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Computer-Aided Design AND APPLICATIONS

Art-focused Teaching Method Design Using Ant Colony Optimization Algorithm

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Abstract. Art computer-aided design (CAD) course not only requires students to master a solid foundation of art design but also emphasizes that students should have the ability to create by using modern scientific and technological means. Considering the constraints of traditional art design teaching methods, This article introduces a new teaching concept, which is the integration of the Ant Colony Optimization (ACO) algorithm to enhance the quality of 3D model design through algorithmic optimization. The study optimized and adjusted art design tasks through the construction of visual integrity tasks using 3D models. Through the analysis of the visual aesthetic accuracy model of the algorithmic art design, a 95.6% high-precision algorithmic visual aesthetic structural art design was constructed. In the process of analyzing the ability to optimize the artistic style of curves, innovative teaching strategies and classification approaches were optimized. In the process of analyzing the AUC value of art teaching strategies, the approach of CAD art design courses was optimized. In the process of cultivating artistic teaching strategies, its excellent classification ability and optimized style provide a good reference for art education design.

Keywords: Art Design; CAD; Innovative Teaching Strategies; ACO Algorithm; 3D Model Optimization
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1 INTRODUCTION

Art and design is a process of transforming abstract ideas into forms that are easy for people to understand and express. The results it produces are often used to explain complex concepts, processes, or systems so that relevant personnel can quickly grasp key information [1]. The process of centrally conceptualizing and expressing solutions to design problems is the initial form of the final solution used to guide design implementation. Art design is the process in which designers concentrate on conceptualizing design issues, emphasizing creative thinking and innovation. It requires designers to explore various possibilities and options to find the best design solution [2]. At

this stage, designers need to comprehensively consider multiple influencing factors such as user needs, market trends, and technological limitations, to determine design goals and constraints and form a comprehensive design concept, making sufficient preparations to guide subsequent design work [3]. It establishes a basic framework and direction for the development of design schemes in the middle and later stages of the entire design process, to ensure the effectiveness and consistency of goals in subsequent design stages. The importance of art design to the entire design process can be divided into two aspects. The phased design results produced during the art and design stage can improve the understanding and transmission efficiency of information, ensuring consistency in information transmission among relevant personnel throughout the entire design process. This stage of achievement is the foundation for communication with the team and clients, and designers need to clearly express their design concepts and ideas through conceptual plans. Thus, introducing the ACO algorithm into 3D model design to automatically adjust parameters can enhance design efficiency and facilitate the exploration of innovative design schemes [4].

In the current era of rapid technological advancement, the country's investment and attention in the field of education are increasing, especially in cultivating art and design talents with innovative thinking and sustainable development concepts. Select excellent ecological design cases from both domestic and international sources, organize students to conduct in-depth analysis and discussions, guide students to evaluate design works from multiple dimensions such as aesthetics, functionality, and ecology, and enhance their perception and understanding of ecological aesthetics. At the same time, combining art computer-aided design courses to achieve a deep integration of ecological aesthetic education and environmental art design teaching, promotes the comprehensive improvement of students' overall literacy [5]. Integrate natural science knowledge such as ecology and environmental science into the teaching content of computer-aided design. Through project-based learning, students can comprehensively apply multidisciplinary knowledge and cultivate interdisciplinary problem-solving abilities in the process of solving practical design problems. In this macro context, integrating ecological aesthetic education into the education and teaching system, especially in the field of environmental art and design, is not only an inevitable choice in response to the needs of the times but also an important way to deepen and expand the connotation and extension of the discipline. Simultaneously, deeply understand the importance of ecological protection. This immersive teaching method can effectively stimulate students' environmental awareness and creativity. In art-related computer-aided design courses, students learn design skills by constructing virtual design scenarios with ecological themes, such as sustainable community planning, green building design, etc., in simulated real environments. To further promote users' thinking and decision-making in the process of artistic creation, some scholars have introduced an innovative interactive mechanism. Developed an auxiliary teaching application for art-related computer-aided design courses. We have achieved high-precision recognition of handwritten text and directly mapped the recognition results to the functional execution of design tools, greatly improving design efficiency and flexibility in creative expression. Utilizing the extended and optimized EMNIST handwritten digit and letter recognition dataset, combined with advanced convolutional neural network (CNN) models [6]. It can also recognize users' handwritten text instructions in real-time through deep learning technology, such as colour codes, layer naming, etc., achieving seamless integration between text and graphic operations. This mechanism not only supports users to directly draw sketches, adjust colours and textures on the interface. The application not only covers basic painting skills training such as line control and color matching, but also incorporates complex graphic design cases. By guiding users to complete a series of design tasks from simple to complex, such as logo design and poster production, it effectively promotes students' learning and mastery of letter writing, graphic composition, and creative ideas [7].

