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Intelligent Optimization Using Multi-objective Genetic Algorithms in New Media Art Design

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Abstract. This article introduces an advanced optimization algorithm tailored for new media art, aiming to validate the efficacy of multimedia interactive technology and intelligent optimization techniques in computer-aided design (CAD). To accomplish this, we employ both multi-objective genetic algorithms (MOGA) and particle swarm optimization (PSO) for processing and analyzing datasets comprising new media art. Comparative experiments reveal that MOGA outperforms PSO in terms of classification accuracy, mean absolute error (MAE), and recall rate, demonstrating its superior reliability. These findings underscore MOGA's proficiency in handling multimedia resource data analysis and offer more robust optimization support for CAD in the realm of new media art. By integrating the unique attributes of new media art with audience preferences, our algorithm enhances the interactive multimedia effects of artworks, delivering a more intelligent and personalized interactive experience. Looking ahead, we are committed to exploring further applications of optimization algorithms in new media art to propel the continued evolution of multimedia interactive technology.

Keywords: New Media Art; Computer-Aided Design; Multimedia Interaction; Optimization Algorithm
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1 INTRODUCTION

Today, in the global digital wave, new media art stands out like brilliant stars in the sky of art. As a seamless fusion of digital magic and artistic originality, this type not only reshapes the boundaries of art but also brings the audience into a fascinating sensory realm. It is undeniable that the emergence of CAD technology has pushed new media art to new heights and presented it to the world in an unprecedented way. Baía and Ashmore [1] delved into the development and challenges of live theatre and performance in the transition from video streaming to virtual reality. In the space of new media art, artists can break through the limitations of traditional theatres and create more diverse forms of performance. At the same time, the audience can also enjoy a more immersive viewing experience, as if immersed in a real and fantastical world of drama. Computer science provides technical support for the construction of the metaverse, while art provides inspiration and ideas for the creation of drama and performance. Its advantage in contemporary art stems from its ability to transcend the limitations of traditional art and achieve a deep integration of art and technology. Cabero et al. [2] explored the application of multimedia interaction technology and virtual reality in artistic interactive multimedia effects through specific cases. In virtual exhibitions, multimedia interaction technology is widely used in the display and interaction of artworks. Through devices such as touch screens, projectors, and sensors, viewers can interact with artworks in real time, such as by changing the colour, shape, or motion trajectory of the screen through touch screens or interacting with virtual artworks through motion sensing. These interactive experiences not only increase the enjoyment of viewing but also make the artwork more vividly and intuitively presented to the audience. In this virtual space, viewers can freely move, rotate their perspectives, and even interact with virtual artworks, such as touching, dragging, or changing their positions. This immersive experience allows the audience to have a deeper understanding of the essence and charm of art.

Leveraging CAD, artists are liberated from the constraints of conventional manual methods, translating their visions into vibrant artworks. Crucially, multimedia interactivity transforms new media creations from static exhibitions into dynamic, real-time interactive experiences. This enhanced interaction and immersion elevate the audience's aesthetic journey, breathing life and intrigue into the artworks. As audiences' aesthetic tastes evolve and technology marches forward, their expectations of new media art intensify. Mere human-computer interactions now fall short, with audiences yearning for deeper immersion in artistic creation and experience. Çamcı and Hamilton [3] analyzed a new perspective on music experience in multimedia interactive environments. In multimedia interactive environments, audio-first VR adds more layers to the music experience by combining visual, tactile, and other sensory stimuli. Listeners can freely explore the virtual music space through VR devices, feel the delicate differences in the performance of different instruments, and even interact with virtual performers. This comprehensive sensory experience makes music more vivid and three-dimensional, making the audience feel like they are in the midst of music creation. Composers can use VR technology to freely combine various instruments and sound elements in virtual space, creating unprecedented music effects. At the same time, VR technology also provides musicians with a broader performance stage, allowing them to break through geographical and time limitations and interact in real time with audiences around the world.

Feng [4] explored the application and impact of intelligent virtual reality technology in art creation and design teaching. Intelligent virtual reality technology provides infinite imagination space and creative possibilities for artistic creation. Artists can use VR technology to construct virtual three-dimensional spaces, presenting their creative ideas more intuitively and vividly. Whether it's painting, sculpture, or architectural design, VR technology can help artists achieve more precise and realistic creative effects. In addition, intelligent virtual reality technology also has strong interactivity, allowing artists to interact with their works in a virtual environment, adjust their creative plans in real time, and better achieve their creative intentions. This interactivity not only improves the efficiency of creation but also enriches the expressive power and connotation of the work. Virtual reality (VR) teaching methods and artificial intelligence technology are gradually penetrating the field of digital media art creation, providing artists with new creative tools and means. The combination of these two technologies not only enriches the expression forms of digital media art but also greatly improves creative efficiency and artistic quality. Gong [5] discussed the application of virtual reality teaching methods and artificial intelligence technology in digital media art creation and the impact they bring. In digital media art creation, artists can use virtual reality devices such as VR helmets and controllers to enter the virtual world for creation. Artificial intelligence technology can generate images with unique styles, such as deep learning algorithms that can simulate the strokes and styles of different painters, creating works with personalized characteristics. In addition, AI can also use image recognition technology to perform style transfer, colour adjustment, and other processing on existing works, enriching the visual effects of the works. In the practical application of new media art, intelligent optimization algorithms can be used in many aspects. For example, through the layout optimization algorithm, the position and size of elements in artistic works can be automatically adjusted to achieve the best visual effect; Color matching optimization algorithm can help artists find the most suitable TINT scheme; The dynamic effect optimization algorithm can adjust the dynamic effect of the work according to the audience's real-time feedback, thus enhancing the audience's immersion. These applications can not only greatly enhance the expressive power of new media works of art but also bring a more intelligent and individualized aesthetic experience to the audience.

