Study on the Application of the Virtual Technology in the Mechanical Assembly Process

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Abstract. The virtual design and manufacturing is applied in the field of virtual reality technology in manufacturing. The virtual assembly is a part of the virtual design and manufacturing, it is based on the virtual reality technology, the computer modeling and simulation technology is used to establish the virtual assembly environment, users can place oneself in the environment, and using multi-dimensional output device. The virtual assembly information modeling is an important part of the virtual assembly, and also the foundation of virtual assembly work and the first premise. The stand or fall of virtual assembly information modeling directly influences the outcome of virtual assembly. Therefore, the virtual assembly information modeling in manufacturing is of great significance. This paper discusses the application of virtual technology in mechanical assembly process design, and trying to build a virtual assembly system model to explore the technical bottleneck in the development of virtual assembly technology, the development and application for virtual assembly technology and application of the system to provide the reference in the guidance or technical methods and means.

1. Introduction

The manufacturing is a pillar of the national economy, not only represents a country's manufacturing technology level and manufacturing capacity, but also determines a country's international competitive position, countries around the world are attaches great importance to the application of advanced manufacturing technology in the domestic manufacturing and research. As one of the main activities of manufacturing assembly occupies an important position in the manufacturing process, the use of reasonable science computer-aided virtual technology to product data effectively, correct management analysis, high speed, can not only change the traditional design method of assembly process, and able to work in the assembly efficiency and assembly quality, assembly get great improvement and improve management and other aspects. Virtual manufacturing is produced in this case, its new manufacturing system and mode has become the inevitable trend in the development of modern manufacturing technology. The virtual manufacturing technology is the integration and application of many advanced subject knowledge, it with digital modeling technology, the computer simulation technology, the basis of the analysis of optimization technique, before the stages of product design or manufacturing, real-time and parallel to simulate the future of the product manufacturing process and its effect on product design, to predict the performance of the product, cost and manufacturability, to achieve the product development cycle and cost optimization, the purpose of the production efficiency of the highest.

2. The Virtual Assembly Technology

The product assembly in the life of the product is very important, according to relevant statistics show that in the production activities, the assembly time accounts for 40% to 60% of production time, assembly costs account for 30% of the total manufacturing cost to about 50%. But with the progress of science and technology, advanced technology, processing technology, materials have been applied to the processing and manufacturing process, product components such as processing time is greatly reduced, it mainly depends on assembly cycle product manufacturing cycle. Virtual assembly technology is based on the analysis of the product model and assembly data processing,

the use of interactive way, in computer of virtual real assembly environment, a series of issues related to assembly for analysis, calculation and verification, planning, and get the optimization of assembly as a result, virtual reality technology is an important application in industrial production. Through the virtual assembly technology in computer virtual environment generated 3D model of the parts, and to operate the model, assembly experiment, test the feasibility of the assembly. Virtual assembly technology involves assembly design, assembly planning and assembly analysis and so on each link, is a combination of design, development, decision-making, simulation, interactive aspects of technology, in the field of product development design and manufacture of the new era is more and more attention and concern. The current commonly used virtual assembly software such as UG, Pro/E, and EON has been widely applied in the design, manufacturing industry.

CAD system and virtual reality in the expression of component model is different. In a commercial CAD system, with the mature of parameterized modeling technology, component geometry information using precise mathematical model to express, Pro/E is a typical representative. In virtual reality environment, in order to enhance the effect of 3D scene real-time is display and speed of triangles in the model to express the geometric object. Therefore, we need to first convert parts parameterized model of CAD into triangles in model, to design good product parts in the virtual reality environment. However, it isn't enough to do this for assembly process design.

3. The Key Technology of Virtual Assembly

(1) The assembly information model

Product assembly information model not only contains the data of the product, but also on the relationship between the components and parts of an expression, is the main product assembly information, the basis and the product assembly design of assembly process planning and assembly automation is the main source of information. Product assembly model information and organizing content mainly includes the image information, the assembly information and the assembly level three parts. Image information refers to parts of shape, color, texture, materials and other information, image information processing in the secondary development of a 3D CAD model. Assembly information the position relationship between parts is in the assembly model. Assembly level refers to the assembly of each component in the hierarchical relationships, according to the principle of top-down subdivision of parts in the assembly, the split process, in order to clearly express the parts in the product hierarchy.

(2) The assembly process knowledge base is established

Will be finishing assembly process design knowledge and abstraction, in accordance with the requirements for database and reasoning machine will have certain adaptive and scalable as part of the assembly process the design of the knowledge base. Experts according to the experience of the assembly production and assembly process documents, summarized in the assembly process design should follow the basic assembly rules, such as pretreatment, after the first down, after the first outside, difficult before they are easy, light weight before and after the first big small, rough after precision, etc. However, in the case of virtual technology, these rules in the specific assembly process knowledge base to identify must be processed by computer.

(3) The assembly process design

Assembly process design is a very important part of the virtual assembly technology, the means of assembly model based on the analysis of information, the computer in the virtual assembly environment, for the product assembly process for interactive operation and assembly feasibility analysis, get the correct and reasonable product assembly sequence and assembly of parts of path, etc.

a. The assembly sequence planning

Assembly sequence planning is to determine the correct assembly sequence, which determines the product assembly cycle and cost and model information is made up of parts, components, the relationship between physical structure and function of a variety of factors. At present commonly

used assembly sequence planning method is based on assembly priority constraint relations, identification method, removal method and knowledge to solve method and matrix method.

b. The assembly path planning

Assembly path planning is to determine the parts assembly trajectory, coordination assembly staff or assembly machine, to avoid collision and interference. The main consideration of the location of the parts, movement direction, virtual volume, interference, collision, and other issues, can use a virtual device simulation of assembly process, record the position and orientation of parts to generate assembly path without collision and interference. But because the virtual equipment is expensive, path planning cost increases, so at present mainly in the form of CAD system for assembly path planning, and within a certain range by using virtual reality technology.

