



## Application of Auto CAD Technology in Interior Furniture Layout Art Design

Jun Li 

College of Fine Art and Design, Hubei Engineering University, Xiaogan 432000, China,  
[lijun4059@hbeu.edu.cn](mailto:lijun4059@hbeu.edu.cn)

Corresponding author: Jun Li, [lijun4059@hbeu.edu.cn](mailto:lijun4059@hbeu.edu.cn)

**Abstract.** Auto CAD Technology has been widely used in architecture, interior, landscape, industry and other design fields. As a new design method, the traditional design method cannot fully express the designer's design ideas, and the advantage of three-dimensional modeling technology is that it can carry out simulation design according to people's thinking mode, so as to quickly and effectively solve many disadvantages existing in two-dimensional design, and make the designed furniture more economical, reasonable and reliable. To a great extent, it can shorten the development cycle of new products.

**Keywords:** CAD technology; furniture; art design.

**DOI:** <https://doi.org/10.14733/cadaps.2022.S8.1-10>

### 1 INTRODUCTION

In recent years, with the wide application of CAD technology in the field of furniture design, furniture design began to step on the track of modernization. However, it should be pointed out that due to the functional limitations of CAD software, it cannot perfectly simulate the virtual three-dimensional model and intuitively express the designer's intention, so the three-dimensional modeling technology is favored by furniture design masters, such as Starikov and Starikova [1]. Autodesk's 3D Max software is one of the excellent 3D modeling software. The application of 3D Max in furniture design is discussed below. The operation of AutoCAD software is relatively simple and has a variety of practical functions. In the process of realizing AutoCAD software design and drawing, designers should draw and calculate similar contents repeatedly, so errors will occur due to tired work. In the process of realizing interior design, VB programming language is used for the secondary development of AutoCAD software to realize the creation of new functional modules, so as to make interior design more convenient, and fast. After realizing the development and design, the files belong to executable files, database files, help folders and block library folders. An interior design Exe belongs to the entrance of the general program of secondary development, and others are the data of data called through the program. If the created CAD image file is double click interior design, the secondary development function interface and drawing interface will be opened

at the same time [2]. In order to achieve effective drawing work, this paper analyzes the secondary development of interior design software of AutoCAD.

## **2 CURRENT SITUATION OF FURNITURE DESIGN**

As a unique scenic spot in the 21st century, modern furniture has become a landmark leading the consumption trend and fashion, and one of the four major consumer products in the world alongside household appliances, clothing and cars, detailed referred as McAlister and Bywater [3]. As the pioneer of furniture manufacturing industry, the core position of furniture design has become unshakable.

Shih and Sher [4] shows that the traditional furniture design method takes brush, drawing board, rubber, ruler and various manuals as tools. Its design method and steps are cumbersome and complex, time-consuming and long R & D cycle, resulting in a lot of unnecessary waste. After the 1970s, with the continuous development and improvement of CAD software technology, furniture design CAD software has been constantly updated, which has rapidly improved the efficiency of furniture design, and a revolutionary change has taken place in the furniture industry. However, because CAD technology cannot intuitively express the ideas of furniture designers, it is more to assist drawing design, and the design quality cannot be fundamentally and effectively guaranteed, 3D modeling technology was born, as shown in Figure 1.