This article aims to propose an intelligent optimization algorithm suitable for new media art and verify its performance in a practical application through experiments. While the advancement and application of technology play a significant role, the true propellant of new media art's development lies in the innovation of artistic concepts. Thus, in examining CAD and multimedia interactivity within the realm of new media art, our guiding principle should be artistic creativity supported by technological tools. This study carries profound theoretical implications and practical relevance, offering valuable insights for the future evolution of new media art. Its novel contributions are outlined below:

(1) The introduction of an intelligent optimization algorithm tailored for new media art. This algorithm aligns with the unique traits of new media art and viewer preferences, refining multimedia interactivity to deliver a more intelligent, personalized interactive journey.

(2) By refining key artistic components like layout, colour schemes, and dynamic effects, this technology elevates the visual appeal of artworks and deepens the viewer's immersion. This innovation represents a profound integration of artistic and technological advancements, furthering the growth of new media art.

(3) Our research, by bridging the intelligent optimization algorithm with multimedia interactivity, has achieved a more seamless and intelligent interplay between new media art and its audience. This interactive experience encourages active audience participation in the creative process, yielding richer, more multifaceted aesthetic experiences.

The article commences with a preface, clarifying the research backdrop, objectives, and importance. A review of pertinent fields follows, offering a landscape of current advancements. Subsequently, we delve into the theoretical underpinnings and core technologies, establishing a foundation for our subsequent inquiries. Building on this, we introduce an intelligent optimization algorithm tailored for new media art and validate its efficacy through experimental testing. We conclude with a synopsis of our findings and a forward-looking vision for future research endeavours.

2 LITERATURE REVIEW

The application of multimedia interaction technology and computer-aided design (CAD) in the field of art design and production is becoming increasingly widespread. Especially based on video streaming multimedia interaction technology, with its unique interactivity and real-time performance, it brings new perspectives and possibilities for art design and production. Meanwhile, the introduction of CAD technology has made art design and production more precise and efficient. Guo and Li [6] discussed the application of multimedia interaction technology based on video streaming and CAD-assisted art design and production. Multimedia interaction technology based on video streams achieves real-time interaction with users by capturing and processing video stream information in real time. In the field of art design and production, this technology can be widely applied in areas such as capturing creative inspiration, real-time modification, and feedback. This not only broadens the artist's creative ideas but also brings a more vivid and authentic artistic experience to the audience. CAD technology has shown unique advantages in the field of sculpture art with its powerful design capabilities and precise modelling expression. Firstly, CAD technology can achieve three-dimensional modelling of sculpture design, allowing artists to observe and understand the form and structure of sculptures visually. Secondly, CAD technology has precise size control and material simulation capabilities. In addition, CAD technology also supports rapid modification and iteration, allowing artists to try multiple design solutions in a short period and find the best creative path. Guo and Wang [7] discussed the application of computer-aided design in sculpture art spatial expression techniques and the impact it brings. CAD technology can help artists plan and adjust spatial composition in virtual environments. Through 3D modelling and view switching, artists can clearly observe the spatial relationship between sculptures and their surrounding environment, thereby optimizing the spatial layout and composition effects.

In the tide of new media art, digital calligraphy and painting have gradually attracted the attention of artists and audiences with their unique charm. Among them, virtual brush modelling, as an important component of digital calligraphy and painting, has attracted much attention in terms of research progress and future prospects. Huang et al. [8] explored the current research status, achievements, and future development trends of virtual brush shapes in digital calligraphy and painting under the background of new media art. At present, researchers mainly achieve precise modelling of virtual brushes by simulating parameters such as real brush strokes, pen pressure, and pen speed, as well as combining digital image processing technology. These technologies not only make virtual brushes closer to real brushes in form but also better reproduce the dynamic changes of brushes during the writing process. Virtual brush modelling technology has also made significant progress. In the field of digital calligraphy and painting creation, more and more artists are starting to use virtual brushes for creation. By adjusting the parameters and settings of virtual brushes, they can easily create works with traditional calligraphy and painting charm. Hui et al. [9] explored the application and impact of multimedia interaction technology and intelligent optimization algorithms in sustainable art teaching practice. Multimedia interaction technology, with its intuitive, vivid, and strong interactivity, provides a new perspective and experience for art teaching. Through multimedia devices, teachers can showcase rich artworks, creative processes, and techniques, enabling students to intuitively experience and understand the charm and connotation of art. Through intelligent optimization algorithms, teachers can objectively and accurately evaluate students' works. Algorithms can analyze and evaluate the composition, colour, techniques, and other aspects of a work based on preset evaluation criteria and indicators, providing scientific evaluation criteria for teachers. Meanwhile, intelligent optimization algorithms can also provide personalized creative solutions and optimization suggestions for students based on their creative characteristics and needs, helping them improve their creative skills.

