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Integration of Motion Capture into 3D Animation Workflows

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Motion Capture (MoCap) is a technique for gathering data of the movements of the human body. With the intention of using this information to drive the movements of 3D models in computer generated animation, MoCap offers significant advantages for producing natural and believably movement in 3D animation and opens up the possibility of bringing to ear acting and live direction into the animation process.

Some major Animation studios expect an output from their animators of around 1-2 seconds of footage per day. So any enhancements to the efficiency of this work are welcomed. At first glance MoCap technology looks like a brilliant way of automating the labour intensive and very highly skilled process of manually animating 3D characters. However it is wasteful to think that MoCap can replace animators with actors. Our group set out to test and evaluate this technology on a live CG animation project and discover how it can actually contribute to the animation production workflow. The project is called “Tenebra” and it is a short animation produced entirely CG. It is a fanatical retelling of the myth of Icarus.

**Types of Motion Capture**

There are several methods of motion capture.

- **Optical methods**, such as those, where white spots are applied to the body at the joints. Their movement across the visual planes of a camera are tracked and analyzed computationally in order to define a motion path for each joint in 3D space. This is widely used in the industry, but has the significant disadvantages of producing noisy data and being limited to movements that take place with the frame of a static camera or set of static cameras.

- **Mechanical methods** that are attached to the body and measure the rotation of the joints. This is a fairly accurate method of data capture but has the unfortunate effect of influencing the actual movements of the actor who wears it.

- **Inertial sensor methods** are covered by electromagnetic interference, and absorption. So the data produced is affected by incidental noise. Also physical disturbance of the sensors causes errors in the data. For example they are knock out of position in vigorous movements. These problems aside the Motion Capture suit method appears to offer the most flexible system for acquiring natural movement.

The limitations of the MoCap suit are that it records only the limbs and some movements, there is no data for finger movement or facial movement. The Xsens suit does not log any information in the vertical dimension relative to the ground. This must be applied manually afterwards.

**In Practice**

In practice, we required three people-the actor and a minimum of two people to tend the kit and operate the software. Setting up the suit took time and a certain amount of understanding of how it is supposed to work. The sensors need to be in the right locations and well settled before calibrating the suit.

The Movember software provided the makers of the suit gave live feedback of the data readings. The data from the sensors is transmitted wirelessly and represented on screen as a standard animation skeleton. Calibration involves the actor taking predetermined poses and performing controlled predetermined gestures. This allows the software to calculate the relative positions and relative rotations of the sensors. It is further constrained by manually inputting the physical dimensions of the actor. In the first sessions this process took several hours, but with practice we gained an intuition for how the software calculating the process and could be completed in a few minutes.

The animation process meant that we had to plan the capture sequence quite carefully. In a process that is quite similar to a simplified film shoot. We produced a list of movements that were needed to tell our story. The scene was set up using pre-defined props to match the movements of the character. We had to add the layer of the layout and ground plans of the scene so that the actor’s movements in real space match the architecture of the 3D model set.

The degree of freedom offered by the Xsens Motion suit allowed a lot of latitude for improvisation in the use of space. E.g. we used the underside of stairwells to simulate the character climbing upside down along a girder.

The data gathered from these actions is remarkably sensitive, seeing the representation of the movements on the skeleton reveals how subtle our movements are and how continuous they are even when we are at rest there are small rotations of the joints. It is this subtlety of movement that gives the unconscious sense of believability that is missing from much computer animation.

**The Clean Up**

The data in raw form contains errors of various types.

- **There are spikes in the motion curves caused by radio frequency interference**
- **Enormous static rotations caused by the sensors slipping out of place after the calibration**
- **Fluctuations in the motion paths, caused by signal interference**
- **Interpolation errors, caused by inappropriate interpolation of data by the Movember software in erroneous instances of signal failure.**

Many of these errors are just a few frames in length and can be fixed quite simply deleting to data held on the problematic frames and creating an appropriate interpolation between the good data that surrounds it. This is a painstaking and labour intensive process. Longer errors not worthwhile repairing as it is less work to retake the shoot or manually animate later on in the process.

The MoCap data is re-targeted onto a control rig which is standard forward kinematic and inverse kinematic rig in Motion Builder software. This means the rotations and translations are applied to the rig. Thus applied, the errors in the data are more easily read and corrected. This is an industry standard animation control rig for driving 3D characters. This rig control over more parts of the body including fingers, Jaw, eyes etc. The MoCap data drives to movement of the parts of the animation rig in to have data for and leaves the rest unchanged. These will be animated manually later.

The animation control rig then has a 2D character model applied to it. This model is moved by the rig and the rig is used in animation software to drive and adjust the final movements of the designed characters.

**Conclusion**

With a small amount of experience and practice it is possible to produce very good quality motion capture data from the Xsens motion capture software.

The product of the Motion Capture data processing is a partially driven character rig, which gives a base animation that is refined by animators to fit with the creative intent of the story. This is a significant aid in accelerating the process of 3D CG animation.

It has the beneficial effect of educating animators about the subtlety of natural movement and how movement convey messages, as the senosity of the system reveals minute gestures and movements that we do not perceive with the naked eye. Seeing the movements on the skeleton, stripped of the context of the personality data the animator in gaining an objective understanding of how gestures communicate meaning. This team used the MoCap for 3D character animation, but it can also be used for analysing movement in other contexts e.g. medical analysis of pathological movements caused by injury or deformity. Also for ergonomics simulation of human behaviour.

It is a technology that necessarily cross-disciplinary. Film direction methods and acting techniques are brought to bear and can enhance the animation process. This project will go on to integrate the MoCap data is a small but significant part of the process that extends what can be achieved.

It is a technology that has not been used successfully by a three person team. In conjunction with 3D animation software and 3D Digital methods in general, the potential for very much smaller production teams to take on highly ambitious projects.

Motion Capture is a relatively undervalued as a technology and it’s high cost of equipment limits widespread utilisation. More comprehensive MoCap data would make the process much closer to filmmaking. CG animation is an artform that allows the visualisation simulation of impossible things. What 3D animation requires of this technology is a reference against to work from, elaborate upon, enhance and extend from.

It’s use with the 3D computer animation process.Itemizes a lot of animator’s attention and time from tedious frame by frame attention on the whole figure and enables a focus on the communicative gestures.

**References**

- Dr Eryk Unver, Dan Hughes, Bernard Walker, Ryan Blackbum, and Lin Chien. 3D Digital Design and Spatial Design, School of Art Design and Architecture, University of Huddersfield.