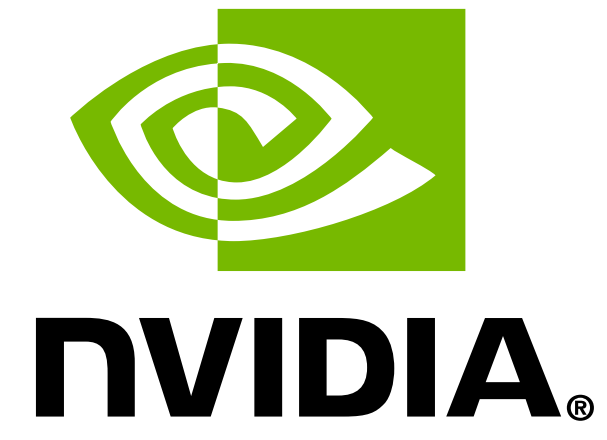# slamRT: a real-time slam system to deal with Rotations and Translations

Herrera C. D.[†], Kim K.[‡], Kannala J.[†], Pulli K.[‡], Heikkilä J.[†]

[†] Center for Machine Vision Research, University of Oulu, Finland

[‡] NVIDIA Research

Abstract

We demonstrate a slam system that deals with both pure rotations and generic camera motion seamlessly in real-time. Inspired by PTAM, it improves performance by also adding non-triangulated features to the map.
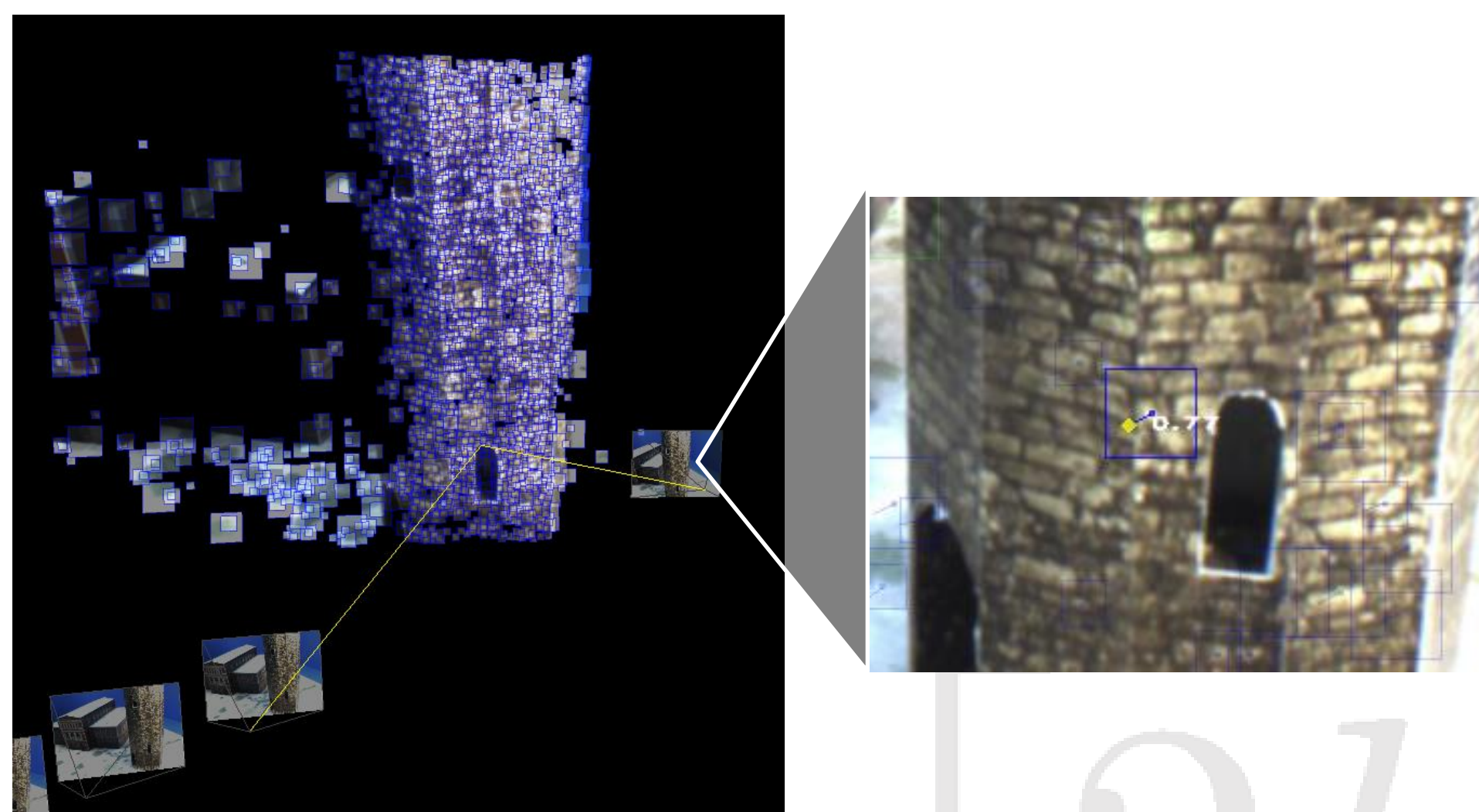
Characteristics:
- Free of restrictions on camera motion
