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A Research on Efficient Skeleton Retargeting Method Suitable for MetaHuman

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Abstract

With the rapid development of 3D animation, MetaHuman is widely used in film production, game development and VR production as a virtual human creation platform.In the animation production of virtual humans, motion capture is usually used.Since different motion capture solutions use different skeletons for motion recording, when the skeleton level of recorded animation data is different from that of MetaHuman, the animation data recorded by motion capture cannot be directly used on MetaHuman. This requires Reorient the skeletons of both.This study explores an efficient skeleton reorientation method that can maintain the accuracy of animation data by reducing the number of bone chains.In the experiment, three skeleton structures, Rokoko, Mixamo and Xsens were used for efficient redirection experiments, to compare and analyze the adaptability of different skeleton structures to the MetaHuman skeleton, and to explore which skeleton structure has the highest compatibility with the MetaHuman skeleton.This research provides an efficient skeleton reorientation idea for the production team of 3D animated video content, which can significantly reduce time costs and improve work efficiency.

Keywords: *Skeleton Retargeting, MetaHuman, Rokoko, Mixamo, Xsens, Animation Adaptation, Motion Capture*

1. Introduction

Creating truly convincing digital humans is difficult, but digital humans are among us.With the release of MetaHuman Creator on the Epic Game platform in 2021, production teams can easily create highly realistic virtual characters, so they have been widely used in three-dimensional animation.Among them, skeleton retargeting technology allows the conversion of animation information in three-dimensional animation. However, there is currently little research on bone reorientation technology and there are many problems.For example, the operation of bone reorientation requires a high number of bone chain settings, so it requires a lot of time and cost.On the other hand, if you animate different bone structures, the final animation effect may be inconsistent.

Hammam proposed a Cartesian control framework that handles redundant and non-redundant task

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specifications. This approach reduces costly joints by enforcing kinematic constraints and employing dynamically consistent redundant solutions [1].During the production process of skeleton retargeting, it is a technical challenge to adapt MetaHuman bones as much as possible to different bone structures.This requires the hierarchy of the bone chain to map all human body structures to ensure that the hierarchical channels of the source bone and target bone are consistent.In selecting the source bone structure, a bone structure that is highly adapted to MetaHuman can greatly reduce the steps of the production process and avoid possible structural information errors.This requires a workflow for animation conversion based on MetaHuman.

The main purpose of this research is to explore an efficient skeleton retargeting method that can significantly reduce the number of complex bone chains while maintaining the animation flow of the target bone.Then, through this method, experiments were conducted using Rokoko, Mixamo, and Xsens bone structures as source bones to explore the adaptability of MetaHuman bones between different bone structures, and to determine which bone structure is the most compatible with MetaHuman bones.It is expected to provide efficient production ideas for the field of 3D animation and virtual character creation. This has important practical value for optimizing workflow and improving production efficiency.The purpose is to promote the widespread application of MetaHuman and at the same time provide a solid foundation for the future development of 3D animation production.

2. Related Research

There is currently very little research that specifically addresses the issue of skeleton retargeting. This article analyzes some domestic and foreign references, including academic journals, conference papers, and magazines, to prove the objectivity of its research, and combines these reference analyzes to illustrate the feasibility of this efficient skeleton retargeting method.

2.1. 3D Animation

As technology advances, animators are able to create highly realistic animations based on complex models and skeletal structures. Hecker proposed a video game character animation system that allows animators to animate characters whose forms have not yet been determined through form-independent animation recording and inverse kinematics solvers, and the system can handle highly variable skeletal forms, for character animation Creation provides greater flexibility and adaptability [2].

2.2. MetaHuman

The concept of Meta refers to social activities in a three-dimensional virtual space that are similar to reality. With the rapid development of AI digital technology, Epic Games' MetaHuman Creator has gradually attracted great attention from academia and industry.As shown in Figure 1. The platform can generate highly realistic virtual characters in real time within minutes and a variety of easy-to-use solutions for creating high-quality three-dimensional animations, and is widely used in film production, game development and VR fields [3]. And with the cooperation of photo scanning technology, virtual characters are becoming more and more realistic [4].

