www.cadanda.com
Computer-Aided Design AND APPLICATIONS

Art Effect Design of Modern Architectural Structure based on Computer-Aided Visual Aesthetics

Renyi Xi

School of Civil Engineering, Sanmenxia Polytechnic, Sanmenxia 472000, China,
104753190553@henu.edu.cn

Corresponding author: Renyi Xi, 104753190553@henu.edu.cn

Abstract. The application of visual aesthetics is indispensable in modern architectural structure art design. With the continuous progress of modern science and technology, it is more and more common to use computer-aided technology to achieve better visual aesthetic effect in modern architectural structure art design. Computer aided software has greatly promoted the innovation of modern architectural structure art design methods and the improvement of design efficiency, so that the role of visual aesthetics in design has been brought into full play. This paper first expounds the modern architectural structure art design under the computer-aided technology, then analyzes the main types of visual aesthetics in the modern architectural structure art design, and finally analyzes the computer-aided technology in the visual aesthetics of modern architectural design from three aspects: symmetry, golden section, rhythm and rhyme visual aesthetics, which provides the reference and exchange for relevant people.

Keywords: modern architecture, visual aesthetics, computer aided technology
DOI: https://doi.org/10.14733/cadaps.2022.S8.55-64

1 INTRODUCTION

After experiencing the era of handicraft industry and great industrialization, human society has entered the electronic society based on computer information age. The fundamental changes of the three times originated from the improvement of social productivity and the development level of science and technology at that time, which changed our way of life and way of thinking [1]. With the liberation of people's physical fitness from the traditional handicraft industry, people's taste is higher and higher, and the transformation speed of pursuing and enjoying beauty is faster and faster. This great change in people's way of thinking has a direct impact on all aspects of daily life. People have been unable to meet the industrialization of construction and other fields, looking forward to large-scale and simplified production, and began to turn to the research of visual aesthetics. During the second industrial revolution, the advent and popularization of computers and automation devices greatly promoted the development of social productivity and made the labor of human nervous system understood in a sense [2]. The development and application of computer make people's life change with each passing day.

Computer aided design originated from the emergence of computer graphics technology. The research conception of computer aided design originated in the 1950s. At first, CAD was interpreted as "Computer-aided Drawing". At that time, the role of computer in design was a new tool to replace traditional manual drawing. However, with the rapid development of information technology and the wide application of computer technology in various fields, the meaning of CAD was constantly changing and expanding. With the development of random computer technology in recent decades, computer drawing has developed from the basic drawing element of "line" to the drawing of computer graphics with points, surfaces and volumes, so that the meaning of CAD has also developed into the concept of computer-aided design, which is well known to people now [3].

With the development of computer technology, relevant computer-aided technology research and development has made breakthroughs, and its application in modern architectural structure art design is also increasing [4]. In fact, if we do not have a good grasp of the relationship between the size of modern architectural design and the proportion of modern architectural design, it will directly affect the actual architectural design, which can lower the value of the building [5]. At this time, this technology is used to reasonably match geometric figures through more scientific and effective methods to control the details in the process of modern architectural structural art design, so as to make the building show a more harmonious and comfortable visual feeling. By introducing computer-aided technology into modern architectural structure art design, designers can scientifically and effectively construct and reorganize the visual aesthetic elements in graphic design with the help of the intelligent processing function of computer [6].

Huang et al. [7] used computer-aided technology to analyze the application of modern architecture in an all-round way, and compared the differences of various visual aesthetics. Varier et al. [8] compared the difference between symmetrical visual aesthetics and golden section visual aesthetics based on AutoCAD software. Taking symmetrical visual aesthetics and rhythm and rhyme visual aesthetics as evaluation means, Yen et al. [9] compared the differences of computer-aided technology of AutoCAD software and Photoshop software on modern architectural visual aesthetics, and put forward countermeasures. Krasnoshchyokov and Belko [10] Collected and analyzed the visual aesthetic construction of modern architecture under different computer-aided technologies, and looked forward to the development of computer technology in modern architectural design. Zanjani et al. [11] classified the visual aesthetics of modern architecture into symmetry, golden section, rhythm and rhyme, and proposed some suggestions on using computer-aided technology to realize the visual aesthetic effect of modern architectural design.

