Master Project

Completion of 3D Point Clouds of Interiors using Autonomous 3D Sensors

University of Zurich[UZH]

Topic

The use of 3D scanning and reconstruction is becoming a vital component in many application domains. In this project we want to combine 3D laser range scanning with autonomous, drone-based acquisition, using the latter technology to acquire the regions that cannot be properly sampled by the first. The target use case is to generate a complete point-based model of building interiors that can then be used to perform an accurate "*as-built*" reconstruction.

Assignment

The main objective of this project is to extend an initially incomplete laser-scanned point cloud model of an indoor environment (possibly accompanied by a partially reconstructed 3D surface model) by filling the missing parts with additional data, eventually forming a complete point-based model. The supplemental data are to be obtained using autonomous flying-drone based 3D scanning. The key problems include the localization and mapping as well as the registration of this new additional 3D data with the initial laser-range scanned 3D model.

To this extent, the tasks of this project include:

- From a given point cloud acquired by a laser-range scanner and possibly partially reconstructed 3D model, identify the incomplete regions.
- Detect optimal locations from where the previously occluded areas could best be scanned and completed.
- Combine existing flying drone technologies to develop a system that can autonomously capture a 3D point cloud of a room while staying clear of obstructions.
- Given a point cloud captured by the drone system (more coverage but poor quality) and a stationary scanner (good quality but poor coverage), co-register the two point clouds by investigating methods based purely on the provided point clouds and methods based on smart use of fiducial markers (e.g. April Tag).
- Merge and integrate the two point datasets into an aggregated final point cloud model, optionally exploiting the identified occlusion and reconstruction viewpoints from the stationary scanned model.
- A further optional goal is to use the 3D point cloud from the stationary scanner to guide the mapping performed by the flying drone.

Requirements

Interest in computer vision, 3D graphics and geometry processing. Application development in C++ and Matlab.

Work Load

- 30% theory
- 50% implementation
- 20% testing

Project Type

This project is primarily aimed to be a Master group project.

Supervision

Prof. Dr. Renato Pajarola
Prof. Dr. Davide Scaramuzza

Claudio Mura (Assistant)
Titus Cieslewski (Assistant)

Contact

Write an E-Mail to claudio@ifi.uzh.ch

An example of the occlusions that are found in laser range scans.

ROBOTICS & PERCEPTION GROUP

VISUALIZATION AND MULTIMEDIA LAB