Stereo Visual Inertial Odometry

Präsentation Masterarbeit

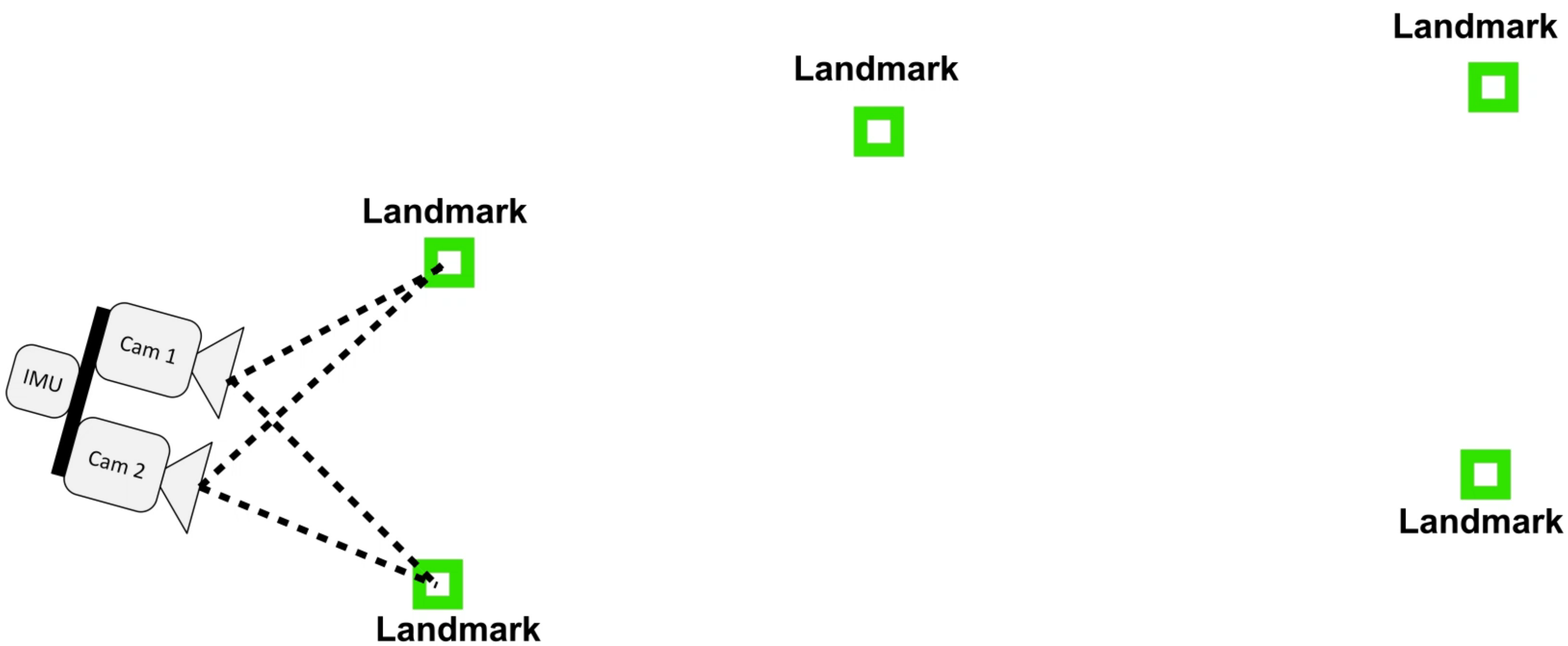
26.10.2019, Philipp Schmid


SERVICE &MAINTENANCE AUGMENTED REALITY


Swiss Technology


iRobot
Roomba
CLEAN

Odometrie-/ SLAM-Problem

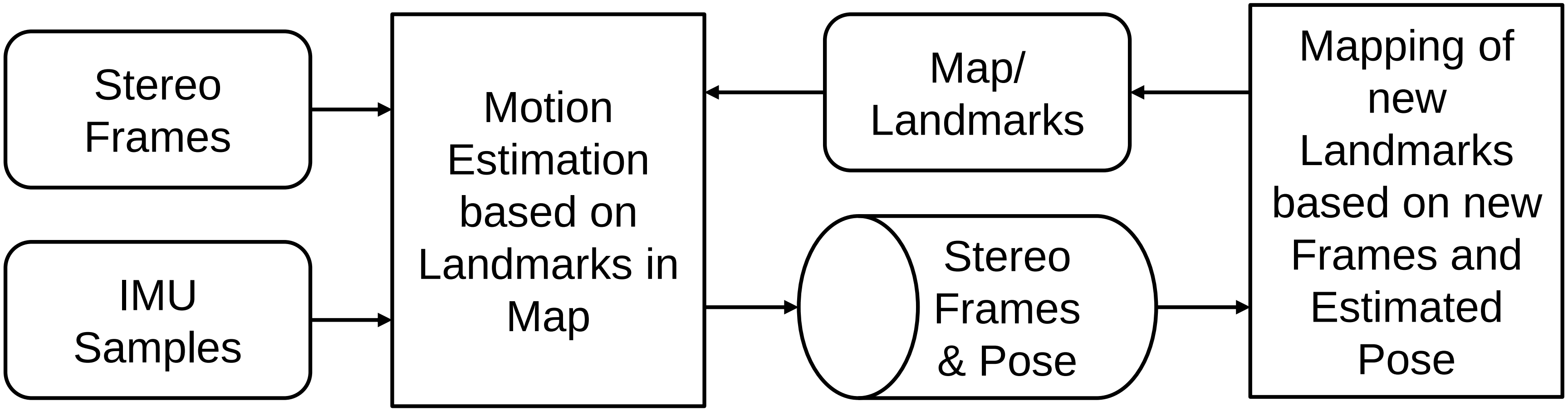


- Aufgabe: Implementation Visual-Inertial-Odometry-Pipeline mit Stereo-Kamera und IMU