Based on the computer-aided technology of AutoCAD software and Photoshop software, this paper compares and discusses the influence laws of different computer-aided technologies on the visual aesthetics of modern architecture through the classification of symmetry, golden section, rhythm and rhyme visual aesthetics of the artistic effects of modern architecture, The best artistic effect design of modern architectural structure under computer-aided visual aesthetics is obtained, which has positive significance and provides research ideas and directions for later research.

2 TYPES OF VISUAL AESTHETICS IN MODERN ARCHITECTURAL STRUCTURE ART DESIGN

In modern architectural structure art design, geometric aesthetics is an important concern in visual aesthetics. The construction of mathematical elements such as symmetry and golden section is the key to the design of visual aesthetic works. In modern architectural structure art design, the scientific and effective design and construction of these key elements can be completed only with the support of computer-aided technology.

2.1 Construction of Symmetrical Visual Aesthetics

Symmetrical elements are the basic elements of the construction of visual aesthetics in modern architectural structure art design. The addition and construction process of symmetrical elements is the construction process of symmetrical visual aesthetics in modern architectural structure art

design. Symmetrical elements can express things, such as the potential beauty in architecture. The application of computer-aided technology in modern architectural structure art design mainly uses accurate calculation to determine the position of the designed things, so as to achieve the purpose of constructing visual aesthetics in the works. Meanwhile, computer-aided technology on the modern architectural structure art design can make the presentation of symmetrical visual aesthetics of buildings more harmonious and natural, give viewers a more comfortable visual experience.

2.2 Construction of Visual Aesthetics of Golden Section

There is a wonderful mathematical proportion in nature, which can help us construct a perfect aesthetic effect - the golden section, which is 0.618 to 1. We can capture the shadow of the golden section from various fields such as music, art and design. The spiral shape of honeycomb and Shell we often see is an application of the golden section in nature. Golden section ratio is widely used in layout division, graphic proportion and logo design of modern architectural structure art design. In the process of modern architectural structure art design, the construction of golden ratio can make the architecture more perfect from the perspective of visual aesthetics.

2.3 Visual Aesthetic Construction of Rhythm and Rhyme

Rhythm and rhyme used to be the professional terms of music and poetry, but in the art design of modern architectural structure, rhythm and rhyme have now become one of the important rules of formal beauty. The performance of rhythm usually has three ways: repetition, gradual change and density. In the continuous repetition, it shows psychological effects such as speed, strength and weakness. Through these performances, it produces the ups and downs rhythm and rhyme, reflecting a sense of order and coordination. Designers need to use computer-aided technology to more accurately design this sense of rhythm, but also speed up work efficiency.

3 MAIN COMPUTER AIDED TECHNOLOGY SOFTWARE IN MODERN ARCHITECTURAL STRUCTURE ART DESIGN

3.1 AutoCAD Software

AutoCAD software has a good user interface, and various operations can be carried out through interactive menu or command line. Its multi document design environment enables non computer professionals to learn to use it quickly. In the process of continuous practice, we should better master its various application and development skills, so as to continuously improve work efficiency.

3.2 Photoshop Software

Photoshop software mainly processes digital images composed of pixels. Using its many editing and drawing tools, it can effectively edit pictures. It has many advantages, such as automatic panoramic generation of multiple photos, flexible black-and-white conversion, more adjustable selection tools, intelligent filters, improved vanishing point characteristics and so on.

4 MODERN ARCHITECTURAL STRUCTURE ART DESIGN METHOD

4.1 Formulate Scientific and Reasonable Optimization Design Scheme

In order to meet the actual needs of construction engineering, the optimization design of building structure needs to formulate a scientific and reasonable optimization scheme. The quality of the optimization scheme determines the function and effect of building structure optimization design. The building structure design is the same, but the design scheme and optimization scheme are different. The two different schemes have a certain impact on the project cost and quality. The design scheme shall fully consider the influence of external force, quality center of gravity and structural layout on the building structure, and try to avoid the structural distortion and

deformation caused by external force. If the structural layout is not standardized, the material consumption will be increased due to distortion and deformation, which will not only increase the cost, but also bring many unsafe factors. In view of these situations, designers must coordinate and communicate with architectural engineers in the optimization design of building structure to ensure the scientific rigor and rationality of the optimization design scheme of building structure.

