CIS 496 / EAS 499 Senior Project
Project Proposal Specification
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Character Animation using Overlays in Video Games

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ABSTRACT

Blending is a fundamental method of generating new motions for character animation in video games. One particular type of motion blending known as overlays is widely used in the video game industry but has not been significantly explored in research literature. Overlays allow you to combine the upper body of one character motion with the lower body of another character motion. For example, you can combine a motion of a character drinking a cup of water with a motion of a character walking to obtain a single composition of the two motions, a character drinking water while walking. As it is difficult to capture every combination of motion desired, overlays provide a powerful and efficient alternative.

The purpose of this project will be to explore methods in implementing overlays and how they may be used in video games. The initial step will involve creating an interface to transplant the upper body of one character motion to the lower body of another character motion to create a composite character motion, without considering the quality of the result. The next step will be automating the generation of these overlays by considering how physically correct the resulting motion would be as well as taking into account any other necessary constraints to create character motions that look human. The final part of the project will be using the generated overlay motions in a game environment to examine the results.

Project Blog: http://motionoverlays.blogspot.com

1. INTRODUCTION

Motion capture is frequently used to create motions for character animation in such applications as simulation and video games. It is often difficult or cumbersome to capture every combination of motion that may be needed. As such, there are methods to create new motions from existing motions that have been captured. Motion blending is one such fundamental method. There are three types of motion blending that are frequently used: interpolation, transitions, and overlays. Overlays are widely used within the video game industry but have not been discussed in detail within research literature. This project seeks to examine overlays and the best methods for implementing them for practical use in video games.

Overlays involve combining the lower body of a character during one motion with the upper body of a character in another motion to create a new composite motion. For example, the motion of a character walking can be composited with a character standing and waving their hand to obtain a character waving their hand while walking. Note that this is distinct from standard motion interpolation because the walking motion is not affected when the two motions are composited.

Though creating an overlay with two given motions is relatively simple, the quality of the resulting motion needs to be considered. The composite motion is not guaranteed to obey any physical constraints or look human. Upper body movements usually affect lower body movements, even if it is ever so slightly. Thus, combining movements from different motions can create an unnatural motion.

This project will seek to automate the generation of overlays that are of good quality by enforcing constraints such as physical-correctness to obtain plausible results. Other qualifiers will also be considered to create motions that look human. By automatically generating these overlays, the number of motions available for use will increase dramatically. To test the generated overlays, the composited motions will be used in a game environment.

1.1 Design Goals

The target audience will be animators and other users interested in creating character motions for use in applications such as video games. This project will seek to increase the number of motions available to an animator given a set of motion clips. Automatically generating overlays will avoid having to capture an exponential number of motions manually and greatly ease the process of character animation. The user will be able to expand their collection of motions through this automatic generation as well as manually create composite motions through a user interface.

1.2 Projects Features and Functionality

This project aims to provide three features:

1) User interface for manually creating overlays. The user will be able to select two motion clips and a composite motion (the overlay) will be created. It is

the user's responsibility to consider the quality of the resulting motion.

2) Automatic generation of overlays. The user will supply a set of motions that were captured. A program will create overlays based on a determined threshold – the composite motions must pass physics checks and other constraints to be considered good. Whether the result looks human or not is another question that will also need to be considered, though that has a less concrete solution.

3) Overlays within a game environment. There will be a game simulation where a user will be able to control a character through an environment. Overlays generated previously will be used for the character animation. By using overlays within a game, the naturalness of the motions can more easily be examined.

2. RELATED WORK

Though overlays are known to be used within the video game industry, there has been relatively little discussion of them in research literature. As such, there is no seminal work to be referenced. However, there are previous works that explore the topic and the topics related to it.

Ikemoto and Forsyth [IF04] first examine overlays but refer to the process as "transplanting limbs." They perform a randomized search of a motion collection and generate new motions based on a set of rules. They use a support vector machine and manually train a classifier to determine which motions look human.

Ren et al. [RP*05] consider an approach to quantifying the naturalness of human motion. They improve upon the method of Ikemoto and Forsyth by training their classifier with only positive examples. They decompose the character of the motion into its body parts and train a combination of statistical models for each part.

Majkowska et al. [MZF06] capture body and hand motions separately and splice the two together. They propose using dynamic time warping and their own distance metric to assess differences in phase between the hand and body motions. Whereas Ikemoto and Forsyth transplant limbs from random pairs of motions, Majkowska et al. combine specific motions with careful alignment over time.

Ikemoto et al. [IAF07] explore methods of distinguishing motions that look natural by using a scoring mechanism to evaluate the quality of transitions in a motion graph.

Safonova and Hodgins [SH05] propose small adjustments to motion interpolation to create a resulting motion that is physically correct. However, a motion can look unnatural even if it is physically correct.

Arikan and Forsyth [AF02] explore creating natural looking motion that satisfies user constraints using a randomized search of a hierarchy of motion graphs. Their method generates multiple motions in real time.

