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Research and Development of CAD/CAM System for Cavity Mold

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ABSTRACT

With the rapid development of science and technology, the demand for product diversification is becoming stronger and the product is getting faster and faster. Especially as plastic products and other light industrial consumer goods production of high-speed growth, more and more complex shape of the mold, the accuracy requirements are getting higher and higher. CNC machining, especially high-speed cutting technology to shorten the mold manufacturing cycle, improve the mold surface quality, to maximize the need to adapt to the needs of market competition to provide strong protection, while UG and other CAD/CAM software is also the digital manufacturing era, to achieve mold design and manufacturing Rapid output to meet the user requirements of the performance of the necessary tools. Based on the UG die CADCAM system development of key technologies and the specific implementation of the method. At the same time the use of documents and database technology will be the actual production of enterprise resources, such as tool library, equipment library, cutting parameter library and UG system related to the library file synchronization management, to achieve resource sharing, and ultimately to UG-based mold CAD/CAM Seamless integration.

KEYWORDS: UG; CAD/CAM; cavity mold

Introduction

In the modern machinery manufacturing industry, the mold industry occupies an extremely important position, more than 70% of industrial products cannot be separated from the mold, mold technology development can greatly promote the development of the entire social industry level, mold industry has become the national economy one of the basic industries, it's in a variety of plastics, home appliances, automobiles, aerospace and other light and heavy industries in the performance is particularly evident, it is considered to measure the level of development of a national manufacturing an important symbol. With the improvement of industrial level, the customer's production cycle requirements of the mold significantly reduced, prompting the mold design and processing efficiency of the continuous improvement.

Plastic mold in the mold occupies a relatively high proportion, and showed an upward trend, and in the plastic parts of the production process, the use of injection molds reached more than 90%. As the injection mold has a lot of cavity, multi-thin wall structure, CNC machining can not fully realize the overall processing of the mold, some specific parts must be electric processing. So EDM technology has become an important part of the mold processing process. Electrode is an essential component of EDM, so improving the design and manufacturing efficiency of the electrode can significantly shorten the mold cycle, so that enterprises in an increasingly competitive market environment in a favorable position. Injection Mold Electrode CAD / CAM system as a way to improve the electrode production efficiency, has become a hot mold industry research.

1. Introduction

1.1. CAD \\ CAM and digital design and manufacturing

CAD \\ CAM and product data management constitute a modern manufacturing enterprise computer application backbone. For the manufacturing industry, design, manufacturing level and product quality, cost and production cycle are closely related. Artificial design, single-piece production of this traditional design and manufacturing methods have been unable to meet the requirements of industrial development. The use of CAD \\ CAM technology

has become the focus of the current manufacturing industry and the future development of technology. The primary task of CAD technology is to provide convenient, efficient digital representation and performance tools for product design and production. Digital representation is the use of digital form for the computer to create the design object to generate internal descriptions, such as two-dimensional map, three-dimensional wireframe, surface and physical and feature model: and digital representation is generated on the computer screen realistic graphics, Real environment for roaming, multi-channel human-computer interaction, multimedia technology. The concept of CAD is not only reflected in the auxiliary drawing, it is more important to play the role of design assistant to help the majority of engineering and technical personnel from the complex check manual, computer freed. Greatly improve the design efficiency and accuracy, thus shortening the product development cycle, improve product quality, reduce production costs and enhance the competitiveness of the industry. CAD and CAM inseparable, even more extensive than the CAD application. Almost modern manufacturing enterprises are inseparable from a large number of CNC equipment. With the continuous improvement of product quality requirements, to efficiently manufacture high-precision products, CAM technology indispensable. Design coefficient only with the NC processing in order to fully demonstrate its great superiority. On the other hand, numerical control technology only rely on the design system to produce the model to play its efficiency. Therefore, in practical applications, the two are naturally closely combined to form a CAD \\ CAM system, in the design and manufacture of the system at all stages of the use of public data in the database, that is, through the public database design and manufacturing process closely To contact as a whole. The NC automatic programming system utilizes the results of the design and the resulting model to form the information needed for CNC machining. CAD \\ CAM greatly shorten the product manufacturing cycle, significantly improve product quality, resulting in a huge economic benefits.