4.2 Optimize the Structural Design of Shear Wall

Shear wall plays a very important role in building structure design. The core of its structural design is the connection performance between beam and column. The coupling beam forms the coupling wall by connecting each wall limb, which virtually increases the binding force of the wall limb, and then increases the stiffness of the Dalian beam, which is easy to produce serious potential safety hazards under the action of earthquake. At the same time, it needs to increase the reinforcement of components, and then increase the use of building materials, resulting in a waste of resources. Therefore, when designers design shear wall coupling beams, they should design them as weak coupling beams. It is also necessary to comprehensively consider many aspects and scientifically arrange the anti-lateral force components. The more shear wall design, the smaller the structural displacement and the increase of lateral force resistance, but the increase of lateral force resistance will increase the seismic action of the structure. Therefore, we should follow the scientific optimization design scheme and optimize the structural design of shear wall according to the basic principles of building structural design and the requirements of relevant standardized standards.

4.3 Strengthen the Optimization Design of Detail Parts

With the continuous development of the construction industry, people have higher requirements for the overall design and detail design of buildings. In modern architectural structure design, it is not only limited to the overall design, but also needs to pay attention to the design of detail parts. As the saying goes: "detail determines success or failure", which fully proves that the detail part of anything is very important, and the optimal design of architectural structure is no exception. For example, beam column members can be treated with high-performance concrete, which can effectively reduce the bottom section, while horizontal members need to reduce the use of concrete, which can enhance their bearing capacity and reduce the cost.

4.4 Component Layout in Structural Optimization Design

The component layout in the optimization design of building structure mainly includes the layout and design of beam column and shear wall. At this stage, many high rise building structural designs adopt frame shear wall structure system, which is mainly composed of reinforced concrete frame and reinforced concrete shear wall. The beam column of the frame is rigid connection, and the frame and shear wall can be rigid connection or hinged connection. Modern building structure system is becoming more and more complex. Buildings with different functions are integrated to form a unique high-rise building, which also increases the difficulty of building structure optimization design. The frame shear wall structure system has flexibility and space, which can meet the use requirements of buildings. In addition, the system has high bearing capacity, good extensibility and integrity, and has strong ability to absorb seismic force, which greatly reduces the lateral displacement of the structure itself.

4.5 Coordination and Optimization of Structure and Building

When designing, we should try our best to ensure that the structure of the building fits closely with the overall plane, so as to achieve the effect of beautiful appearance and reasonable structure. The layout of building columns and walls shall be consistent with the functional requirements of the building plane. At the same time, the depth and bay of each room shall be unified, and the building system shall be as simple as possible, and there shall be no dislocation with the column. The height and cross-sectional area of each floor shall be the same. During the design of the building or elevator, the bearing components in the corner area with more stress concentration or stress

direction shall select high-strength building materials as far as possible, so as to reduce the self-weight. Light weight building materials shall be selected for non load-bearing construction, and the center of gravity, rigid center and mass center shall be overlapped in the layout of the overall building to prevent torsion.

Figure 1 is the flow chart of artistic effect design of modern architectural structure. It can be seen from it that when designing modern architectural structure, we should first determine a reasonable design scheme according to the needs and performance of the building to ensure the scientific rigor of the design of the building. Secondly, the structural design of shear wall is optimized according to the bearing capacity and structural displacement in modern building structural design. Thirdly, in order to ensure the visual aesthetic effect of modern architectural structure, the details of architectural structure should be fully considered in architectural structure design. Because the building structures are made of concrete, in order to save the space of the building structure and ensure its visual aesthetics, it is necessary to optimize the component layout of the building structure design. Finally, in order to realize the overall aesthetics and functionality of modern building structure, the structure should be coordinated and optimized with the building.

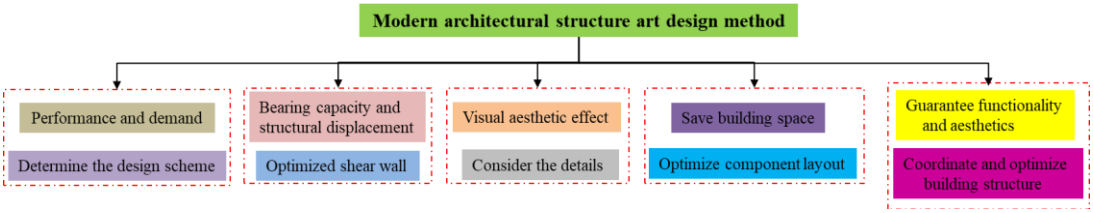

Figure 1: Flow chart of artistic effect design of modern architectural structure.