Figure 1. MetaHuman Creator

2.3. Skeleton Retargeting

Skeleton retargeting technology allows you to apply source animation data to another target character with a different bone structure. This technology is very effective in saving time and resources. Research shows that although this technology has been applied in many fields, there are significant differences in size, shape, and proportion of bones involved, and few technologies solve the problem of reorientation. Aberman proposed a deep learning-based framework that achieves effective transfer between different skeletal structures without the need for display pairing between motion data,providing an effective motion redirection tool for animation production and game development [5]. Massih proposed a method of retargeting animation styles to non-human characters,allowing stylistic features from the source character to be added to the movements of another character with a different body shape [6].

2.4. Bone Adaptation

As the complexity of three-dimensional characters increases, animators are challenged to become more efficient. Especially when performing animation conversions between different skeletal structures,how to maintain animation quality while reducing production time becomes a key issue.Monzani proposed a method to solve motion redirection using an intermediate skeleton, allowing motion data to be converted between hierarchies and different geometric characters, and using an inverse kinematics engine to enforce Cartesian constraints, maximally close to the captured motion data [7]. Among them, Rokoko, Mixamo and Xsens are the best-performing animation conversion bones and are widely used in bone reorientation.

Rokoko is a company focusing on motion capture technology and solutions. The features of real-time motion capture with wearable technology provide production teams of all sizes with an effective way to achieve motion capture. Ghani proposed a new fitness method using motion capture through Rokoko Smart Suit, which eliminates the limitations of the camera range of online teaching by providing a 3D view of the instructor, and combines the virtual reality function to improve the realism of exercise [8].

Mixamo is Adobe's efficient online service platform that provides quick solutions for 3D animation production. Because it has the advantages of a large number of animation databases and strong software compatibility, it is widely used in animation production and virtual reality projects [9].

Xsens MVN is a system focused on providing high-precision full-body human motion capture. Based on unique and state-of-the-art miniature inertial sensors, biomechanical models and sensor fusion algorithms, it is suitable for scientific research and detailed motion analysis by providing powerful data analysis and software to process complex motion data [10].

This study will further explore based on these prior studies, focusing on solving the efficiency and adaptability issues of bone reorientation, especially for MetaHuman, a highly complex virtual human model.

3. Efficient Skeleton Retargeting Method based on MetaHuman Animation

This section details the innovative ideas in the efficient bone reorientation method. Figure 1 is an idea map. In the bone retargeting process, the quality of animation conversion depends on whether the bone chain mapping is accurate. This requires the animator to set a large number of bone chains to ensure that the information of the two bones is calibrated without errors, which takes a lot of time and cost. For example, the skeletal chain of a hand requires setting up three skeletal chains from the clavicle to the upper arm, the upper arm to the forearm, and the forearm to the hand. However, the key point of the efficient method proposed in this study is that only one skeletal chain from the clavicle to the hand needs to be set up. , the same applies to the remaining three limb bone chains. Does this method still maintain the smoothness of the target animation while greatly reducing the bone chain? This study will prove the feasibility of this method through experimental operations.

