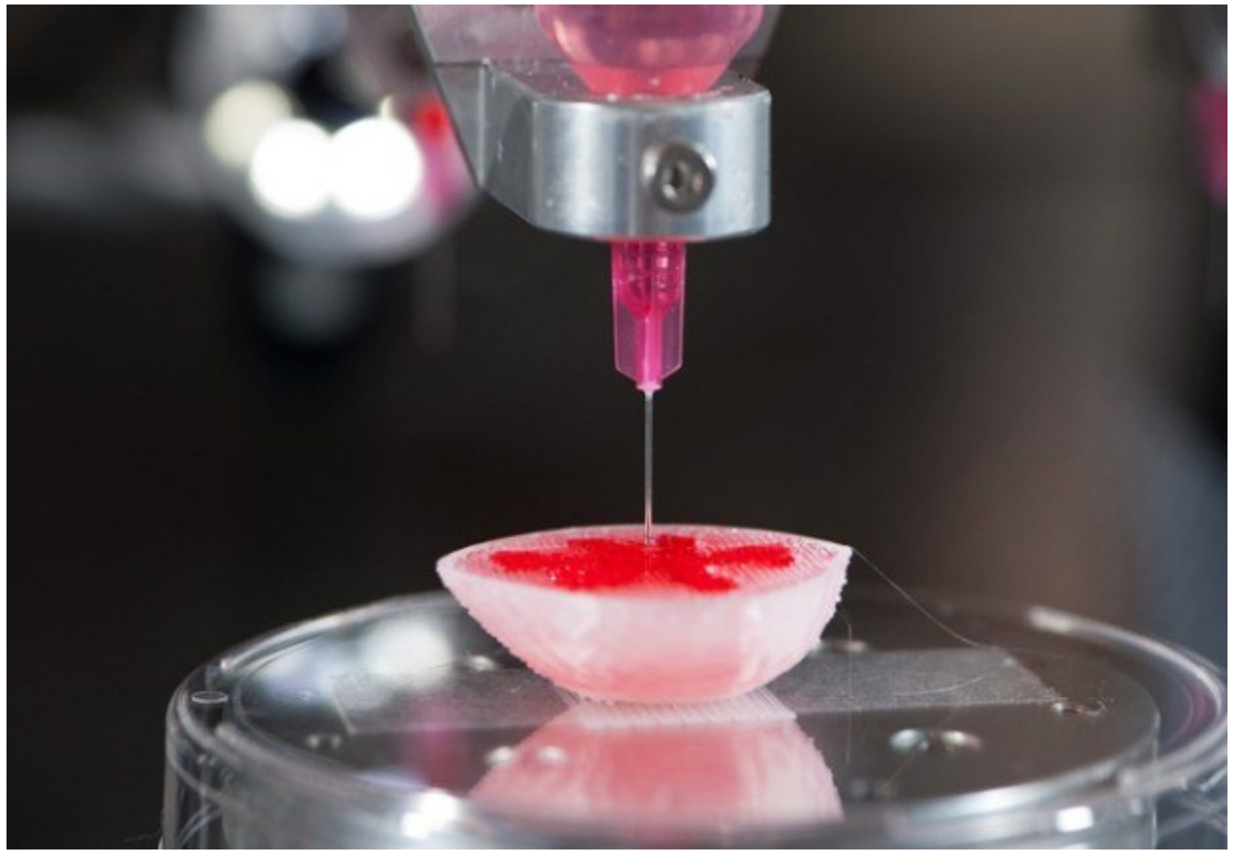
Localization and Mapping of 3-D interior space using Depth Camera

User holding and moving a standard Kinect camera should be able to rapidly create detailed 3D reconstructions of an indoor scene.

Electronic Device Printing



Bio Printing

Self Driving Car

Iterative Closest Point (ICP) Algorithm

Input : A pair of Point Clouds

↓

Selection of Points

↓

Matching

↓

Assigning Weights

↓

Rejecting certain points

↓

Assigning Error Metric

↓

Minimizing Error Metric

↓

Output : Transformation Matrices (Rotation and Translation) taking from one cloud to the other

Computing Trajectory of the camera using (ICP) Algorithm

$$Given\ {}^{G}_{1}R\ and\ {}^{G}_{1}O$$

R is the orientation of the camera and O is the initial translation of camera wrt Ground

$$For\ every\ consecutive\ pair\ of\ images$$
$$ICP\ outputs\ matrices\ TT\ and\ TR$$