5 APPLICATION ANALYSIS OF COMPUTER AIDED TECHNOLOGY IN VISUAL AESTHETICS OF ARCHITECTURAL STRUCTURE ARTISTIC EFFECT DESIGN

Most designers usually take the principle of image composition as the basic theoretical support when designing the current architectural structure art, and apply the golden section line and some numerical values generated in the application of aesthetic properties, so that the building can have a strong visual impact, give the admirer a higher visual experience and improve the visual value of the work. The application of computer-aided technology in visual aesthetics in architectural structure art design is, on the one hand, to further improve the value of architecture through the understanding and analysis of aesthetic principles.

The expected score of visual aesthetics construction based on different computer software is shown in Figure 2. The higher the expected score is, the higher the confidence that the image belongs to the high-quality category. It can be seen that when AutoCAD software and Photoshop software are used as computer-aided technology software, the expected score of visual aesthetics of rhythm and rhyme is the highest, followed by golden section aesthetics and symmetry aesthetics. And the auxiliary effect of AutoCAD software is higher than the score expectation of Photoshop software. This shows that through computer-aided technology, geometric aesthetics, golden section ratio and other elements in visual aesthetics can be fully applied to modern architectural design, improve the visual aesthetic effect of modern architecture, and use science and technology to help the further development of art and promote the development and progress of modern architectural design.

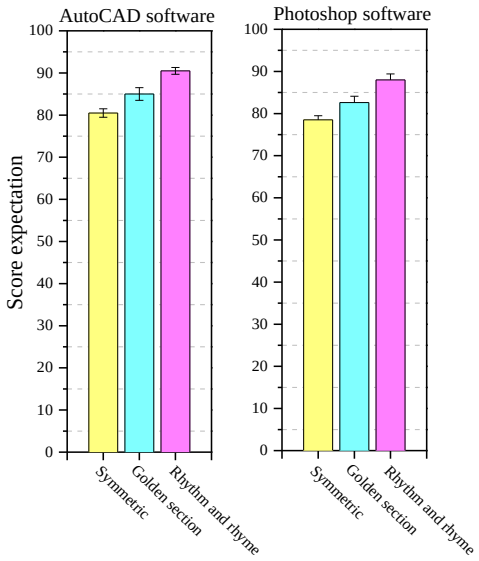

Figure 2: Score expectation of visual aesthetics construction based on different computer software.

Using computer-aided technology, after the modern architectural image is locked, its composition can be judged through the analysis of the image, the designers can master the contour proportion of the picture. The change curves of true rate and false positive rate of visual aesthetics construction based on different computer software are shown in Figure 3. It can be seen that when AutoCAD software is used as computer-aided technology, the real rate and false positive rate of modern architectural aesthetic images show a negative correlation, but the changes of the three visual aesthetics construction are relatively gentle. When Photoshop software is used as computer-aided software, the real rate and false positive rate of modern architectural aesthetic images also show a negative correlation, and the construction of three visual aesthetics changes violently. Computer aided technology based on AutoCAD software and Photoshop software can improve the predictability and foresight of visual aesthetics, and has a good prospect of art design.

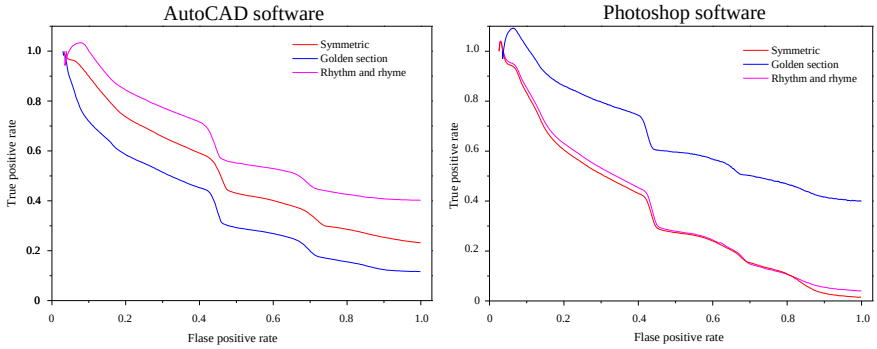

Figure 3: Change curves of true positive rate and false positive rate constructed by visual aesthetics based on different computer software.