CAD \\ CAM technology is already a fairly mature technology. Boeing 777 new generation of large passenger aircraft to four and a half years of successful development, the use of new structures, new engines and the new teaser are all in one step, immediately put into mass production. The aircraft is delivered directly to the customer after shipment, and the failure rate is almost zero. Media propaganda called 'paperless design', and Boeing itself that this should be attributed to CAD \\ CAM design and manufacturing integration.

1.2. CAD \\ CAM software introduction

CAD \\ CAM technology is based on computer and peripheral equipment and system software. It includes two-dimensional drawing design and three-dimensional geometric design. It is a kind of design method designed by computer. It is characterized by the ability to recognize and create high-speed computing power, huge storage capacity and logical judgment ability. CAD \\ CAM technology with the network and parallel high-performance computing high-performance computing and the popularity of transaction processors, so that luxury, collaboration, virtual design and real-time simulation technology in CAD \\ CAM has been widely used. CAD architecture can be divided into three levels: base layer, support layer and application layer. The base layer consists of computers and peripherals and system software. With the extensive use of the network, remote collaborative virtual CAD environment will be the main trend of CAD support layer. Application layer for different application areas of the demand, have their own CAD special software to support the corresponding CAD work. CAM technology has become the important part of CAX (CAD CAE CAM) system, which can be directly established on CAD system. At present, CAM technology has become an important part of CAX (CAD CAE CAM) system, which can be directly established on CAD system. to parameterize. All-related three-dimensional geometric model (entity + surface) on the processing of programming, generate the correct processing trajectory. Typical CAD systems are UG and so on. It is characterized by the processing mode of the local surface, which is directly related to the complexity of the part, but not directly related to the technological characteristics and process complexity of the product. CAM system only to CAD model of the local geometric features as the target of the basic form of processing, has become intelligent, the level of further development of automation constraints. Only by using the model-oriented, process-oriented CAM system, can we break through the existing level of CAM automation and intelligence. The development trend of CAD technology is mainly reflected in the following aspects: 1 standardized CAD software should generally be integrated in a heterogeneous work platform, only rely on standardized technology to solve the CAM system to support heterogeneous cross-platform environmental problems. At present, in addition to CAD support software to gradually achieve the ISO standards and industry standards, the application of standard parts library, in addition to standardized design method has become the necessary content in the CAD system, and to the rationalization of engineering design applications. 2 intelligent: design is a highly intelligent areas of human creative activities, intelligent CAD is the inevitable direction of the development of CAD From the human understanding and thinking model, the existing artificial intelligence technology simulation of human thinking activities obviously inadequate. Therefore, the intelligent CAD is not only simply the existing intelligent technology and CAD technology, more importantly, in-depth study of human design thinking model, the final use of information technology to express and simulate it, will produce efficient CAD system , For the field of artificial intelligence to provide new theories and methods. CAD this trend will have a profound impact on the development of information science. The development trend of CAM technology will be reflected in the following aspects: 1 object-oriented; structural system for the characteristics of the process; traditional CAM surface as the target architecture will be changed to the overall model (entity) for the process characteristics of the structural system. The system will be able to automatically identify and

extract all the process characteristics and have a specific process area according to the technical requirements. It is the integration, automation and intelligence of CAD \\ CAM to a new level. 2 intelligent system based on knowledge; the future CAM system can not only inherit and intelligently determine the process characteristics, but also has the model comparison, the residual model analysis and judgment function, the tool path is optimized and the efficiency is higher. But also has the workpiece, including fixtures, anti-off, anti-collision function, improve the safety of operation, more in line with the high-speed processing technology requirements, and open process associated with the library, knowledge base, library and tool library, Knowledge accumulation, learning, use become possible. Is related to the programming possible to be dimensionally related, the parameters are designed and other features of the CAD field, promising to be extended into the CAM system. 3 to provide a more convenient process management tools: CAM process management is a critical part of CNC production, the future of CAM system process management structure for process management and real-time modification provides the conditions, the leading CAM system already has CAPP Development environment or editable process template, can be experienced by the technical staff of the product design process, CAM system can be fully automated batch processing procedures.

