

# 3-Dimensional Reconstruction of a Room based on Stereo Images

Computer Vision 2023 | Group 15 | Authors: Alex Adami, Alex Straub, Jinxin Ai, Kilian Grießl, Manuel Krummschmidt, Simon Martin

# Task Allocation

1 - 4: AS, JA, KG GUI: AS, JA

5 - 7: AA, MK, SM Poster: AA, AS, JA, KG, MK, SM

# Discussion & Outlook

- Limited to rectangular rooms and objects
- Efficiency and run time of code is not optimal
- Optimize order of algorithms (e.g. Cluster before Plane Fitting)
- Task Allocation in before/after Point Cloud is possible due to given Ground Truth Point Cloud
- Generation of Point Cloud is the most crucial and challenging part
- Improve ability to generalize the Point Cloud creation for varying data sets

# Sources

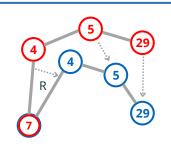
- [1] Singhal, Prateek, et al. "Top down approach to detect multiple planes from pair of images." Proceedings of the 2014 Indian Conference on Computer Vision Graphics and Image Processing, 2014.
- [2] Triggs, Bill, et al. "Bundle adjustment—a modern synthesis." Vision Algorithms: Theory and Practice: International Workshop on Vision Algorithms Corfu, Greece, September 21–22, 1999 Proceedings. Springer Berlin Heidelberg, 2000.
- [3] Torr, P. H. S., and A. Zisserman. "MLESAC: A New Robust Estimator with Application to Estimating Image Geometry." Computer Vision and Image Understanding. 2000.

# Image Processing



- Feature Detection (SURF, ORB)
- Feature Matching between image pairs
- Sort image pairs according to number of matched features
- Create branches from the best image pairs

Camera Geometry - Multiview



- Estimate relative geometry of branches with Multiview Triangulation [1]
- Rotate real camera positions to match the estimated geometry from Bundle Adjustment [2]

3

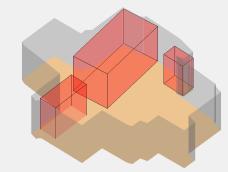
# **Filtering**

- Filter out branches with high deviation of geometry
- Transform the Point Cloud to world coordinate system with estimated rotation

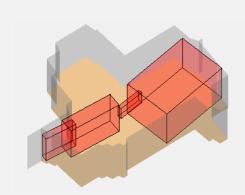
# **Challenges:**

Unreliability in Multiview
Triangulation leads to low
number of valid branches

# **3D Reconstruction**

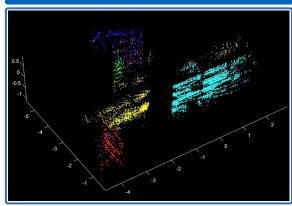


With Ground Truth Point Cloud



With Our Point Cloud





Rotate PC to X/Y
Filter outliers

# 7

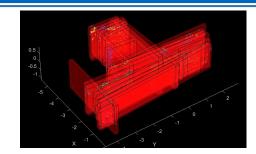
# Create Ground Floor

- Transform cuboids into lines in 2D plane
- Detect spanned area
- Find outlines of detected area
- Raise outlines to walls with room height in 3D

### **Challenges:**

- Adding missing outlines
- Hard decision rules instead of identifying based on intuition

# Fit planes

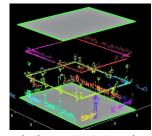


- Find planes parallel to X and Y
- Fit cuboids around walls

## **Challenges:**

Detecting correct walls

# Detect Ceiling, Floor and Objects



- Fit horizontal planes in PC and calculate room height (MSAC) [3]
- Eucledian Distance Clustering for Object detection (pcsegdist)

# **Challenges:**

- Features on ceiling and floor required
- Cluster Distance Parameter is dependent on room size
  - \*\* PC in figure from ground truth points of test data