With the rapid development of the times and society, comprehensive artistic quality has become an indispensable component of modern people's knowledge system, which has a profound impact on shaping well-rounded individuals. However, traditional art teaching models often focus on theoretical lectures and skill imitation, neglecting the integration with modern technology, resulting in limited learning efficiency and interest stimulation. Given that art courses are at the forefront of curriculum reform, the research aims to explore an innovative teaching model that combines intelligent

classroom environments with art computer-aided design courses. Build a teaching design centered around concept maps, and help students form a systematic knowledge system through the joint drawing of concept maps and knowledge structure trees by teachers and students. Especially through graphic interactive visual teaching and algorithmic practice, to reshape the face of art education [8]. These interactive records can serve as subsequent learning resources, promoting the deepening and expansion of knowledge. In the field of education, art courses have become increasingly prominent as an important way to cultivate students' aesthetic perception, innovative thinking, and humanistic literacy. Relying on intelligent cloud service technology, data analysis is conducted on students' learning behaviour, preferences, and abilities to automatically generate personalized learning paths and resource recommendations. Set up virtual discussion and note-taking areas in the intelligent classroom environment, encourage students to use instant messaging tools for thinking collisions, and record learning experiences. At the same time, traditional hand-drawn concept maps are digitized using computer-aided design software such as Adobe Illustrator, Sketch, etc., enhancing interactivity and intuitiveness. Utilize environmental simulation software such as Lumion and Enscape to render the design work with realistic lighting, materials, and scenes, and evaluate the sustainability of the design through performance analysis tools [9]. This teaching method that combines reality and virtuality helps students better understand the consequences of design decisions and cultivate scientific design thinking. Introduce parametric design software to teach students how to use algorithm-driven design to achieve rapid iteration and optimization of creativity. For example, based on students' performance in concept mapping, push targeted design skill videos or case studies. By adjusting design parameters, explore the impact of different design schemes on artistic effects and ecological performance. Meanwhile, utilizing intelligent technology to assist students in discovering the intrinsic connections between knowledge and forming personalized cognitive maps. Encourage students to use computer-aided design software for practical exploration, transforming theoretical knowledge into practical works. This study aims to explore innovative teaching strategies for art CAD courses, specifically focusing on the application of the ACO algorithm in 3D model design.

(1) In this study, the ACO algorithm is introduced into the art CAD course, which realizes the deep integration of algorithm theory and art design practice.

(2) In the research, the application of the ACO algorithm in 3D model design is systematically studied, and the visual effect or structural performance of the model is optimized by automatically adjusting the model parameters.

(3) This article emphasizes the close combination of theoretical knowledge and practical operation and improves students' practical ability through project-driven teaching. This teaching mode helps students to master theoretical knowledge and improve their practical operation ability.

In the specific implementation process, this study will first analyze the current teaching mode and existing problems of art CAD courses, and then combine the principles and characteristics of the ACO algorithm to build an ACO algorithm model suitable for 3D model design. Through case analysis and effect evaluation, the advantages of the ACO algorithm in automatically adjusting 3D model parameters are verified. Finally, this study summarizes the application results of innovative teaching strategies and ACO algorithms in art CAD courses and puts forward the future research direction.

2 LITERATURE REVIEW

The combination of education and technology has always been a hot research topic in the field of art CAD. Many scholars have conducted in-depth discussions to find innovative teaching strategies and improve the teaching effectiveness of art and design. Liu and Huang [10] designed an innovative teaching model for art computer-aided design courses. This model deeply integrates Internet technology and aims to create an open, flexible and efficient learning environment. Choose Microsoft's ASP NET framework as the development language. At the database level, select Microsoft SQL Server 2010 (or higher) as the backend database management system. By utilizing its powerful features and rich library support, it provides a solid technical foundation for art-related

computer-aided design courses. In course design, emphasis is placed on practice and innovation based on the characteristics and needs of art students. By setting specific design tasks and group collaboration modes, students are encouraged to actively participate in learning, and promote teamwork and knowledge sharing. Develop dynamic web pages using ASP and NET web database middleware technology, and use ADO NET technology and OLE DB interface to achieve smooth connection and efficient access to the database. This innovative teaching model not only focuses on the implementation of technology but also emphasizes the innovation of teaching content and methods. At the same time, relying on the IIS server to build an information service platform, stable publishing and efficient access to teaching resources have been achieved. Group cooperative learning is a major highlight of this teaching model. It breaks the traditional one-way indoctrination teaching model, allowing students to establish positive interdependence in the process of completing common tasks. Through continuous communication, negotiation, and compromise, students have learned how to integrate into a team and achieve common goals while maintaining individuality. In addition, this teaching mode also focuses on using Internet resources to expand learning. Maba [11] accesses rich design cases, tutorial resources, and industry information through online platforms, broadening horizons and inspiring inspiration. For students who pursue individuality and artistic expression, although this process is challenging, it is also a valuable learning opportunity. In this mode, each student can utilize their professional knowledge while learning to listen and respect the opinions of others, to grow together through interaction. At the same time, teachers can also use online tools for remote guidance and instant feedback, improving teaching interactivity and pertinence.

