

Research on Game Virtual Character Behavior Decision Driven by Artificial Intelligence Algorithms

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Abstract. Online games have achieved sustained and rapid growth in various aspects such as game variety, quantity, genre, market size, and number of practitioners. The significance of behavioral Decision model is to make virtual roles have the ability to be as similar as possible to the behavior of real entity objects. Therefore, this article attempts to conduct research on AI (Artificial Intelligence) algorithmic driven game virtual character behavior decision-making. Research has shown that the algorithm proposed in this paper can train states in a stable state space faster in behavioral decision-making experiments. In the early learning stage, the advantages of the algorithm are not obvious. With the progress of learning, the Rate of convergence of the algorithm will gradually accelerate. On the whole, the Rate of convergence of the algorithm in this paper is higher than that of ACA (Ant Colony Algorithm) algorithm. This article takes virtual football competition as an example to construct a virtual football competition scene and conduct research on the behavior decision-making module of virtual players participating in football competition. The aim is to make virtual players have a certain degree of autonomy and intelligence, and their behavior decision-making module has a good sense of reality.

Keywords: Artificial Intelligence Algorithms; Game Virtual Characters; Behavioral Decision-Making.

1. Introduction

With the emergence of virtual reality, users will not be limited by time and space. Modeling and displaying the objects that exist objectively or fictionally in reality will enable people to simulate and observe some problems that have occurred in reality or are likely to occur at some time in the future according to their own needs. By simulating such a virtual environment, the laws of things' development and the phenomena generated will be analyzed, providing valuable conclusions for the real world. At this stage, China's online game industry presents a fast and stable development trend, the industrial chain is becoming more and more perfect, and the development environment of the industry is becoming more and more mature [1]. Online games have achieved sustained and rapid growth in game variety, quantity, theme type, market scale and the number of employees. The significance of behavior decision model is to make virtual characters have the ability to behave as similar as possible to real entity objects. When faced with practical problems, many studies often involve human beings, such as teaching experiments, medical simulations, drills in various practical links, etc., all of which need to consider the relationship between users and virtual reality and the understanding and cognitive ability of virtual characters to different situations [2]. AI is a new technical science that studies and develops theories, methods, technologies and application systems for simulating, extending and expanding human intelligence. It belongs to a branch of computer science, which attempts to explain the essence of human intelligence and create a new intelligent machine that can respond in a way similar to human intelligence. The game runs in real time, so it is very important to maintain a stable frame rate during the whole game. However, technical problems such as pathfinding and behavior decision-making just need to consume a lot of CPU and memory resources, which brings certain difficulties to the development of game pathfinding and behavior decision-making technology [3-4]. In order to meet the increasing demands of players on all aspects of the game, survive in the fierce competition, and even stand out, game development technology is constantly developing and improving. In this paper, taking virtual soccer Athletics as an example, we build a competitive scene in virtual soccer, and study the behavior decision-making module of virtual

players who participate in football competitions, aiming to make virtual players have certain autonomy and intelligence, and their behavior decision-making module has a good sense of reality [5]. The picture, sound effect and system have been continuously improved, especially in the picture effect, which has achieved great leap-forward development. Therefore, it is of great practical significance to study the game virtual character behavior decision-making technology of game AI algorithm and apply it to game software development, which will improve the efficiency of game software development and improve the quality of the game [6].

2. Research on Behavior Decision Algorithms for Virtual Characters in Games

2.1. Application of Artificial Intelligence Algorithms in Virtual Character Modeling

AI is the study of intelligent behavior of virtual characters by humans, and is an interdisciplinary field that combines psychology and computer science. AI uses computer science and technology to simulate and extend human intelligence and psychology, achieve biomimetic thinking, and take some reasonable behaviors. It has been widely applied in the behavior modeling of virtual characters [7]. Finite-state machine, as its name implies, is a system composed of finite states. At the same time, virtual characters can only have one state in the state machine, that is, the current character's state. When a Finite-state machine is stimulated by a state change, the state of the role changes from the current state to another state corresponding to the excitation. AI is the use of computer technology to simulate and extend human intelligence and psychology, achieve humanoid thinking, and take some reasonable behaviors. Create virtual characters with trustworthy behavior, enabling them to not only express their emotions, emotions, and emotions, but also perceive the surrounding environment and make the most appropriate behavior in the current environment [8]. Summarize the trusted virtual character behavior modeling framework as shown in Figure 1.