3. PROJECT PROPOSAL

This project will implement overlays and examine the resulting motions through a three step process. The first and most fundamental step is to manually create an overlay from two motions. A user interface will be created to make this process easier, allowing the user to input any two motions and generate an overlay. The interface will not check for any constraints or guarantee the quality of the overlay in any way. Once this step is completed, automatic generation of overlays will be implemented. By considered previous works related to the issue, the aim of the project is to generate composite motions that will satisfy constraints in an attempt to create natural and human looking results. The final step will involve using these overlays in a practical manner. A game environment will be created so that the user will be able to control a character that exhibits the overlay motions generated previously. The naturalness of the character animation in this game will demonstrate the quality of the generated overlays.

3.1 Anticipated Approach

This project will utilize an existing code framework (C++) with motion graphs and useful animation tools already implemented. This framework will be augmented to include the functionality for creating overlays.

For the first step of the project, a widget will be created for manually creating overlays using examples from the existing code. This interface will be tested using available motion capture clips.

The second step will adapt the previously created interface to consider constraints such as physical-correctness. Some constraint checks already exist within the framework for other examples and can be similarly implemented for overlays. Other constraints will need to be implemented based on existing research work. This part of the project will be very research heavy and will take trial and error with a number of different methods for generating quality motions.

Once overlays can be generated automatically, a game environment will be created using OGRE (a graphics rendering engine). The overlays generated previously will be included within the motion graph used to animate the character in the game. Thus, the user can examine the quality of the overlays by controlling the character within the game environment.

3.2 Target Platforms

This project will utilize Qt for the user interface and OGRE for the game environment. The program(s) created for the project can be run on any platform that is compatible with these libraries.

3.3 Evaluation Criteria

The results of the generated overlays can be evaluated through the game environment. By examining the character animation within the game, the results of the overlays can

be examined. Primarily, users will be looking to see how natural the overlay motion looks. The criteria for quality results include how human the character motion looks, if the motion is physically correct, and how plausible the motion appears. As overlays are used primarily within the game industry, examining our results through this game will be practical.

4. RESEARCH TIMELINE

Project Milestone Report (Alpha Version)

- Completed researching related works
- Learned existing code framework
- Generated sample overlay from two motions.
- Implemented user interface for creating overlays with two motions as the input.
- Implemented the generation of overlays without constraints.
- Implemented the generation of overlays with some constraints.

Project Final Deliverables

- A program that can automatically generate overlays that are of good quality (defined as passing certain conditions) given a set of motions.
- A game environment with a user controlled character. The character will utilize overlays generated previously. This game can be used to examine the resulting motions.

Project Future Tasks

- Improving the generation of overlays by creating conditions for which motions look human.
- A more robust game with unique motions to clearly examine the results of the overlays.

See Figure 1 for the Gantt chart.

References

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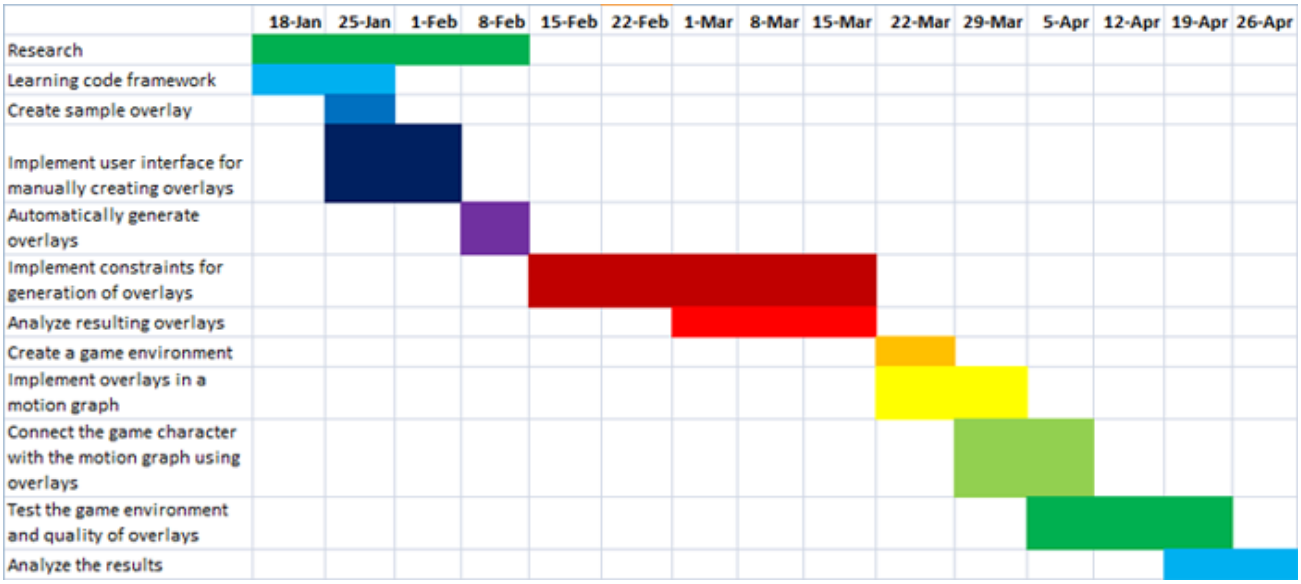

Figure 1: *Gantt chart for project timeline.*