Übersicht

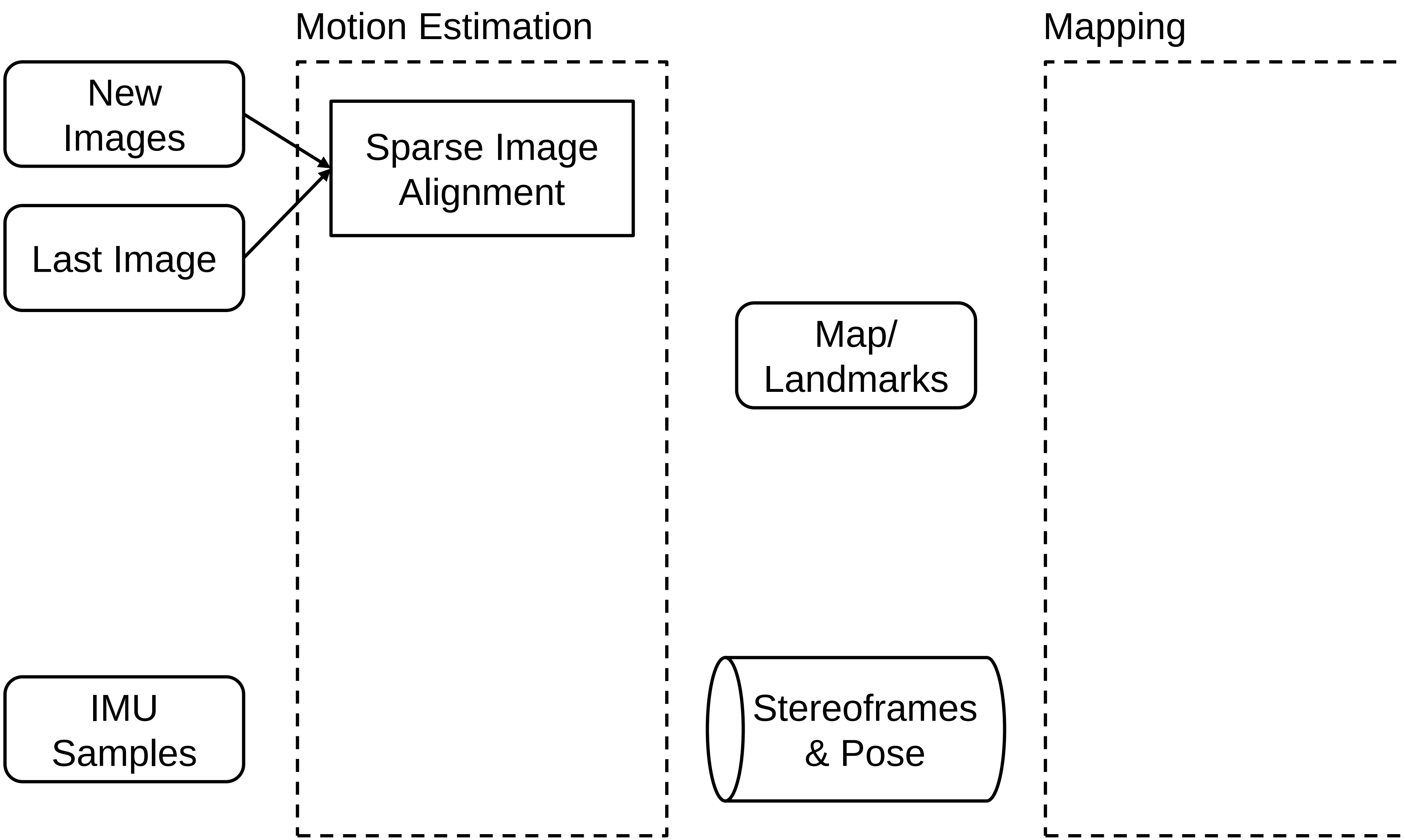
- Motivation und Problemstellung
- Grundidee VIO/VI-SLAM
- Implementierter Algorithmus
- Demonstration & Resultate
- Zusammenfassung & Ausblick

