service robotik

ZAFH

Bearing Only SLAM based on SIFT-features in Omnicam Images

Zentrum für angewandte Forschung an Fachhochschulen

SLAM for Service Robots

SLAM (*simultaneous localization and mapping*) mechanisms are a key component towards advanced service robotics applications. Currently, a major hurdle are the still high costs of suitable range measuring devices. A solution are bearing-only SLAM approaches since these can be used with cheap sensors like omnicams.

The general approach of using an *Extended Kalman Filter* (EKF) for bearing-only SLAM based on artificial landmarks has been described and evaluated earlier. Instead of articificial landmarks, we now use SIFT features as natural landmarks.

This work describes SIFT feature preselection and landmark identification mechanisms that are pivotal towards the robust application of SIFT features within a bearing-only SLAM approach based on the EKF. We exploit viewing areas to massively reduce ambiguities and mismatches in SIFT feature reobservations and thus significantly reduce false identifier assignments.

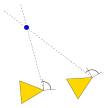
The Key Idea

- Delayed landmark initialization for EKF integration
- Manage observation poses of uninitialized landmarks by EKF to ensure consistency among observation poses
- Probabilistic observation model extracts viewing angle of a landmark from omnicam image
- Initialize a landmark by intersecting at least two half-lines using a probabilistic error propagation model
- Vertical features are unaffected by mirror curvature
- Merge everything by EKF

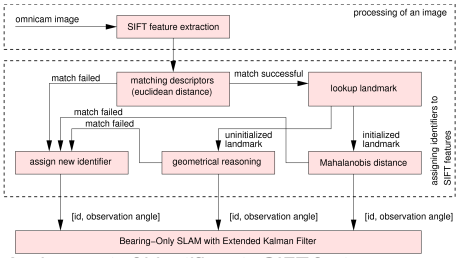
Method

The Extended EKF State Vector

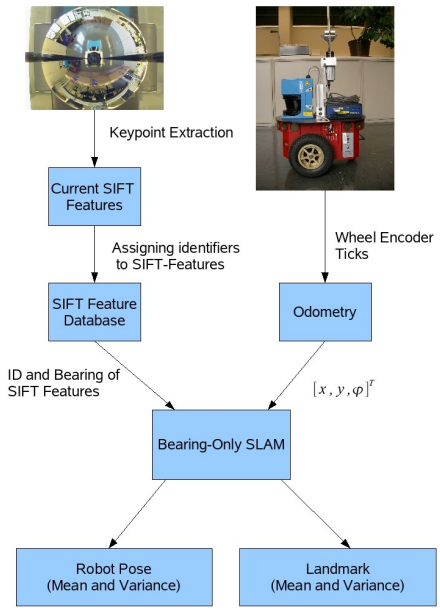
$$x = [\, x_v^T \,,\, x_{v_m}^T \,, \ldots \,,\, x_{v_1}^T \,,\, x_{f_1}^T \,, \ldots \,,\, x_{f_n}^T \,]^T$$



Multiple observations of the same landmark are the basis for both, the delayed initialization of a new landmark and the reobservation of an already observed landmark.



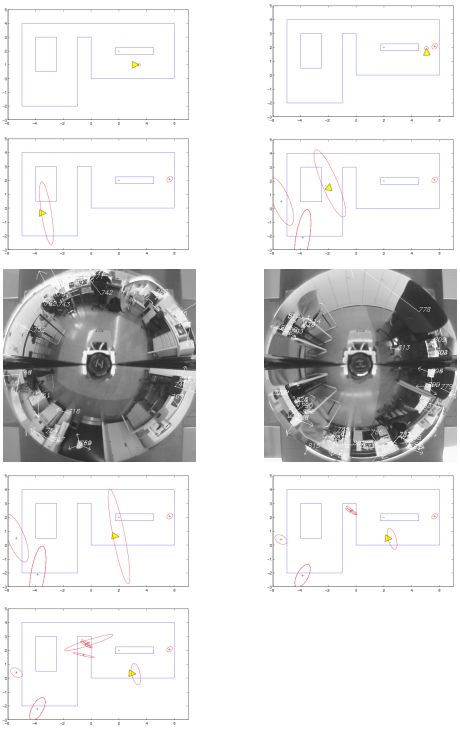
Assignment of identifiers to SIFT features.



The overall processing scheme.

The environment used for the experiments.

Results



The sensing steps 5, 9, 35, 40, 52, 53 and 54 of a 75 step run with closing a loop.

Investition in Ihre Zukunft
gefördert durch die **Europäische Union**
Europäischer Fonds für regionale Entwicklung
und das **Land Baden-Württemberg**

IFI
Institut für Informatik
Hochschule Ulm

Hochschule Ulm
Siegfried Hochdorfer [Dipl.-Ing.(FH), M.Sc.]
Prof. Dr. Christian Schlegel

Echtzeitsysteme und Autonome Roboter
Fakultät Informatik
Prittwitzstr. 10
89075 Ulm

0731 / 50-28242
schlegel@hs-ulm.de
http://www.hs-ulm.de/schlegel

http://www.zafh-servicerobotik.de/

Verbundpartner: Hochschule Ulm / Prof. Dr. Schlegel (Sprecher)
Hochschule Ravensburg-Weingarten / Prof. Dr. Ertel, Prof. Dr. Voos
Hochschule Mannheim / Prof. Dr. Ihme, Prof. Dr. Wirnitzer

beratende Universitäten: Uni Ulm / Neuroinformatik (Prof. Dr. Palm, Prof. Dr. Neumann)
Uni Heidelberg / Prof. Dr. Hamprecht

gefördert durch die Landesstiftung Baden-Württemberg im Rahmen der Zukunftsoffensive IV

Industriepartner, Organisationen, Verbände:
AGCO, ifm, InMach, inovel
(und weitere)