## **3 ADVANTAGES OF 3D MODELING TECHNOLOGY IN FURNITURE DESIGN**

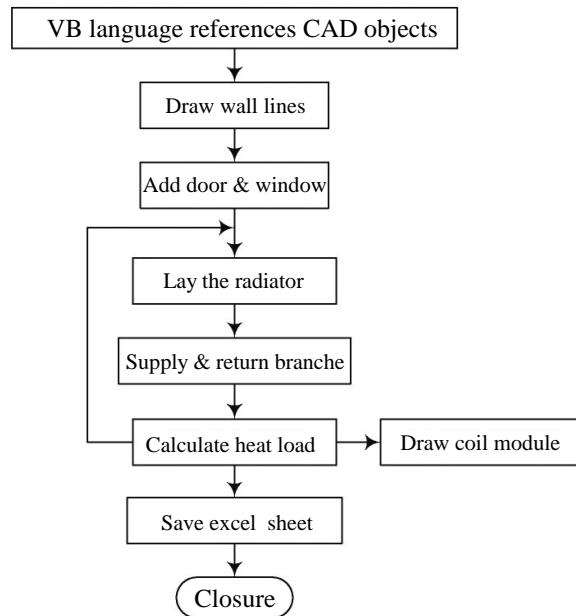
The predecessor of three-dimensional modeling technology belongs to three-dimensional painting art. The initial form is very simple and develops slowly, but later, with the rapid development of computer technology, three-dimensional modeling technology has been continuously improved, especially the three-dimensional modeling software 3D Max launched by Autodesk company in the United States, which makes three-dimensional modeling technology develop rapidly and widely used. At the same time, 3D modeling technology has been an indispensable and important part in the field of furniture design.

### **3.1 New Ways of Furniture Modeling Design Expression**

In the traditional practical expression of furniture modeling, whether pencil sketch, structural sketch, watercolor perspective effect drawing or finer three views, cannot intuitively and effectively express the design ideas that designers want to express. However, there are many deficiencies in manual solid models. In order to make up for so many deficiencies, we have to find another way. Therefore, Numajiri et al. [5] concluded that the computer 3D modeling technology with low cost, high efficiency, easy storage and easy modification after completion has become a new expression of furniture modeling design and design process of main functional modules, as shown in Figure 1.

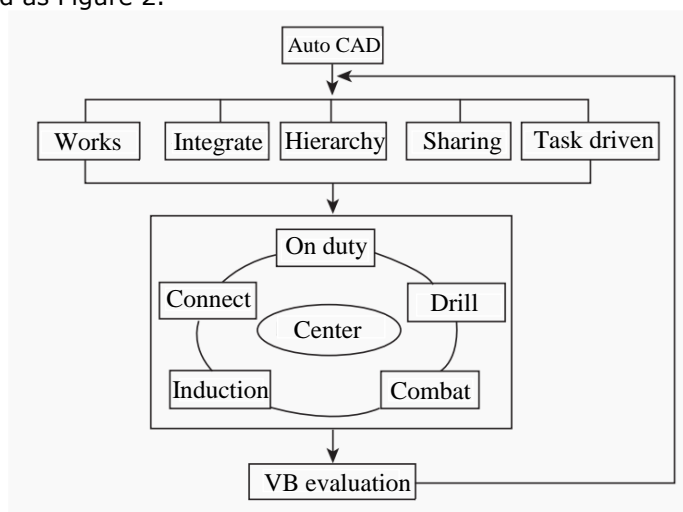
### **3.2 Make the Performance Effect of Furniture Products More Realistic and Lively**

Because the traditional dynamic furniture modeling design needs to consider the workload of painting, and also needs the designer to have professional color understanding and grasp the professional skills of color contrast and color harmony, it has great limitations in design. Furniture design cannot have too many patterns and modeling cannot be too complex, For the furniture with excellent shape, the traditional two-dimensional painting expression method is almost difficult to achieve. However, in the environment of computer 3D modeling technology, the complexity of modeling is no longer scruples. Using the computer 3D modeling technology, we can flexibly give the model materials, imitate the real-world objects through the model rendering settings and the control of materials and lights, give the model real and reliable colors without the solid model, achieve the effect of photo level, and render repeatedly until satisfactory [6].