Jin et al. [10] explored the academic value and practical significance of traditional art technology under new media art. Virtual reality technology, with its highly realistic visual presentation and immersive interactive experience, provides unprecedented possibilities for learning traditional Chinese art. This immersive learning approach helps to enhance learners' perception and understanding of traditional art, enabling them to have a deeper understanding of the charm and connotation of art. Multi-touch human-computer interaction desktop technology provides a more convenient and intuitive way to learn traditional Chinese art. By touching the screen, learners can easily browse and select art content for interactive learning and practice. This technology not only improves learning efficiency but also makes the learning process more vivid and interesting. Learners can experience and learn the production and expression techniques of traditional art through simulation exercises, thereby better mastering relevant knowledge and skills. Kim and Lee [11] explored a new perspective of human-computer interaction in virtual reality art on future art consumption. Human-computer interaction virtual reality art is an important component of new media art. It utilizes virtual reality technology to present artworks to the audience through highly realistic virtual environments and immersive interactive experiences. This art form breaks the boundaries of traditional art and brings unprecedented artistic enjoyment to the audience. Driven by new media art, future art consumption will pay more attention to human-computer interaction and personalized needs. Virtual reality technology enables consumers to freely explore and experience artworks in a virtual environment based on their preferences and needs. This personalized consumption model will make art consumption more diverse and precise. Performance media art is a form of media that conveys artistic connotations through performance forms, including various performing arts such as dance, drama, and acrobatics. Virtual reality technology creates an immersive virtual space for the audience by simulating the real environment. Driven by new media art, the integration of performative media art and virtual reality has begun, bringing audiences an unprecedented visual feast.

Sansom and See [12] explored how performative media art can be transformed into virtual reality in the context of new media art and analyzed its significance and impact. This integration is mainly reflected in two aspects: firstly, through virtual reality technology, performative media art is presented in virtual space, allowing the audience to experience the charm of art firsthand. The second is to use virtual reality technology to create more possibilities for performing media art, allowing artists to create and perform more freely in virtual space. Yan et al. [13] explore how to use digital technology to achieve non-realistic rendering of digital mountain models in Chinese ink painting style in the context of new media art. In order to combine the artistic charm of traditional ink painting with modern technology and create a new form of artistic expression. After the construction of the digital mountain model is completed, the key is how to transform it into an art form with a Chinese ink painting style. This requires us to conduct in-depth research on the brush and ink techniques and artistic expression of ink painting and transform them into digital algorithms and parameter settings. Specifically, by adjusting the material and lighting effects of the digital model, the ink colour changes and stroke textures of ink paintings can be simulated. Adjusting the shading method of the model presents the variation of ink colour intensity in ink painting. Zhang et al. [14] explored human motion recognition technology and its applications in virtual reality art media interaction environments based on SVM. By identifying user motion data, real-time control of character actions in the virtual environment can be achieved. In virtual dance games, users can control the dance performance of virtual characters through their own dance movements, achieving a more natural and immersive interactive experience. Artists can use SVM-based human motion recognition technology to transform user motion data into dynamic elements in virtual artworks. In virtual painting applications, users can control the movement of their brushes and colour changes through their own motion trajectory, creating unique works of art. In virtual reality art exhibitions, SVM-based human motion recognition technology can achieve interaction between audiences and exhibits. Viewers can trigger reactions or change the way exhibits are displayed through their own actions, increasing their sense of participation and immersion.

Traditional digital media art creation relies on the creativity and manual skills of artists. Computer-assisted creation based on artificial intelligence can provide artists with richer creative materials and inspiration through algorithms and big data analysis. Zhao et al. [15] analyzed computer-assisted digital media art creation based on artificial intelligence. AI technology can automatically generate multimedia content such as images, audio, and video, helping artists break through the limitations of traditional creative modes and achieve more free and personalized creation. Through deep learning algorithms, automatically generate images with artistic style, or perform style transfer, color adjustment, and other processing on existing images to present unique visual effects in the work. At the same time, it can also analyze a large amount of music data, learn the rules and techniques of music creation, and automatically generate music works with artistic value. Multimedia computer-aided interaction systems are playing an increasingly important role in vocal teaching. Especially based on speech recognition technology, it provides new teaching methods and possibilities for vocal teaching. Zhou and Gong [16] discussed the optimization of a multimedia computer-aided interaction system for vocal teaching based on speech recognition in order to provide useful references for the progress and development of vocal teaching. Speech recognition accuracy is a key factor affecting system performance. In order to improve recognition accuracy, the following measures have been taken: firstly, to optimize the algorithm model and enhance the recognition ability of the model by introducing advanced technologies such as deep learning. The second is to increase training data and enrich the training materials of the model by collecting more vocal teaching corpora. The third is to provide real-time feedback and adjustments and continuously optimize the model based on user feedback and usage.