To maximize learning effectiveness, Ng et al. [12] adopted a flipped online classroom teaching model, aiming to provide students with more in-depth discussion and practical time in face-to-face online courses through pre-recorded video textbooks and online collaborative activities. In terms of research methods, a mixed research approach was adopted, including learning satisfaction surveys, teacher online classroom observation records, and semi-structured interviews. When exploring teaching innovation in art computer-aided design (CAD) courses, we introduced a new method that comprehensively evaluates the impact of this innovative teaching model on students' learning outcomes, satisfaction, and artistic literacy improvement through multidimensional data collection and analysis. These videos cover everything from basic design software operations to the application of advanced design concepts, especially how to integrate artistic features into modern design. Students learn independently by watching videos before class, while in class, they focus on solving problems, deepening understanding, and completing design projects through group collaboration. The research results of Peddecord [13] indicate that this teaching model that combines mobile applications (such as Muyu) with flipped online classrooms has shown significant advantages in art computer-aided design courses. Students can better integrate Shu Bailan's artistic style into their designs during the creative process, demonstrating unique creativity and depth. It not only effectively stimulates students' interest and enthusiasm for art and design, but also significantly improves their software operation skills, art theory knowledge, and innovation ability. By combining mobile applications such as muyu (although originally referring to mobile instruments, in this case, it can be likened to interactive tools or software focused on art and design), to enhance students' learning experience.

When exploring educational innovation in art-related computer-aided design (CAD) courses, computer distance learning systems have demonstrated unprecedented flexibility and inclusiveness. Specifically, Qiu [14] designed a neural network-embedded learning framework based on shared memory and efficient bus structure. This system relies on online platforms, breaking the geographical and time limitations of traditional education, allowing any student passionate about art and design, regardless of their background, to log in to the system at the most convenient time and delve into the essence of art and design. Given the excellent self-learning ability of neural networks in the field of artificial intelligence, further research suggests integrating neural network technology into the teaching of art-related computer-aided design courses. This teaching method without an admission threshold greatly expands the audience's scope of art education and promotes the popularization and inheritance of art knowledge. Wang [15] focuses on the application and research of VR technology in art and design teaching, introducing the development history of VR technology and the types of

equipment features. The purpose of teaching is to enhance students' enthusiasm, participation, and ability development. The reasonable application of VR technology in teaching can produce good teaching results. In the future, virtual reality technology will be the most critical technology in the field of education. Through extensive literature review and research on practical experimental teaching cases of VR technology and corresponding national policy environments, the feasibility of applying virtual reality technology in teaching has been proposed. And explain the teaching objectives, construction content, and teaching methods of the course. The teaching of art and design majors requires students to have the ability to self-analyze three-dimensional space, and the use of virtual reality technology can meet the requirements of cultivating this ability in art and design teaching. Finally, desktop virtual reality technology was chosen as the solution to the current art and design teaching. Among them, the technical means of desktop virtual reality teaching were summarized, and finally, desktop virtual reality teaching aids were constructed and displayed in VR in the classroom. After studying the characteristics and types of VR technology and practical teaching cases, the concept of desktop VR technology intervention in experimental model-making courses was proposed. Reasonably integrating this technology based on software application and applying it to product design teaching courses can better meet students' subjective exploration needs and cultivate their spatial modelling thinking abilities.

3 ART CAD 3D MODEL OPTIMIZATION

Since its development, three-dimensional art has formed a mature production process and standards, and the realistic art style represented by Disney has become mainstream in the market. The Chinese animation school, characterized by ink-wash art and folk art, was once glorious, but in the context of the planned economy at that time, the low-cost creative approach cannot be replicated today. The innovation of 3D artists in the visual style of 3D art has gradually entered a new stage. We can have a better understanding of the extensibility and diversity of visual styles in 3D art, break through the inherent style that has been passed down to this day, explore and maintain the artistic quality of 3D art, and open up a new path for the development of 3D art in China. Based on the current status of 3D art, attempt to explore the artistic quality of 3D art itself and seek inspiration for the future style of Chinese 3D art. It is imperative to analyze, summarize, reproduce, and innovate the characteristics of traditional art. By interpreting and analyzing existing non-realistic style animation works, useful references can be provided for animation creators in terms of cultural understanding and the combination of technical methods and techniques, which is conducive to creating animation works with Chinese characteristics. This article starts from the perspective of technical implementation and the traditional artistic characteristics corresponding to representative works and conducts a specific analysis of existing non-realistic art style three-dimensional art cases, summarizing the artistic characteristics of traditional art corresponding to representative works. At the beginning of this new stage, it is imperative to analyze, summarize, reproduce, and innovate the characteristics of traditional art. In analyzing the implementation methods of using 3D art technology, combined with the current situation of 3D art in China, to create excellent 3D artworks with Chinese characteristics, it is necessary to explore local story themes. The characteristics and cultural connotations of traditional Chinese art, as well as the establishment and optimization of its production workflow, provide useful references for Chinese 3D art creation. By analyzing existing non-realistic 3D artworks, a summary of the current status of non-realistic 3D art styles is presented. Figure 1 shows the application of CAD in environmental art design.