Computer-aided software is important in innovating modern architectural structure design methods and improving design efficiency, and gives full play to the role of artistic visual aesthetics in design. Figure 4 is the change curve of the quality and beauty rate of visual aesthetics construction with

time based on different computer software. It can be seen from this that the quality and aesthetic rate of the three visual aesthetics constructions, whether based on AutoCAD software or computer-aided technology based on Photoshop software, shows a gradual downward trend with the increase of time. Among them, the quality and aesthetic rate of symmetrical visual aesthetics construction decreases the fastest, and the quality and aesthetic rate of golden section visual aesthetics construction decreases slowly. The above results show that time has little impact on the golden section visual aesthetic design of modern architecture.

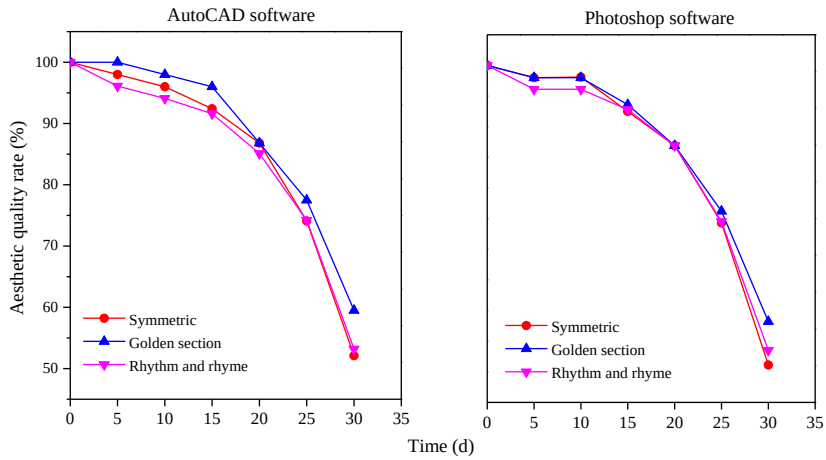

Figure 4: Aesthetic quality rate of visual aesthetics construction with time based on different computer software.

The external evaluation values of building structures constructed based on visual aesthetics under different computer software are shown in Figure 5. It can be seen that the external evaluation value of golden section visual aesthetics under the two computer-aided computing software is the lowest, the external evaluation value of rhythm and rhyme visual aesthetics is the highest, and the external evaluation value of symmetrical aesthetics is in the middle. The above results show that for the art construction of modern architecture, people still value the rhythm and rhyme of buildings. This reflects the visual aesthetic enjoyment of modern architecture art, and also shows the advanced nature of modern architecture to some extent. In general, modern architectural structure art designers can achieve efficient visual aesthetic effects with the help of computer-aided technology. In general, modern architectural structure art design will obtain new development and transformation.

The problem of image aesthetic evaluation is to learn the distribution of images in different aesthetic quality levels. This distribution not only reflects the differences between users' aesthetic preferences, but also can be applied to the traditional aesthetic classification prediction task through some transformation. We construct an aesthetic distributed learning framework based on computer-aided technology, which can preserve the original size of the input image without damaging the inherent beauty of the image, and use the semantic information as auxiliary information to improve the performance of aesthetic evaluation. In order to show that our method also shows good performance in Image Aesthetic classification task, we compare and analyze the proportion of image aesthetics under different computer-aided software. The proportion of visual aesthetics of modern architectural structures based on different computer software is shown in Figure 6. It can be seen that in the computer-aided technology based on AutoCAD software, the golden section visual aesthetics construction accounts for the highest proportion, followed by the symmetrical visual aesthetics construction. When Photoshop software is used as computer-aided technology, the proportion of symmetrical visual aesthetics is the highest, and the proportion of rhythm and rhyme visual aesthetics is the lowest. In general, different computer-aided technology

software has different emphasis on visual aesthetics, and the results are slightly different, but this reflects the diversification and intelligence of modern architectural structure art effect design.