**Figure 1:** Design process of main functional modules.

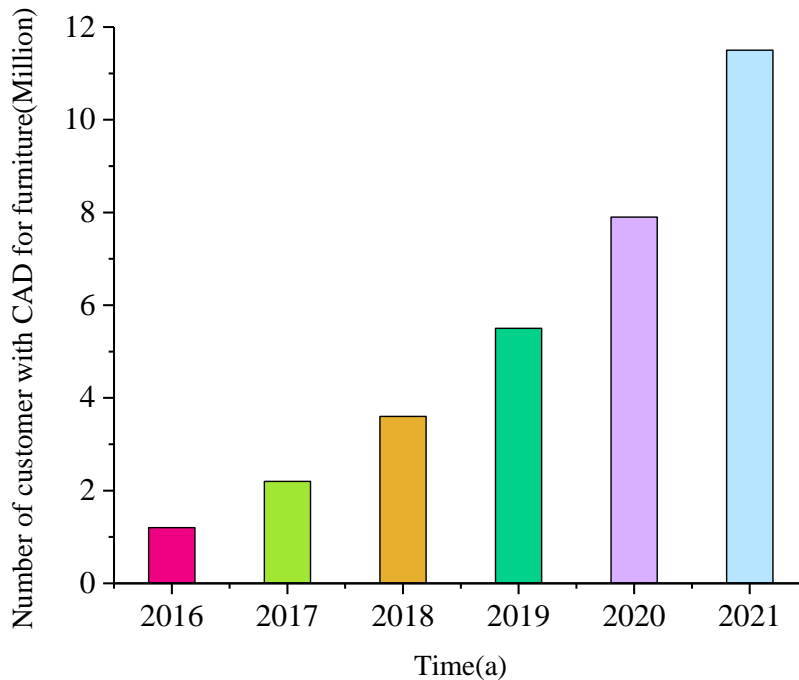
Furniture design with the help of computer software is different from the traditional manual furniture design scheme. It is not only necessary to effectively confirm the local graphics, but also need to correct the scale size of the graphics after the overall graphics effect is basically formed, so as to avoid inconsistent pattern proportion in the process of pattern decoration and pattern extraction in local graphics. Determination of local graphics the determination of local graphics is an important link in computer-aided furniture design. Țălu and Țălu [7] determine the selection direction of local graphics and patterns according to different positions of furniture can make the shape of furniture tend to reflect the three-dimensional effect in the spatial environment in detail processing, illustrated as Figure 2.



**Figure 2:** Furniture design of CAD architecture.

### 3.3 Make Furniture Design Achieve the Effect of Unity of Man and Machine

The modeling design of furniture products can not only affect people's direct feelings about the appearance of furniture, but also have an indirect psychological and physiological effect on people in the process of use. The advantage of using computer modeling technology is that it can consider man-machine as a unity for design, make furniture closely cooperate with human functions, optimize design procedures, reduce labor consumption, improve working environment, and then quickly and effectively design more perfect furniture. Figure 3 shows histogram of the number of customer groups for furniture CAD over time.

