

Kinect Multi-Camera Body Scanner

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Abstract:

The goal of this project is to develop a multi-depth camera body scanning system that will allow for the capturing of accurate animated motions and poses from all directions. The system would serve a similar role to that of a Vicon motion capture studio, but would be a much cheaper alternative. Unlike other approaches which incorporate non-rigid registration, which deforms the point clouds to make fitting more visually appealing, this project will strictly use rigid-registration to produce the most accurate results. This poster focuses on the calibration of the system, and the network requirements to link and synchronize the multiple data-streams together.

Methods:

- Confirming Accuracy of Data:

Conduct a series of tests to estimate the accuracy of the Kinect depth data points. This is important for confirming the relevancy of corresponding points and analyzing frame overlap.

- Calibration:

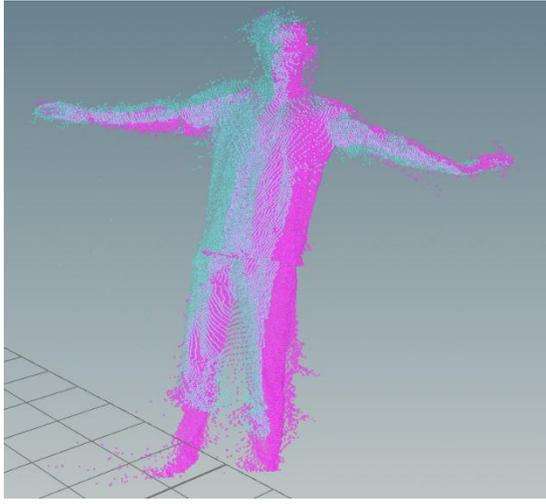
Sphere Alignment Method	Box Fitting Method
<p>Uses four spheres to act as corresponding markers between different camera angles. Different diameters are also tested to find the best results. After recording, spheres are detected and equal template spheres are inserted optimally to act as markers. A least squares method then finds the optimal transformation between frames/markers.</p>	<p>A box is used to find the optimal transformation between camera frames. The corresponding planes on each frame are used for alignment, and a RANSAC algorithm is used to detect each one and them and remove noise. Afterwards, a template box is fit to the data, and a least squares algorithm is applied to find the optimal transformation between frames.</p>
	

- Build Network to Link Multiple Sensors:

Main difficulty is the Kinect v2's dedicated USB3 hub hardware requirement, which prevents multiple Kinects from being connected to the same computer. As a result, one computer is needed per Kinect, and a network is needed to link the system together. Challenges include synchronized data collection, and data merging. The possibility of real-time point cloud process/analysis also comes up.

Results:

The Kinect's depth readings were found to be within 1% of the actual distance tested. As a result, the position of corresponding shapes between frames can be trusted.

Calibration Results	
Sphere Alignment Method	Box Fitting Method
<ul style="list-style-type: none"> - Spheres of 1in, 2in, and 4in were used for testing. The 4in Styrofoam spheres produced the best results of the three. - Overall, the alignment was close, but still off by a few degrees of rotation. Also, the process requires a lot of time to remove noise that offsets the results. Marking the spheres also takes time. 	<ul style="list-style-type: none"> - A RANSAC algorithm is applied to identify the planes and immediately rule out noise, which speeds up the processing. - Overall, there were still questionable areas in the alignment, but the overall result were better than the sphere alignment method. A con is that only two cameras can be calibrated at a time.
	

The network was able to trigger multiple Kinects to capture data in synchronization. However, when attempting to stream the point clouds in real-time, the bandwidth could not support the amount of data coming in, and there was a lot of lag. A hard-wired network may solve this. Results can still be viewed after capturing is complete though.

Future Work:

- Fitting a template to the data
- Hardware synchronization of the Kinects to make timing more precise.