge from Germany WALTER Tool Company Carbide Tool integrated samples.Figure 4 contains a sculptured surface of the mold cavity and the island, according to the snag in the portfolio optimization tool, The die-extensive portfolio optimization tool for 20,12,8,5. Calculation, the workpiece material selected for carbon steel, cutting speed 100m/min recommended value. Milling depth of two sixth tool diameter, feed rate according to the recommended values from the process tool that automatically calculated. Meanwhile, the assumption that the existing level Cutter Tool Tool Library specifications for f3, f4, f5, f6, f8 and f10, f12. f16, f20. Similarly, semi-finishing and finishing tool selection algorithm, the tool diameter ball mill for 4 and 3.

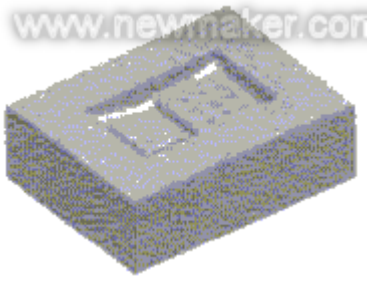


Figure 4 contains the island and sculptured surface of the mold cavity

4 Summary and Discussion

The planning process usually die of high technology and experience NC data preparation and processing almost as much time. Therefore, the automatic process planning cavity NC machining instructions and it is even more urgent needs. We systematically studied the tool selection process planning die, the die roughing, semi-finishing. and finishing tool of choice for the method, the corresponding algorithm. UG/OPEN environment in a preliminary API programming, and developed a prototype system CATS. Tool to determine the type and specifications based on the recommendation of manual processing system is also under Tools parameters (cutting speed. Milling depth, feed and so on), corresponding to the processing time for assessment. CAD/CAM its ultimate aim is to achieve a truly integrated, and then have to deal with NC machining instructions. At present, the CATS system is independent of the interface UG CAM interface. CATS results of the decisions need to be re-entered into CAM users. What needs to be pointed out is that the mold cavity to enhance the overall processing efficiency, from roughing, semi-finishing. finished the overall consideration for the multi-objective optimization, which will be our next step is to conduct the work.