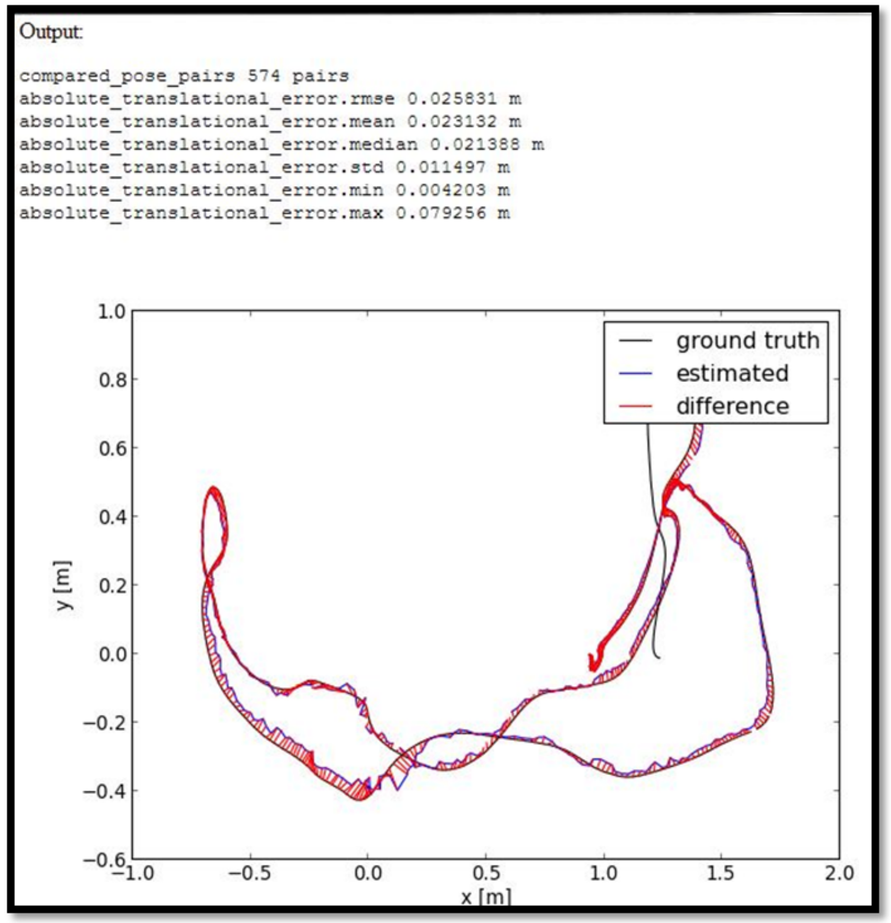
TT : Translation w.r.t previous camera position

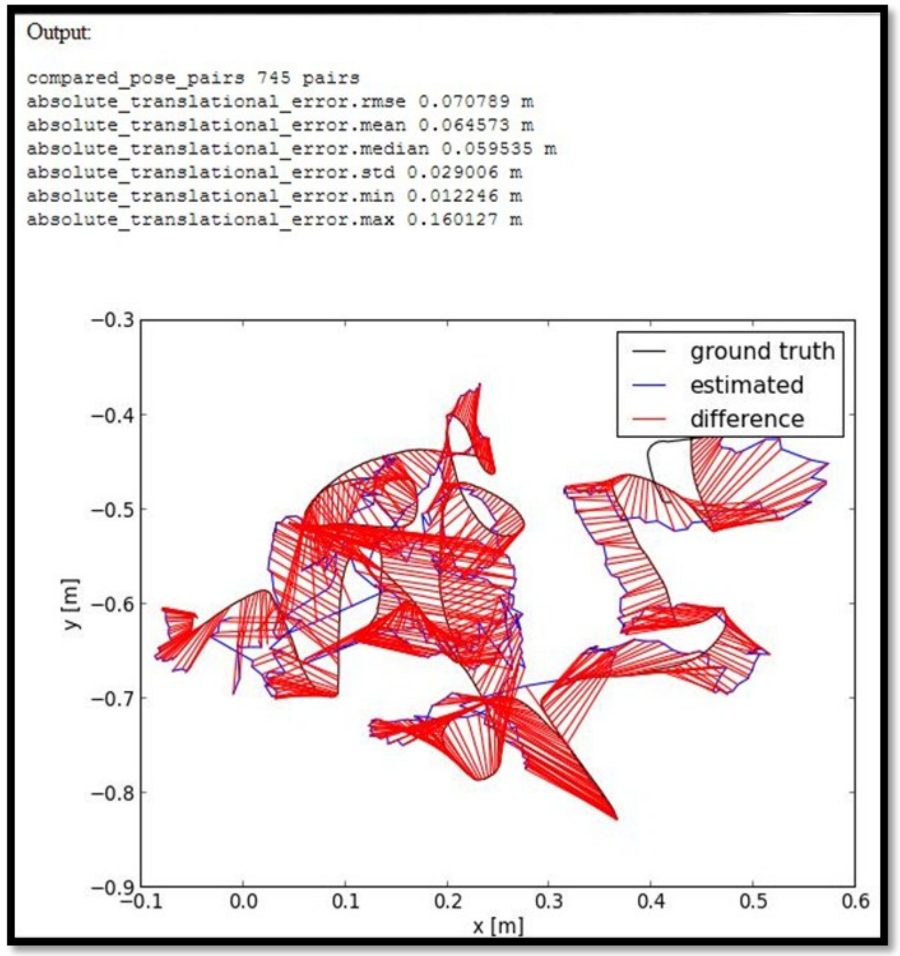
TR : Orientation w.r.t previous camera orientation

