Research on Application of Computer Parameterization Technology in Modern Office Furniture Design

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Abstract. With the continuous development of computer technology, modern office furniture design has gradually turned to parametric, process-based, and customized development, but the difficulty lies in the continuous optimization and adjustment of parameters. Aiming at the difficult problems of parametric design, this paper selects and analyzes the modulus and structural characteristics of modern office furniture, summarizes the main calculation formulas, and establishes a parametric characteristic model of furniture, laying a theoretical foundation for practice.

Keywords: Parametric Technology, Modern Office Furniture, Characteristic Model

1. Introduction

With the continuous development of computer technology, modern office furniture design has gradually turned to parametric, process-oriented, and customized development, but the difficulty lies in the continuous optimization and adjustment of parameters [1, 2]. In the early days of the development of CAD technology, designers often used human-computer interaction to mark dimensions when drawing product graphics. The dimensioning values were fixed, and the generated graphics had only the geometric information of the pixels themselves, and the design process Design knowledge, design constraints, functional conditions, etc. are not retained [3-5]. In addition, there is no constraint relationship between the internal components of the product, and most of the designs are improved designs, which cannot achieve size changes and serialized designs [6].

Aiming at the difficult problems of parametric design, this article selects and analyzes the modulus and structural characteristics of modern office furniture, and aims to explore the application of computer parametric technology in modern office furniture design, in order to lay a theoretical foundation for subsequent design.

2. Parametric design technology

2.1. Definition of parametric design

Parametric design is to use a predefined method to establish the geometric constraint set of the graph, specify a set of dimensions as parameters to associate with the geometric constraint set, and integrate all the correlations into the application, and then use the man-machine The interactive way is to modify the parameter size through the dialog box, and finally the method is realized by the program
executing the expression sequentially according to these parameters.

Compared with the traditional method, the parametric design method has the biggest difference in that it stores the entire design process and can design a family rather than a single product model. Parametric design enables engineers to draft part drawings as soon as possible without considering the details, and can update the design by changing some dimensional parameters without having to run the whole process of product design, which greatly improves the modification methods of graphics and improves the flexibility of design plays a more and more important role in conceptual design, dynamic design, solid modeling, assembly, tolerance analysis and synthesis, mechanism simulation, optimization design and other fields, and reflects high application value.

Parametric design has become an effective means for initial design, product model editing and modification, design and comparison of multiple schemes, and is very popular among engineering designers.

2.2. Parametric product design process
Parametric design technology takes constraint modeling as the core and dimension-driven as the characteristic. The product design process, that is, the parametric design process, can be regarded as the process of constraint satisfaction. The design activity is essentially to establish the constraint model and solve the constraint by extracting the effective constraints of the product.

In the process of designing products, functional constraints, structural constraints and manufacturing constraints are integrated into design goals, and they are mapped into specific geometric/topological structures, which are transformed into geometric constraints. Taking geometric constraints as the geometric reference elements and surface contour elements that constitute the geometric/topological structure, various shape parameters and position parameters can be derived to form a parametric product geometric model. The parametric product design process is shown in Figure 1 below.

![Parametric product design process](image)

**Figure 1.** Parametric product design process.

3. Parametric modeling technology
Parametric modeling is an important development of CAD technology and also a development direction of virtual design. The main idea of parametric modeling is to use geometric constraints and engineering relationships to illustrate the shape features of product models, so as to design a cluster of similar design pears in shape or function. By defining a set of parameters to control the design results, the design model can be modified by adjusting the parameters, and a series of similar designs can be
easily created. Parametric modeling can meet the needs of designing engineering series products and related process equipment with the same or similar geometric topology, and has played a great role in shortening the design cycle of products, reducing costs and enhancing market competitiveness.

Feature technology is a new monument in the development of CAD/CAM technology. It is bred and grown in the historical process of the development and application of CAD/CAM technology to a certain level, requiring further improvement of the integration and automation of production organizations.

The advantage of feature-based design is that the geometric and non-geometric engineering information of the part can be input at one time, and the product design can be carried out from a higher level. Feature-based modeling methods provide conditions for products to achieve high efficiency, standardization, and serialization; from the perspective of processing, feature geometry corresponds to a certain processing method, making it easy to determine the processing technology according to the principle of group technology. Therefore, the feature-based design method helps to achieve structured and modular design, reduces human error, and improves efficiency. The disadvantage is that the product needs to be comprehensively analyzed, and the shape to be processed is found and pre-defined.

Feature is a comprehensive concept. Generally speaking, features are signs or signs of the characteristics of objective things. The occupation of characteristics by their nature is a reflection of certain functions in an environment. Such as a reflection of the CAPP function in the CIM environment. From the perspective of part application function and manufacturing method, features can be defined as the carrier of geometric, topological and semantic information describing the local features of parts. The more strict definition of feature is: feature is a geometric prototype shape that contains engineering or meaning. The feature here is no longer ordinary voxels, but a functional element that encapsulates various attributes and functions.