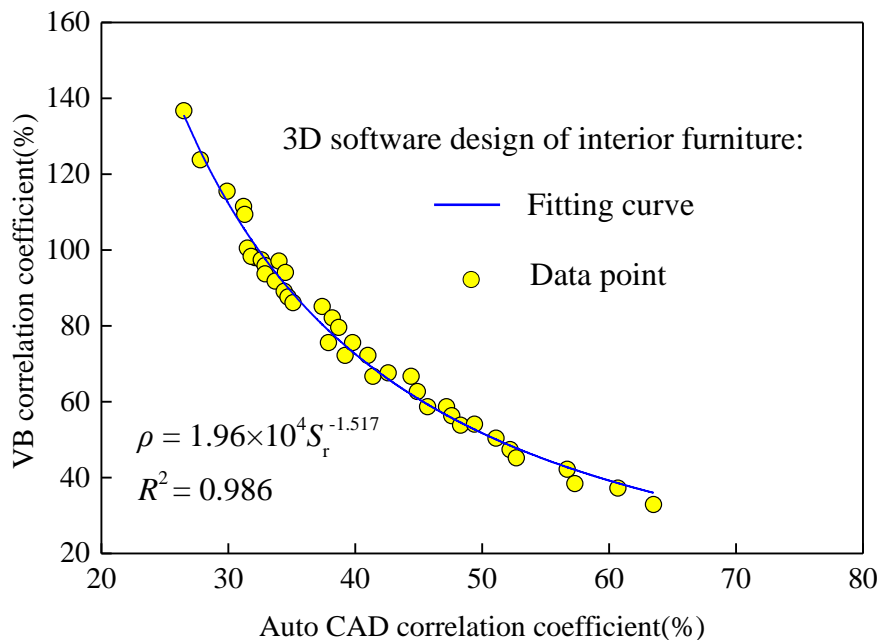


**Figure 3:** Histogram of the number of customer groups for furniture CAD over time.

With the continuous development of science and technology, modern furniture design has got rid of the backward way of pure manual drawing design. Relying on computer multimedia technology, 3D drawing method can not only replace the pure manual plane drawing method, but also combine the preset relevant dimensions, after correcting the "datum line", The drawings of furniture design are presented in a 3D three-dimensional form. This is far more able to reflect the artistic beauty of graphic patterns and decorative patterns in furniture design than the plane view drawing method of top view and left view [8].

### 3.4 Coordinate the Relationship Among Shape, Function and Material in Modeling Design

The form is the embodiment of the functional requirements, which determine the design of the form. The material basis directly affects the quality of the form. The three are closely related to each other. Only by coordinating the relationship between the three can we better serve the furniture design and design exquisite and excellent furniture products [9], as illustrated with Figure 4. In the environment of computer three-dimensional modeling technology, furniture designers can easily and quickly modify the model parameters on the computer to reduce the limitations of material conditions. In addition, rich material editing skills imitate the real texture effect, which makes up for the lack of shape.



**Figure 4:** Correlation diagram and fitting analysis of interior furniture 3D design software.

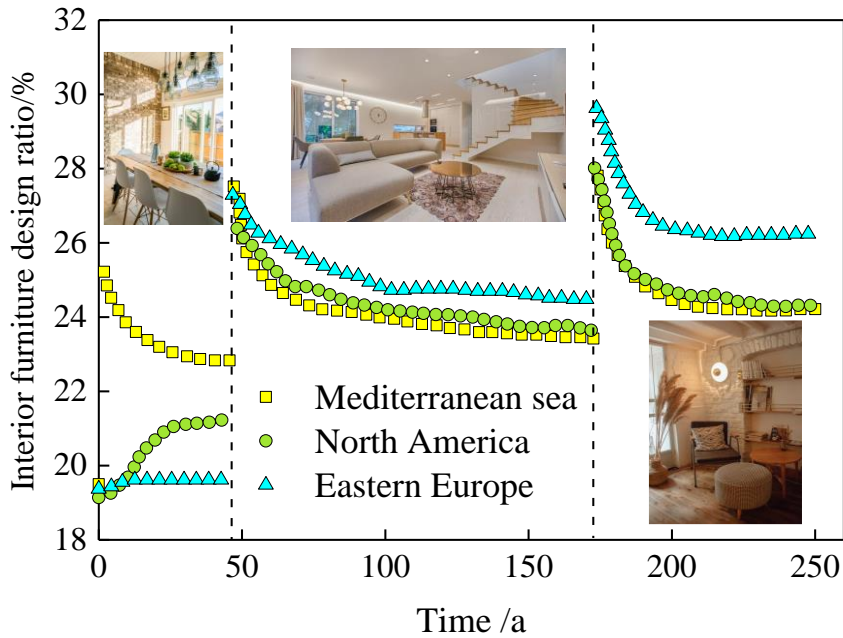
Interior designers can use real-time rendering to fully show the color and material of indoor space, effectively select multiple lights and materials, and use comparison to realize the selection of the best scheme. Interior designers can effectively control the effect of interior design and avoid a large number of adjustment picture steps and expensive rendering of renderings in the traditional design process. Interior designers can make the real lighting situation, accurate materials and finishes in the architectural information model through Revit, so as to realize the production of shading drawings and achieve realistic effects in the design process. Figure 5 illustrates application ratio of furniture style and 3D design in typical regions of the world. Although the rendering speed of materials and lights in the Revit renderer has been improved, interior designers still need to use the Revit model and rendered pictures to provide the required design drawings for the producers, so as to polish them again, so as to accurately show the design intention and reduce the rework rate.