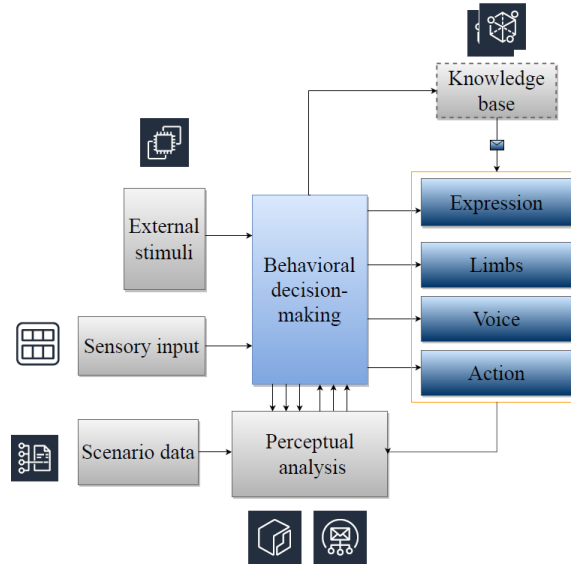


Figure 1. Virtual Character Behavior Modeling

In AI algorithms, due to the fact that when calculating the probability of an individual being selected, it is generally necessary to compare the individual's fitness with the fitness within the population, so the individual's fitness needs to be maintained at a positive value. If the objective function is the minimum problem, then

$$Fit(f(x)) = \begin{cases} C_{\max} - f(x) \\ 0 \end{cases} \quad (1)$$

In the formula, $C_{\max}$ is the maximum estimated value of $f(x)$, which can be an appropriate input value, or the maximum value of $f(x)$ in the ongoing process or the maximum value of $f(x)$ in the

current population can be used. Obviously, there are multiple ways to take the value of $C_{\max}$. If the objective function is a maximization problem, then

$$Fit(f(x)) = \begin{cases} f(x) - C_{\min} \\ 0 \end{cases} \quad (2)$$

In the equation, $C_{\min}$ is the minimum estimated value of $f(x)$. $C_{\min}$ can be an appropriate input value, or the minimum value of $f(x)$ in the current generation or previous K generations, or it can be a function of population variance.

The virtual character in a virtual scene dies while fighting with a player, and the system needs to generate a new virtual character. The new character is generated by genetic algorithm using the previously deceased virtual character as the parent. Through analysis of combat experience, the virtual character can execute new strategies to interact with the user, making it more challenging for the user [9-10].

2.2. Passing Decision

The passing strategy is very important in virtual soccer. Whether it is attacking with the ball or organizing defense, players need to handle the passing carefully. Need to be able to analyze the various situations of the role itself and the game environment in which the role is located, and make a reasonable response to it. It needs to be able to weigh different goals and behavior standards and choose a better solution under bounded rationality. It needs to be rational and humanized, and it needs to show different personality characteristics for different roles or different states of roles. A good passing action can not only interfere with the decision-making of the opposing players, avoid wasting physical strength in fighting with the opposing defenders, but also enhance the interaction among virtual players to a certain extent, and enhance the appreciation of virtual soccer sports. As shown in Figure 2, if player A1 decides to pass the ball to his teammates after investigating the current stadium situation. A1 searched for the two closest players A2 and A3, and found that A3 was marked by an enemy player B3, so A2 with higher security was chosen as the passing object.