According to the point of view of set theory, the characteristic subclass set is a collective composed of some characteristic individuals with common characteristics. It is defined as formula (1):

\[ F_i = \{ f_i \mid i \in N \} \]

Where: \( F_i \) is the set of characteristic subtypes; \( f_i \) is an individual of the set of characteristic subtypes; \( N \) is the set of integers.

The classification of features is the same as the definition of features, depending on the corresponding application field and part type. According to different manufacturing methods, the characteristics can be divided into casting, forging, welding, machining and injection molding. According to different types of parts, they can be divided into shaft and disc type, plate type, box type and free feature. In short, from the perspective of design and manufacturing integration, features can be classified based on such standards; each type of feature is the basic functional unit of part design, and its processing methods and manufacturing methods are basically the same.

4. Modern office furniture design

4.1. Choice of modulus

The use of modular series for product design is one of the most basic principles of industrial design. For the purpose of generalization and serialization of furniture design, the dimensions of different furniture and their components are unified and coordinated, so as to reduce the specifications of panel components. And easy to interchange, furniture designers must master and use furniture modules. Furniture modulus is the standard size unit selected in furniture design, and it is the basis for the coordinated dimensions of furniture and its hardware parts, various standard panels of furniture and related equipment.

(1) Choose "50" as the basic modulus of cabinet furniture, from which N50, 100, 150, 200, 250... series are obtained, that is, 50mm is upgraded. It can be widely applied to the outer dimensions of cabinet furniture. At the same time, three times the basic modulus is used as the enlarged modulus, so
that the selected size is more concentrated, that is, 150, 300, 450, 600, 700... series are used.

(2) The storage space size is the basic modulus, and the door is the main component. The cabinet is based on the centerline and has a half-hidden door structure. The priority number series is adopted to develop a general series of panel component sizes.

(3) According to the "3" module series, eleven specifications are divided, 300, 450, 600, 750...1650, 1800, and the specifications of common cabinet furniture are divided according to the "3" module.

(4) "32" is the basic modulus MO, with 2MO, 3MO, IOMO, 15MO... etc. as the enlarged modulus, design the height of the furniture, and use 3/2M0, 5/2MO, 7/2MO... as the sub-modulus design The size of furniture accessories.

The parametric design system of cabinet panel furniture adopts 32ram series hardware connectors in the connection mode. In order to realize the generalization, serialization and standardization of panels, the system design cabinet is in X (width), Y (depth), Z (height) ) Adopts the "32" module series in the direction. Specifically, the height of the side panel and the drawer adopts the "32" module series. The horizontal partition of the cabinet can be selected according to the 32mm pit. And the door can be installed in the appropriate position according to the 32mm hole distance, and the drawer and the drawer, the door and the door, and the drawer and the door can be combined and interchanged in any way. The use of "32" modulus in depth can produce a 32mm hole pitch on the cross section of the horizontal plate, which is beneficial to the coordination of the horizontal plate and the side plate, and can be installed and positioned. In order to simplify the design, the width of the cabinet is also designed as an arithmetic sequence with 32mm as the level difference. Due to the rule of the ratio of width to height, it is easy to give people a good sense of scale.

4.2. Organizational structure characteristics

Each unit plate has its own different connection form. The parametric design of the cabinet panel furniture in this article adopts a relatively simple connection form. The whole cabinet adopts a side plate to clamp the bottom plate, a cover plate is added on the top, a front plate, and a side plate. It is a structure that uses the round tenon rod to position the ground, and the eccentric connector is tightened.

(1) Side board

The structural holes of the side board are located at both ends of the board, and the eccentric connector holes on both sides are close to the edge of the board (40-50mm), that is, they are all in front of the original holes. According to practical experience, this is conducive to positioning and installation. The distance between the positioning round tenon hole and the nylon barb hole is a multiple of 32mm, and the hole depth is based on the nylon barb hole depth as the standard. This is conducive to processing the drill at one time and improving production efficiency. In this design, a side board and a cover board share two round rod Zen and two eccentric connectors. The positions of the structural holes on the cover plate and the bottom plate correspond to the positions of the holes on the side plate.

At present, in production, the center of the short side of the side plate is also used to determine the positioning round tenon hole, and then push out other holes on both sides in multiples of 32mm. This design shares three round tenon bars and three eccentric connectors.

(2) Stand up partitions.

The stand partition is inside the large cabinet. For example, a three-door or four-door wardrobe plays a role of dividing space. At the same time, it also increases the rigidity of the cabinet and reduces the deflection and deformation of the cabinet.

The connection of the vertical partition utilizes the structural holes on the cover and the bottom plate. In order to prevent the installed vertical partition from having a gap with the cover and the bottom plate, a round tenon is used between the vertical partition and the cover, and the eccentric connector is tightened. form. However, in consideration of cost reduction, only round bars are used to connect the vertical partition and the bottom plate.

(3) Diaphragm

The connection between the fixed transverse partition and the side plate and the vertical partition
adopts the form of round tenon positioning and eccentric connector tensioning. The structural holes are distributed at both ends of the plate, at the corresponding position of the side plate and the vertical partition. Knock in the nylon barbed nut.