Figure 2 illustrates the procedure of sparse point cloud reconstruction utilizing incremental 3D reconstruction techniques. The process primarily bifurcates into two fundamental components: initially, the image feature matching phase, which entails intricate feature extraction and matching from the input image, constituting a pivotal step in assuring the quality of the ensuing reconstruction; secondly, the restoration of camera pose and spatial structure. In this stage, parameters are automatically refined through the ACO algorithm to facilitate precise camera pose estimation and optimal reconstruction of the three-dimensional spatial structure, ultimately attaining the finest visual outcome.

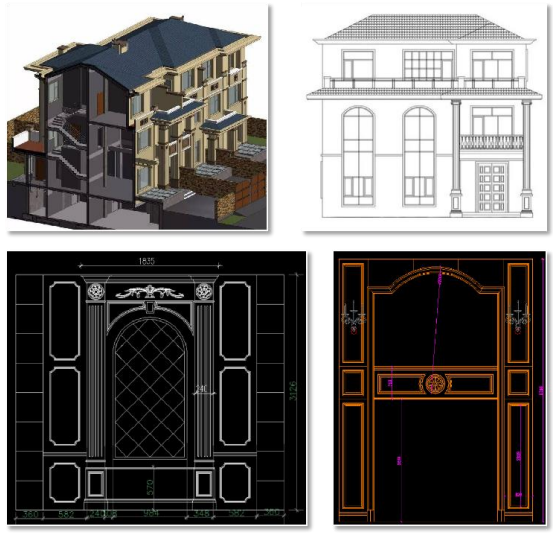

Figure 1: Application of CAD in environmental art design.

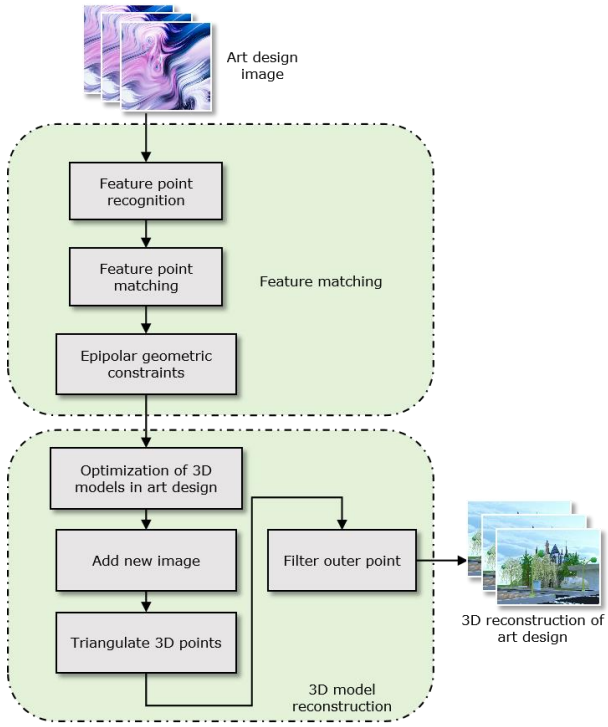

Figure 2: Basic flow chart of sparse 3D reconstruction.

By using a multi-objective optimization strategy, designers can effectively meet the optimization requirements of rendering efficiency, memory occupation, and other key aspects while ensuring the ideal visual effect and structural performance of 3D models. Views on scene understanding and layout estimation of art design Figure 3.

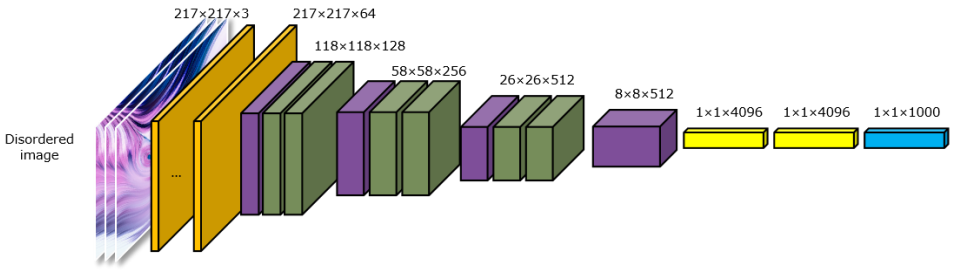

Figure 3: Understanding and layout estimation of art design scenes.

Assuming n represents the number of images involved in 3D model design, C_i denotes the internal participation and external parameters of the i image, m signifies the reconstructed 3D space points, and X_j represents the coordinates of the j 3D space point, the objective function of beam adjustment optimization is as follows:

$$g\ C,X\ =\sum_{i=1}^{n}\sum_{j=1}^{m}w_{ij}\left\|q_{ij}-P\ C_i,X_j\ \right\|^2 \tag{1}$$

In the formula, w_{ij} serves as an indicator variable, indicating the presence of a point j in the image i. Specifically, if the point j is present in the image i, w_{ij} is assigned a value of 1; otherwise, it is set to 0.

