The Impact of Artificial Intelligence for Computer Graphics on Animation Ontology Cognition and Its Future Development

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Abstract:
Animation belongs to a thing closely combined with technology, and its ontology cognition will be affected by technological innovation. The combination of artificial intelligence and computer graphics, referred to as AICG, will have some significant impact on animation ontology cognition, enhance the importance of animation technology ontology, empower animation content expansion and process, and promote technological innovation and interdisciplinary research. Based on this, based on AICG, this paper analyzes the application of AICG in animation creation, constructs PFNN model, intelligently generates animation actions, and describes the principle and main structure of PFNN action generation model. Finally, it shows the future development trend of AICG participating in animation creation, and promotes the deeper integration of AICG technology and animation creation.

Keywords: artificial intelligence for computer graphics; animation; ontological cognition; influence; future development.

INTRODUCTION

Artificial Intelligence for Computer Graphics (AICG) mainly refers to the content generated by artificial intelligence technology, including but not limited to text, pictures, videos, music, etc., which covers the process of automatically creating new content by AI technology such as machine learning and deep learning [1]. Animation ontology cognition refers to the definition, essential characteristics, expression forms, creation rules, aesthetic language and other aspects of animation, belonging to the unique aesthetic characteristics and expression means of animation [2]. With the innovation and application of AICG technology in recent years, its application in animation creation is becoming more and more extensive. Based on this, this paper analyzes the impact of AICG on animation ontology cognition, and looks forward to the future prospects of AICG participating in animation creation.

AICG'S INFLUENCE ON ANIMATION ONTOLOGY COGNITION

Elevate the Importance of Animation Technology Ontology

In the traditional animation creation process, animation technology ontology has been the cornerstone of animation creation. However, with the rapid development of AICG technology, the ontology cognition of animation technology has gradually been paid attention to. Unlike traditional animation, which relies mainly on manual rendering and image post-processing, AICG technology makes the technical ontology of modern animation prominent [3]. Animation production through AICG technology, the use of deep learning, machine learning and other technologies, reduce a large number of manual production links, can present a richer, more delicate animation characters, greatly improve the quality of animation production. Moreover, the introduction of AICG into animation production has also greatly lowered the technical threshold for animation production and given a large number of non-professional animation creators more opportunities to participate in production [4]. Some animators use AICG-related design tools to create free animation content. Under this background, the importance of animation technology itself is gradually revealed. Professional animators can use AICG technology to reduce production costs and improve production quality, while the participation of non-professional animators further expands the cultural diversity of animation and produces more excellent and rich animation works. For example, Glenn Marshall, an Irish AI computer artist, used CLIP's AI model to transform AI with a dancer's dance as the theme to generate a new image of "crow dancing on the wasteland", as shown in Figure 1. The AI animated film Crow won the Best Short Film Award at the Cannes Film Festival 2022.

Empowering Animation Content Expansion and Flow

AICG technology not only changes the way animation is made, but also provides new possibilities for content expansion. Animation creators through algorithmic generation and intelligent recommendations, AICG technology can explore a wider range of story lines and character settings, driving a variety of animation content creation. In addition, the application of AICG in various aspects of animation production, such as automated image processing and real-time rendering, greatly improves the efficiency of animation production, and also enables creators to focus more on animation creative production and deep mining of content, thus bringing richer types of works to the animation industry and further meeting the diverse needs of viewers for animation content. On the other hand, AICG technology through advanced algorithms, machine learning capabilities, etc., so that animation production to achieve the previous technology can not achieve the complexity and detail of the picture. Traditional animation relies on frame-by-frame shooting and persistence of vision principles to simulate motion. Based on the traditional frame-by-frame shooting and persistence of vision principles, AICG technology automatically generates coherent animation frames through a deep learning model, thereby presenting better and more complex animation scenes [5]. At the same time, AICG technology can also realize the parsing of natural language and transform it into animated visual elements, which can broaden the cognitive boundaries of animation ontology to a great extent.