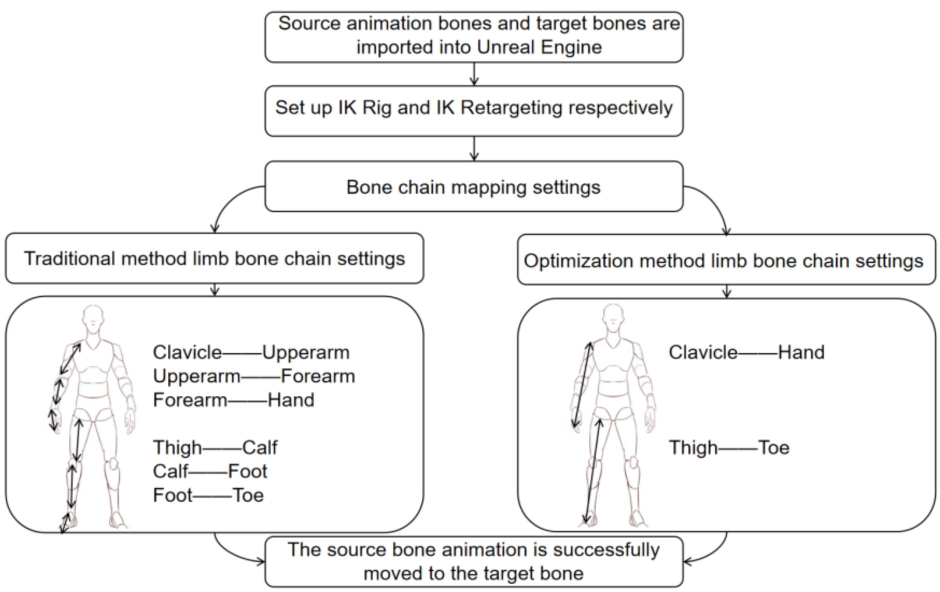


Figure 1. Idea Map of Efficient Methods

4. Experiment

4.1. Experimental Methods and Design

This section will discuss whether the efficient bone reorientation idea can be applied to animation conversion through comparative research on data collection. After it is clear that this idea meets the required conditions for animation conversion, this section will select Rokoko, Mixamo, and Xsens, the three most widely used skeletal structures in today's 3D animation, as the source skeletons in the experiment, and the MetaHuman skeleton as the target of the experiment. skeleton. Then, an efficient method was used to conduct bone reorientation experiments on the three skeletal structures, and the three target animations were compared and observed to have the highest degree of restoration of the source animation. The production time will be added to the final result summary to more objectively record the operating efficiency of the three processes. Summarize a set of skeleton reorientation workflow with low time cost and high animation adaptability. The experimental process is shown in Figure 2.

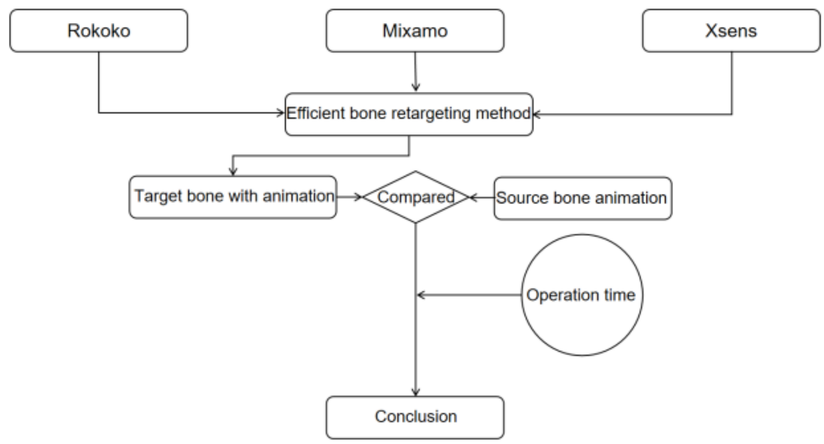


Figure 2. Experimental Method Map

4.2. Experimental Process

4.2.1.Use the Rokoko Skeleton as the Source Bone to Map to the MetaHuman Bone Structure

This part uses Rokoko as the source skeletal animation to optimize the redirection of MetaHuman. At the beginning of the experiment, Rokoko's motion capture suit was used to perform performance capture in Rokoko Studio, and an FBX file with animation information was obtained. The file was imported into Unreal Engine for IK Rig and IK Retargeting channel settings. In the IK Rig bone chain setting process, follow the traditional steps to set the bone chain of the head and spine. In the limb bone chain, only the clavicle to the hand and the thigh to the toe are set. After the settings are completed, in the IK Retargeting settings, calibrate the two bones to T-Pose. Finally, the source bone animation was selected to map to the target bone, and it was found that the Rokoko source animation was successfully mapped to the MetaHuman bone. By looking at the key frames, we found that in some frames the distance between the feet of the target animation is slightly larger than the source animation, and some frames show that the limbs are slightly out of shape, but the overall animation is relatively smooth. This proves that the method of reducing bone chains is feasible. The overall operation time takes 7 min.

