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**Integration of Motion Capture into 3D Animation Workflows**

**Introduction**

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 believable movement in 3D animation and opens up the possibility of bringing to ear acting and live direction in 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 the glance Motion Capture technology looks like a brilliant way of automating the labour intensive and very highly skilled process of manually animating 3D characters. However it is worthwhile 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 “Teleman” and it is a short animation produced entirely CGI. It is a faithful retelling of the myth of Icarus.

**Types of Motion Capture**

There are several methods of motion capture.

There are 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.

There are 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.

The method we used is based on the Xsens motion capture suit which uses inertial sensors attached to the body. This method avoids the major problem of the other methods. It is relatively unobtrusive to the actors movement allowing a large range of movement of both the limbs and spine and the large scale up to a radius of 150 metres. The disadvantages are the sensors are effected by electromagnetic interference, and absorption. So the data produced is affected by incidental local noise. Also physical disturbance of the sensors causes errors in the data, e.g. if they are knocked out of position in vigorous actions. 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 only records only the limbs and spine movements, there is no data for fine 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.

**Conclusion**

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

The product of the Motion Capture data processing is a partially driven character rig, which gives a base animation that is re-touched by the animators in line with the creative intent of the story. This is a significant aid in accelerating the process of 3D CGI animation.

It also has the beneficial effect of educating animators about the subtlety of natural movement and how movement convey messages as the serenity 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 these gestures communicate meaning. The team used the MoCap for 3d character animation, but it can also be used for analyzing movement in other contexts e.g. medical analysis of pathological movements caused by injury or disease. Also for ergonomic simulations of human behaviour.

As 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 hoped that this technology can be 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 undeveloped as a technology and it’s high cost of equipment limits widespread utilization. More advanced systems will extend into capturing facial movements and hand movements. As well as other kinds of movement (perhaps from video data). However it is inevitable as the technology advances that costs will fall and capabilities increase.

Comprehensive MoCap data would make the process much closer to film making. CG animation is an artform that allows the visualisation simulation of impossible things. What 3D animation requires of this technology is a reference base to work from, elaborate upon, enhance and extend from.

It’s use with the 3D computer animation process removes 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.

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**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 Moven software provided the makers of the suit gives live feedback of the data readings. The data from the sensors is transmitted wirelessly and represented on screen via a standard animation skeleton. Calibration involves the actor taking up predetermined poses and performing controlled predetermined gestures. This allows the software to calculate the relative positions and relative orientations of the sensors. This 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 calibrating and the process could be completed in a few minutes.

The animation process meant that we had to plan the capture session quite carefully. It is a process that is quite similar to a simplified film shoot. We produced a lot of movements that were needed to tell our story. The scene was set up using an improvised props to match the intuitive movements dictated by the contents of the story. We had to be aware of the layout and ground plans of the scene so that the actor’s movements in real space match the architecture of the 2D model set.

The degree of freedom offered by the Xsens MoCap suit allowed a lot of latitude for improvisation in the use of space. E.g. we used the underside of stabilite to emulate the character climbing upside down a ladder.

The data gathered of these acting sessions 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 are small rotations of the joints. It is a subtlety of movement that gives the unconscious sense of believability that is missing from much computer animation.

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 Moven software in small 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 the surrounding it. This is a painstaking and labour intensive process. Longer errors not worthwhile repairing as it is less work to retake the shot or manually animate later on in the process.

The MoCap data is regrafted 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 offer control over parts of the body including fingers, jaw etc. The MoCap data is driven to movement of the parts of the animation rig the has data for and leaves the rest unchanged. These will be animated manually later.

The animation control rig has a 2D character model applied to it. The 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.