To sum up, the research on new media art and CAD has achieved remarkable results, which provides a valuable reference for related fields. However, with the development of science and art, this field still faces challenges. Therefore, we need to continue to deepen research and promote the integration and innovation of new media art and technology.

3 THEORETICAL BASIS AND KEY TECHNOLOGIES

3.1 Theoretical Basis

(1) New media art theory

As a combination of digital technology and artistic creativity, the theoretical basis of new media art covers many disciplines, such as art, computer science, and communication. In terms of art, new media art inherits the aesthetic concept and creative techniques of traditional art, and at the same time, it incorporates modern scientific and technological elements, forming a unique artistic style and expression form. In computer science, new media art relies on the support of computer technology and algorithms and realizes the digital creation, storage, and dissemination of works of art. In communication, the new media art has realized the widespread and real-time interaction of works of art with the help of the Internet and new media platforms.

(2) Intelligent optimization algorithm theory.

The intelligent optimization algorithm is a search algorithm that draws inspiration from natural or human intelligent behaviour. It excels at locating the optimal or near-optimal solution within intricate search spaces. By simulating natural evolution or human intelligence, these algorithms can swiftly resolve problems. In new media art, intelligent optimization algorithms play a pivotal role in enhancing artistic elements like layout, colour, and dynamic effects. This, in turn, elevates the expressiveness of the artwork and enriches the audience's aesthetic experience.

3.2 Key Technology

(1) CAD Technology

CAD technology leverages computer systems and software to aid in the design process. In new media art, this technology is extensively utilized for creating and refining artistic works. CAD enables artists to effortlessly conceive, design, and revise their creations, significantly enhancing both the efficiency and quality of the artistic process. Additionally, its support for various file formats facilitates the seamless storage and dissemination of artistic works.

(2) Multimedia Interactive Technology

Multimedia interactive technology facilitates information exchange and interaction between humans and computers, as well as between computers themselves, through specialized systems and equipment. In the realm of new media art, this technology plays a pivotal role in the exhibition and interactive engagement with artistic works. Audiences can delve deeper into the creative process and experience a richer, more diverse aesthetic journey through multimedia interactivity. Furthermore, a wide array of interactive modes and devices, such as touch screens, sensors, and virtual reality equipment, offer viewers a plethora of engaging options.

(3) Intelligent Optimization Algorithms in New Media Art

The integration of intelligent optimization algorithms into new media art is crucial for bridging the gap between art and technology. By aligning with the unique characteristics of new media art and audience preferences, tailored algorithms can be developed. These algorithms can refine key artistic elements, such as layout, colour, and dynamic effects, delivering a more intelligent and personalized interactive experience. Moreover, they can adjust the dynamics of the artwork based on real-time audience feedback, thereby amplifying the audience's sense of immersion. Achieving these functionalities demands proficiency in algorithm principles, implementation techniques, and customized development tailored to specific use cases.

3.3 Multimedia Interactive Technology and Intelligent Optimization Algorithm

As new media art continues to thrive and evolve, multimedia interactive technology emerges as a pivotal tool for artistic experimentation and advancement. Intelligent optimization algorithms have shown remarkable advantages in solving complex optimization problems. This section will discuss in detail how to apply MOGA to CAD under the new media art to realize the intelligence and optimization of multimedia interactive technology. New media works of art usually combine images, sounds, dynamic effects and other elements, requiring the audience to interact with them highly. This interaction not only increases the attraction and immersion of artistic works but also brings many challenges to multimedia interaction technology. For example, how to balance the presentation effect between different media elements, how to adjust the expression form of works in real-time according to the audience's behaviour and feedback, and how to ensure the fluency and stability of the interaction process.

Traditional multimedia interactive technology often relies on the designer's experience and intuition for manual adjustment. This method is not only inefficient but also difficult to ensure the performance effect of the work in different scenes and audience groups. Therefore, there is an urgent need for an intelligent algorithm that can automatically optimize the effect of multimedia interaction. MOGA is a biologically inspired optimization algorithm that mimics natural selection and genetic processes to efficiently search for the best solution within a given solution space. Unlike the traditional single-objective optimization algorithm, MOGA can deal with multiple optimization objectives at the same time and find a balanced state among them. This characteristic makes it especially suitable for dealing with problems involving multiple conflicting optimization goals in new media art.

MOGA represents the solution of the problem as a chromosome (that is, a candidate solution) by coding and then initializing a chromosome population. In the process of evolution, the algorithm performs selection, crossover, and mutation operations according to the fitness value of chromosomes (that is, the value of an objective function) to generate new chromosome populations. Through an iterative evolution process, the algorithm can finally find a set of optimal solutions that perform well on multiple objectives.