Figure 1. AI animation "crow" screenshot

Advancing Technological Innovation and Interdisciplinary Research

The application of AICG has further promoted technological innovation and interdisciplinary research in the field of animation. In order to achieve a higher level of animation generation, researchers need to combine computer science, art design, psychology, film production and other disciplines of knowledge, not only to promote the progress of AICG technology, but also for animation creation brought new perspectives and inspiration [6]. The application of AICG technology greatly enriches the expression methods and effects of animation. Through advanced calculation models and algorithms, AICG can create visual effects that are difficult to achieve in the past, such as extremely realistic light and shadow effects, complex natural phenomena simulation, such as water, fire, smoke, etc. In addition, animation creators can combine psychological user experience research to fully collect and interpret the emotional data of the audience, so as to better understand the emotional needs of the audience, so as to make targeted adjustment and optimization in animation content creation.

In addition, the application of AICG in animation has also stimulated new research fields, such as the application of machine learning algorithms in character animation, the exploration of generative adversarial networks (GAN) in animation image generation, etc., which provide new impetus for the development of the animation industry in the future [7].

APPLICATION CASES OF AICG PARTICIPATING IN ANIMATION CREATION

AICG participates in animation creation. Taking animation character design as an example, it can generate diversified character images and actions by using automatic generation confrontation network, which can not only improve the efficiency of animation character design, but also stimulate the creative inspiration of animation creators [8]. At the same time, AICG's participation in animation creation can also help creators realize dynamic generation, adjust the movements and characters of animated characters in real time, further improve the expressiveness of animated characters and enhance the immersion experience of viewers. Taking animation character action generation as an example, this paper analyzes the application of AICG in animation creation.

Agent Action Generation

The core of AICG's participation in animation creation is to create a real-time data-driven action generation model, so that the agent character can get natural, smooth and diverse actions to control the generation of character animation after making autonomous behavior decisions. The difficulty with this motion process is that there is a large amount of high-quality motion capture data available to process. Considering that the data is nonlinear, in order to make the animated character automatically adapt to the environment to generate actions, Holden et al. proposed a phase function neural network (PFNN), which can map the control information of the joystick as input to the actions of the animated character [9]. This model uses a phase function to generate variables representing the period of motion as weights for the regression network for each frame. Once generated, these weights are used in a neural network to generate a character pose for the current frame that matches the control parameters in real time. PFNN also solves the drift problem by post-watering the feet. Therefore, this paper uses PFNN model to generate agent action, and its flow is shown in Figure 2:

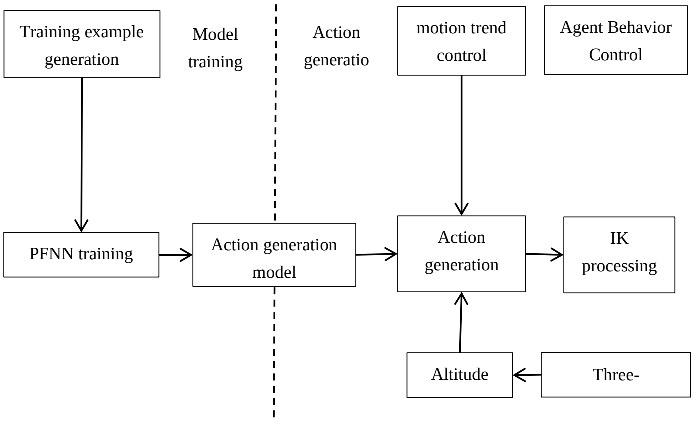

Figure 2. Agent action generation flow

The concrete flow scheme mainly includes two parts: (1) model training, which uses a large amount of motion capture data to train the model and obtain the animation motion generation model; (2) Action generation: using the trained action generation model to obtain the terrain height in the three-dimensional scene, obtaining the motion trend control from the behavior control module in the behavior modeling of the agent, and inputting the action generation model to obtain the generated action[10].

Model Construction

The basic idea of PFNN model agent action generation is to generate periodic weight variables through a phase function as neural network weights, so as to predict the current frame of character action. There are three stages: (1) Preprocessing stage: firstly, preprocess the data set and extract the control parameters provided by the agent character automatically. (2) PFNN is trained on the preprocessed data in training phase; (3) PFNN input parameters are obtained from agent characters and virtual 3D environment in operation phase, and are transmitted to network model as inputs, so as to obtain the motion posture of the character in current frame [11].