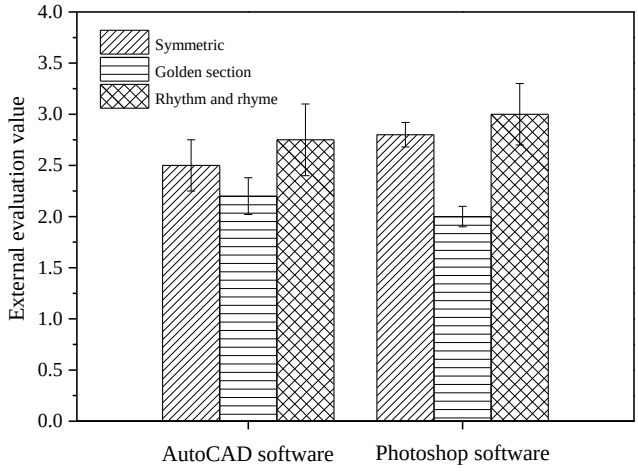

Figure 5: External evaluation value of building structure based on visual aesthetics under different computer software.

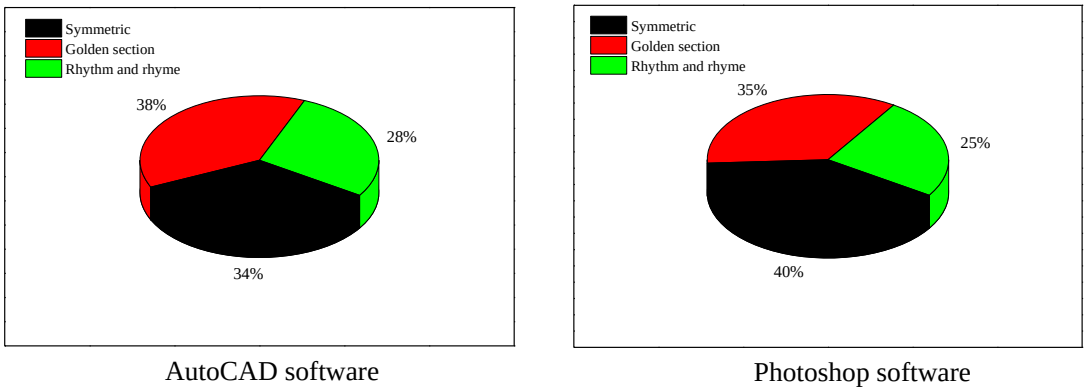

Figure 6: Proportion of visual aesthetics of modern architectural structure based on different computer software.

Based on computer-aided technology, the aesthetic quality of modern architecture is divided into visual aesthetic grade distribution of symmetry, golden section and rhythm and rhythm. This distribution-based representation not only reflects the difference of designers' aesthetic preference for the same modern architecture, but also can be applied to the traditional aesthetic label classification task through some transformation. In view of the semantic evaluation of architectural aesthetics, we aim to combine the semantic evaluation of architectural aesthetics with the visual aesthetic information. Based on the two computer-aided software, the statistical probability of visual aesthetics in modern architecture is analyzed and predicted in detail, and the role of visual aesthetics and semantic understanding of modern architecture is highlighted. Figure 7 is the statistical analysis probability of modern architectural structure art effect based on computer-aided visual aesthetics. It can be seen that whether AutoCAD software or Photoshop software is used as computer-aided technology, the visual aesthetics of modern architectural art effect presents a good development prospect, and its probability distribution law is the same.

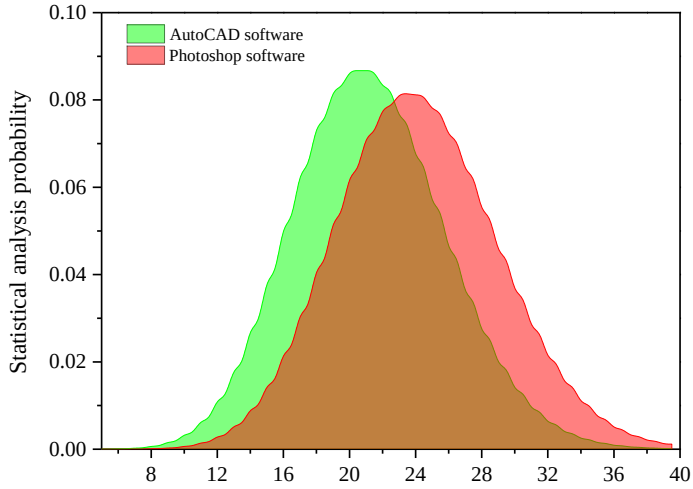

Figure 7: Statistical analysis of artistic effect of modern architectural structure based on computer-aided visual aesthetics.