1.3. UG NX software main function

With the rapid development of computer aided design and auxiliary manufacturing technology, the connotation of engineering design and manufacturing industry and its related technologies have undergone profound changes. This is especially significant in structural design and functional design in the field of mechanical engineering. Virtual reality technology, three-dimensional modeling technology, parameter design technology and other new concepts have penetrated into the traditional structural design, the corresponding computer program tool path set and computer self-selected processing parameters and other new methods are playing an unprecedented role in promoting The development of engineering design technology and manufacturing technology. In the modeling function, in addition to other software has a common function, it also has a flexible composite modeling, complete simulation photography, fine animation rendering and rapid prototyping tools, composite modeling allows users to build in the entity Modeling, surface modeling, wireframe modeling and feature-based parametric modeling, the designer can determine the best modeling method according to the actual design of the project, so as to get the best design effect. In the processing function, UG software for the practicality of the computer-aided manufacturing, adaptability and performance, by covering the manufacturing process, to achieve manufacturing automation, integration and customization, resulting in product manufacturing cycle, product manufacturing costs and product manufacturing quality And so give the user a great benefit to the handset. The powerful features of UG software provide help for virtual reality modeling and virtual reality manufacturing for complex parts.

2. Design of 3D Modeling Based on

2.1. Geometric modeling technology

Geometric modeling refers to the point, first, surface, body and other geometric elements, after translation, rotation and other geometric transformation and, cross, poor and other geometric operations, resulting in solid modeling. Geometric modeling technology as the basis of CAD \\ CAM technology, in the field of mechanical engineering is extremely extensive. A variety of mechanical design using geometric modeling technology to establish a computer model, in the car body, ship hull and aircraft fuselage design can not only replace the physical model of the production, and can greatly shorten the design cycle, saving manpower and material resources. The following describes the physical modeling of the parametric technology, variable modeling technology and feature modeling technology.

2.1.1 Parametric modeling techniques

Parametric modeling is to establish the constraint relationship between the graph and the size parameter, and then use the constraints to define and modify the geometric model. These size constraints and topological constraints reflect the factors to be considered in the design, and a set of parameters that are parameterized to maintain a certain relationship with these constraints. The original design entity naturally satisfies these constraints, and when a new parameter value is entered, Keep these constraints and get a new shape. Parametric modeling systems, also known as size-driven systems, only consider the geometric constraints of objects, regardless of engineering constraints. The structural shape of the design object is stereotypes, and a set of parameters can be used to set the size relationship. Parameters and control the size of the control object has a clear correspondence, the parameters of the solution is simple, the design results of the size of the modified. The size-driven geometric model consists of geometric elements, size constraints, and topological constraints. When you modify a dimension, the system automatically retrieves the position of the dimension in the dimension chain, finds its starting geometry, and terminates the geometric elements The new size adjustment, get a new model, if not satisfied, then keep the topological elements unchanged, according to the size of the constraints of the geometric model, or even all meet the constraints so far.

2.1.2 Variable modeling technology

The variable modeling technology is based on the parametric modeling technology. After further modification, the design idea is put forward. The variable modeling not only retains the parametric modeling based on the feature, the size-driven geometric shape modification, the all-data related advantages, definition has made a fundamental change. The variable modeling divides the size constraints and topological constraints in the geometric constraints, satisfying the constraints and increasing the constraints of the engineering. The guiding ideology of the variable modeling technique is that the designer can use the first-sized design, allowing the use of incomplete size constraints, giving only the necessary design conditions. Variable modeling process is similar to the engineers in the mind thinking about the design process to meet the design requirements of the geometric shape is the first, the size of the details of the later gradually refined and perfect. The design process is relatively free and loose, the designer has more time and energy to consider the design, which is consistent with the creative thinking of the law. Variable design technology under the circumstances of arbitrary product design, not only to achieve size-driven, but also to achieve the constraints of the drive, that is, driven by the relationship between the engineering geometry changes, more suitable for product innovation and design.

2.1.3 Feature modeling technology

The process of constructing a three-dimensional solid model is called feature modeling. The result of modeling is called geometric modeling. Based on the characteristics of the physical modeling process in addition to the use of parametric modeling technology, variable modeling technology, but also the use of feature modeling technology and database linkage technology.