In every generation of the GA, let $s_{\max}$ represent the fitness value of the best sequence, $\bar{s}$ denote the average fitness value among all sequences and s signify the fitness value of any given sequence. Subsequently, the crossover probability P_c and mutation probability P_m for that particular sequence are determined as follows:

$$P_c = \begin{cases} \dfrac{k_1 \ s_{\max} - s}{s_{\max} - \bar{s}}, & s \geq \bar{s} \\ k_3, \quad s < \bar{s} \end{cases} \tag{1}$$

$$P_m = \begin{cases} \dfrac{k_2 \ s_{\max} - s}{s_{\max} - \bar{s}}, & s \geq \bar{s} \\ k_4, \quad s < \bar{s} \end{cases} \tag{2}$$

$$k_1, k_2, k_3, k_4 \leq 1 \tag{3}$$

Drawing from past experiences, throughout the entire evolutionary process, it is observed that the crossover probability should progressively diminish as the number of evolutionary algebras increases, ultimately stabilizing at a fixed value. This study employs an adaptive approach to adjust the crossover probability accordingly:

$$P_c = \frac{1}{2 + 0.8 \ln G} + \varphi \tag{4}$$

Let G represent the number of evolutionary algebras and φ denote the convergence limit for the crossover probability.

As a special coding method of the second chromosome, the resource allocation matrix is coded by real numbers. The scale of the matrix is $N_s * N_j$, and all the values in it fall within the range of [-1,1]. The values in the matrix are directly proportional to their priorities; that is, the larger the values, the higher the priorities. Figure 1 shows a schematic diagram of this concept.

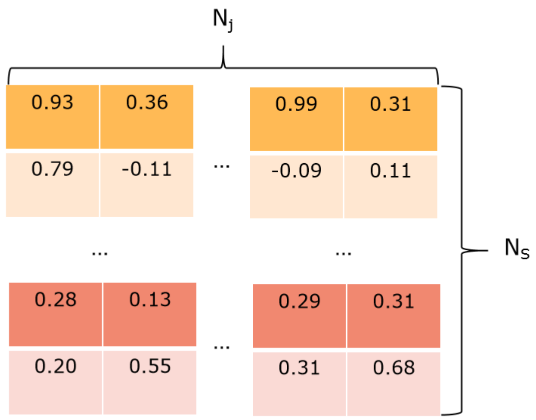


Figure 1: Schematic diagram of resource allocation matrix coding.

Aiming at the CAD demand under the new media art, we propose an optimization model of multimedia interaction technology based on MOGA. The model aims to achieve the best performance of works of art in different scenes and audience groups by automatically adjusting multimedia elements's parameters and interactive logic. The operation flow of the algorithm is shown in Figure 2.

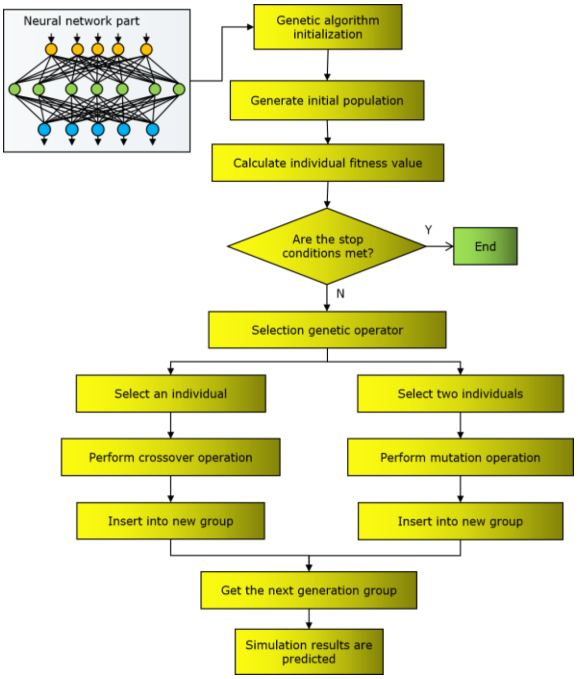


Figure 2: MOGA operation process.

First, we need to define the objective function of the optimization problem. In new media art, these goals may include maximizing the audience's immersion, minimizing the interaction delay, and ensuring the visual and auditory effects of the work. Secondly, the decision variables of the optimization problem need to be determined. By adjusting the values of these variables, the expressive forms and interactive effects of works of art can be changed. In the process of evolution, according to the fitness value of chromosomes, selection, crossover and mutation operations are carried out to generate new chromosome populations. In order to evaluate the fitness value of chromosomes, it is necessary to design an appropriate evaluation function that can comprehensively consider multiple optimization objectives and give a comprehensive score. Finally, through an iterative evolution process, a group of optimal solution sets with good performance on multiple objectives is found. These optimal solution sets correspond to different multimedia element parameters and interactive logic configuration schemes. Figure 3 shows the multimedia interactive interface.

