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Integration of Motion Capture into 3D Animation Workflows

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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 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 wishful 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 CG. It is a futuristic retelling of the myth of Icarus.

Types of Motion Capture

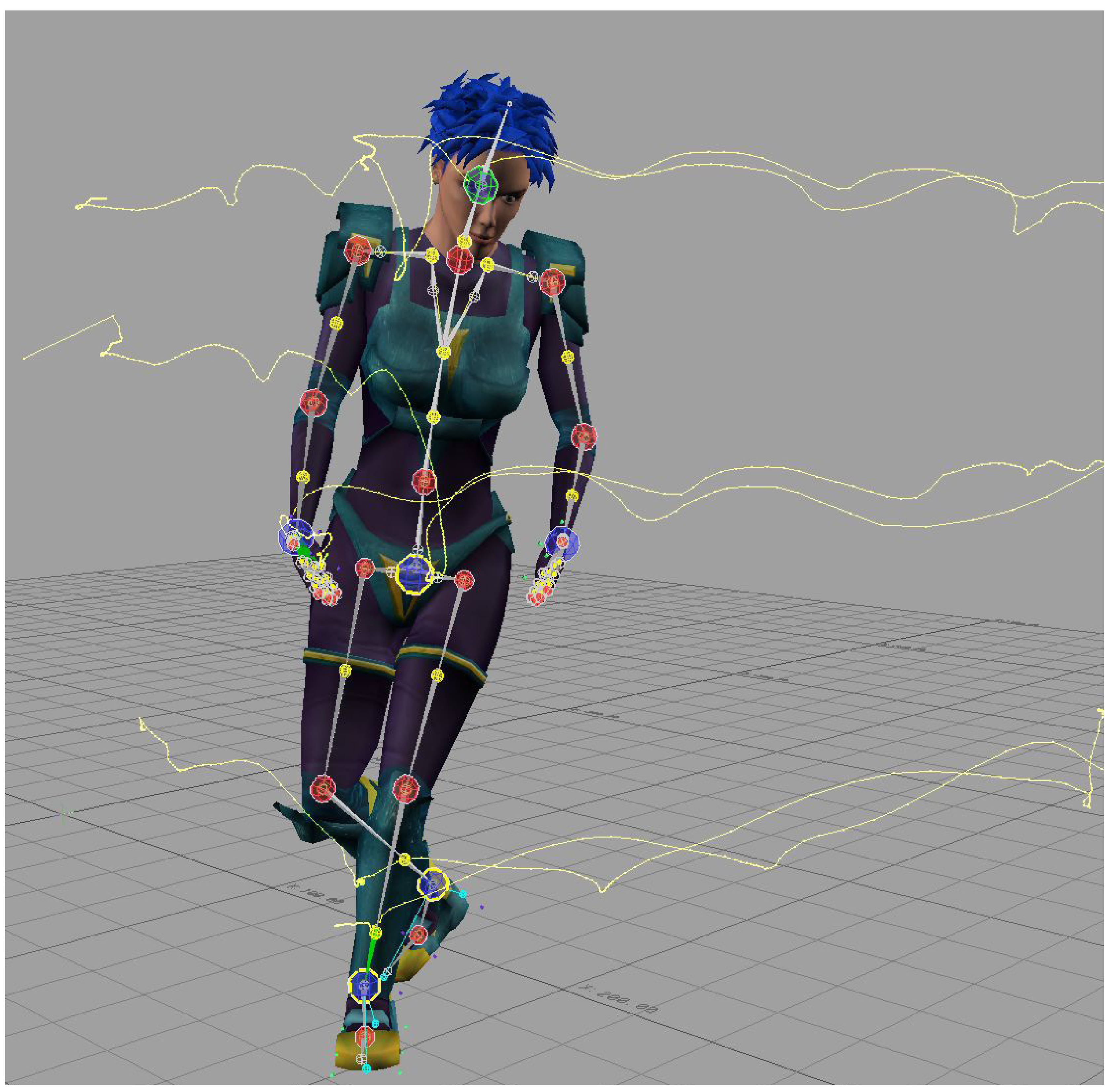
There are several methods of motion capture.