### 3.5 Stimulate the Creative Inspiration of Furniture Designers

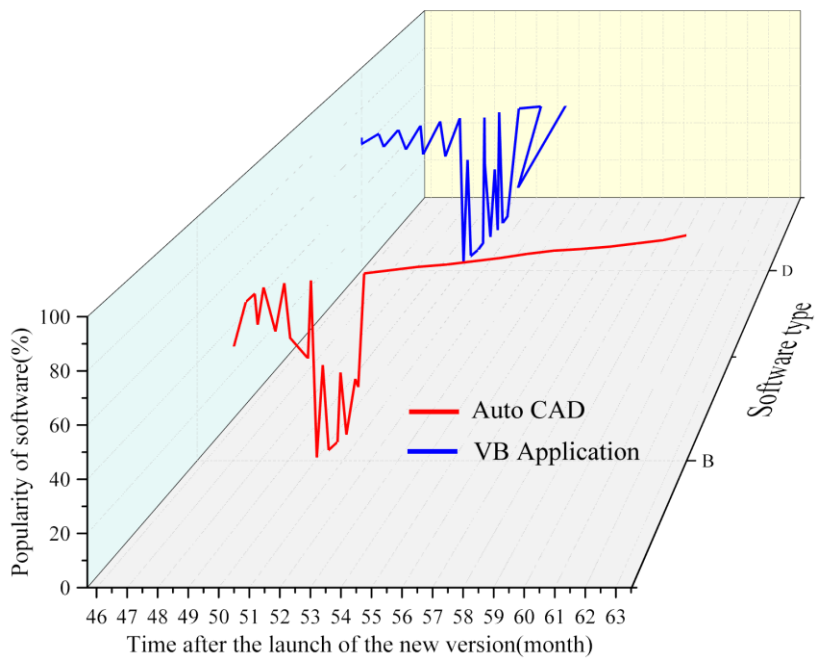
According to the traditional manual painting design method, it not only consumes a lot of time, physical strength and energy, but also is difficult to make secondary modification, which greatly limits the designer's creative inspiration and causes the slow development of the whole industry. However, in the environment of computer three-dimensional modeling technology, through rapid modeling, we can effectively show a variety of design schemes and simply and intuitively show the designer's design ideas of different styles. In the process of design, arbitrary innovation and modification can also be carried out to observe the furniture modeling from the perspective of three-dimensional world and determine the best scheme. Therefore, this new technology is a practical tool to improve designers' creative ability and thinking. Figure 6 shows application ratio of furniture style and 3D design in typical regions of the world.

Designers can use professional Revit files linking graphic design and other equipment to fully grasp the status of indoor three-dimensional and space, and can switch between three-dimensional and two-dimensional at will, so as to fully tap the shortcomings and advantages of space and

realize the development and design of its own characteristics, rather than applying a picture. Use different perspectives to truly feel the three-dimensional nature of interior design, and realize the design through the three-dimensional characteristics.



**Figure 5:** Application ratio of furniture style and 3D design in typical regions of the world.



**Figure 6:** Application ratio of furniture style and 3D design in typical regions of the world.

## 4 PRECONDITIONS FOR FURNITURE DESIGN WITH 3D MAX

If you want to use 3D Max software for furniture design, the preconditions must require the designer to have strong spatial imagination ability and be able to simulate the three-dimensional model of the designed furniture in the brain. With this ability, you can easily solve the problem of computer three-dimensional modeling. The following are the key preconditions:

### 4.1 Fast and Effective Material Map Editing

It is necessary for designers to master the basic commands of 3D modeling, such as moving and zooming. It is important for designers to be familiar with the basic commands of 3D modeling, such as image and zooming. In 3D Max, it mainly depends on the adjustment of bitmap. For furniture design that requires very precision, designers can edit the bitmap in Photoshop to generate the best material effect, and then map it.