- Takes advantage of triangulated points to speed up matching and pose estimation
- Reduces drift by matching to map features
- Performs bundle adjustment in the background
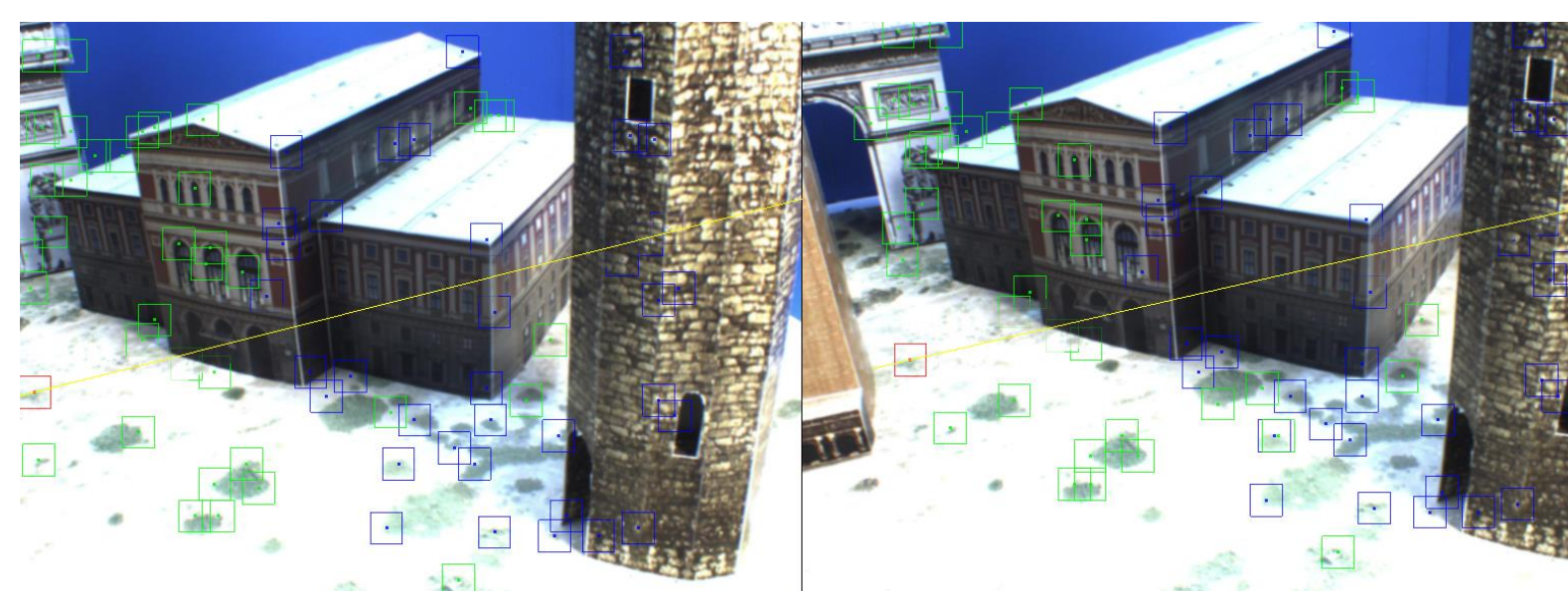- Real-time and open source
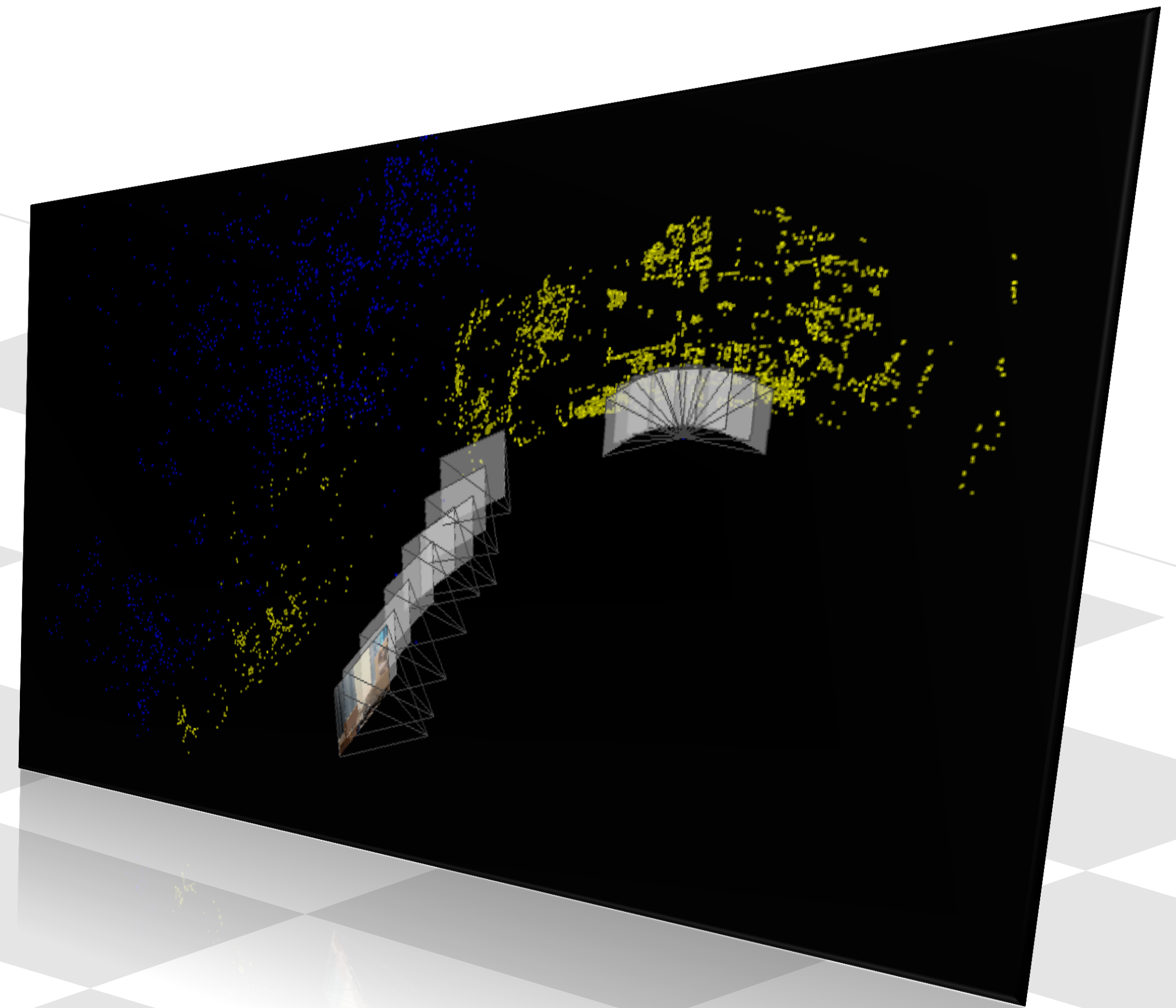
Mixing 2D and 3D features

