Mocap+MRI=?

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Abstract

This poster proposes a basic idea to observe differences that exist between skeletal postures coming from two methods: postures generated by an only ordinary mocap process, and anatomically and individually accurate skeletal postures generated by a ordinary mocap process together with a medical imaging method such as MRI.

1 Introduction

Our goal is to describe or model the correspondences between actual skeletal postures and mocap markers attached to the skin surface. A mocap system can be used to generate an accurate posture for a specific joint of a human body.

Commercial mocap systems use the coordinates of mocap markers to clearly indicate the skeletal posture of a subject. In fact, the relative coordinates between mocap markers and skeletal structures are not perfectly fixed, so they are slightly articulated in general.

We think that the current mocap process has some problems, as shown below.

- Ordinary mocap systems usually map marker data to a simple skeletal structure, which is far from accurate anatomically and individually.
- The ordinary mocap process does not consider skin artifacts, such as the skidding effect between the skin (a marker) and a bone.
- You will never get anatomically and individually correct skeletal postures, since mocap systems can only look at the surface of the subject.

To solve these problems, we propose performing an appropriate medical imaging method in addition to the ordinary mocap. The MRI method seems to be appropriate for the proposed method since it is a non-invasive way to obtain the internal state of a subject's body. The major drawbacks of MRI are its small scan area and the long time that it takes to scan. Our mocap markers consisted of oil and can be easily identified in an MR image, as shown in Figure 1. This poster targets a human forearm but does not describe it explicitly.

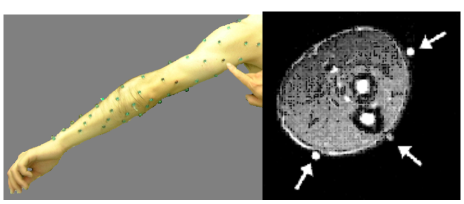

Figure 1. Markers (left) on the arm and the MR image (right).

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2 Our Work

First, we need to extract the bones by observing the internal structure of a subject's body. A forearm has two stick-like bones, called long bones, and a slice MR image of them shows different features in the middle of the bone, a diaphysis, and on each end, epiphysises. An epiphysis holds much more water than other bony parts. This means that a simple thresholding technique is sufficient for extraction. A diaphysis includes soft coarse tissues (bone marrow) which fill the central core, and a hard dense tissue (compact bone) which wraps the core. A core of diaphysis appears as a clear circle region on a single slice of an MR image. Otherwise, a part of the compact bone does not show sharply and is hard to distinguish. The center of the diaphysis core is located, then the edge that has almost the same distance from the center is detected. Then, the edges of the slices are combined and transformed into a 3D geometric representation.

Once the 3D bone geometries of the forearm are ready, you can visualize the geometric relation between the bones and the mocap markers, which are also extracted from MR images. We chose the poses under several conditions, such as bending or stretching the elbow joint with supination and pronation (outer and inner rotation of the elbow joint). The subject had to stay still for each specific pose during the MRI scan. Figure 2 reconfirms that there is some kind of tight constraint between the mocap markers and the bones, but the constraint does not seem to be a non-rigid type. Based on the observation results, we were able to make an approximate mapping model that describes the relative position between the mocap markers and bones in local space coordinates that are fixed to the bones. Only the mocap data (marker positions) of arbitrary joint movements on an elbow are needed to estimate an internal bone state if the mapping model has already been derived from the same subject.

3 Conclusion

The proposed mocap process powered by medical imaging technology seems to be helpful for examining the actual internal state of a skeletal structure. A sort of skidding skin artifact over the skeletal structure can be observed that was not derived from a ordinary mocap process. We now want to study applying the proposed method to other parts of a skeleton.

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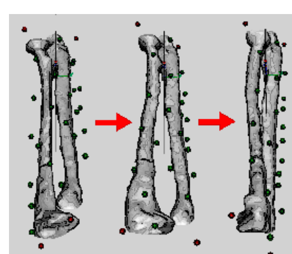

Figure 2. Mocap markers and actual forearm bones.