Material maps can be roughly divided into two categories. The first category is a two-dimensional map that represents the pattern and pattern on the surface of furniture surface materials. This map has very strict requirements for the pattern and texture of the map, and requires each sub cell pattern to be seamlessly spliced with other sub cell patterns. The second type is the three-dimensional map showing the concave convex texture of furniture surface materials. This kind of map itself is not three-dimensional, but is realized by the concave convex adjustment of 3D max. the designer can adjust the concave convex parameter value according to the needs of furniture materials. Generally, the concave convex value can be adjusted to 20.

### 4.2 Base Tool Modifiers for Shaping and Adjusting Base Geometry

Commonly used modifiers include: edit polygon, edit normal, edit mesh, extrude, chamfer, optimize, etc. similarly, mastering these commonly used modifiers is very important for designers to improve design speed.

There are many types of modifiers, mainly including: network selection modifier, polygon selection modifier, patch selection modifier, spline editing modifier, mesh editing modifier, optimization modifier, UV coordinate modifier, UVW map modifier, material modifier, etc. each modifier corresponds to different modification commands. Designers need to be very familiar with various modifiers so that they will not be in a hurry and delay the overall design process.

Due to the use of 3D computer drawing tools, it is easy to be missing in the pattern adjustment of curly grass pattern (Figure 7). According to the basic operation steps of CAD drawing, generally, it is only necessary to select the matching graphics in the drawing library. Generally, these graphics are easy to find in the public drawing library, also illustrated as Papadiochou and Pissiotis [10]. However, if the designer makes an empirical mistake and takes the pattern with a "take doctrine" attitude, the overall scheme of the furniture design is basically unavailable.

Because the basic mode of all graphics in the public gallery is displayed in the image information browsing mode Jpg format, which cannot be directly applied in the CAD drawing system. Even if the graphics are opened by browsing in Photoshop, the graphics can only appear in the furniture design manuscript in a superposition way because they do not have the right to modify, and will not coincide with the overall design scheme.

### 4.3 Rational Use of Lighting

In furniture design, reasonable lighting construction can properly express a tone, which is very important for the appearance effect of the whole design. Lighting helps to express an emotion and guide the audience's eyes to find a specific position. In the lighting design, we generally use the "three-point lighting method", that is, main light, auxiliary light and backlight. The main light is used as the main light source to provide overall lighting, the auxiliary light is used as the auxiliary light source to set off the overall atmosphere, and the backlight also plays an embellishment role

as the auxiliary light source. Experienced designers can quickly and effectively grasp the relationship between various light sources, which is a difficulty for beginners. They need to calm down and debug slowly, accumulate experience and stabilize their feet in order to design immortal works.



**Figure 7:** Secondary development of embedded modern style furniture by software aided design.

Figure 8 shows scatter matrix diagram of interaction between sofa design with different attributes. Some designers who are familiar with the computer CAD operating system generally use the method of converting the image storage format to complete the retrieval of curly grass patterns. In fact, this operation method also has some uncertainty, because it is based on PNG saved graphics and the basic resolution of graphics saved in JPG format is completely different, which may lead to size distortion in furniture design scheme.

The effective way to solve this problem is to design a complete roll grass pattern according to the common roll grass pattern PNG format-based image database, so that in any case, as long as it is necessary for design, the curling grass pattern can be retrieved at will according to the size of the graphic size.