$P\ C_i,X_j$ represents the coordinate of point j on image i after projection transformation, while q_{ij} denotes the actual image coordinate of point j on image i.

In practical calculations, the Levenberg-Marquardt algorithm is employed to iteratively optimize for the minimum re-projection error:

$$\Delta=-\ J_f^TJ_f+\lambda I\ ^{-1}J_f^Tf \tag{2}$$

In the formula, λ represents the weight parameter. When λ is large, the formula resembles the gradient descent method with a small step size. Conversely, as λ decreases and approaches 0, the formula aligns with the Gaussian Newton method. The process of finding the optimal value involves adjusting λ: after each iteration, if the objective function successfully decreases, λ is reduced; otherwise, λ is increased, and the iteration continues. Once the error value falls below a specified threshold after several iterations, the optimized parameter variables are outputted.

In 3D model optimization, the ACO algorithm can be used to automatically adjust various parameters of the model, such as mesh density, texture resolution, and material properties, to achieve the best visual effect or structural performance. The probability of each and selecting its next step (excluding intermediate destinations in the tabu list S) is dependent on several factors: the pheromone concentration ξ_{ij} on the path, the magnitude η_{ij} of heuristic information, the significance α of pheromone concentration and the importance β of heuristic information. The specific selection probability is detailed as follows:

$$p\ i,j\ =\frac{\xi_{ij}^{\ \alpha}\ \eta_{ij}^{\ \beta}}{\sum_{h\notin S}\xi_{ih}^{\ \alpha}\ \eta_{ih}^{\ \beta}} \tag{3}$$

An overabundance of pheromone residue on the path i,j can obscure the heuristic information present, ultimately affecting path selection in the subsequent cycle. To counteract this, artificial ants employ a storage mechanism analogous to human brain information processing, where fresh information is retained while outdated information gradually diminishes or is purged over time. Upon the completion of a cycle involving n elements from the convenient set C, the artificial ants refresh and process the residual pheromones on each path.

During the interval between time t and time $t+n$, the pheromone concentration on path i,j undergoes updating and adjustment adhering to the prescribed rules.

$$\tau_{ij}\ t+n\ =\rho\cdot\tau_{ij}\ t\ +\Delta\tau_{ij}\ t \tag{4}$$

$$\Delta\tau_{ij}\ t\ =\sum_{k=1}^{m}\Delta\tau_{ij}^{k}\ t \tag{5}$$

Here, ρ represents the residual coefficient of the pheromone, with its value ranging within $\rho\in\ 0,1$.

This article is devoted to exploring innovative teaching strategies and algorithms in art CAD courses, especially systematically studying the application of the ACO algorithm in 3D model design. By introducing the idea of the ACO algorithm and improving it, the automatic adjustment of model parameters is realized, and then the visual effect of the model is optimized.

The application of the ACO algorithm in 3D model optimization improves the efficiency of optimization and gives designers more freedom. Designers can customize the optimization objective function and heuristic information according to the actual needs, to realize the optimization requirements of different aspects of the model.

In practical applications, the optimization of 3D models often involves the trade-offs between multiple objectives. For example, you may need to consider the rendering efficiency and memory occupation of the model while pursuing visual effects; It may be necessary to consider the rigidity and deformability of the model when optimizing the model structure. This article focuses on exploring innovative teaching strategies and algorithms in art CAD courses, with a specific emphasis on systematically studying the application of the ACO algorithm in 3D model design. By introducing and enhancing the concept of the ant colony optimization algorithm, automatic adjustment of model parameters is achieved, ultimately optimizing the visual effect of the model. The paper proposes the use of J to enhance the η factor in the traditional ACO:

$$\eta_{ij}=\frac{1}{J} \tag{6}$$

A smaller η_{ij} value indicates that the design task J has a disproportionately large value, implying excessive load. Selecting this design task would exacerbate the imbalance in the overall design platform's load. Conversely, a larger obtained η_{ij} value corresponds to a smaller J value.

The credibility of a node evaluates the reliability of design elements, with higher credibility indicating greater reliability and safety. Tasks are prioritized for design elements with high credibility. The success rate of task scheduling by grid design elements is quantified as follows:

$$T_d=\frac{T_s}{T_a} \tag{7}$$

T_d represents the reliability of design elements, T_a denotes the total number of tasks accepted by the node, and T_s indicates the number of tasks completed by the node.

A higher T_a value corresponds to a higher T_d for the design element, resulting in a lower error rate when executing design tasks. When $T_s = T_a$ indicating that the node has completed all accepted tasks, its credibility is 1, suggesting greater reliability of the element.

