Computational camera placement optimization improves motion capture data quality

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Authors: Jens Nirme (1,2), Henrik Garde (2)

(1) LUCS (Lund University Cognitive Science), Lund University, Lund, Sweden
(2) Humlab (Lund University Humanities Lab); Lund University, Lund, Sweden

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Abstract: 3D motion tracking data collected from multimodal communication setups by use of passive reflective markers and high frequency infrared cameras is very accurate. However, occlusion and visual overlap complicates unambiguous identification of markers and decreases data quality considerably. These problems could be related to suboptimal camera positions. Data loss is often experienced during recordings of natural, spontaneous, undirected, unpredictable multimodal communication. It is especially difficult to work with gestures, characterized by short changes in velocity and directionality of markers on hands and fingers. Data loss occurs when hands or fingers are folded, close to each other or to objects or subjects that are parts of the experiment. The data loss causes problems with post processing like filling in occluded markers as well as event tracking. Typical camera setups are generally well suited for capturing a full body motion on the floor whereas hand gestures are often small movements close to the body. To find optimal camera positions and angles manually by trial and error is very time-consuming due to the number of possible camera positions and to constraints such as distracting IR beam sources obtained directly by other cameras. Here we present a possible solution, namely a simulation of motion capture that predicts marker visibility, given scenarios and camera configurations. In a VR program enabling a virtual room to be equipped with props like tables and armchairs (similar to the experimental set-up in the real world) we add an animated skeleton with a simple body and virtual, simulated markers attached to it. Based on realistic movements, i.e. similar to those expected to take place in an experiment with a real participant, we then run the simulation which assesses the chosen camera configuration by counting visible markers frame-by-frame. By repeating this for other configurations we have a qualified 'best' camera set-up. With this automated guide to optimize camera setup for difficult motion capture a range of projects can achieve customized set-ups for experiments, depending, for example, on different levels of mobility or fidelity, i.e. number of markers, cameras and limited positions to mount them. A dynamic motion capture set-up combined with VR technology also allows the creation of experimental platforms to study speech-gesture processing, for instance. An easily set up framework based on 3D body motion data and recorded speech allows extremely controlled experiments to be run on a larger scale. Optimized camera placement is an essential part of that setup.

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