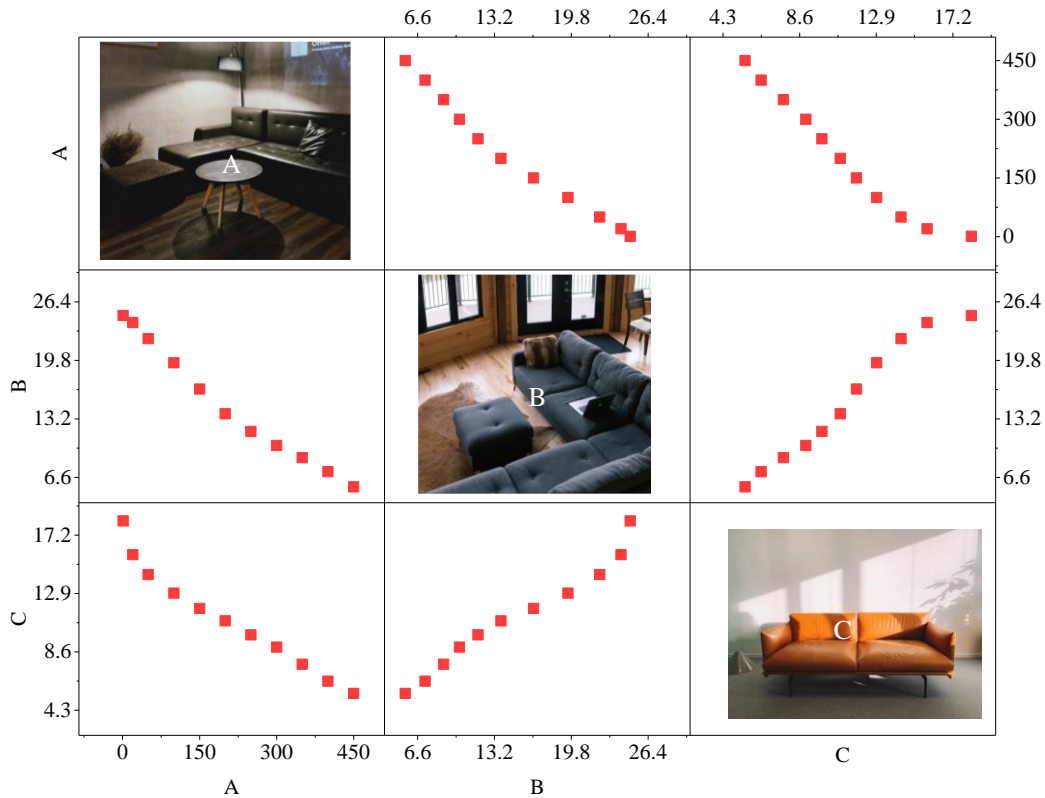
## 5 APPLICATION OF 3D MODELING TECHNOLOGY IN FURNITURE DESIGN

If you want to use 3D Max software for furniture design, the preconditions must require the designer to have strong spatial imagination ability and be able to simulate the three-dimensional model of the designed furniture in the brain. With this ability, you can easily solve the problem of computer three-dimensional modeling. The following are the key preconditions:

After drawing the three views in Autodesk CAD software, we can carry out modeling and editing in 3D Max. After 3D Max modeling is completed, we need to use the material editor, which can easily and quickly modify and control the color, map, self-illumination, transparency, bump and reflection / refraction parameters of furniture design. To achieve the final effect of the design. In order to get the ideal furniture design effect drawing, the environment must be edited and processed, mainly including light source (including ambient light, flash and spotlight), background setting, camera installation, etc. after processing, the effect can be rendered and a beautiful furniture design drawing can be obtained. In the performance of the structure of furniture, especially the connectors, some transparent materials can be used for easy observation. However,



it should be noted that before using 3D Max to create a model, the system unit needs to be reasonably set, so as to ensure that the created model is consistent with the size of objects in the real world. The unit can be set to millimeter, centimeter or inch according to different personal habits.



**Figure 8:** Scatter matrix diagram of interaction between sofa design with different attributes (unit: %).

At the beginning of designing 3D Max software, Autodesk reserved the conversion interface with Auto CAD to directly import auto CAD DWG format files for editing. The three views of furniture can be observed intuitively in the four viewports of 3D Max, which not only makes up for the lack of functionality of Auto CAD software, but also intuitively expresses the designer's intention and facilitates the designer's drawing observation. For the final rendering, 3D Max has also been optimized. Designers can render in disguise according to the design of different levels.

Autodesk 3D Max is constantly updating and launching new versions, and has been updated to 2013 so far. Whether as a senior designer or a beginner, we should keep pace with the times and meet the needs of the development of the new era. Don't always hold on to the old software and don't try the updated version. The result of such circular conservatism will be abandoned by the times and become the abandoned baby of the old times.