6 CONCLUSION

To sum up, the application of computer-aided technology in modern architectural structure art effect design is mainly based on the basic principles widely used in modern architectural structure art design and the relevant concepts and data of geometric aesthetics, and adopts the methods of intelligent analysis and function assistance to improve the value of modern architectural structure art design works in the perspective of visual aesthetics appreciation. Using AutoCAD software and Photoshop software as computer-aided technology, this paper makes a comparative analysis on the visual aesthetics of symmetry, golden section, rhythm and rhyme in modern architecture. In general, the visual aesthetics of modern architectural structure art design has been greatly developed with the help of the application of computer-aided technology. The use of computer-aided technology makes the modern architectural structure art design give the audience a better visual experience, enrich the elements of modern architectural structure art design, and promote the development of modern architectural structure art design industry.

Renyi Xi, https://orcid.org/0000-0002-8228-5649

REFERENCES

[1] Viera, R.; Maurine, P.; Dutertre, J.-M.; Bastos, R.-P.: Simulation and Experimental Demonstration of the Importance of IR-Drops During Laser Fault Injection, IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, 39(6), 2020, 1231-1244. https://doi.org/10.1109/TCAD.2019.2928972

[2] Top, N.; Şahin, İ.; Gökçe, H.: Computer-aided design and additive manufacturing of bone scaffolds for tissue engineering: state of the art, Journal of Materials Research, 36(3), 2021, 3725–3745. https://doi.org/10.1557/s43578-021-00156-y

[3] Guo, Y.: The microscopic visual forms in architectural art design following deep learning, The Journal of Supercomputing, 78(11), 2021, 1-19. https://doi.org/10.1007/s11227-021-03888-0

[4] Constant, S.-J.: Bricks as arguments: Representing polysemy in Amsterdam School architectural design, Journal of Argumentation in Context, 10(3), 2021, 349-367. https://doi.org/10.1075/jaic.20012.con

[5] Yurtseven A.-Z.; O'Dwyer, L.-M.; Lawson, J.: Designing effective professional development for technology integration in schools, Journal of Computer Assisted Learning, 36(2), 2020, 160–177. https://doi.org/10.1111/jcal.12394
[6] Kong, S.-C: Delivery and evaluation of an e-Learning framework through computer-aided analysis of learners' reflection text in a teacher development course, Kong Research and Practice in Technology Enhanced Learning, 16(28), 2021, 1-22. https://doi.org/10.1186/s41039-021-00172-w
[7] Huang, W.-H.; Ren, J.; Yang, T.; Huang, Y.: Research on urban modern architectural art based on artificial intelligence and GIS image recognition system, Arabian Journal of Geosciences, 14(10), 2021, 1-13. https://doi.org/10.1007/s12517-021-07222-z
[8] Varier, D.; Dumke, E.-K.; Abrams, L.-M.; Conklin, S.-B.; Barnes, J.-S.; Hoover, N.-R.: Potential of one-to-one technologies in the classroom: Teachers and students weigh in, Educational Technology Research and Development, 65(4), 2017, 967–992. https://doi.org/10.1007/s11423-017-9509-2.
[9] Yen, M.-H.; Chen, S.; Wang, C.-Y.; Chen, H.-L.; Hsu, Y.-S.; Liu, T.-C.: A framework for self-regulated digital learning (SRDL), Journal of Computer Assisted Learning, 34(5), 2018, 580–589. https://doi.org/10.1111/jcal.12264.
[10] Krasnoshchyokov, V.-A.; Belko, T.-V.: Redesign and Retro Design as Methods of Creating Works of Modern Art and Design, Observatory of Culture, 17(6), 2021, 594-605. https://doi.org/10.25281/2072-3156-2020-17-6-594-605
[11] Zanjani, N.; Edwards, S.-L.; Nykvist, S.; Geva, S.: The important elements of LMS design that affect user engagement with e-learning tools within LMSs in the higher education sector, Australasian Journal of Educational Technology, 33(1), 2017, 19–31. https://doi.org/10.14742/ajet.2938