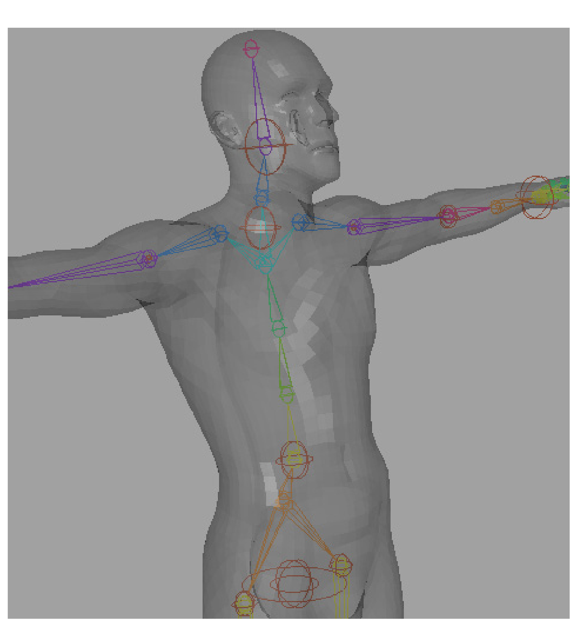
There are optical methods, such as Vicon, where white spots are applied to the body at the joints. Their movement across the visual plane of a camera are tracked and analysed computationally in order to define a motion path for each joint in 3D space. This is widely used in the industry, but has the 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.

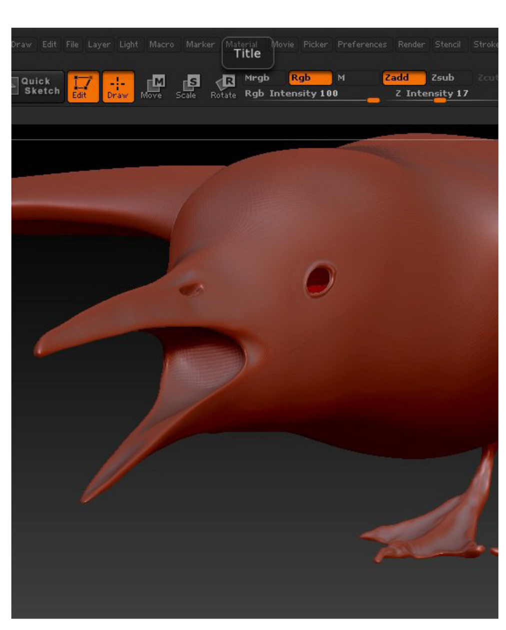
There are mechanical methods that are attached to the body and measure the rotation of the joints. This is a fairly accurate method of data capture but has the unfortunate effect of influencing the actual movements of the actor who wears it.

The method we used is based on the Xsense motion capture suit which uses inertial sensors attached to the body. This method avoids the major problem of the other methods. It is relatively unintrusive to the actors movement allowing a free range of movement at both the intimate scale 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 effected by incidental topical noise. Also physical disturbance of the sensors causes errors in the data. e.g. if they are knock 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 records only the limbs and spine movements, there is no data for finger movement or facial movement. The Xsense 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 Xsense Moven inertial sensor system.