Grundidee Visual Inertial Odometry

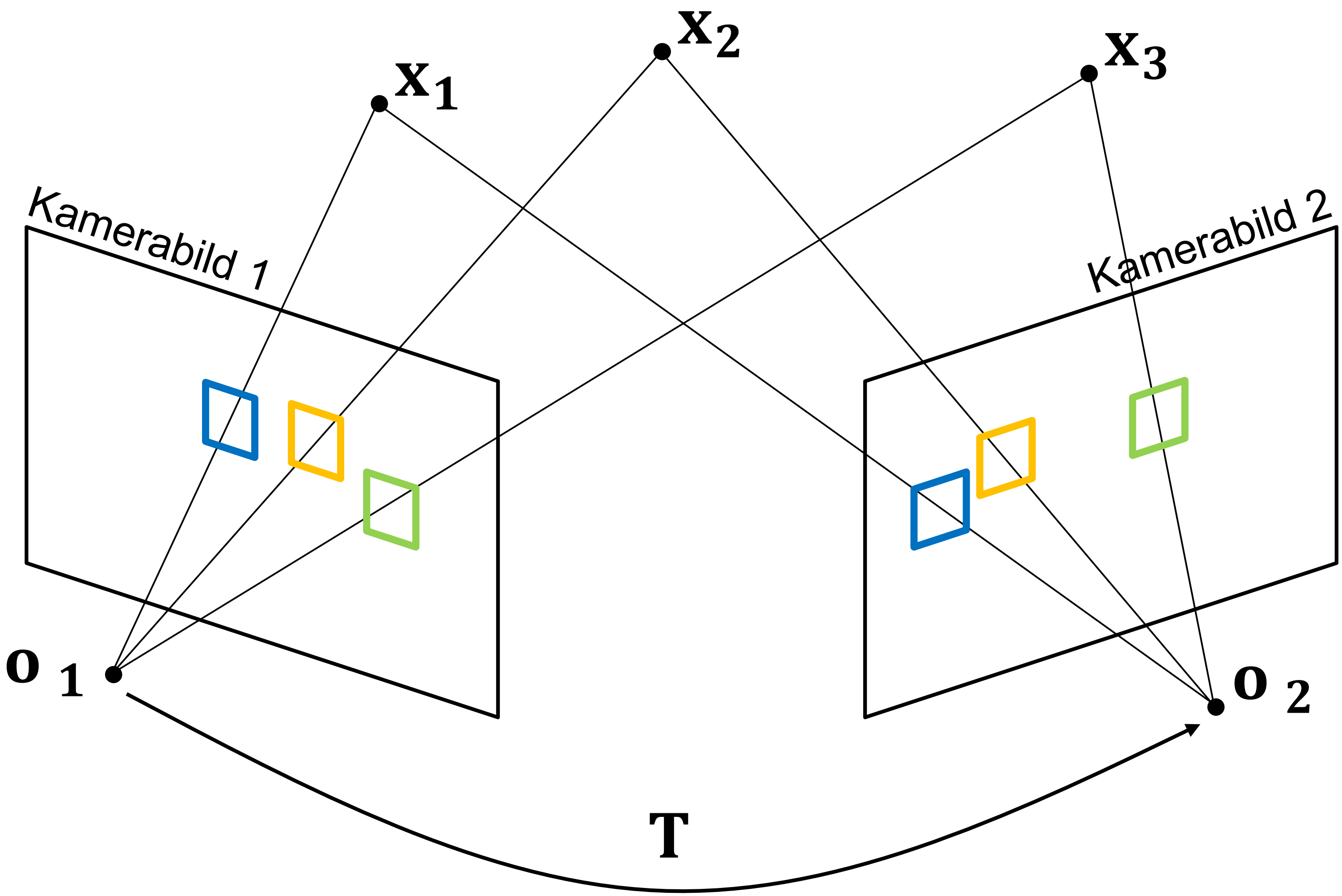


Henne-Ei-Problem!