In the algorithm, ants are assigned particle properties. During each iteration, particles track two extreme values for uniform updating: the individual p_{best} extreme value and the g_{best} optimal solution discovered by the population. For artistic 3D model design, the specific location is the path, and cross-mutation measures should be implemented according to GA:

$$v_{k+1} = c_0 v_k + c_1\left(p_{best_k} - x_k\right) + c_2\left(g_{best_k} - x_k\right) \tag{8}$$

$c_0 v_k$ is derived from GA. The incorporation of the latter two components can be seen as a crossover operation inspired by GA, where the ants traverse the current solution, the global extrema, and the individual extrema. The resultant solution then defines a new position, from which the ultimate shortest path is computed.

ACO algorithm transforms the optimization problem of the 3D model into the problem of finding the optimal parameter combination by simulating the behaviour mechanism of ants releasing pheromones and choosing paths according to pheromone concentration in the process of finding food. Firstly, the algorithm randomly generates a set of initial parameter solutions as the starting point of "ants", and then makes each "ant" move in the solution space and update the pheromone concentration it carries. In the process of moving, the "ant" will choose the next moving direction according to the pheromone concentration of the current position and the preset heuristic information (such as the visual effect evaluation function and structural performance evaluation function). After many iterations, the algorithm will converge to a set of optimal or nearly optimal parameter solutions, thus realizing the automatic optimization of the 3D model.

4 EXAMPLE ANALYSIS OF ART DESIGN

The reason why artificial intelligence can have an impact on designers' thinking and practical processes is that it can learn and solve problems that are equivalent to or even surpass those of humans. It can not only help designers complete highly repetitive and low creativity design work, and assist designers in integrating design knowledge from massive data but also quickly explore and generate new design solutions from different perspectives according to the guidance of designers. On the one hand, the powerful computing power possessed by artificial intelligence enables it to complete complex calculations in a very short amount of time. This feature enables it to utilize massive design data and continuously develop its learning ability. This ability can help designers analyze, reason, and generalize, explore the potential value of massive user data, enhance designers' insight, and assist designers in more accurately identifying design problems and positioning user needs. Designers can create targeted datasets by adjusting the input of the model to obtain various types and styles of design results. On the other hand, artificial intelligence can continuously learn. For example, the development of generative models can provide designers with more creative stimulation. Therefore, under this influence, designers need to pay attention to the instrumental role of artificial intelligence, reposition their role in the design process, and clarify their relationship with artificial intelligence. This data-driven design pattern greatly expands the space for design exploration, fully stimulates designers' creative thinking, and presents more design possibilities for designers. Artificial intelligence profoundly affects production modes and design environments. Technological changes profoundly affect design, and the progress of science and technology is the driving force for design development. Artificial intelligence mainly infiltrates production modes and design environments, subtly driving design changes. Adjust the original design process to better allocate functions, improve efficiency, and enhance the quality of design output during the design process. In terms of production mode, under the guidance of artificial intelligence, the production of

various industries is beginning to trend toward full-process digitization and automation. Figure 4 shows an example of artistic design.

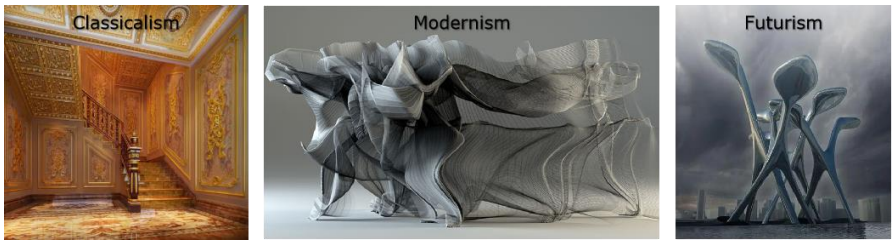

Figure 4: Example of art design.

In terms of design environment, as the living environment changes, designers face increasingly complex design problems. Compared with the original production mode, "automation" is gradually expanding from downstream manufacturing to decision-making and design in the middle and upper reaches, and the production mode is gradually transforming towards full process automation. Stakeholders in design cannot do without the support of digital technology when making decisions and designs. Therefore, learning to collaborate with digital devices is a necessary skill for designers. When the problems faced by designers cannot be solved by their human power, artificial intelligence is a good choice as designers need tools that go beyond human intelligence to some extent. Therefore, in the design process, how to maximize the utility of machine intelligence and human intelligence is a problem worthy of attention in design research in the era of intelligence. Figure 5 shows the accuracy test results.

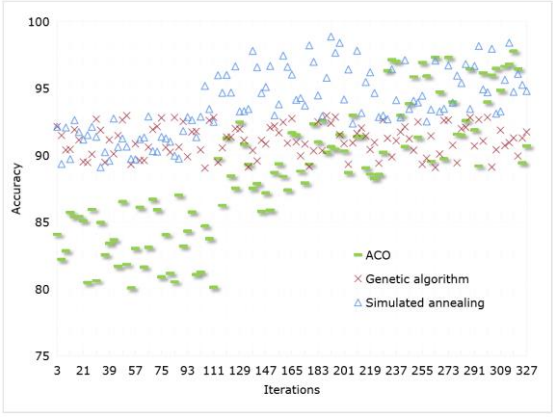

Figure 5: Accuracy test.