The fixed transverse partition is best installed at the center of the height of the side panel. This is mainly considered from the perspective of the force of the side panel. The side panel and the vertical partition are pulled by the fixed transverse partition to prevent the side panel from collapsing to both sides. For example, in the design of one side of the small door of the three-door wardrobe. Of course, the fixed diaphragm can also be moved up or down in design according to actual needs.

There is no need to drill holes on the movable diaphragm, use movable diaphragm pins to insert movable diaphragm pins at the appropriate height row holes of the side plate, and then put on the movable diaphragm.

(4) Backplane
The back panel is the simplest part of the cabinet furniture, and it is also an important structural component that cannot be ignored. If the back panel is not properly designed, it will warp and deform, cause the seam or even fall off, which will seriously affect the use. Therefore, in cabinet furniture, the installation structure of the back plate must also be carefully designed. The basic requirement is that it can be repeatedly disassembled and assembled, and can be firmly fixed in the corresponding position.

Most of the furniture sold on the market today is in a non-detachable form. The back panel is usually nailed directly into the tongue and groove behind the cabinet with round nails, and the surrounding edges are nailed; or the top panel and the side panels on both sides are slotted. Insert from the lower end, and nail the bottom plate flush with the inner side of the slot or the fixed middle partition board. The common feature of the two is that they cannot be disassembled. Therefore, the structure of the back panel must be improved accordingly in the disassembly and assembly of furniture. The improved method is mainly to divide the backplane into two from the middle, and connect the middle seam with I-shaped backplane guide grooves. In this way, the problem that the backplane is too wide and inconvenient for packaging can be solved, and the two backplanes can be simply connected together. However, in actual use, this method is only suitable for the length of the backplane within 1 meter. When the length is greater than 1 meter, the seam and partial fall off will occur due to the warpage of the backplane.

When designing large cabinets (side board height>1600mm), the modern panel furniture CAD system uses three back panel braces (top, bottom, middle) in the height of the side panel, and the braces and side panels are different. The groove and the back plate are embedded in the grooves of the side plate and the brace, sharing two back plates. This not only greatly increases the rigidity of the cabinet body, but also solves the problem of excessively large backplanes. At the same time, there is no need to slot or cut the cover and bottom plate, which does not affect the appearance.

(5) Watch board
The viewing plate and the side plate are connected by right-angle pieces, and the viewing plate whose length exceeds 800mm is connected with the bottom plate in the middle.

(6) Drawer
Drawer is an important part of furniture function and one of the important factors of furniture facade design. Therefore, drawer design is very important. Dovetail structures are used in traditional furniture. However, this structure does not meet the requirements of easy disassembly and assembly, so it is no longer used in modern panel furniture. The drawer front plate, drawer side plate, and drawer back plate designed by this system are all slotted, and the drawer bottom plate is embedded in the groove. The drawer front plate, drawer side plate, and drawer back plate are connected by round tenon bars and eccentric pieces. A round tenon rod is used to connect the front panel and the drawer front panel. In order to improve the load-bearing capacity of the drawer, a drawer bottom bracket is installed under the drawer, and a round tenon rod is used to connect the bracket with the drawer front plate and the drawer back plate. Drawer slides are used to connect the drawer to the side panel or vertical partition.

(7) Door panel
The particleboard can be processed by edge sealing. In order to improve the appearance of the panel furniture, the door can use MDF to process the decorative stitch or embossed pattern through the processing center, and then vacuum the film for three-dimensional decoration. Concealed hinge connection is used between the door and the cabinet. According to the positional relationship between the door and the side panel, the door is divided into two structures: cover door and embedded door.

4.3. Parametric feature modeling

In the panel furniture design, the panel category includes two types of cabinets and drawers. Each type of panel is the object of user parameterized design. Cabinet panel furniture is characterized by panels and can be divided into side panels and covers. Board, bottom plate, etc. Each type of plate has the same shape feature, namely a rectangular parallelepiped. Its size can be determined by the X, Y, and Z dimensions in the world coordinate system, and its position in space can be determined by the coordinates of the base point. A characteristic model of bookcases based on the structural characteristics of cabinet-like panel furniture. First of all, the bookcase, a typical representative of cabinet panel furniture, is the most described object. First, it is divided into three categories: structural parts, decorative parts, and interface accessories, because decorative parts belong to the free-form surface category. , J3n3- can be attached to the board separately: The interface accessories part is mainly the hardware used in the connection between the plates, and there is an independent hardware database to store it, so the structural parts become the main description object of the bookcase. As a plate type, it can be divided into two parts: cabinet and drawer. They also have a common shape feature-cuboid. As a positive feature, there are several different negative feature options, including chamfering and punching. Wait.

As an assembly, the drawer is composed of 6 sub-parts. The characteristic surfaces, characteristic edges and characteristic points involved in the constraint relationship in each sub-part are used as assembly units to form the assembly constraint model of the drawer bottom plate.

5. Conclusion

The application of parametric technology in CAD software will bring great convenience to engineering designers. Aiming at the difficult problems of parametric design, this article selects and analyzes the modulus and structural features of modern office furniture, summarizes the main calculation formulas, and establishes A parametric feature model of furniture was developed to lay a theoretical foundation for practice.

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