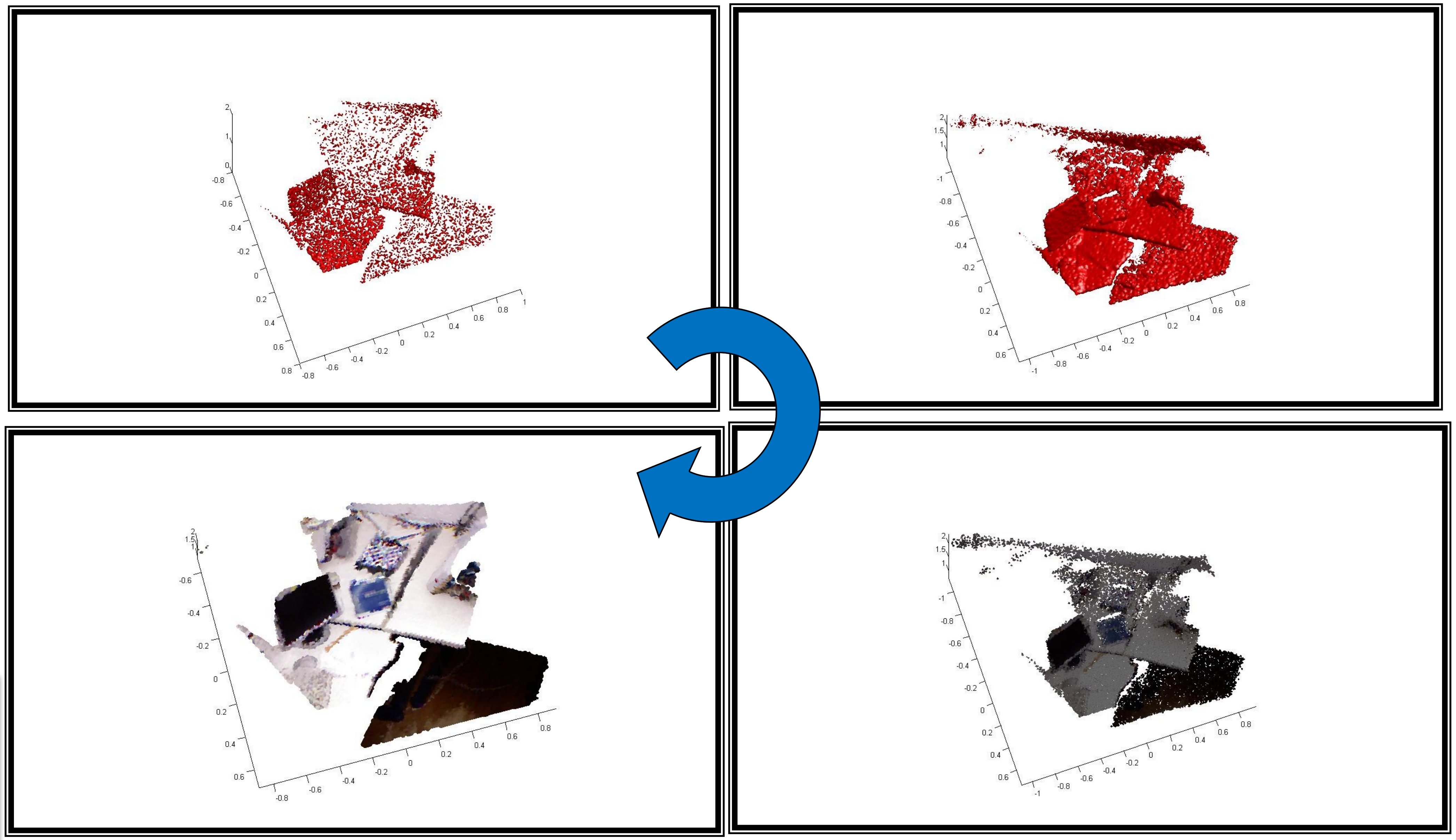
$$for\ i^{th}\ iteration$$
$$TR = {}^{i+1}_{i}R \quad TT = {}^{i+1}_{i}O$$
$${}^{G}_{i+1}R = {}^{G}_{i}R \cdot {}^{i+1}_{i}R = {}^{G}_{i}R \cdot (TR^{-1})$$
$${}^{G}_{i+1}O = {}^{G}_{i}O - {}^{G}_{i+1}R \cdot {}^{i+1}_{i}O = {}^{G}_{i}O - {}^{G}_{i+1}R \cdot TT$$

Storing R and O values at each step gives the trajectory of the camera at every step

Some Results







References :

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2. "KinectFusion: Realtime 3D Reconstruction and Interaction Using a Moving Depth Camera".2011 (By Shahzan Izadi et all)
3. "Efficient Variants of the ICP Algorithm".2001 (by Szymon Rusinkiewicz and Marc Levoy)
4. "A Volumetric Method for Building Complex Models from Range Images".1996 (By Brian Curless and Marc Levoy)