Figure 3: Multimedia interactive interface.

Employing a weighted SVM classification approach to rectify classification biases stemming from imbalanced sample sizes:

$$\min \phi(x) = \frac{1}{2}\|\omega\|^2 + C\lambda_i \sum_{i=1}^{l} S_i \xi_i \tag{5}$$

$$\begin{aligned} & s \cdot t \cdot y_i (\omega_{xi} + b) \succ 1 - \xi_i \\ & \xi_i \geq 0 \end{aligned} \tag{6}$$

In the given context: λ_i $(\lambda \geq 1)$ represents the weight assigned to class i, particularly when $\lambda_i > 1$ signifies a limited number of samples in class i; s_i $(s_i > 0)$ denotes the weight accorded to sample x. Furthermore, $s_i > 1$ serves as an indicator of x_i's significance, while $s_i = 1$ signifies that x_i holds general importance. Conversely, $s_i < 1$ indicates that the sample x is of lesser importance.

The accuracy of classification is impacted by adjusting both the class weight, denoted as λ_1, and the sample weight, represented as s_i. These adjustments aim to minimize classification errors and enhance the overall reliability of the classification process. The Lagrange function corresponding to the aforementioned optimization problem is as follows:

$$L(w,b,\xi,\alpha,\beta)=\frac{1}{2}\|w\|^2+C\sum_i\xi_i$$
$$+D\sum_i v_i\cdot G_i-\sum_i\alpha_i\left(y_i\left(w\cdot x_i+b\right)-1+\xi_i\right)-\sum\beta_i\xi_i \tag{7}$$

Let $\alpha'=\left(\alpha'_1,\ldots,\alpha'_l\right)^T$ represent any potential solution to the given problem, select a positive component α' to derive the normal vector w' and determine the optimal classification threshold b' for the hyperplane.

$$w'=\sum_i\alpha'_i y_i x_i-D\sum_i T_i*G_i$$
$$b'=y_i-\sum_i y_i\alpha'_i\left(x_i\cdot x_j\right)+D\sum_i x_j\cdot\left(T_i*G_i\right) \tag{8}$$

Thus, for any given unknown class sample x, its discriminant function is:

$$f(x)=\sum_i\alpha'_i y_i\left(x_i\cdot x\right)+b' \tag{9}$$

4 ALGORITHM SIMULATION TEST

The core goal of this study is to verify the effectiveness of multimedia interactive technology and intelligent optimization algorithms of CAD. In order to achieve this goal, the accuracy and consistency of data are very important. Therefore, preprocessing the collected data sets of new media art has become one of the key steps in the research. Figure 4 shows the process of data outlier removal. Outliers are often regarded as noise or interference in data analysis, which may be caused by errors in data acquisition, equipment failures, human errors and other reasons. If these abnormal values are not handled, it is likely to mislead the subsequent data analysis and lead to the analysis results deviating from the real situation.

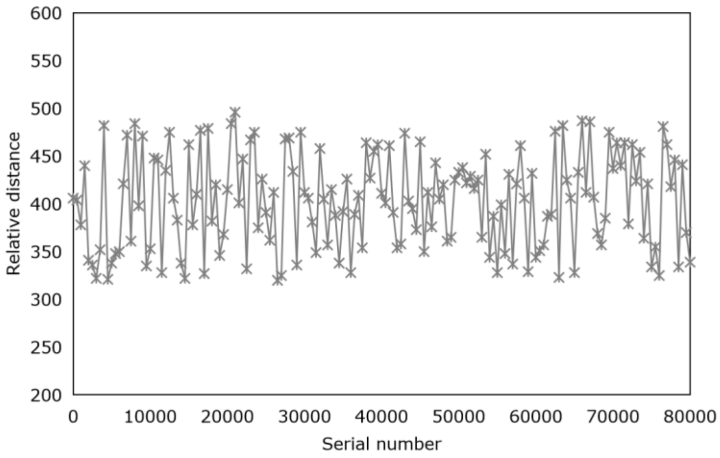


Figure 4: Data de-outlier processing.

The realization of this step may involve a variety of statistical methods and technologies, such as data cleaning, data screening, data transformation and so on. The utilization of these methodologies aids in pinpointing and eliminating abnormal values that deviate significantly from the standard data distribution, thereby bolstering the dataset's precision and dependability. Following outlier treatment, the dataset's quality undergoes notable enhancement. This advancement not only lays a firm groundwork for subsequent analytical endeavours but also offers more precise data support for validating the efficacy of CAD multimedia interaction techniques and intelligent optimization algorithms.

Subsequently, an optimization model grounded in user attributes and information entropy is trained using the preprocessed dataset. This model acquires the ability to anticipate users' ratings for new media art based on their characteristics and information entropy through this training process. Test samples are employed to assess the model's performance, and a comparison is drawn between the predicted and actual ratings.