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

It also has the beneficial effect of educating animators about the subtlety of natural movement and how movement convey messages as the sensitivity 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 aids the animator in gaining an objective understanding of how gestures communicate meaning. The 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 ergonomic simulations 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 notable that this technology can be operated 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 utilisation. More advanced systems will extend into capturing facial movements and hand movements. As well as other kinds of movement perhaps extracted from video data. However it is debatable as whether brilliant accuracy is required for animation purposes. 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 liberates 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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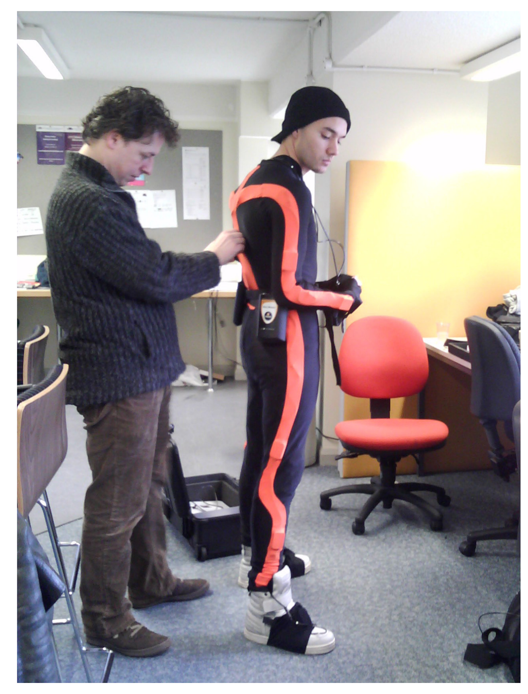

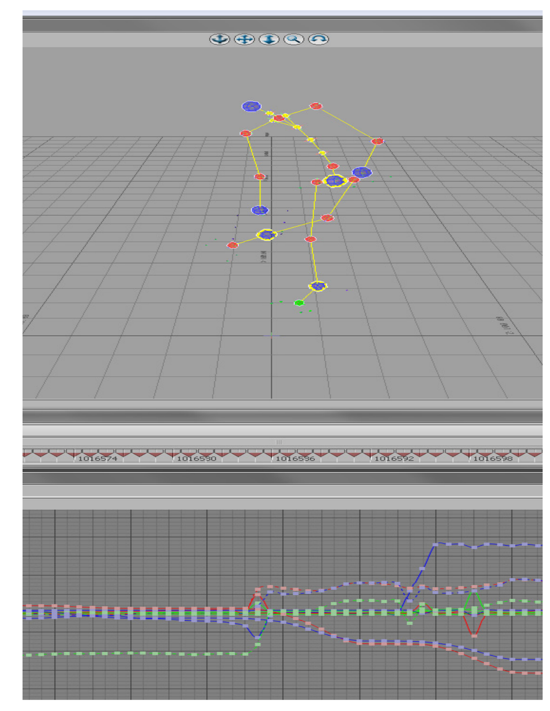

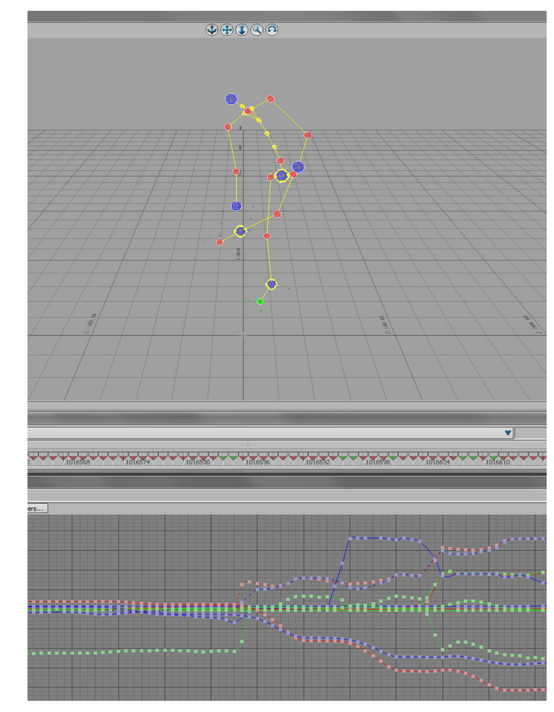

In Practice

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 it 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 as 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 rotations 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. 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 improvised props to match the intimate movements dictated by the contents of the story. We also 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 3D model sets.

The degree of freedom offered by the Xsense MoCap 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 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 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
- Erroneous 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 momentary 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 surrounds 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 retargeted 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 more parts of the body including fingers, jaw eyes etc. The Mocap data drives to movement of the parts of the animation rig the it has data for and leaves the rest unchanged. These will be animated manually later.

The animation control rig then has a 3D 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.