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PRACA DYPLOMOWA INŻYNIERSKA

TEMAT: SKELETAL ANIMATION USING INVERSE KINEMATICS IN THE UNITY ENGINE

WYKONAWCA: ŁUKASZ BIAŁCZAK

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PROMOTOR: DR INŻ. ADAM BOROWICZ

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Contents

1. Introduction

1.1 Motivation

Animation is the technique of displaying different positions of a character or object in rapid succession to create the illusion of movement. It is used in various forms of entertainment, such as movies and video games. In the latter, unlike in the former, the animation sequences are performed in real time and therefore impose additional constraints. Without the freedom to process a single frame for minutes or hours during the rendering of the scene, the animator must compromise on the quality and realism of the sequence in order to optimize for gameplay. Furthermore, the interactive nature of video games makes it impossible for the artist to create predefined animation sequences for every possible situation that may occur in the game. As a result, predefined animation sequences are often generic and do not allow the character or object to interact naturally with their surroundings.

Game developers have come up with many methods to improve the realism of animation in games such as playing cutscenes for critical interactions between a character and the world. However, this paper will focus on the use of procedural animation and, more specifically, the application of inverse kinematics to skeletal animations in video games.

1.2 Problem Formulation

In standard skeletal animation, the skeleton is represented by a tree-like structure of transforms. Animation sequences are typically performed by updating the position and rotation attributes of these transforms, starting from the root and propagating to the leaves. When applying inverse kinematics to skeletal animation, the transforms are updated starting from a leaf and then back up the chain up to a selected node, allowing for a procedural approach to creating animation sequences that better reflect a realistic interaction between an animated object and its surroundings without the need to manually bake the sequence. Examples of interactions that are well-suited for the application of inverse kinematics include a character pressing a sequence of buttons or pulling a lever, or adjusting a character's limbs to uneven terrain. However, finding the proper parameter values for the skeletal transforms is

not always a trivial task and may require advanced optimization methods. This dissertation aims to acquire a more in-depth understanding of the basic algorithms used in inverse kinematics, as well as discover the built-in functionalities that the Unity engine offers for such implementations.

2. Related Work

2.1 Overview

2.2 Use Cases

2.3 IK Algorithms

2.4 Advantages and Disadvantages

3. Inverse Kinematics in the Unity Engine

3.1 FABRIK implementation

3.2 Spider Movement

3.2.1 Project Setup

3.2.2 Scripts

3.3 Human Animation Sequence

3.3.1 Project Setup

3.3.2 Scripts

4. Experiments

5. Conclusion

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