The concept of a feature is broad and is limited to discussing geometric features, which are parameters that can be driven by a parametric model that satisfies the following conditions:

(1) Is one of the entities or parts of a specific composition

(2) Can correspond to a certain shape

(3) Has engineering significance

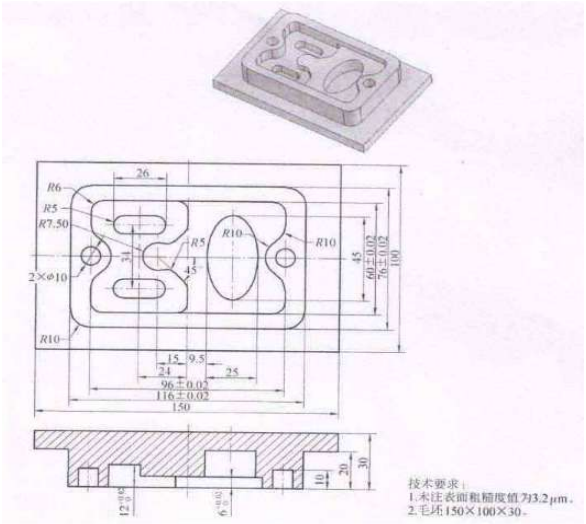
(4) The nature is predictable

The geometric model of a part can be viewed as a series of features that can be used to alter the geometry of a part by changing the shape and position of the feature.

2.2. Structural shape analysis and modeling ideas

2.2.1 Part structure analysis

As shown in the figure below, the part has a cavity, an oval, a keyway, and a hole.



2.2.2 Modeling ideas

First create

(1) Draw a 150 * 10 cuboid.

(2) Draw a 116 * 76 * 20 cuboid, and do boolean;

(3) Down four rounded corners:

(4) Draw two holes with a diameter of 10;

(5) Draw a long 96 wide and 60 deep 12 cavity

(6) Draw a boss;

(7) Draw two keyways;

(8) Painted oval.

2.3. Three-dimensional modeling design

2.3.1 Create a file in the name of chenfangmin.prt

Open the software UG NX, click the new icon in the file name blank enter chenfangmin, units select mm, click OK button to create a new file in the name of chenfangmin.prt, click the application icon, click the drop-down menu click on the modeling icon, Then you can start the three-dimensional modeling process.

2.3.2 (1) Draw a box of 150 * 100 * 10 cubes

Click the Insert icon, click the drop down menu and click on the design feature, then click on the icon cubes and draw as required by the drawing.

(2) Draw a box of 116 * 76 * 20 cubes

Draw the height of 20 rectangular box and the height of the box 10 is basically the same, when drawing the coordinate system to be moved, click the Insert icon, click on the drop-down menu design features, and then click the icon rectangle, click the coordinates of the positive direction of the point of the constructor, After modifying the coordinates, press the drawing request.

(3) Click on the insert icon, then click on the details of the feature, click the edge of the round, according to the requirements of drawing.

(4) Click the format icon, click the wcs icon, then click on the origin, select the top 20 of the rectangular surface, as required to move to the center

(5) Draw a hole with a diameter of 10

Click the Insert icon, click the drop-down menu and click on the design feature, then click the cavity icon and draw it by drawing.

(6) Draw the closed curve

Click on the  icon to enter the sketch environment, select the  icon in the toolbar, and then select the  drawing required to draw the closed curve, after drawing the  icon, complete the sketch operation. Draw a nice sketch closure curve to get the drawing required for the cavity. Click the stretch icon, select the closed curve, select the z-axis negative direction icon, in the end value input height 12, and for the Boolean difference operation, press OK. Finish stretching.

(7) Draw the keyway

Click the Insert icon, click the Design feature icon in the drop-down menu, and then click the keyway icon. The pop-up dialog box is clicked on the Cartesian icon to draw the keyway as required by the drawing.

(8) Moving the coordinate system

Click the format icon, in the drop-down menu, click the wcs icon, then click the origin icon, pop-up dialog box point in the z-axis input -12, click OK.