Figure 6 shows the error analysis of the optimization process. In the comparison between the ant colony algorithm and root mean square algorithm, the genetic algorithm and simulated annealing algorithm have significant advantages. The accuracy of the first two algorithms decreased by an average of 25%. In the process of optimizing detailed models, the algorithms have a high artistic style model quality in the construction of 3D models that conform to artistic styles.

Figure 7 demonstrates that this algorithm excels in recall rate, achieving 97.4%. A high recall rate signifies the algorithm's capability to successfully retrieve and optimize most 3D models adhering to a particular artistic style, minimizing instances of missed detections. This aspect is crucial for satisfying the demand for design diversity in practical applications.

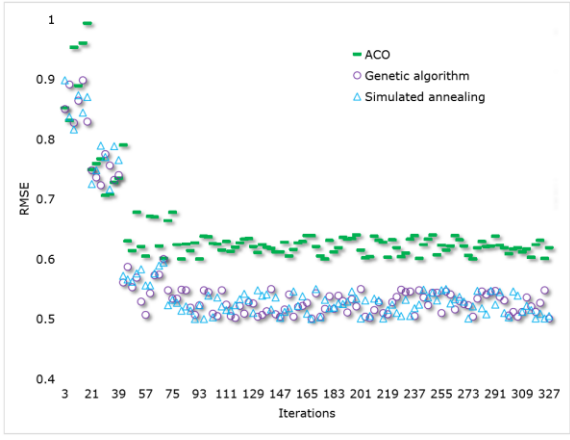

Figure 6: Error test.

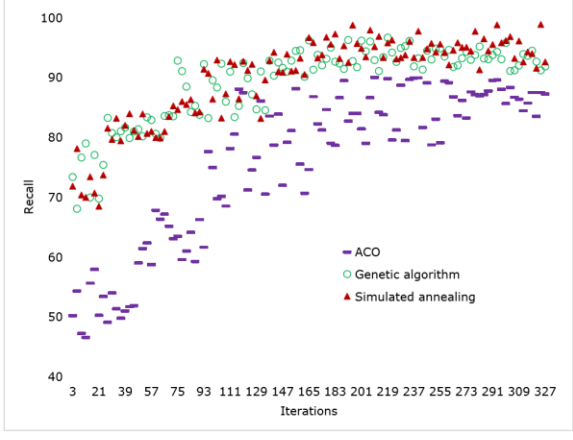

Figure 7: Recall test.

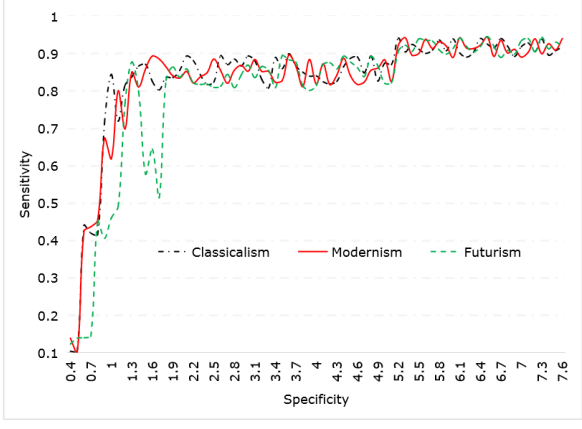

Figure 8: ROC curve.

Figure 8 shows the analysis of key performance indicators for curve classification. In the evaluation and classification of algorithm curves, the model style of artistic optimization has a lower optimization level among different evaluators. In the construction of curve structure value, its area has obtained a higher AUC value. In the analysis of key indicators of ideal performance, its ability to draw negative categories has high practical application and promotion value.

In the mixed art of 3D animation technology and art, the development of technology plays an extremely important role in expanding the visual style of 3D animation. The artistic aesthetic of creators is also driving breakthroughs in digital technology, and the two complement each other. The development of digital technology has brought great convenience to the level and efficiency of animation production. In terms of aesthetics, it has also opened up new paths for the development of animation art. The initial stage of 3D animation technology was centred on the pursuit of realism, and today the level of realistic reproduction has reached a high level. This analysis of the realism of digital images means that the audience cannot perceive the real counterparts that the digital images imitate, and the imitation behaviour is transparent in the digital images. Through the analysis of non-realistic art styles in 3D animation works from various regions in the previous text, whether it is the reproduction of traditional hand-drawn styles in the United States, Japanese cartoon 3D animation, or the style of Chinese ink painting art. This leads the audience to overlook the realistic significance contained in realism, and only perceive realism as a special aesthetic style and automatically see it as a whole with exaggerated imagery. Realism has become an aesthetic feature of 3D animation. This aesthetic feature is generated under the mimetic characteristics of 3D animation technology. They are all imitations of a certain art style in 3D animation, and the reasons for the emergence of these styles may be due to cost savings or the pursuit of their aesthetic style. Finally, through the processing of 3D animation technology, the original artistic style is reproduced, giving the visual style a mixed and diverse visual experience, showcasing a high degree of beauty that combines modern technology and art.