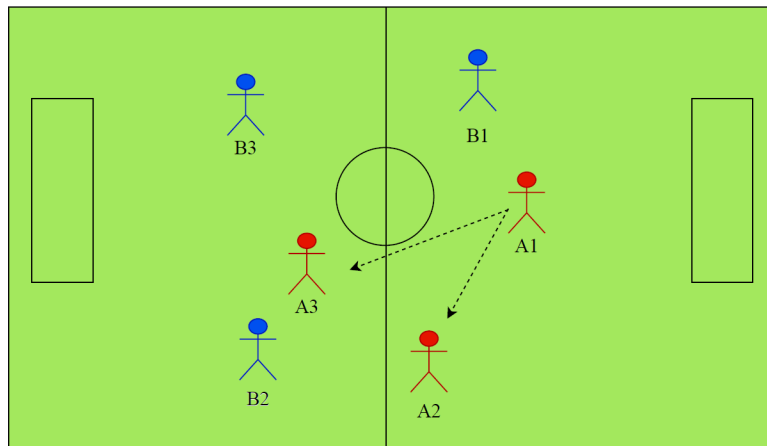


Figure 2. Schematic diagram of passing the ball

After excluding all the enemy players who do not pose a threat, the ball-holding player also needs to calculate whether the remaining local players have the opportunity to intercept the ball. Players don't exist in isolation in the environment. In most cases, they will have partners. Therefore, in addition to independently accomplishing their goals and attacking the enemy, they should also be able to show certain cooperative behaviors. If there is a team or leader, it should also be able to obey the arrangement of the team or leader. If the enemy player wants to intercept the ball, he must run to the vertical intersection of the passing trajectory and his position in advance.

2.3. Shooting Decision

The common goal of virtual players is to win virtual football competitions, and scoring goals is the most important means of winning games. Many of the reasoning in AI is based on imprecise reasoning based on intuitive experience. In games, conditional behavioral production is often used to construct game decision systems. Whether through the tacit cooperation between the entire team or the individual abilities of individual players, the ultimate goal of all actions is to score goals. Virtual players should have the ability to interact emotionally with users, which can enhance the realism of the user experience and help users immerse themselves in the game's plot. Immersive experience has a certain impact on both the user's body and physiology. When people interact with virtual players, their body and mind are fully immersed in the situation, filtering out all irrelevant perceptions and entering a state of immersion, achieving deeper psychological resonance. In general, when the opportunity for shooting arises, the attacking player with the ball often approaches the opponent's baseline and is relatively close to the opponent's defensive player and goalkeeper. This situation is conducive to accurately modeling the local situation. Based on the above situation, using numerical calculation methods that are relatively simple and effective can actually more effectively perform shooting decision-making operations, seize opportunities to score goals. When shooting directly, the first step is to determine whether there is a shooting angle that can score a goal. The general method is to randomly make a certain number of attempts within the goal range to check if there are opposing players intercepting the line. If the line is safe, the goal line with the highest success rate should be taken and the shooting operation should be directly executed to achieve the goal of scoring.

3. Result Analysis

Compared with traditional stand-alone games, the life cycle of virtual games is compared, and players usually spend a long time on a virtual game training. This means that virtual games usually need to design more and more kinds of trained and controlled characters for players to challenge. If the planning cannot conveniently configure the diverse training of the characters, it will greatly affect the playability and sustainability of the game. In order to further verify the effectiveness of the algorithm proposed in this paper, this chapter will compare it through simulation experiments. In the experiment, the number of trained states of two different algorithms changes with the number of training times as shown in Figure 3. Through the experimental comparison, it can be seen that the algorithm in this paper can train the state in the stable state space faster in the behavior decision experiment. In the early learning stage, the advantages of the algorithm are not obvious. With the progress of learning, the convergence speed of the algorithm will gradually accelerate. On the whole, the convergence speed of the algorithm in this paper is higher than that of ACA algorithm.

