

Evaluation of ORB-SLAM3 for Real-Time Monocular Applications

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Problem

Real-time visual SLAM enables camera-based localization and mapping using only monocular image input. This project evaluates the robustness and real-time capability of **ORB-SLAM3** under varying environmental conditions and computational constraints.

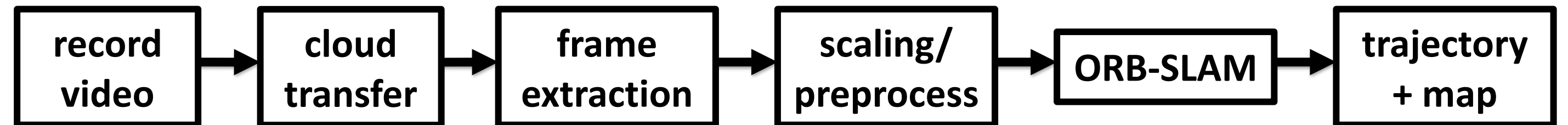
Related Work / Motivation

ORB-SLAM3 is a state-of-the-art feature-based SLAM system. In contrast, direct methods such as **LSD-SLAM** operate directly on pixel intensities and therefore require less computation. This motivates the evaluation of the real-time performance of feature-based approaches on low-end hardware.

Your Approach / Solution

The performance and processing time of ORB-SLAM3 were evaluated in different indoor scenarios with varying lighting conditions and image resolutions.

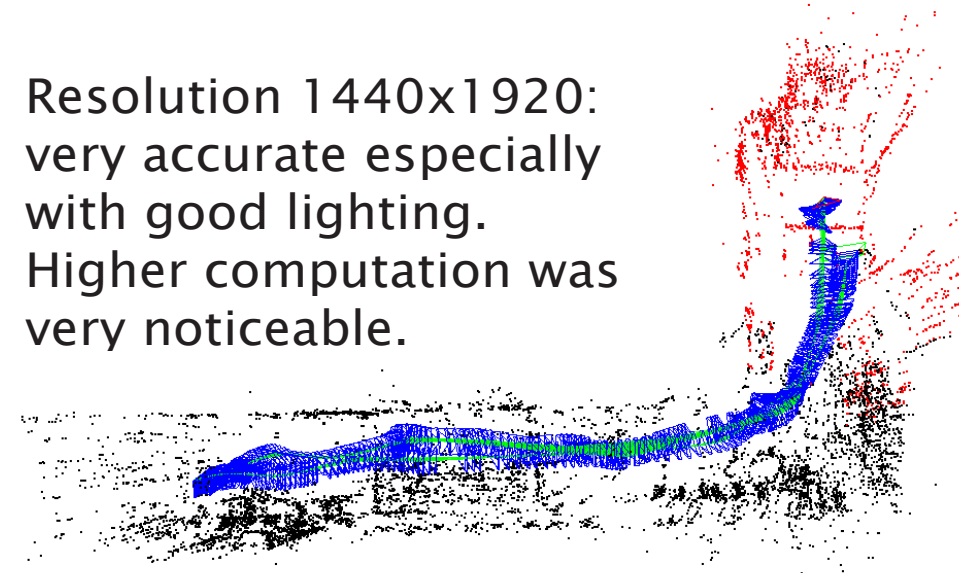
Pipeline for offline-use:



Videos were recorded using a smartphone and transferred to a Computer via cloud services. Frames and timestamps were extracted and optionally downsampled. The processed data was then fed into ORB-SLAM3 for offline SLAM evaluation.

Results

Resolution 1440x1920:
very accurate especially with good lighting.
Higher computation was very noticeable.

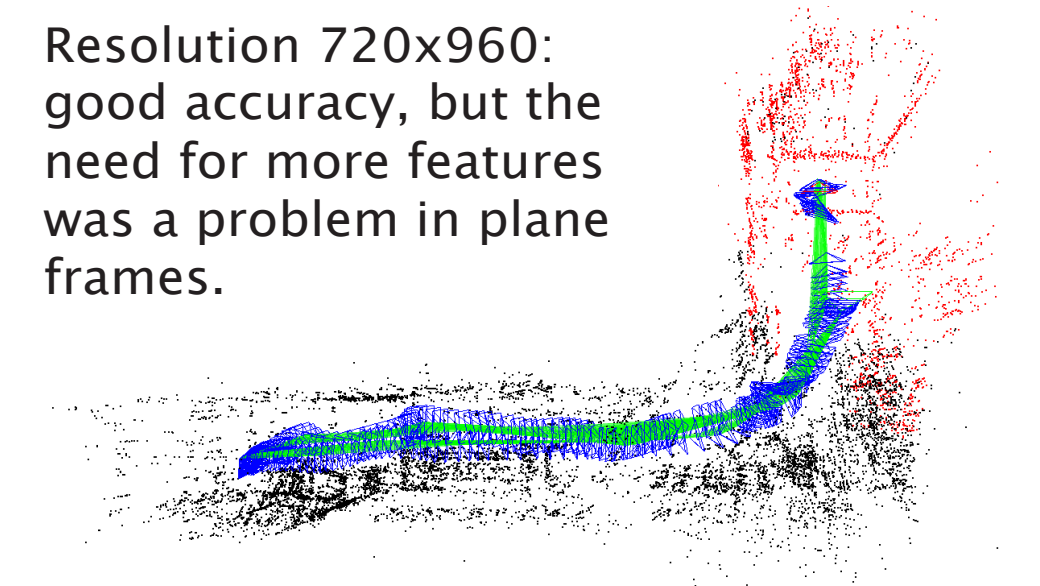


- ◆ Quality: very high
- ◆ Time: 90 seconds
 - good offline-use



- ◆ Testing area: 3.5 x 7.5 m
- ◆ Video: 45 seconds long, mid → good lighting
- ◆ CPU: AMD Ryzen5
 - mid-range hardware

Resolution 720x960:
good accuracy, but the need for more features was a problem in plane frames.



- ◆ Quality: high
- ◆ Time: ~45 seconds
 - mid-end real-time-use

Conclusion: ORB-SLAM3 is a high-quality tool, that can be used for real-time Mono-SLAM purposes. However performance degrades under poor lighting and rapid motion. Tracking failures often result in the creation of a new map, limiting long-term stability. It's current best use case is mid-range offline processing.

References

- Campos et al., ORB-SLAM3: An Accurate Open-Source Library for Visual, Visual-Inertial, and Multi-Map SLAM. IEEE Transactions on Robotics, 2021
- Andrew J. Davison, MonoSLAM: Real-Time Single Camera SLAM. IEEE TPAMI, 2007
- Engel et al., LSD-SLAM: Large-Scale Direct Monocular SLAM. ECCV, 2014