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# ON LIGHTING LIMITATIONS OF MARKER MOTION ANALYSIS USING COMMERCIAL SOFTWARE APPLICATIONS

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***Abstract:*** *In this article we determine the limitations of non-professional marker motion analysis systems, designed using commercial software, considering the lighting conditions. We use a high speed video camera to record the circular motion of a metallic disc at different angular velocities and we are able to determine the maximum velocity range where the motion analysis software tools can efficiently analyze the trajectory of a marker installed on the disc. This velocity is important especially if the motion analysis system is designed to be portable and can be used by untrained or inexperienced personnel..*
***Keywords:*** *motion analysis, inverse kinematics, software for motion analysis*

## 1. INTRODUCTION

In our former research, we designed a motion capture and analysis system which uses video analysis of markers installed on the human body to determine trajectories of the main joints of the body or body part. Between the advantages of this system, we mention that the system is portable and easy to use even by non-expert personnel. For this to be true, we have to take into consideration any kind of perturbing factors which might influence the quality of the recording, which might lead to the inability to use the experimental data delivered by the system. One of the most important perturbing factors is the lighting - poor lighting surely leads to poor video data. Being able to set a maximum limit range at which the system can operate in practical conditions (which can include poor lighting) is an important aspect in the design of this kind of motion capture and analysis system, and our main aim in this paper.

## 2. MATERIALS AND METHODS

We tried to simulate a practical situation where poor lighting might occur. Inside, without external lighting, on a cloudy day, we recorded the circular motion of a disc, at different angular velocities. A white paper marker was installed on the metallic disc, and for the recordings we used the AOS-X PRI high speed video recording camera, using 120 frames per second. We started at the velocity of 80 resolutions per minute (rpm) and then gradually increased the velocity, with a step of 20, therefore video recording the disc at 80, 100, 120, 140 and 160 revolutions per minute. The video materials were then imported in Adobe After Effects and Kinovea (two software applications able to follow the motion of a marker) in order to determine the limits at where the motion of the marker can be efficiently followed by these applications.
We obtained 10 sets of video materials for each considered angular velocity. Each of these video materials were then imported in Adobe After Effects and Kinovea, and we used the built-in marker tracking tool in order to see where the marker "jumps" out of the trajectory.
Up until 120 resolutions per minute (including), the experiment went perfectly fine, both of the applications being able to efficiently follow the marker. Starting at 140 rpm's, the marker begun to leave the trajectory, outside human intervention being necessary in order to "drag" the marker back to its trajectory - this is possible and useful for some random analysis of motion parameters, but highly inefficient if we have to process massive amounts of data using a motion capture and analysis system of this kind.

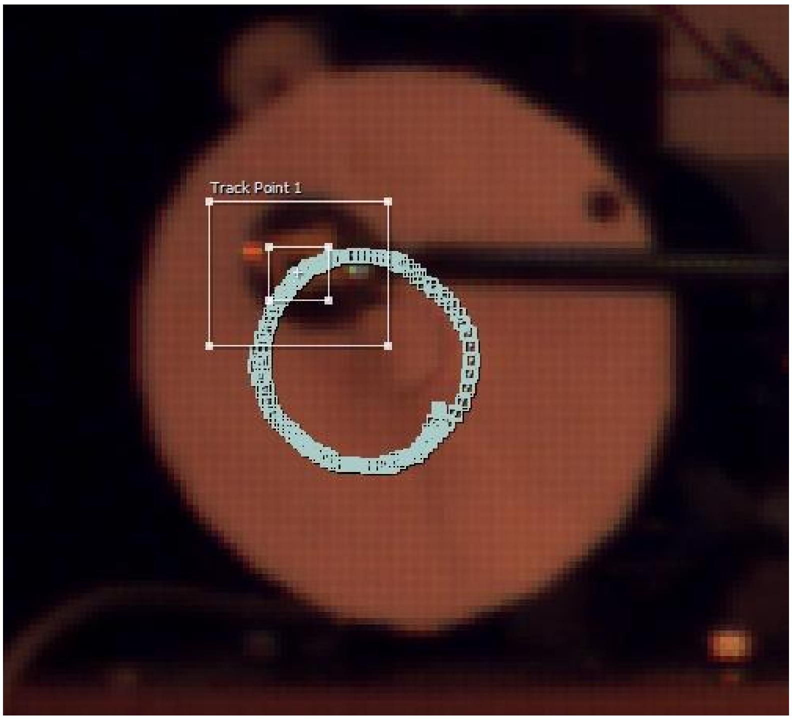


**Figure 1:** Marker recording at 120 resolutions per minute - the trajectory can be obtained automatically, by just using the tracking tool in the software

At 160 resolutions per minute, the automatic tracking of the marker was simply impossible, practically the trajectory of the marker was lost in less than a second, huge amounts of human intervention being necessary in order to somehow obtain some data (this data we probably cannot trust anyway.

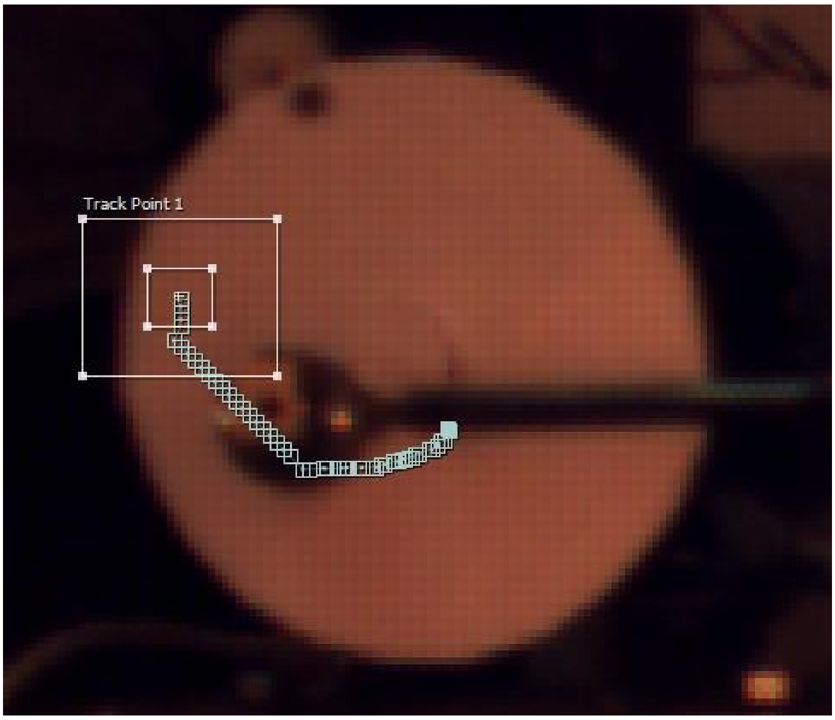


**Figure2:** Marker recording at 160 resolutions per minute - the trajectory cannot be obtained automatically, the marker tracking tool cannot follow the trajectory for more than a second

## 3. CONCLUSION

We established a point where this kind of motion capture and analysis system reaches its limits, that point being around 140 resolutions per minute, when following the circular motion of a body. When using these commercial applications above and a system of this kind, we recommend to design the experiments for a maximum circular velocity of 120 rpm.


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