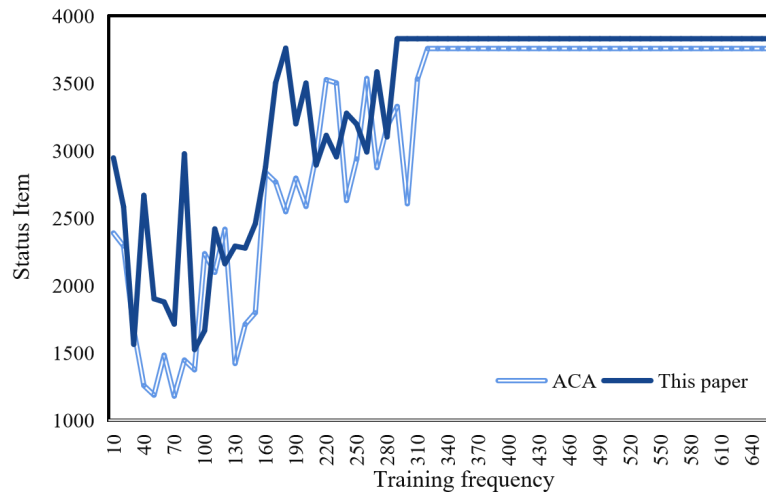


Figure 3. Changes in the number of states of two algorithms with training times

For virtual games, it is always hoped that a single server can simultaneously host as many players as possible. Because in online games, the interaction between players is very important, and the more players interact, the more beneficial the operation of the game. Moreover, if the server can simultaneously carry more players, under the same conditions, it can also reduce the cost of operation. The effectiveness of the algorithm proposed in this paper in game virtual character behavior decision-making can be further verified through simulation experiments.

4. Conclusion

The complexity of virtual reality technology is high, which not only makes users experience real effects in multiple senses, but also ensures the real-time operation of the whole scene. The intelligentization of virtual characters in virtual scenes is a big problem in virtual reality technology, and the related theories and technologies of intelligent virtual characters are not simple, so it is difficult to keep the balance between the authenticity and real-time performance of characters. It has been widely used in behavior modeling of virtual characters. At the same time, the virtual role can only have one state in the state machine, that is, the state of the current role. When the finite state machine is excited by the state change, the state of the role changes from the current state to another state corresponding to the excitation. In this paper, the research shows that the algorithm can train the state in the stable state space faster in the behavior decision experiment. In the early learning stage, the advantages of the algorithm are not obvious. With the progress of learning, the convergence speed of the algorithm will gradually accelerate. On the whole, the convergence speed of the algorithm in this paper is higher than that of ACA algorithm. With the continuous development of online games, modules play an increasingly important role in online game competition. I believe that more developers and resources will be put into the research and application of technology. More and more, better and better technologies will be applied to game projects. We should not only become learners and users of core technologies, but also become research inventors of core technologies.

References

- [1] Abdallah M, Cason T, Bagchi S, et al. The Effect of Behavioral Probability Weighting in a Simultaneous Multi-Target Attacker-Defender Game[J]. *Mathematical Problems in Engineering*, 2021, 55(10):21-33.
- [2] Surti C, Celani A. Newsvendor Game: A Behavioral Exercise in Decision Making under Risk[J]. *Decision Sciences Journal of Innovative Education*, 2019, 17(4):32-48.
- [3] Jiajia W, Zhen L, Tingting L, et al. Uncertainty model to generate virtual characters' behavior in serious games for social training[J]. *Journal of Image and Graphics*, 2019, 31(10):46-72.
- [4] Zhai X, Asmi F, Yuan J, et al. The Role of Motivation and Desire in Explaining Students' VR Games Addiction: A Cognitive-Behavioral Perspective[J]. *Mathematical Problems in Engineering*, 2021, 20(15):48-59.
- [5] Quan-Hoang V, Ho M T, La V P, et al. A Multinational Data Set of Game Players' Behaviors in a Virtual World and Environmental Perceptions[J]. *Data Intelligence (in English)*, 2021, 3(4):24-41.
- [6] Zhai X, Asmi F, Zhou R, et al. Investigating the Mediation and Moderation Effect of Students' Addiction to Virtual Reality Games: A Perspective of Structural Equation Modeling[J]. *Discrete Dynamics in Nature and Society*, 2020, 38(12):22-40.
- [7] Liu Y H. Study on Emotional Improvement and Health Promotion of Senior Citizens Participating in Virtual Reality Games[J]. *Data Intelligence (in English)*, 2022, 16(4):11-23.
- [8] Kbis N, Mossink L. Creative Artificial Intelligence -- Algorithms vs. humans in an incentivized writing competition[J]. *Journal of China Operation Research Society (English)*, 2020, 42(12):33-46.
- [9] Chou Y L, Moreira C, Bruza P, et al. Counterfactuals and causability in explainable artificial intelligence: Theory, algorithms, and applications[J]. *Information Fusion*, 2022, 33(8):8-18.
- [10] Peng Y X, Du S Y, Zeng T Y. Preface: Special Issue on Optimization Models and Algorithms in Artificial Intelligence[J]. *Journal of China Operation Research Society (English)*, 2019, 7(4):3-10.