Implementierter Algorithmus

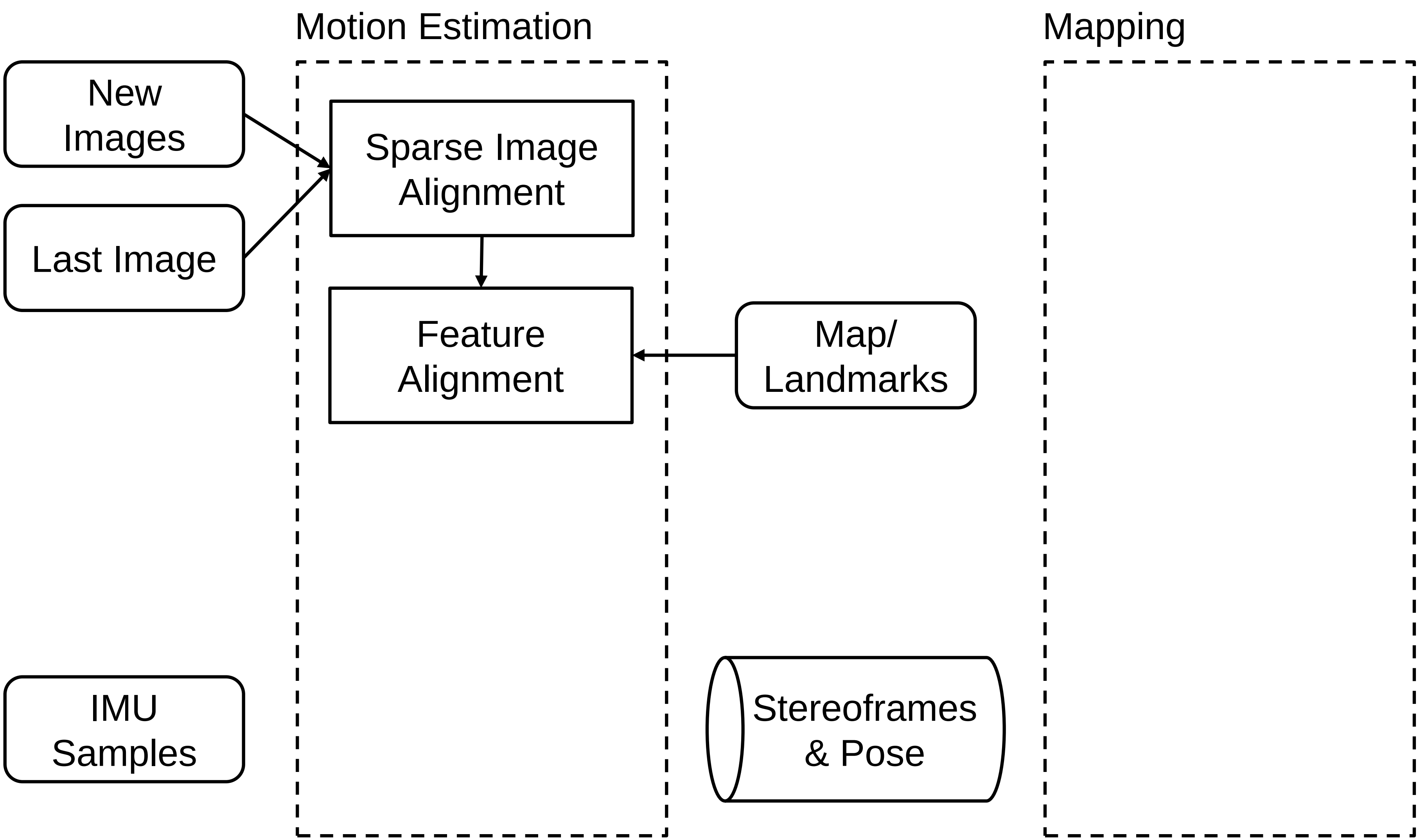


Motion Estimation – Sparse Model-based Image Alignment



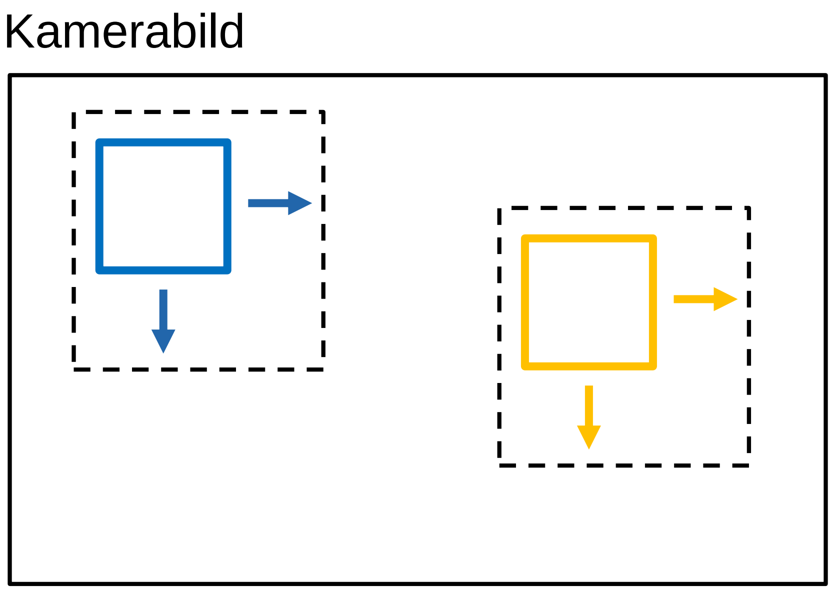
$$\underset{\boldsymbol{T}}{\operatorname{argmin}} \sum_{i \in \boldsymbol{I}} \left\| \boldsymbol{P}_{r,i} - \boldsymbol{P}_i(\pi(\boldsymbol{T} \cdot \mathbf{x}_{\boldsymbol{i}})) \right\|^2 \qquad \underset{\boldsymbol{T}}{\operatorname{argmin}} \sum_{i \in \boldsymbol{I}} \rho\left(\boldsymbol{P}_{r,i} - \boldsymbol{P}_i\left(\pi(\boldsymbol{T} \cdot \mathbf{x}_{\boldsymbol{i}})\right)\right)$$

