Motion Graphs Applied to Facial Expression Modeling

Literature Review II

INTRODUCTION

When animating facial expressions for video games or computer-generated 3D movies, there is a desire to make the characters lifelike. A character will often transition from one expression to another to express emotion, speech, or interaction with its environment. In the physical world, transitioning from one expression to another does not happen instantaneously; rather, there are complex movements that occur.

Historically, facial expression transition has required hours of motion capture or been animated manually to create the most intricate and lifelike movements possible. The process of manually animating all the required transitions is very time-consuming for 3D artists. Ideally, an artist could create all the individual expressions required for a production and later sequence and transition between them automatically.

In order to automatically generate a realistic facial movement, Serra et al in their paper "Easy Generation of Facial Animation Using Motion Graphs" apply ideas from a 2002 SIGGRAPH paper by Kovar et al titled "Motion Graphs". The general concept is to create realistic motions generated automatically using motion graphs for facial expressions. "Motion Graphs" described using motion graphs to procedurally generate body motion. Applying the same concept to facial expressions is useful to reduce manual animations required to achieve a realistic transition of facial expression.

Motion Graphs (2002)

In 2002, the idea of a motion graph - a directed graph between animation states - was introduced. The idea uses the mathematical concept of a directed graph where nodes signify animation states and edges are the transitions between states. Nodes were created from the start and end frames of different motion capture clips. Ideally, nodes that could be reasonably transitioned between (often labeled to constrict edge creation) would be connected and allow for generation of animations. Nodes were also created mid-animation, meaning fewer frames were required before transition. The introduction of these mid-motion nodes allows for more nimble transitions.

The paper tested the process of generating movements using motion capture data. The motion capture data that was donated to the group contained no information of facial expression, only skeletal structure. This simplification of the human form was enough to generate a model of a wireframe human walking. Certain restrictions were required to make this dataset useful, such as labeling the planted foot of a node. The result was a relatively convincing automatically generated animation between previously disconnected data captures - walking normally and sneaking around.

Easy Generation of Facial Animation Using Motion Graphs (2017)

The greatest deviation from the original work on motion graphs is the inclusion of different error parameters. While the skeleton's key points (and its corresponding layout) were used to simply mathematically calculate similarity of body positions in "Motion Graphs", Serra

et al calculated similarity using a multitude of parameters. Most distinctly, emotion was a large driver of error/similarity calculation.

The group did not simply find the shortest paths on the motion graph. Instead, to create more humanistic movements, randomization was introduced to the synthesis. The minor differences in transition reduce repetitiveness and make movements far more organic.

COMPARISON

Both papers modeled human movements using directed graphs. The graphs were constructed using different heuristics and error calculations. Both pruned the graph and generated animations using the same base idea of an error calculation. To reiterate, the original paper used skeletal motion capture data. The later paper uses 3D-modeled faces as a dataset.

CONCLUSION

The idea of using directed graphs to model states of human movement is very useful when trying to automatically generate animations.The generated animations can greatly reduce the time required to capture motion or manually animate a character. This approach allows transitions to be generated that would have been nearly impossible to otherwise create.

REFERENCES

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