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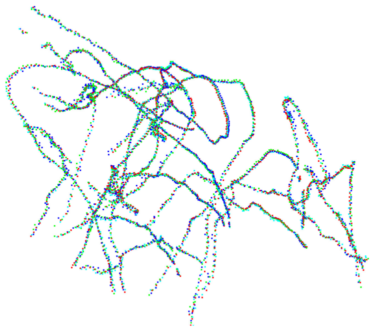
Subject Area	Sensor, Actuator and Communication Systems

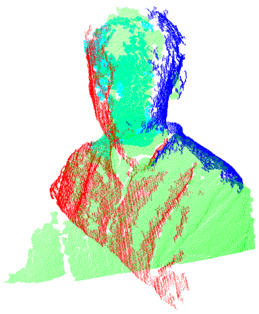
3D Registration

Registration of multiple Kinect cameras

Camera Assembly



Trace of the calibration body viewed from the different cameras



Assembled 3D image

Introduction: For the people tracking system developed at HSR, an extension which can assign people to tracks will be developed. To recognize the people, a 3D face recognition is planned. When there is just one camera, depending on the orientation of the head, some parts of the face are hidden. So multiple 3D cameras are needed. The main target of this project is to register multiple Kinect cameras to one common coordinate system. To do this, one camera is selected as the reference of the coordinate system and for all the others, a transformation is estimated.

Approach/Technologies: To solve this problem, there are several possibilities. The best from the user point of view would be to just walk trough the camera assembly and the different 3D images are registered one to each other until all transformations to a common coordinate system are found. A more robust approach would be to use a calibration object which is detected by the cameras and used to calculate the transformation.

Solution: At a first glance, it seems that this problem has already been solved. There are many papers about 3D image registration. Some of these algorithms are implemented in the well known Point Cloud library. But none of them performs robustly enough for the problem at hand. The main problem is finding the right correspondences to estimate the transformation. Also to determine the quality of the found transform is difficult. Another disadvantage is the high computation time which is between one and 15 min for one image. The second approach, using a simple sphere as calibration object, works quite well. A sphere can easily be found in a point cloud using a RANSAC segmentation algorithm. This algorithm gives also the center of the sphere and the radius. Moving the sphere through the field of view of all cameras, each frame gives a center point for each camera. Using these points, the transformations are estimated. This works quite fast. Segmenting the sphere can be done in real time and calculating the transformation is done in less than a second, even with more than 1000 reference points.