Implementierter Algorithmus

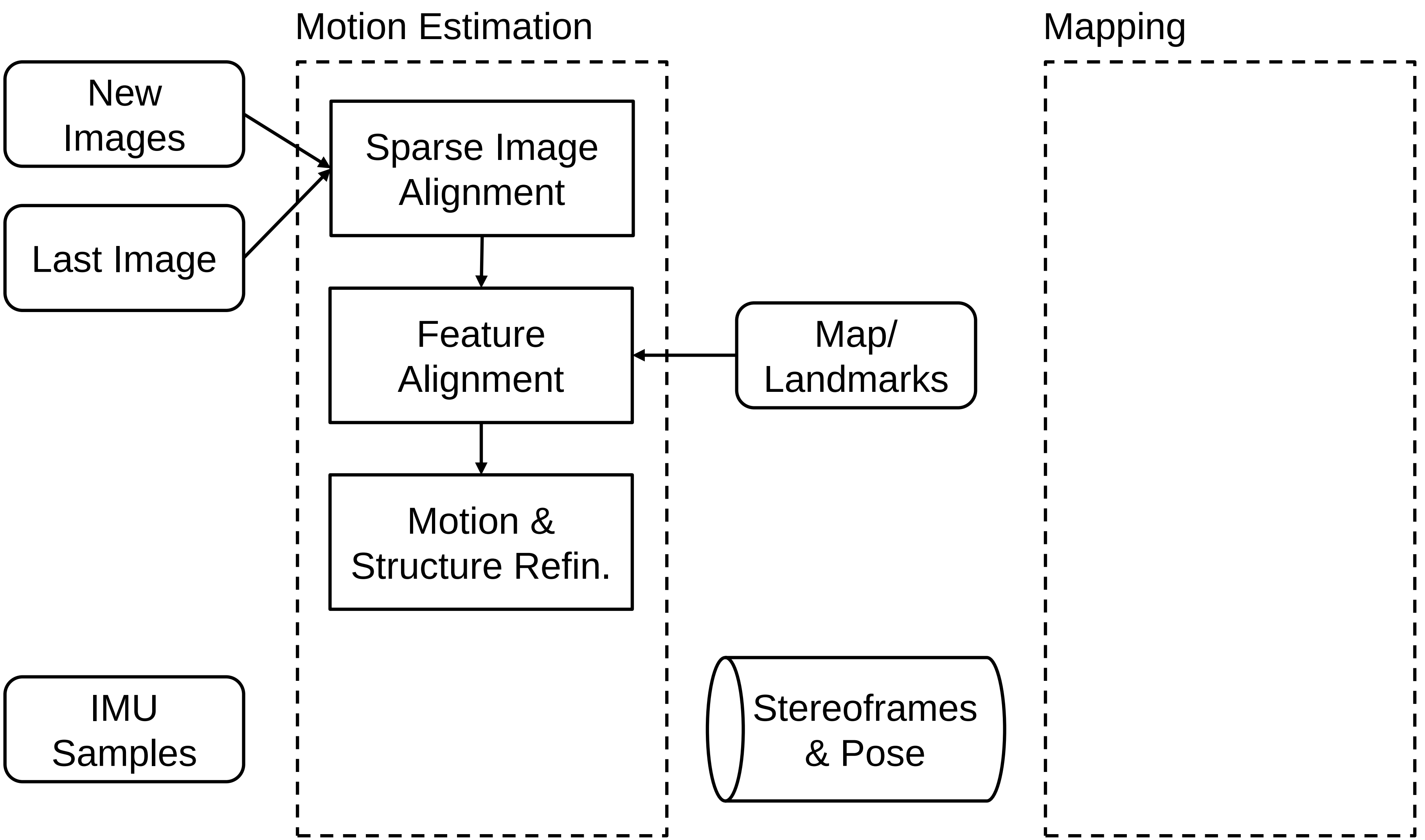


Motion Estimation – Feature Alignment

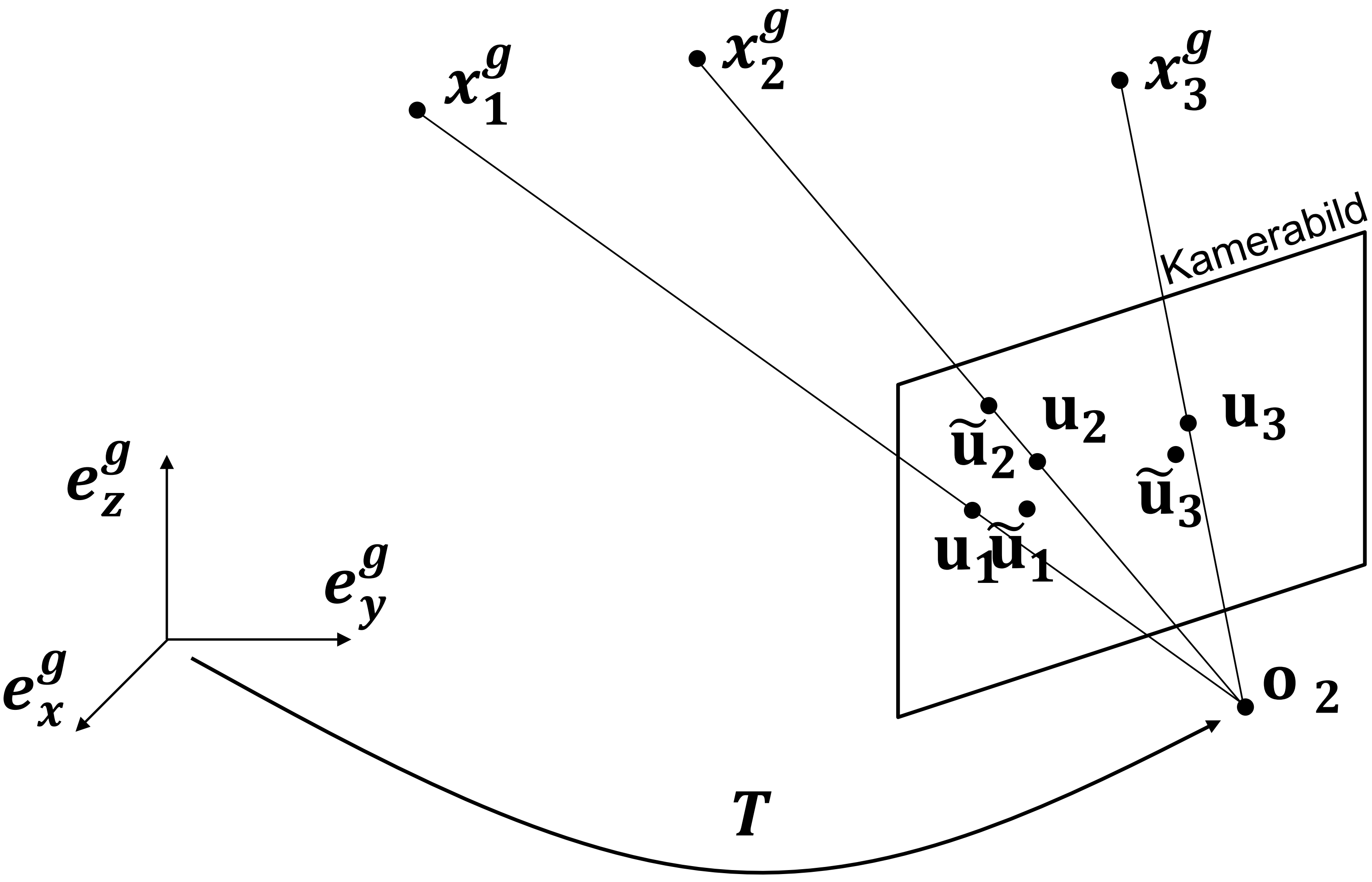
- Globales Suchverfahren über Interpolation und Korrelation