The neural network structure: given input parameters $x \in R^n$, output parameter $y \in R^m$ y, phase parameter $p \in R$, Construct a three-layer neural network with the following formula:

$$\Phi(X;\alpha) = W_2 ELU(W_1 ELU(W_0 x + b_0) + b_1) + b_2 \tag{1}$$

Network parameters α be defined as $\alpha = \{W_0 \in R^{h\times h}, W_1 \in R^{h\times h}, W_2 \in R^{m\times h}, b_0 \in R^h, b_1 \in R^h, b_2 \in R^h\}$。 where h is the number of cells in the hidden layer and is set to 512, The activation function uses exponential linear units (ELUs).

Phase function: In the PFNN agent action generation process, the network weights are determined by phase p and parameters β Compute the phase function for the input, which is also a Gaussian process or another neural network, using Catmull-Rom spline functions, where each control point represents a certain weight configuration of the neural network, and the function Θ performs smooth interpolation between the neural network weights.Given four control points $\beta = \{\alpha_0, \alpha_1, \alpha_2, \alpha_3\}$, Catmull-Rom spline function Θis defined as follows:

$$\begin{gathered}\Theta(p;\beta) = \alpha_{k_1} + w\left(\frac{1}{2}\alpha_{k_2} - \frac{1}{2}\alpha_{k_0}\right) \\ +w^2\left(\alpha_{k_0} - \frac{5}{2}\alpha_{k_1} + 2\alpha_{k_2} - \frac{1}{2}\alpha_{k_3}\right) \\ +w^3\left(\frac{3}{2}\alpha_{k_1} - \frac{3}{2}\alpha_{k_2} + \frac{1}{2}\alpha_{k_3} - \frac{1}{2}\alpha_{k_0}\right) \\ w = \frac{4p}{2\pi} (\mathrm{mod}\ 1)\end{gathered} \tag{2}$$

$$K_n = \left\lfloor \frac{4p}{2\pi} \right\rfloor + n - 1 (\text{mod } 4)$$

Loss function: Assume that the input and output of the ith frame are xi, yi, phase pi, matri $X = [x_0, x_1 \cdots]$, $Y = [y_0, y_1 \cdots]$, $P = [p_0, p_1 \cdots]$, The loss function of PFNN is defined as follows:

$$\text{Cost}(X, Y, P; \beta) = ||Y - \Phi(X; \Theta(P; \beta))|| + \gamma|\beta| \quad (3)$$

where the first term is the mean square error of the network output and the true value, and the second term is the regularization term, γ is the regularization coefficient, set to 0.01.

Action Generation

Regarding the input/output of PFNN and the corresponding features to be extracted, for each frame i, the system needs phase p to calculate the network weights. The input xi to the network model also includes control parameters of motion, pose of motion of the character in the last frame, and environmental parameters. The corresponding output yi, including the motion state of the character in the current frame, the phase change, the displacement of the root node, the motion trajectory of the next frame and the mark of whether the foot joint touches the ground, is used for IK post-processing [12].

Dropout and LI regularization are used to suppress overfitting during model training, which takes approximately 6 hours on NVIDIA GeForce Titan X GPUs, and the PFNN network hyperparameters are described in Table 1.

Table 1. PFNN hyperparameters

Name of parameter	Parameter choice
Learning rate	0.0001
Batch size	32
Epoch	20
Dropout	0.7
Regularization coefficient	0.01

The data set used here is the data set collected by PFNN, and the types of actions include walking, running, squatting and jumping, etc., and the display effect part is shown in Figure 3.

