Motion Estimation of Multiple Depth Cameras Using Spheres

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Introduction	Overview
 Problem: Previous motion estimation methods for Kinect-like cameras are all plane-based methods, with the simultaneous visibility problem in calibrating multiple depth cameras Goal: Estimate motions between multiple depth cameras automatically Solution: Use spherical objects to estimate motions between multiple depth cameras, and avoid simultaneous visibility problem due to the symmetry of sphere object 	 Pipeline Sphere contour detection and get sphere center in each view Motion estimation using factorization approach with sphere centers in each camera view as correspondences Refine motion parameters by using bundle adjustment







Sphere Center Estimation

Main idea: 2D image of a sphere contour is an ellipse, use Hough transform for robust ellipse detection, and then select proper sphere image with RANSAC and known sphere radius. Solution:

- Use Hough transform for ellipse detection
- Based on the detected sphere contour images, we fit the sphere with the point clouds by lifting the pixels within the sphere contour images to 3D, and remove infeasible candidates with sphere radius
- Recover the sphere center

Camera Motion Estimation

Solution: Recover motion parameters of multiple depth cameras from spheres' centers by using a factorization method for 3D point sets. The factorization method is advantageous over other methods in that it treats each view equally and recover all the camera motion matrices simultaneously **Estimate translations:** $\mathbf{t}_i = \frac{1}{n} \sum_{i=1}^{n} \mathbf{O}_{i,j}$

Centre the data: $\tilde{O}_{i,j} = O_{i,j} - t_i$

Estimate rotations:





References

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