Furniture design is a comprehensive discipline, which contains rich theoretical knowledge and solid technical support, and three-dimensional modeling technology is just the tip of the iceberg. If you want to really become an excellent furniture designer, you must develop your comprehensive quality in an all-round way and fully understand the design technology and design theory.

## 6 CONCLUSION

Compared with the traditional way of furniture design, three-dimensional modeling technology has many characteristics, such as more realistic and vivid performance effect, can make furniture design achieve the effect of human and machine unity, can effectively coordinate the relationship between form, function and material in modeling design, and can better stimulate the creative inspiration of furniture designers. Nowadays, the integration of 3D modeling technology in furniture design has become the inevitable development direction of furniture design and an indispensable practical tool for designers. Furniture manufacturing industry has distinct traditional processing characteristics. The application in furniture design will greatly reduce errors in the design process, shorten the development cycle and enhance the competitiveness of products.

## 7 ACKNOWLEDGEMENT

2021 Open project of Hubei Small Town Development Research Center: Rural tourism innovation research.

Jun Li, <https://orcid.org/0000-0001-5125-5044>

## REFERENCES

- [1] Starikov, A.; Starikov, A.: Review of the modern CAD systems for the furniture industry, Actual Directions of Scientific Researches of the XXI Century Theory and Practice, 8(1), 2020, 244-249. <https://doi.org/10.34220/2308-8877-2020-8-1-244-249>
- [2] Xie, C.; Schimpf, C.; Chao, J.; et al.: Learning and teaching engineering design through modeling and simulation on a CAD Platform, Computer Applications in Engineering Education, 26(4), 2018, 824-840. <https://doi.org/10.1002/cae.21920>
- [3] McAlister, A.-M.; Bywater, J.-P.; Chiu, J.-L.: Exploring experienced designers' strategies in a CAD learning environment, Computer Applications in Engineering Education, 30(1), 2022, 42-63. <https://doi.org/10.1002/cae.22441>
- [4] Shih, Y.-T.; Sher, W.-D.; Taylor, M.: Using Suitable Design Media Appropriately: Understanding How Designers Interact with Sketching and CAD Modelling in Design Processes, Design Studies, 53(2), 2017, 47-77. <https://doi.org/10.1016/j.destud.2017.06.005>
- [5] Numajiri, T.; Morita, D.; Nakamura, H.; et al.: Using an In-house Approach to Computer-Assisted Design and Computer-Aided Manufacturing Reconstruction of the Maxilla, Journal of Oral and Maxillofacial Surgery, 76(6), 2018, 1361-1369. <https://doi.org/10.1016/j.joms.2017.11.042>
- [6] Taleyarkhan, M.; Dasgupta, C.; Garcia, J.-M.; et al.: Investigating the impact of using a CAD simulation tool on students' learning of design thinking, Journal of Science Education and Technology, 27(4), 2018, 334-347. <https://doi.org/10.1007/s10956-018-9727-3>
- [7] Țălu, M.; Țălu, Ș.: The optimal CAD design of a 3D hexagonal toroid with regular hexagonal cross-section used in manufacturing of LPG storage tanks, Hidraulica, 11 (2), 2018, 49-56. <https://doi.org/10.1088/1757-899x/444/8/082019>
- [8] Xie, C.; Schimpf, C.; Chao, J.; et al.: Learning and teaching engineering design through modeling and simulation on a CAD platform, Computer Applications in Engineering Education, 26(4), 2018, 824-840. <https://doi.org/10.1002/cae.21920>
- [9] Spitznagel, F.-A.; Boldt, J.; Gierthmuehlen P.-C.: CAD/CAM ceramic restorative materials for natural teeth, Journal of Dental Research, 97(10), 2018, 1082-1091. <https://doi.org/10.1177/0022034518779759>
- [10] Papadiochou, S.; Pissiotis, A.-L.: Marginal adaptation and CAD-CAM technology: A systematic review of restorative material and fabrication techniques, The Journal of Prosthetic Dentistry, 119(4), 2018, 545-551. <https://doi.org/10.1016/j.prosdent.2017.07.001>