OpenFusion
Real-time 3D surface reconstruction
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Overview
OpenFusion is an implementation of Microsoft's KinectFusion system. This system enables real-time tracking and reconstruction of 3D scene using a depth sensor.

A stream of depth images is received from the camera and is compared to the model built so far in order to track the 6DOF camera position. The camera position is then used to integrate the new depth images into the growing volumetric model, resulting in an accurate and robust reconstruction. OpenFusion is built as a pipeline of four stages, each of which is computed in parallel on the GPU. This enables fast parallel computations of vast amounts of data. The four main stages of the pipeline are:

1. Depth Map Conversion
2. Camera Tracking
3. Volumetric Integration
4. Raycasting

Depth data received from the camera is noisy and full of holes. The model is fixed and smoothed our as more data is received.

Raycasting
The model is raycasted to find the currently viewed vertex map. This map is passed to the camera tracking phase to be compared to the new depth.

Future Work
- Integration of RGB into reconstructed model
- Augmented reality applications
- Wide scale scanning
- 3D printing of reconstructed models

Depth Map Conversion
Depth data is received from the camera and raw global vertex and normal maps are calculated according to the camera calibration and current position.

Camera Tracking
Find the 6DOF camera position using the ICP (Iterative Closest Point) algorithm.

Corresponding points are found between the existing model and the new converted depth map, and are used to find the current camera transformation.

Dynamic scene interaction
The reconstructed model is adapted according to dynamic changes in the scene without losing accuracy.

Volumetric Integration
The model is stored in a voxel grid as a signed distance function, in which the zero-crossing defines the model's surface.

New depth maps are fused to the existing model using the transformation calculated in the camera tracking phase.

Bibliography