(9) Draw sketch closure curve

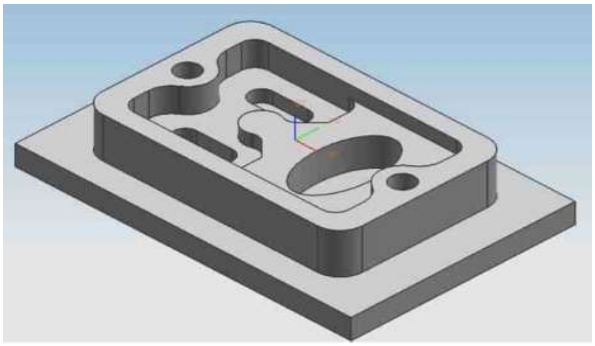
Click on the icon to enter the sketch environment, select the icon in the toolbar, and then select the drawing required to draw the closed curve, after drawing the icon, complete the sketch operation. Stretch Draw a good sketch closed curve, get the drawings required. Click the stretch icon, select the closed curve, select the up direction, in the end of the icon, enter the stretch height 6, and for the Boolean operation, press the OK button to complete the operation.

(10) Draw an ellipse

Click on the input icon, then click the curve icon, and then click the ellipse, pop-up dialog box point of the constructor in the xc axis input 22, in the z-axis input 6, press OK to determine the center of the ellipse, pop-up ellipse dialog box, Half-axis icon input 22.5, in the long axis icon input 12,5 click OK. Stretch the ellipse, click the stretch icon, select the negative direction of the z-axis at the end of the input height 14, and for the Boolean difference press the OK button to complete the operation.

(11) The auxiliary plane is moved to the other layers

Click the format icon, then click to move to the layer icon, click on the component, select , pop up the dialog box, enter a number, OK can. Click the format icon, select the layer's settings icon, OK. Click 1 Work and click on the invisible icon and press OK. As shown below:



3. CNC simulation based on UG

3.1. Process analysis

Roughness of the parts require relatively high parts of the clamping folder with a flat clamp. In the work piece installation, pay attention to the work piece installation, to be placed in the middle of the jaws. When installing the vise, fix it with the fixed jaws. The work piece is machined to be higher than the jaws to avoid interference with the jaws. When installing the work piece, pay attention to the work piece floating.

3.2. Establishment of blanks

Open the preset icon drop-down menu Click on the object icon, pop-up dialog box in the work layer icon, enter 2, click OK. Open the application icon drop-down menu, click the modeling icon, open the Insert icon, click the Design feature icon, select the box icon, click the point builder icon and click the reset icon to confirm. Click into the box dialog box, select the input length and width dimensions, followed by the Boolean settings icon to create, complete the rough

3.3. Create toolpath

The tool path is mainly composed of five modules, namely, interactive process parameter input module, tool path generation module, tool path editing module, three-dimensional processing dynamic simulation module and post-processing module. The following five modules are simple to introduce.

(1) Interactive process parameters input module. Through the way of human-computer interaction, with the dialog box and process guide form of props, fixtures, programming origin, rough and parts and other process parameters.

(2) Tool path generation module. Has a very rich tool path generation methods, including milling, turning, wire cutting and other processing methods.

(3) Tool track editing module. The tool path editor can be used to observe the movement of the tool and provide the function of extending, shortening and modifying the tool path. At the same time, you can edit the toolpath by controlling the graphic and text information.

(4) Three-dimensional processing dynamic simulation module. Is a method of testing NC machining without the need for machine tools, low cost and high efficiency. You can check the tool and parts and fixtures are collision, whether the cut and processing margin distribution, so that in the editing process in a timely manner to solve.

(5) Post-processing module. Including a common post processor, the user can easily create user-defined post-processing. By using the machining data file generator, a series of interactive options prompts the user to select parameters that define the characteristics of a particular machine and controller, including controller and machine specifications and types, interpolation methods, standard cycles, and so on.

4. Conclusion

This design uses UG software to complete the corresponding modeling and processing part has its own characteristics. UG is a set of CAD, CAM workers in one of the more perfect high-end software, select UG as a CAD / CAM software is more appropriate. Before modeling, you should first analyze the structural characteristics of the parts according to the engineering drawings, and understand what to draw in the modeling process, what to draw and what to draw. And then processing simulation, we must first draw the rough processing, and then create a tool, the geometry of the parent node group, in the production process tool nose operation, and finally the process of simulation.

NX software CAD / CAM typical parts of the modeling and simulation CNC machining three-dimensional solid modeling is not only very intuitive, but also graduation design is a comprehensive test of graduates of the ability. The design of the graduation project is based on the UG enough to achieve parametric design, CNC programming technology can not only complex surface model for manufacturing, but also to ensure the accuracy of parts manufacturing and manufacturing! I deeply feel that the development of manufacturing is based on this model continues to move forward.

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