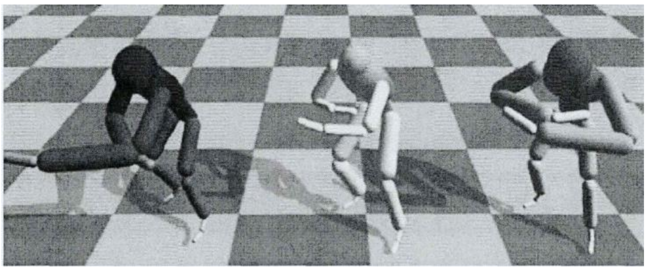

Figure 3. Example of action effect display

ANALYSIS OF THE FUTURE DEVELOPMENT OF AICG PARTICIPATION IN ANIMATION CREATION

Combined with the above analysis, AICG participation in animation creation is the trend, but AICG will have a significant impact on animation ontology cognition. In order to improve the quality of animation creation and avoid falling into the strange circle of excessive technology stacking, AICG should pay attention to the reasonable treatment of the unity of technology and art, animation double ontology, animation consciousness theory, etc. in the future, so as to protect the sustainable development of China's animation industry.

Unification of Technology and Art

The advancement of AICG technology has greatly lowered the threshold for animation creation, and the popularity of AICG technology has enabled more non-professional creators to participate in animation production, bringing rich creative expression and diverse narrative methods [13]. However, the rapid development of AICG technology also brings new challenges, whether the content generated by AICG can truly reflect the artistic depth and emotion of animation creation. Although machines can simulate beautiful images and characters, whether technology can understand human emotions and cultural backgrounds and automatically generate creative works with depth is still controversial in the animation industry [14]. Therefore, the future of AICG's participation in animation creation needs to find a balance between technology and art, emphasizing the deep cooperation between AICG technology and animation creators, using AICG to improve the efficiency of animation creation, and at the same time integrating the artistic ideas of creators into machine-generated content, rather than relying solely on technology or art, but organically combining the two to achieve higher levels of animation creation [15].

Animated Double Ontology

When discussing the future development of AI-generated content (AICG) in animation creation, the dual ontology of animation provides us with an important theoretical framework. The dual ontology emphasizes the dual attributes of animation as an art form, namely "technical ontology" and "artistic ontology" [16]. Technical ontology focuses on tools, techniques and methods in the animation process, while artistic ontology focuses on emotion, narrative and aesthetics of creation [17]. The introduction of AICG makes the relationship between the two more complex, but it also provides new possibilities for their combination. Animation biontology provides a new perspective for us to understand AICG's participation in animation creation. Animation art noumenon should be under the control of "human" consciousness, and maintaining respect and exploration for art noumenon will be the key to ensure the continuous development and innovation of animation creation [18].

Animation Consciousness Theory

Animation ideology emphasizes the ideology, cultural background and emotional expression embodied in the animation creation process. The core of this theory is that despite technological advances, the ultimate goal of animation is to convey thoughts and emotions, reflecting human experiences and values [19]. With the participation of AICG, animation creators need to pay more attention to the combination of their own creative consciousness and technology. Animation consciousness theory holds that the animator's unique perspective and cultural background are the soul of the animation work [20]. Although AICG can provide technical support and efficiency improvements, animators still need to maintain control of content and emotional communication throughout the creative process. This means that the future animation creation will no longer be a simple opposition between technology and art, but a deep fusion of the two.

CONCLUSION

In summary, AICG has a profound and extensive impact on animation ontology cognition, which not only enhances the importance of animation technology, empowers the expansion and flow of content, but also promotes animation technology innovation and interdisciplinary research. In the future animation creation, human-computer collaboration will become a normal state. AICG is not to replace human creators, but as an auxiliary tool to help creators improve the efficiency and quality of animation creation. With effective collaboration, animation creators can take advantage of AICG technology while maintaining control over the creative process. This collaborative relationship requires a closer connection between creators and technology to achieve optimal creative results. However, with the continuous maturity of AICG technology, related ethical and legal issues have become increasingly prominent. How to protect the copyright of creators and prevent the content generated by AICG from infringing the intellectual property rights of others will be an important issue to be solved in the future. In the future, AICG's participation in animation creation needs to establish a clear ethical and legal framework, which not only helps to safeguard the rights and interests of creators, but also ensures the healthy development of animation industry.

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