Motion Capture Animation for Physical Model Analysis

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Abstract

This paper presents a motion capture technique applied to animation, in order to analyze physical models. A low cost motion capture environment has been built, which is validated through a case study. An experiment is described, showing the main steps to be performed using the motion capture technique. Finally the generated animations are used to analyze physical models in a virtual three dimensional scene.

1. Introduction

Animation becomes a very important tool for physical model analysis, as it can be found in many simulations software. To represent more complex models based on the real world, motion capture techniques may be used to capture object movements during real experiments and to generate the corresponding animations. With this purpose we built a low cost motion capture environment to be used with simple systems, composed of one particle. Experiments performed in the motion capture environment can be analysed through the models virtual three dimensional (3D) animated representation, as well as explored navigating through different points of view in the scene [2].

2. Motion capture

Motion capture, or simply mocap, is a technique for tracking real movement in the 3D space, and saving that movement as a series of three coordinates (XYZ). These coordinates are then used to aid animation of a computer character or other particle, so it can describe exactly the original movement. Usually, human performers are the subjects in motion capture, but virtually anything could be captured [4].

In optical motion capture, a series of high resolution cameras are set up around an area to be captured. Markers (small spheres) are placed in strategic locations on the performer. Through software these markers can be located by triangulating the various camera views. The marker locations are recorded as 3D coordinates.

Motion capture is an expensive technique. The special cameras and others equipments can cost many tens of thousands of dollars. Some movie studios and video game publishers have established their own dedicated mocap studios, but most mocap work is contracted to individual companies that specialize in motion capture [3].

3. The motion capture environment

This work aims to propose a low cost environment for motion capture. In order to achieve this, the experiments made use only two video cameras to capture the same scene. Thereforem, domestic mini-DV video cameras were used to record the movement of the object. These cameras were positioned perpendicular to each other: the camera 1 recorded the XY plan and the camera 2 recorded the ZY one.

After recording the movement, the cameras had to be synchronized to take the same sequence of video. To meet the aim of low cost environment, an external time code generator has not been used. An external time code generator is a device used to synchronize multi-cameras shoots. To synchronize the video a photography flash was used when the cameras started to record. This flash made one frame of both videos bright as a “white” frame. This white frame was then be used as the mark to find the same frame position in both videos. During the capture process the view area of each camera was measured to determine the relation between pixels and real distances.

4. Video processing and motion detection

In order to process the videos, the first think to do was converting the videos into digital files. As a digital mini-DV camcorder has been used, this step could be performed just transfering the data from the camera to a video editor software. A low resolution video (320x240) allows using analogical camcorders, such as VHS, 8mm or Hi8. In this case, the process of coverting into digital video needs an analogical to digital device.

To process the images, the videos were split in 30 images for each second. These images were then saved as a sequence of image files [1].

The task of detecting the particle of interest on the image consisted in comparing the image without the particle to images with the particle. In our case study, a ball was the particle.

Firstly, the second frame was taken, that appeared after the white frame, to be the reference image. In other words, the image without the particle. To find out the particle, an image was generated with the difference value of the reference image and the others images (containing the particle). Using this image, the center of the particle (X,Y) could be found. The processing of all images generated two sets of points (X,Y), one from the camera 1 and other from the camera 2. The camera 1 set represents the position in the XY plan in the 3D environment. From the camera 2 set were only used the X positions, which represent the depth information, or the Z component in a XYZ system. This information had then to be converted to real world scale. The relation between real distances and pixels that was calculated during the capture process allows this convertion.

5. Case study: the bouncing ball

In order to demonstrate the viability of using the proposed low cost motion capture environment successfully, a case study has be performed. This case study realizes an experiment that uses physical models, in 3D. In the real world, a bouncing ball performs a 3D movement. Therefore, it is a good study for analysis using motion capture animation and has been applied in this work.

Firstly, the ball movement was captured with two cameras and a set of positions with 3D components (X,Y,Z) was generated [2]. Afterthat, this dataset was used to build a VRML (Virtual Reality Modeling Language) model that shows the 3D animated ball in a virtual 3D scene, as illustrated in Figure 1.

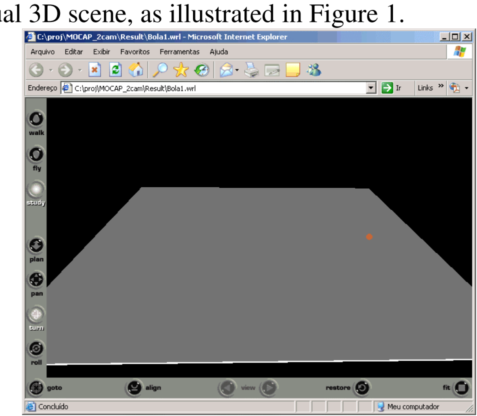

Figure 1. 3D animated ball

6. Conclusions

This work shows that it is possible to use low cost motion capture for generating animations that can be used for physical model analysis. These animations may also be used for others purposes, such as computer generated short films. The use of multiple particles is a topic of ongoing research.

7. References

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