Implementierter Algorithmus

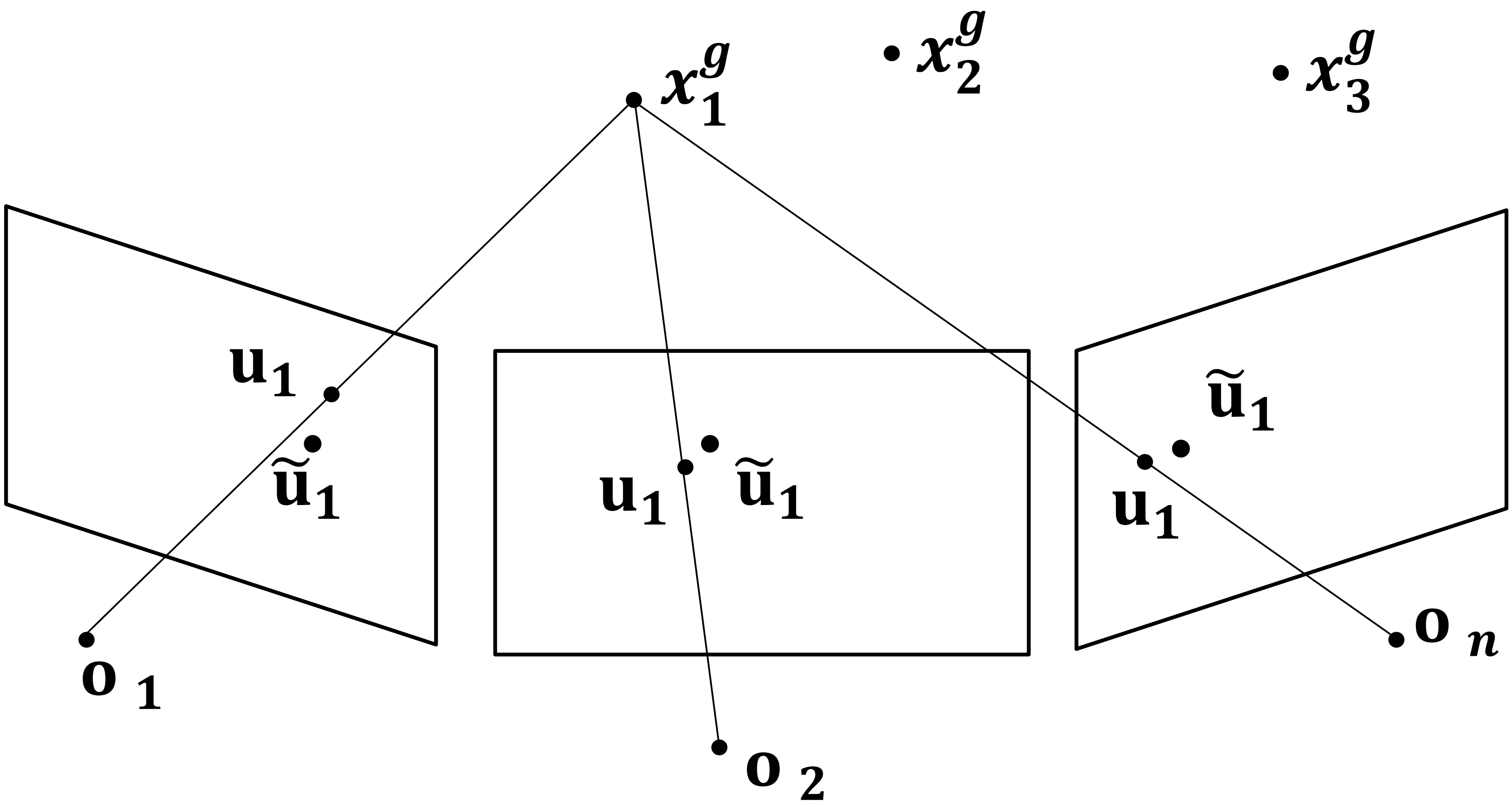


Motion Estimation – Bundle-Adjustment



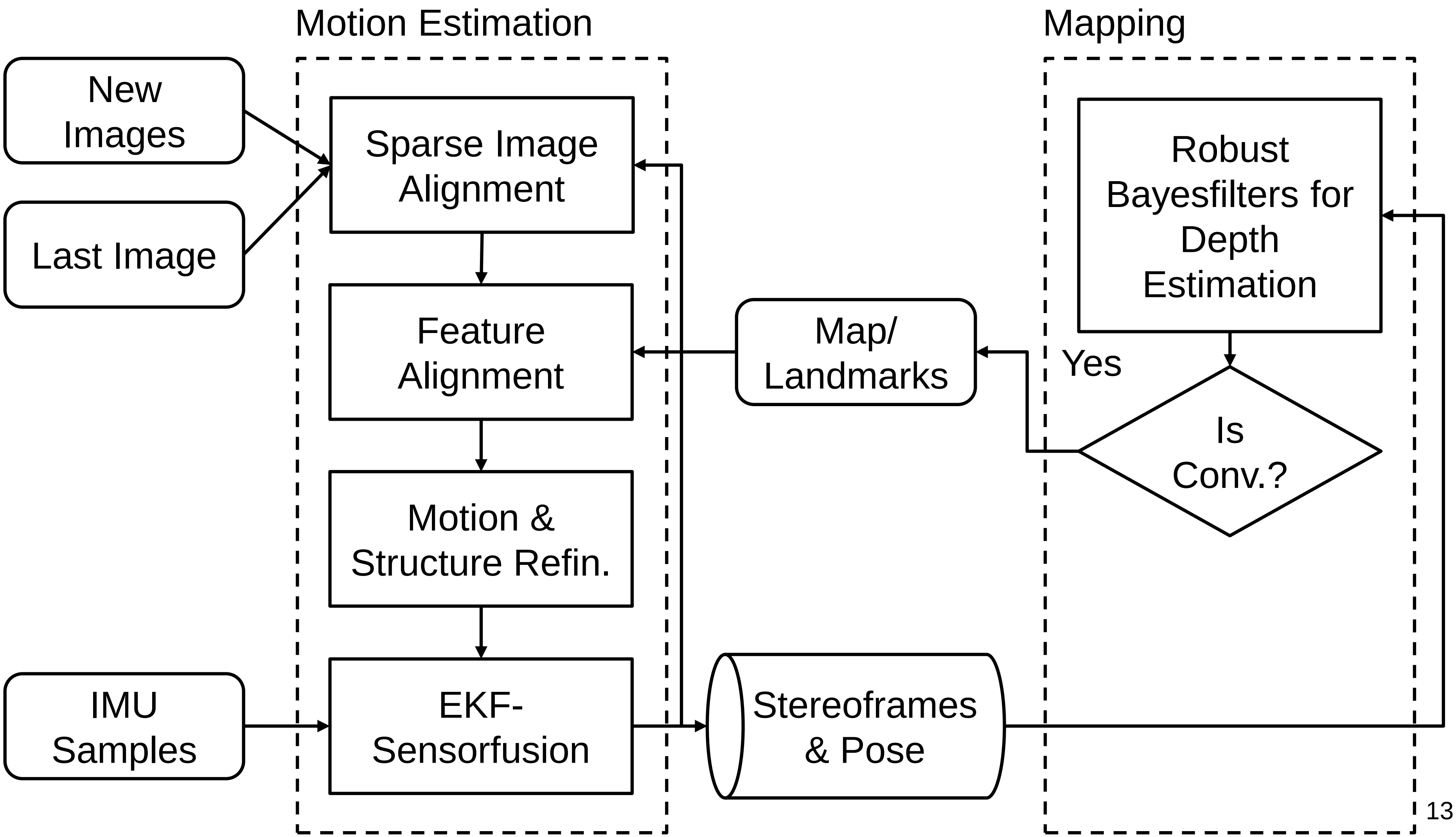
$$\underset{T}{\operatorname{argmin}} \sum_{i \in I} \left\| \mathbf{u}_i - \pi(T \cdot x_i^g) \right\|^2$$