4.2.2.Use the Mixamo Skeleton as the Source Bone to Map to the MetaHuman Bone Structure

After confirming the feasibility of this method through the above-mentioned experiments on Rokoko animation, this part uses Mixamo as the source bone structure to optimize the redirection of MetaHuman. The experiment uses the character model and animated FBX files from the Mixamo official website as the source animation. Use the same method to set the bone chains of the head and spine in the IK Rig bone chain setting process. In the limb bone chain, only the clavicle to the hand and the thigh to the toe are set. After the setup is complete, perform posture calibration. Finally, I selected the source bone animation to map to the target bone, and found that the Mixamo source animation was also successfully mapped to the MetaHuman bone. By looking at the key frames, we found that not only did there be no mold-crossing in each frame, but the restoration of the overall animation was almost the same as the source animation. The overall operation time is 5 min.

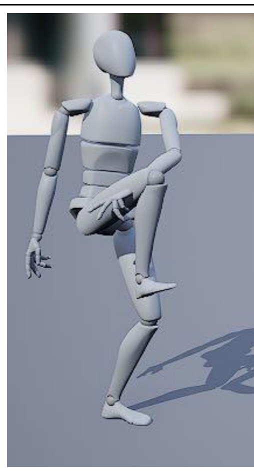
4.2.3.Use the Xsens Skeleton as the Source Bone to Map to the MetaHuman Bone Structure

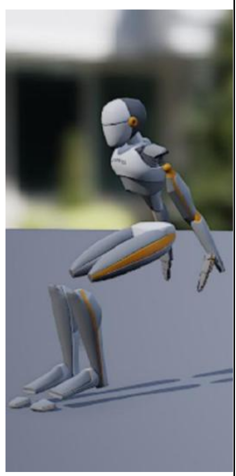
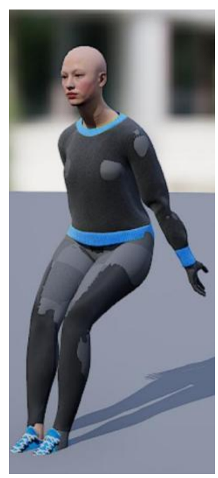
From the final results of the above two experiments, it can be concluded that this method has high feasibility. This section uses Xsens as the source bone structure to perform the third bone redirection on MetaHuman. The experiment uses Xsens' motion capture suit to perform performance capture in MVN Animate, and imports the FBX file with animation information into Unreal Engine for experimentation. In the same way as the above operation, although the final animation effect maintains the smoothness of the source animation, joint distortion occurs in a few frames. The overall operation time is 6 min.

4.4.Comparison of Experiment Results

Combine the data obtained from the above experimental process with tables and pictures, as shown in the table1. Comparing the restoration degree, production problems, and production time of the animation after three kinds of skeleton redirection with the source animation, it is concluded that the Mixamo skeleton is the source animation skeleton with the highest degree of restoration and the lowest time cost during the animation conversion process, and is compared with MetaHuman Bones are the most compatible.

Table 1. Animation Data Comparison

Contrast factors/skeletal types	Source animation	Target animation	Problems that arise	Production time	Compatibility
Rokoko			1.Model crossing 2.The neck is slightly curved 3. Hand restoration is low	7min	Generally

Mixamo			No problem occurred	5min	Very good
Xsens			1.Joint distortion 2.Legs have low degree of restoration	6min	Better

5.Conclusion

Through the experiments and analysis of this study, an efficient bone retargeting method suitable for MetaHuman was deeply discussed. In 3D animation production, using different performance capture solutions may result in a mismatch between the source bone structure and the MetaHuman bone structure, so bone retargeting is required. We proposed and experimentally confirmed an efficient bone reorientation method that maintains the accuracy of animation data while reducing bone chains, and has made practical applications on three bone structures: Rokoko, Mixamo, and Xsens.

Experimental results show that this method greatly reduces the setting of the bone chain while maintaining the smoothness of the animation, thereby significantly reducing the time cost. Among the three different bone structures, the Mixamo bone performs well in terms of restoration and time cost, and is the best compatible with the MetaHuman bone. While Rokoko also achieved good results, Xsens has a slight problem with joint twisting.

Taken together, this research provides an efficient skeleton reorientation idea for the production team of 3D animation video content, which effectively reduces the time cost in the production process and improves work efficiency. However, choosing the appropriate source bone structure for different projects and needs still requires careful consideration to ensure optimal fit and effect. Future research can further optimize the method, explore the applicability of more bone structures, and provide more practical technical support for the animation production of virtual human models.

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