A 3D ROOM MODEL FROM IMAGES ONLY

Computer Vision Challenge 2023 | Group 24

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Allocation of Work
GUI: Sami
Preprocessing: Marius, Lorenz, Lukas
3D Reconstruction: Marius, Daniel
Detection: Lorenz, Lukas

References
1: https://miro.medium.com/v2/resize:fit:1100/format:webp/1*QinDfRawRskupf4mU5bYSA.png
2: https://mathworks.com/help/vision/ref/detectsurffeatures.html
3: https://mathworks.com/help/stats/pca.html
4: https://mathworks.com/help/vision/ref/pcfitplane.html
5: https://mathworks.com/help/matlab/ref/fft2.html
6 https://en.wikipedia.org/wiki/Nearest_neighbor_search

Preprocessing

Image similarity
- Histogram
- FFT
- PCA [I]

Image Preprocessing
- Grayscale
- Sharpen
- Enhance contrast
- Remove Noise

3D-Reconstruction

3D-Reconstruction
- SURF feature extraction
- Feature matching
- Epipolar geometry
- Triangulation
- Bundle adjustment

Essential Matrix

Dense-Matching and vSLAM
- Epipolar rectification
- Dispartiy map
- Recompute camera poses with loop closures

unused

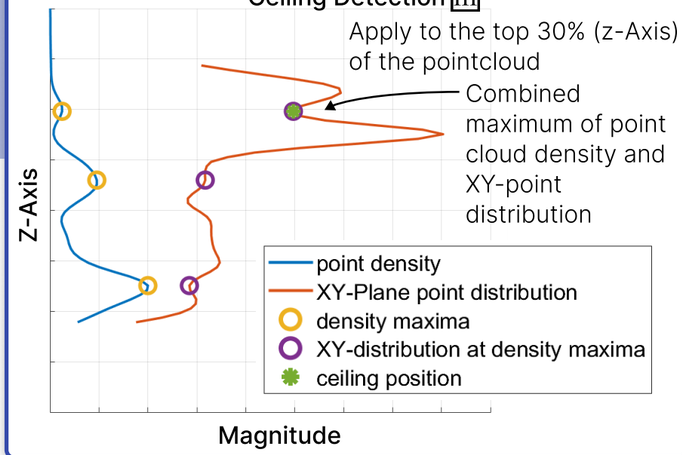
Plane Detection & Alignment
- Ceiling and floor planes
- Pointloud Alignment [II] [III]

Scaling Factor
- Scaling Factor from room height
- (Scaling factor from 2 points)

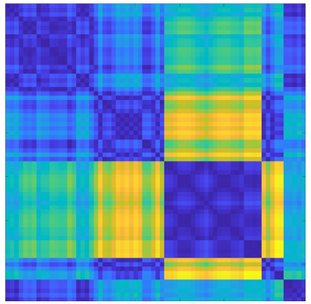
Model Detection

Cuboid Detection
- Cluster point cloud
- Fit cuboids around cluster
- Filter cuboids

Ceiling Detection [III]



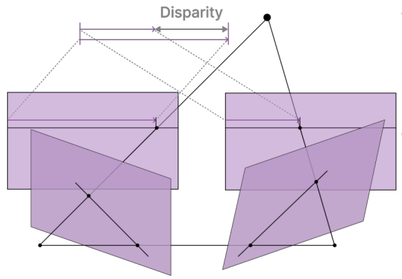
Dissimilarity Matrix [I]



- Calculate features with with **histogram** or **FFT2**
- Project images/ features into a lower dimension with **PCA**
- Sort Images via nearest neighbor

← conference-hall

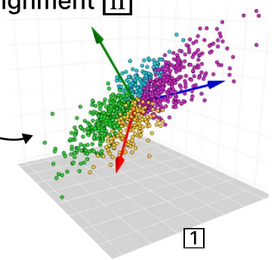
Dense-Matching



- Images projection so that **epipolar lines** are horizontal
- **Disparity**/Depth estimation along lines

Point Cloud Alignment [II]

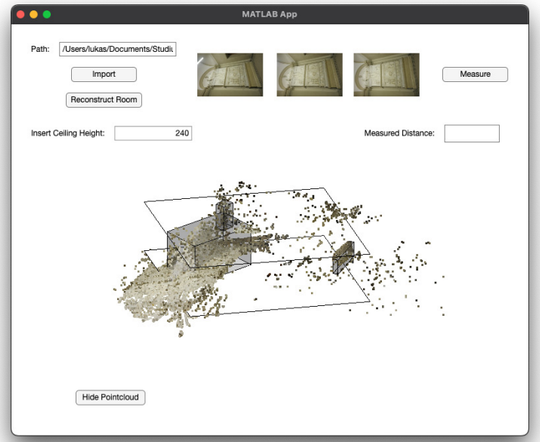
- **PCA** of all points in the Point cloud
- Determine initial rotation
- Align it to Coordinate system



Algorithms and Tools
- SURF [2]
- Principal Component Analsys (PCA) [3]
- MSAC (plane fitting) [4]
- Fast Fourier Transform in 2D (FFT2) [5]
- Nearest Neighbor [6]

Learnings
- Reconstruction from non-stereo pictures is hard
- **Image order** is important and complicated
- SLAM would be helpful to avoid the cameras drift

Relief



Delivery Area