Structure Refinement – Bundle-Adjustment

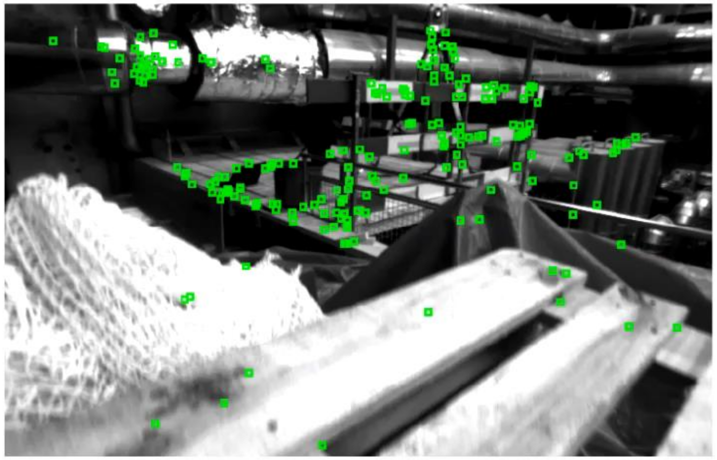


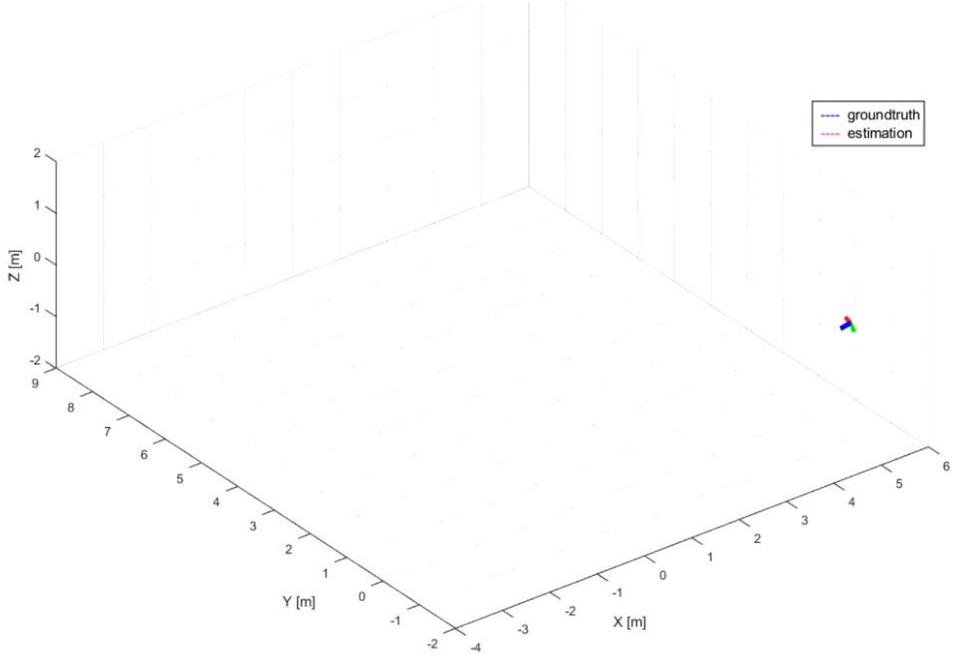
$$\underset{x_i^g}{\operatorname{argmin}} \sum_{j \in J} \left\| \mathbf{u}_i^j - \pi(\boldsymbol{T}_j \cdot \boldsymbol{x}_i^g) \right\|^2$$