To substantiate the model's efficacy, two optimization algorithms—MOGA and PSO—are employed to predict the test samples. A scatter plot illustrates the relationship between the predicted and actual values. Specifically, Figure 5 depicts the scatter plot of the test sample predictions using MOGA. The plot reveals a concentrated scatter distribution, with most points clustering near the diagonal. This indicates that the model exhibits strong predictive accuracy, suggesting that MOGA adeptly handles multi-objective optimization challenges within new media artwork datasets, extracts pertinent features, and constructs a reliable prediction model.

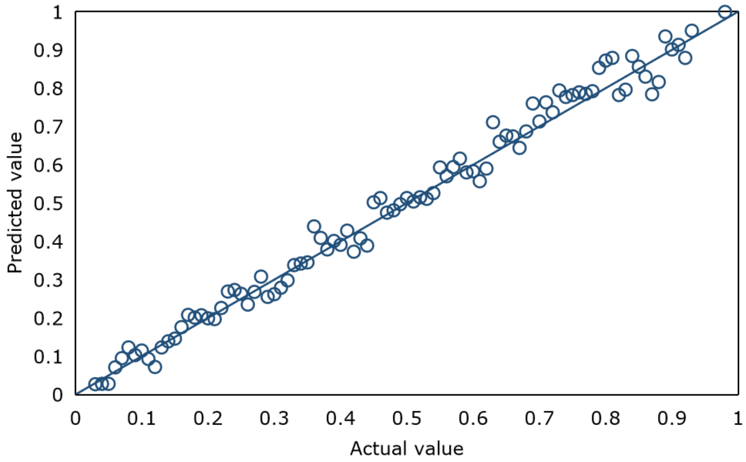


Figure 5: Scatter plot of predicted value and actual value of MOGA.

The PSO-based optimization model was employed for testing to facilitate comparison with other algorithms. As Figure 6 demonstrates, it illustrates the scatter plot comparing the predicted and actual values of the test sample using the PSO algorithm. Compared with Figure 5, it can be found that the distribution of scattered points in Figure 6 is relatively scattered, and some scattered points obviously deviate from the diagonal. This shows that the accuracy of the PSO algorithm in forecasting scores is relatively low, and there are some errors.

Upon comparing Figure 5 and Figure 6, it becomes evident that the MOGA-based model proposed in this article outperforms the PSO algorithm in terms of classification accuracy. This is primarily due to MOGA's robust global search capabilities and superior convergence when tackling multi-objective optimization challenges. MOGA adeptly balances multiple optimization objectives, yielding more precise prediction outcomes. Conversely, the PSO algorithm may struggle with complex optimization tasks, sometimes converging prematurely on local optima, thereby compromising prediction accuracy. Classification accuracy serves as a pivotal metric for gauging an algorithm's performance, reflecting its proficiency in accurately categorizing multimedia resource data. In today's rich multimedia resources, it is particularly important to classify images, audio, video and other data effectively. Figure 7 shows the comparison results of classification accuracy of different algorithms in multimedia resource data analysis. MOGA performs well in classification accuracy and has obvious advantages compared with other algorithms.

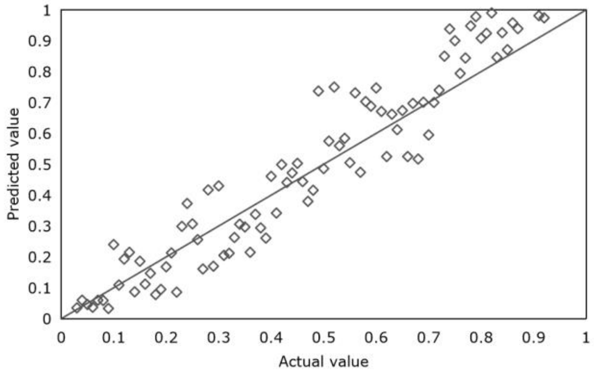
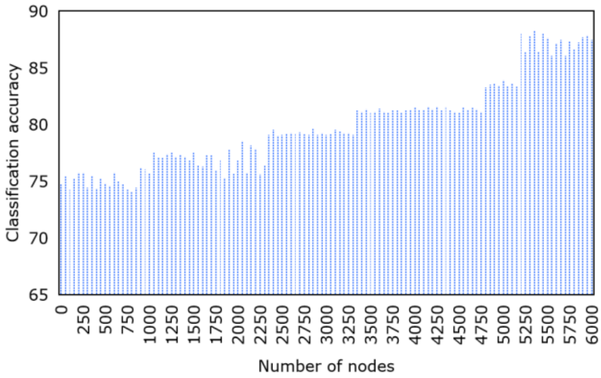
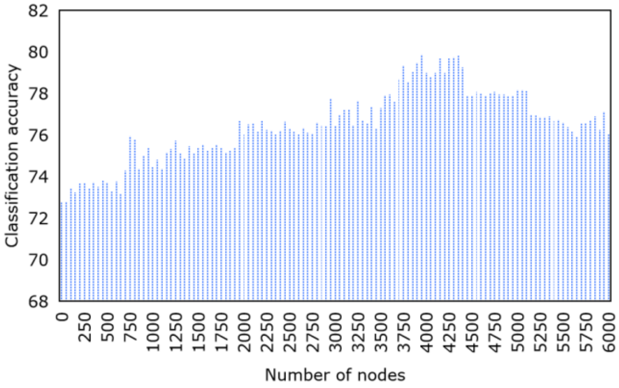


Figure 6: Scatter plot of predicted value and actual value of PSO algorithm.