5 CONCLUSIONS

This article concludes that intelligent image tools can optimize the creative thinking results of art. By listing representative works of non-realistic art styles and collecting a large amount of relevant information on technical and artistic features, analyze and study them. Understand and verify the differences in production processes between non-realistic art styles and realistic visual styles in 3D animation, and summarize the characteristics of the production process for non-realistic art styles in 3D animation. The paper analyzed and summarized the characteristics of non-realistic art style in 3D animation, and sorted out and analyzed the representative works of this style. Empirical research method for analyzing representative cases from the perspectives of traditional artistic characteristics and technological implementation: combining the author's practice and experience. At the same time, based on the current situation of Chinese animation creation, this study proposes exploring the non-realistic artistic expression of 3D animation to maintain the diversified style of animation art. Has good practical research value.

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REFERENCES

[1] Calilhanna, A.: Ogene Bunch music analyzed through the visualization and sonification of beat-class theory with ski-hill and cyclic graphs, The Journal of the Acoustical Society of America, 148(4), 2020, 2697. https://doi.org/10.1121/1.5147469

[2] Chen, Y.: The Path and Value of Integrating Ecological Aesthetic Education into the Teaching of Environmental Art Design Major, Journal of Contemporary Educational Research, 7(11), 2023, 190-196. https://doi.org/10.26689/jcer.v7i11.5660

[3] Diversi, R.; Bartolini, A.; Benini, L.: Thermal model identification of computing nodes in high-performance computing systems, IEEE Transactions on Industrial Electronics, 67(9), 2019, 7778-7788. https://doi.org/10.1109/TIE.2019.2945277
[4] Dai, Y.; Wu, Z.: Mobile-assisted pronunciation learning with feedback from peers and/or automatic speech recognition: A mixed-methods study, Computer Assisted Language Learning, 36(5-6), 2021, 861-884. https://doi.org/10.1080/09588221.2021.1952272
[5] Danchenko, N.: Acousmatic music: principles of graphic visualization, Bulletin of Kyiv National University of Culture and Arts Series in Musical Art, 3(1), 2020, 37-47. https://doi.org/10.31866/2616-7581.3.1.2020.204337
[6] Dong, Y.; Yang, X.; Zhao, X.: Bidirectional convolutional recurrent sparse network (BCRSN): an efficient model for music emotion recognition, IEEE Transactions on Multimedia, 21(12), 2019, 3150-3163. https://doi.org/10.1109/TMM.2019.2918739
[7] Guo, S.; Li, X.: Computer-aided art design and production based on video stream, Computer-aided Design and Applications, 18(S3), 2020, 70-81. https://doi.org/10.14733/cadaps.2021.S3.70-81
[8] He, G.: Schema interaction visual teaching based on smart classroom environment in art course, International Journal of Emerging Technologies in Learning (IJET), 15(17), 2020, 252. https://doi.org/10.3991/ijet.v15i17.16441
[9] Liu, F.; Yang, K.: Exploration on the teaching mode of contemporary art computer-aided design centered on creativity, Computer-Aided Design and Applications, 19(S1), 2021, 105-116. https://doi.org/10.14733/cadaps.2022.S1.105-116
[10] Liu, M.; Huang, J.: Piano playing teaching system based on artificial intelligence–design and research, Journal of Intelligent & Fuzzy Systems, 40(2), 2021, 3525-3533. https://doi.org/10.3233/JIFS-189389
[11] Maba, A.: Computer-aided music education and musical creativity, Journal of Human Sciences, 17(3), 2020, 822-830. https://doi.org/10.14687/jhs.v17i3.5908
[12] Ng, D.-T.; Ng, E.-H.; Chu, S.-K.: Engaging students in creative music making with musical instrument application in an online flipped classroom, Education and Information Technologies, 27(1), 2022, 45-64. https://doi.org/10.1007/s10639-021-10568-2
[13] Peddecord, K.-M.: Behold the future: Implications of automated image analysis for the photographic arts, The International Journal of the Image, 13(1), 2022, 47. https://doi.org/10.18848/2154-8560/CGP/v13i01/47-62
[14] Qiu, Q.: The application of neural network algorithm and embedded system in computer distance teach system, Journal of Intelligent Systems, 31(1), 2022, 148-158. https://doi.org/10.1515/jisys-2022-0004
[15] Wang, T.: Exploration of the inheritance and innovation carrier of national culture in the teaching model of art design major in higher vocational colleges: integrating Lijiang Baisha murals into higher vocational art design curriculum system, Journal of Contemporary Educational Research, 8(1), 2024, 165-172. https://doi.org/10.26689/jcer.v8i1.6016