3D reprojection error

3D features reproject to a single point
Detected vs. reprojected: $\|\hat{p}_c - p_c\|^2$
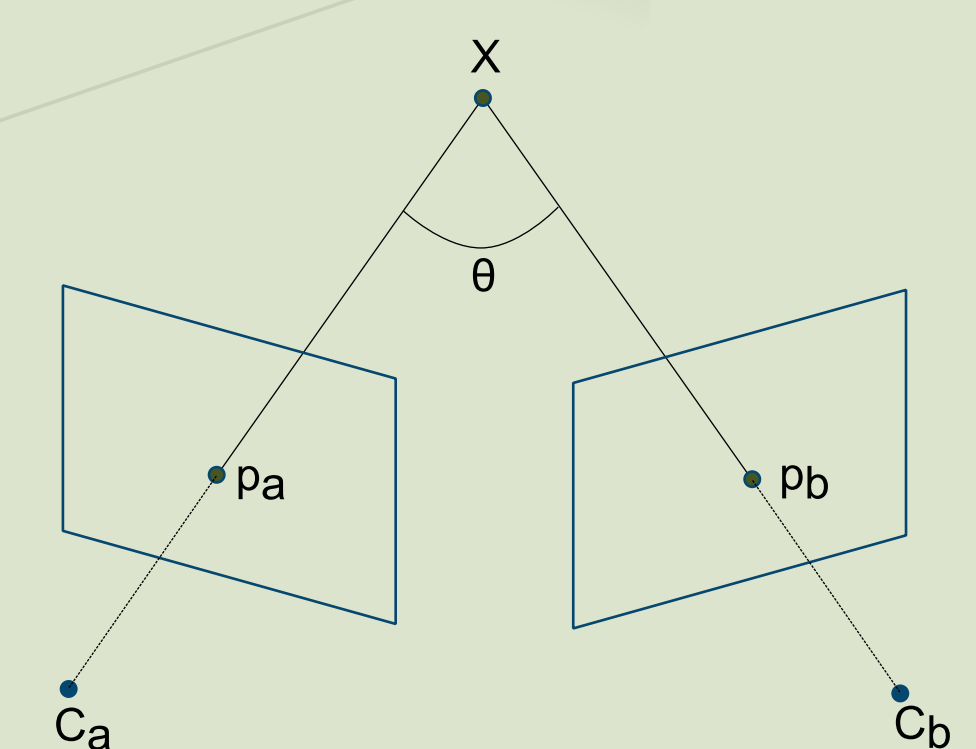
2D epipolar error

2D features reproject to an epipolar line
Distance to line: $|Norm(p_a K_a E_{ab} K_b) p_b|^2$

Upgrading 2D to 3D

- Features are triangulated when the angle θ is above threshold.
- Dynamic baseline based on distance

$$C = \sum \|\hat{p}_C - p_C\|^2 + \sum |Norm(p_a K_a E_{ab} K_b) p_b|^2$$

Non-linear minimization (LM)

Keyframe selection

Compromise: map complexity vs. scene coverage.

