3D Scene Reconstruction From Multi-View RGB Images Using a Monocular Camera

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Why 3D Reconstruction from RGB?

- Reconstruct real-world scenes using just RGB images

- Augmented reality and robotics applications

- Avoid depth sensors or pretrained pipelines (e.g. COLMAP)

Related Work

- COLMAP: Feature-based SfM & dense reconstruction
- OpenSfM: Open-source photogrammetry system
- [Paper] A Method of 3D Reconstruction from Image Sequence
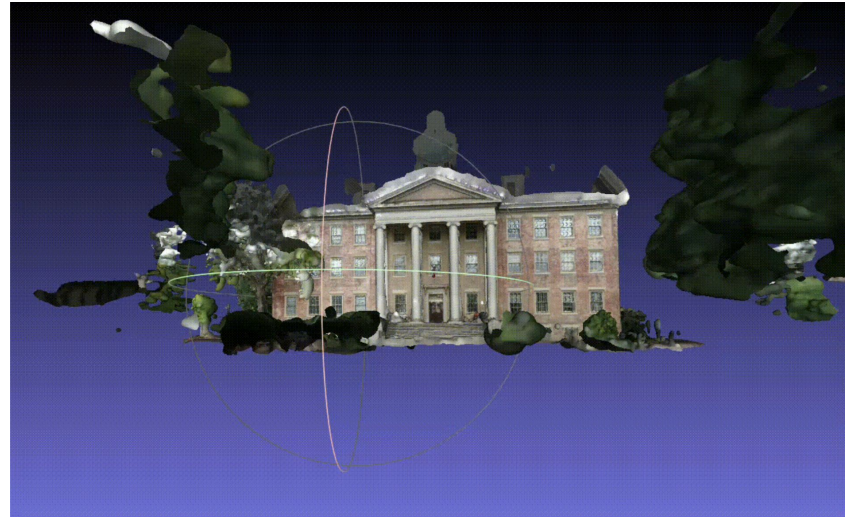
Pipeline Overview

- Calibration and Image Undistortion
- SIFT + FLANN + Lowe's Ratio Matching
- Relative Pose Estimation
- Pose Chaining
- Triangulation
- Bundle Adjustment
- [Experimental] Depth Map Fusion using MiDaS

Pose Estimation + Triangulation

- Fundamental + Essential Matrix
- recoverPose in OpenCV
- TriangulatePoints for matched keypoints
- Early results showed stretched or skewed lines

Pose Chaining and Optimization

- Chained poses using matrix multiplication

- Global trajectory maintained

- Ceres-based Bundle Adjustment

- Optimizes camera poses + 3D structure

Experiments & Results

- Car Scene: Partial mesh over hood

- City Model: Failed due to reflectivity

- Sparse clouds forming object-like clusters

- Final visualizations in Open3D
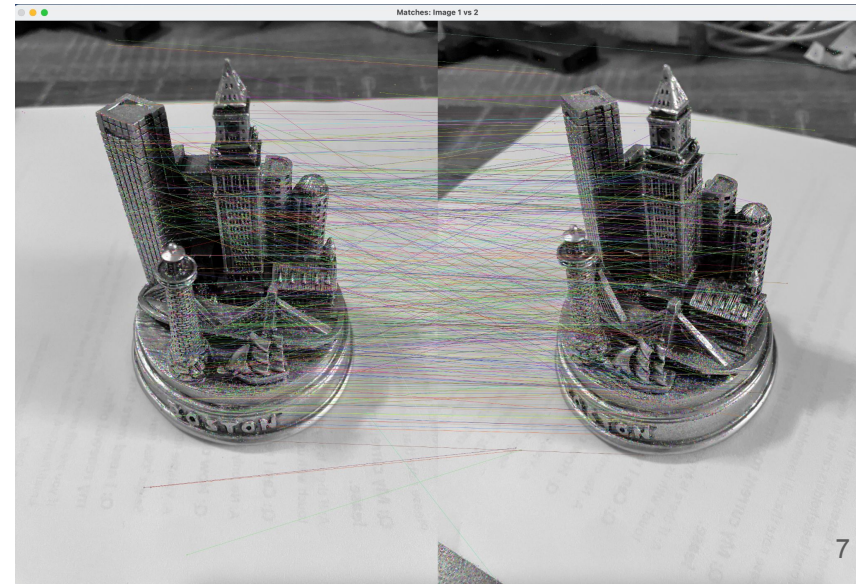
Discussion & Summary

- Doing it from scratch = high complexity

- COLMAP does this better, but is a black box

- Pose chaining and bundle adjustment were critical

- Reflective, low-texture scenes remain difficult

- Good foundation for future AR/robotics work

Thank you!