(a) MOGA



(b) PSO

Figure 7: Comparison of classification accuracy of different algorithms.

The reason why MOGA is superior to other algorithms in classification accuracy is mainly due to its powerful global search ability and balanced optimization ability for multiple targets. When dealing with multimedia resource data, it is often necessary to consider multiple interrelated or conflicting goals, such as classification accuracy and calculation efficiency. Through the simulation of natural selection and genetic processes, MOGA effectively navigates the solution space in pursuit of the optimal outcome while considering multiple objectives, thereby achieving more comprehensive and precise classification results.

Beyond classification accuracy, the MAE and recall rate serve as significant metrics for assessing algorithm performance. This study contrasts the MOGA and PSO algorithms' performances in these areas, visualizing the comparisons in Figures 8 and 9. Figure 8 reveals that the MOGA approach introduced in this article exhibits a notably lower MAE compared to the PSO algorithm. This means that the error of MOGA in predicting multimedia resource data is smaller, and the prediction result is closer to the actual value.

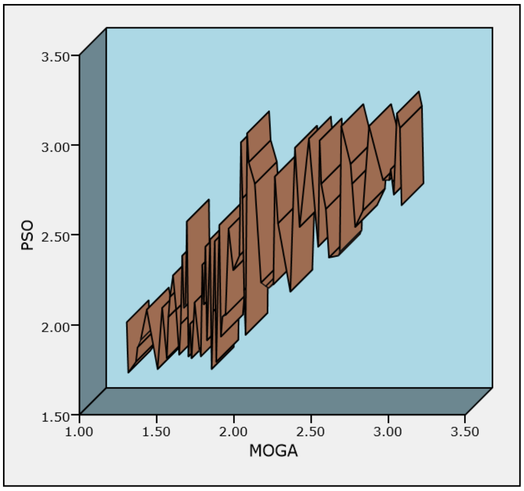


Figure 8: MAE comparison.

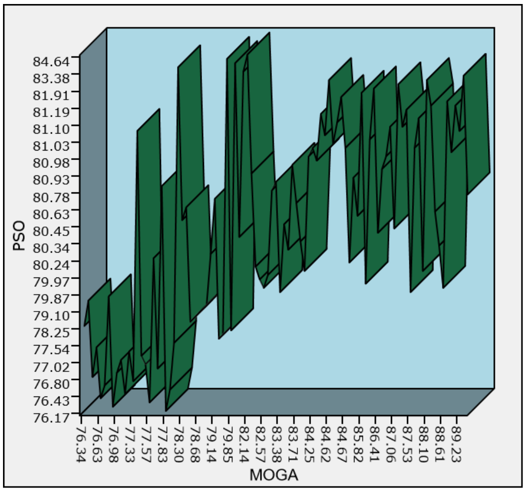


Figure 9: Comparison of recall rates.

Figure 9 shows the comparison results of recall between MOGA and PSO. Compared with the PSO algorithm, the recall rate of this method is significantly improved. This means that MOGA is more accurate in identifying positive examples in multimedia resource data and can reduce the situation of missing reports.

The results further verify the effectiveness and accuracy of MOGA in processing multimedia resource data analysis. In future work, we can consider further optimizing MOGA to improve its practical application effect in multimedia interactive technology. At the same time, we can also explore the possibility of applying MOGA to other related fields to promote the wider application of intelligent optimization algorithms.

5 CONCLUSIONS

This study is devoted to verifying the effectiveness of multimedia interactive technology and intelligent optimization algorithms of CAD, especially paying attention to the application of MOGA. By preprocessing the data set of new media art, the accuracy and consistency of the data are ensured, which lays a solid foundation for subsequent analysis. The results show that MOGA performs well in prediction scoring, and the scatter plot of the predicted value and the actual value is closely distributed around the diagonal, which proves the high accuracy of the model. Compared with the PSO algorithm, MOGA is superior in classification accuracy, which is due to its powerful global search ability and multi-objective balanced optimization ability. Further analysis shows that the MAE of MOGA is obviously lower than that of PSO, which shows that its prediction result is closer to the real value. At the same time, MOGA has also significantly improved the recall rate, which shows that it is more accurate in identifying positive examples and helps to reduce the number of missing reports in practical applications.

To sum up, this study successfully verified the effectiveness of the optimization model of multimedia interaction technology based on MOGA. This model shows superiority in many aspects, such as prediction score, classification accuracy, MAE and recall rate, and provides a new powerful tool for CAD in the field of new media art. In the future, we will continue to explore more application scenarios of MOGA in multimedia interactive technology and strive to optimize the performance of the algorithm further so as to promote the wider application of intelligent optimization algorithms in related fields.

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