New keyframe selection criteria:
- Add when 3D features are observed from different angle
- Add when 2D features can be triangulated
- Add when new 2D features are available
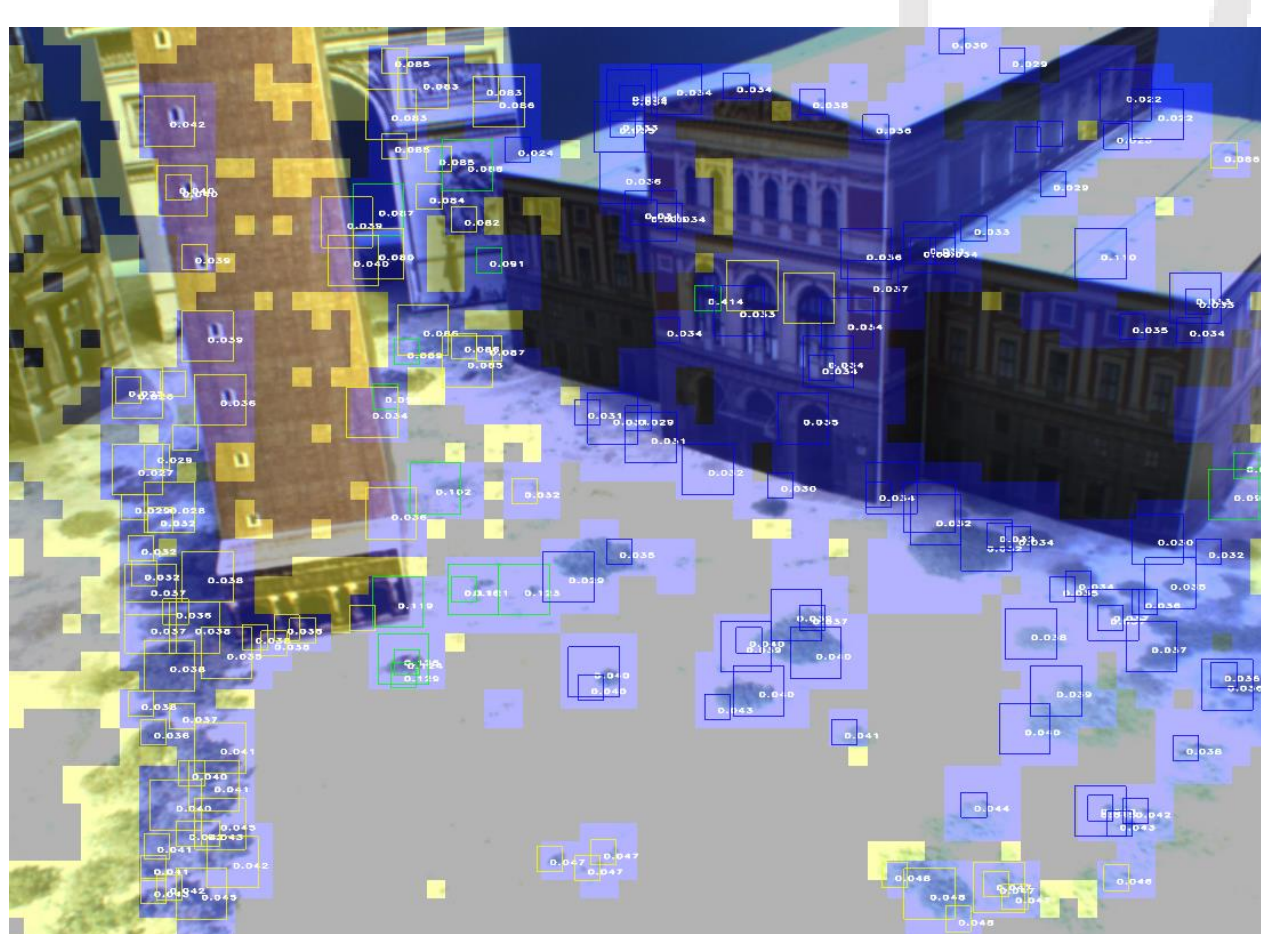
Contributions

- Hybrid cost function allows pose tracking with and without a translation.

- New keyframe selection minimizes map complexity while maximizing map coverage.

- Open source.