Implementierter Algorithmus - EKF

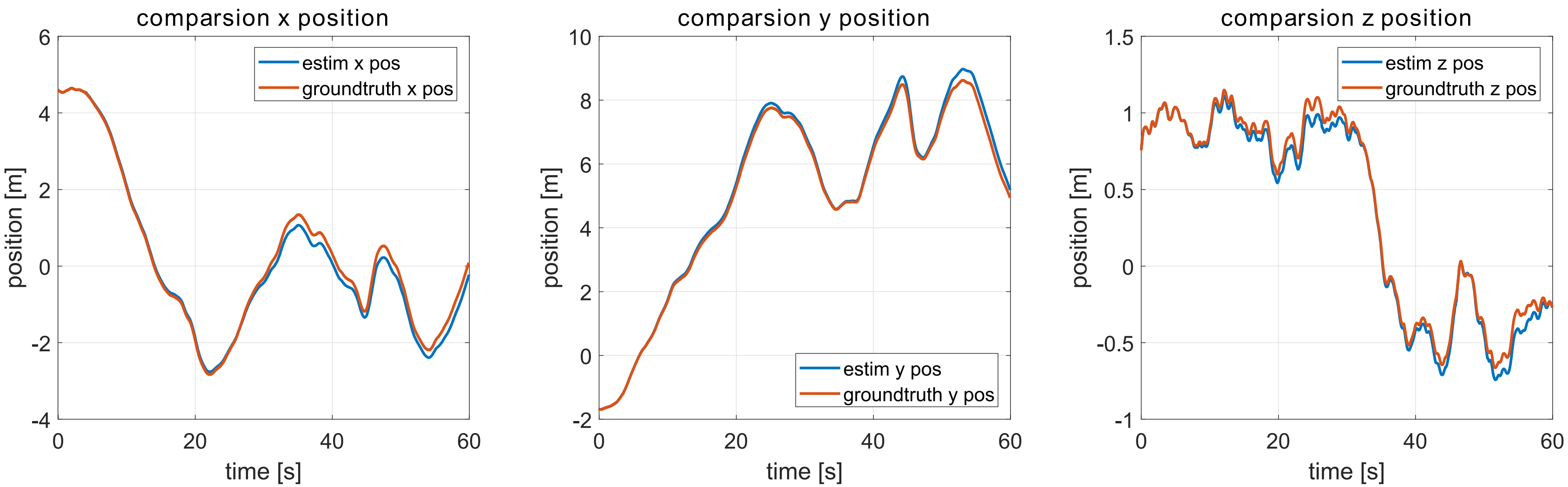


Demonstration EuRoC-Dataset

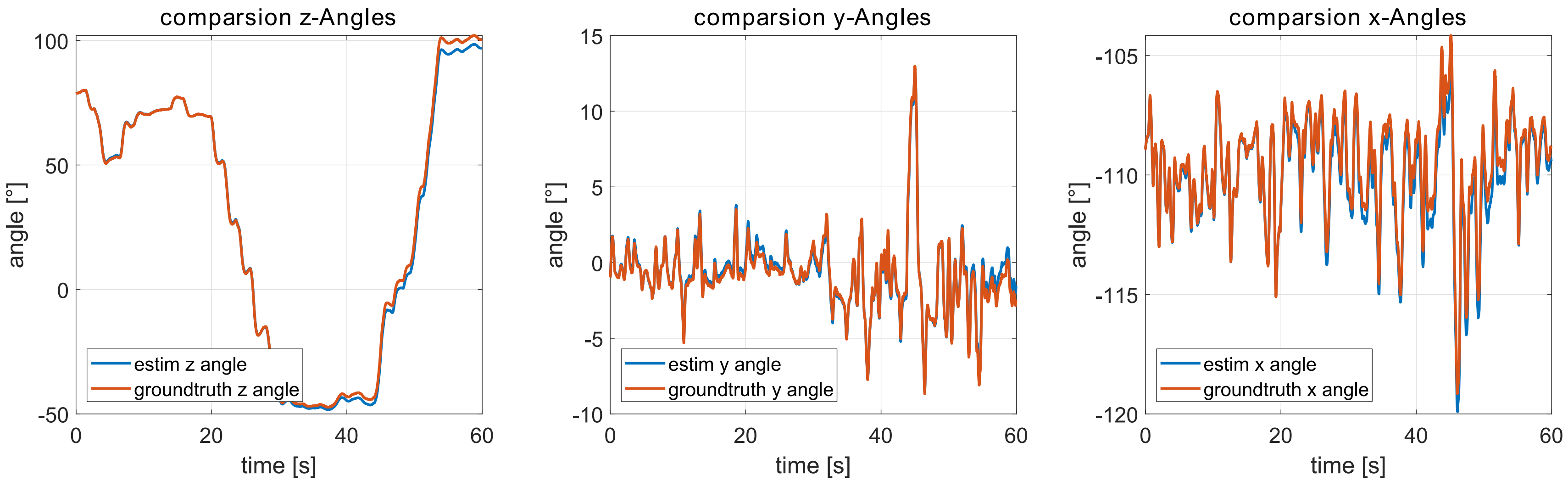




Auswertung EuRoC-Dataset: Position



Auswertung EuRoC-Dataset: Winkel



Zusammenfassung & Ausblick

- Zusammenfassung:
  - Funktionsweise Algorithmus gezeigt
  - Drift ~1% auf 55 m Trajektorie
  - Beherrschbarkeit der Technologie gezeigt

- Ausblick:
  - Technologie für Verbesserungen bezüglich Robustheit und Genauigkeit/Drift bekannt
  - Embedded Lösung gut denkbar (z.B. Smartphoneprozessor)