(4) The assembly process output

Virtual assembly technology will be according to the assembly sequence planning and assembly sequence diagrams, automatic generation of assembly path planning with the corresponding assembly process, to form a complete assembly process diagram, and finally in the form of assembly process card product assembly process planning. In addition, the virtual assembly can also be generated assembly reference for technical personnel and the animation.

4. The Virtual Mechanical Assembly Process Application

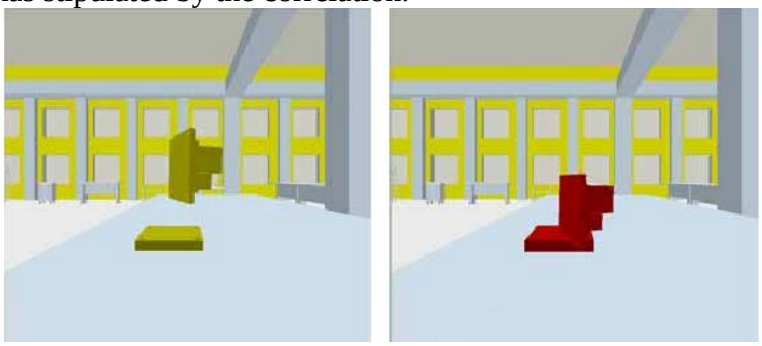
(1) The top-down assembly design approach

In this study, mainly discuss the application of virtual technology in mechanical assembly, therefore the top-down assembly process, the design and assembling the steps as follows:

a. The determine of the design goal. Determine such as product design purpose, how to meet the functional requirements, necessary sub assembly, assembly and other assembly relationship, which design will probably change, and have no reference design. Define the general assembly structure. The assembly of each assembly sketch out includes at least the name of the assembly, assembly tree. Each child may come from an existing design assembly, or merely an empty part, but then can refine each assembly. These structures are product architect design and maintenance; the result will be released to all other staff to participate in design.

b. The design model of the skeleton. Each assembly has a skeleton model, the 3D design space to use it to determine the spatial location and size of assembly, the relationship between the parts and components as well as simple mechanism motion model. Skeleton model contains the whole assembly of the important design parameters; these parameters can be reference in components, so the skeleton model is the core of assembly design. The design intent is through the assembly structure. The design parameters from the upper assembly have passed to the lower parts.

c. The component design. When required by the design information, specific parts design can begin. Can directly in the assembly of parts design, also can part modeling assembly has been completed in advance. In terms of product entity model, top-down design technology is to establish a product structure parts, assembly structure constraint model and assembly model, namely, to establish the coupling relationship between parts, and automatically inherit after parts design assembly relations, has stipulated by the correlation.

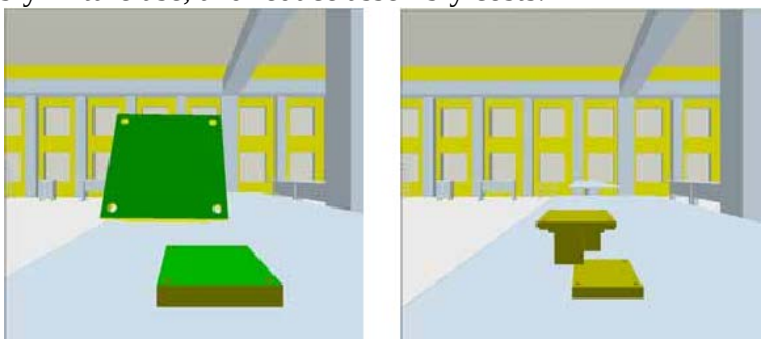


a) Prior to the collision b) Parts after the collision

Figure 1 collision detection between the parts

(2) The virtual assembly sequence optimization design and analysis

Assembly sequence planning of the generated assembly sequence generally is not the only, even if it is a few parts tend to generate many feasible assembly sequences, need according to certain standard to choose a most reasonable assembly sequence. This needs to evaluate assembly sequence and choice, assembly sequence optimization based on the optimization goal, choose the most reasonable, the stability of assembly sequence. The stability of the sub assembly degree of reaction of the stability of the sub assembly, in the assembly sequence planning, the optimization of assembly sequence pair can assembly stability criterion. Correctly determine assembly stability, can reduce the feasible solution space of assembly sequence, reduce the number of feasible assembly sequence and assembly fixture use, and reduce assembly costs.



a) Before the parallel constraint b) After the parallel constraint

Figure 2 parallel constraint operations

5. Summary

With the rapid development of science and technology, the competition of global market, to speed up product development, will be manufacturing a variety of products to the market to grasp market opportunities and strives for the survival and promote the development of important guarantee. Assembly information model is established in this paper, the virtual assembly system, assembly process, process methods, as well as to the assembly sequence optimization design, this paper analyzed the content of the discussion, and to further improve the application of virtual technology in mechanical assembly has certain guidance and reference significance.

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