EVALUATION METHODOLOGY FOR OPTICAL SELF-POSITIONING

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MOTIVATION

For intra logistics localization use cases, e.g. forklift or AGV tracking, novel methods of camera-based self-positioning using machine learning may soon become a real alternative to more classical approaches.

The potential benefits are considerable. Since the algorithms learn *natural* features, there is no more need for infrastructure, e.g. hand-crafted QR-codes.

However, the recent algorithmic advances in academia use methodology without industrial metrics in mind and also rely on unconvincing datasets.

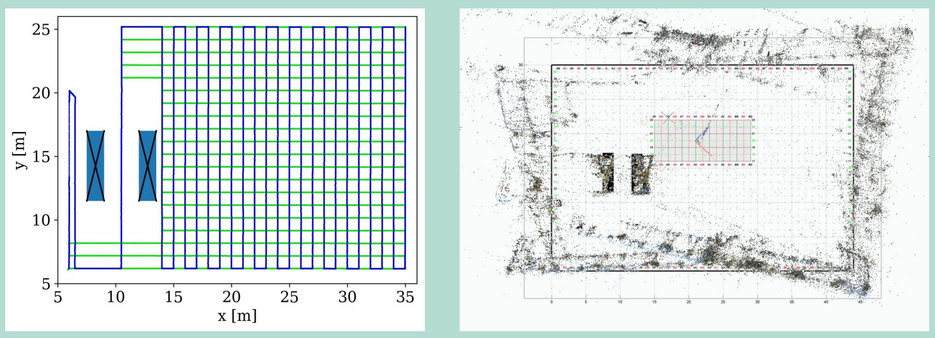
For enabling the transfer of these data driven methods into real-world applications, we developed an evaluation methodology and dataset for a very challenging warehouse environment.

WAREHOUSE DATASET

The indoor logistics *Warehouse* dataset aims at providing a solid basis for the development and evaluation of machine learning based positioning schemes.

The data recording platform on the L.I.N.K. 3D Positioning System recorded data in an intra-logistics environment (*Warehouse*).

The dataset covers an area of 1,320m^2 and contains 464,804 images of 640x480 pixels. One trajectory was recorded on a forklift, the others using the L.I.N.K. 3D Positioning System. Each image was labeled with a 3D position ground truth that was recorded using the highly precise optical Nikon iGPS system. The dataset includes different scenarios that allow a detailed analysis of positioning schemes based on the evaluation methodology. It is very challenging to classical feature-based approaches, and thusly, very realistic.



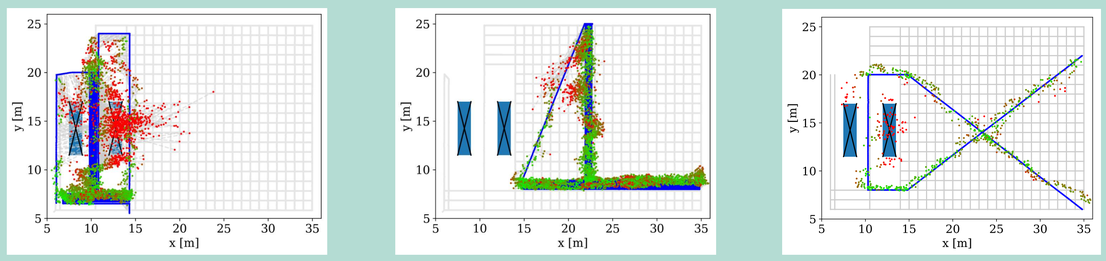
The large *training* dataset of the *warehouse* environment is very challenging. Feature-based Structure from Motion schemes like Colmap fail.

EVALUATION METHODOLOGY

The evaluation methodology allows to benchmark the tested positioning schemes considering their various properties and requirements for real-world applications.

SPACIAL ISSUES

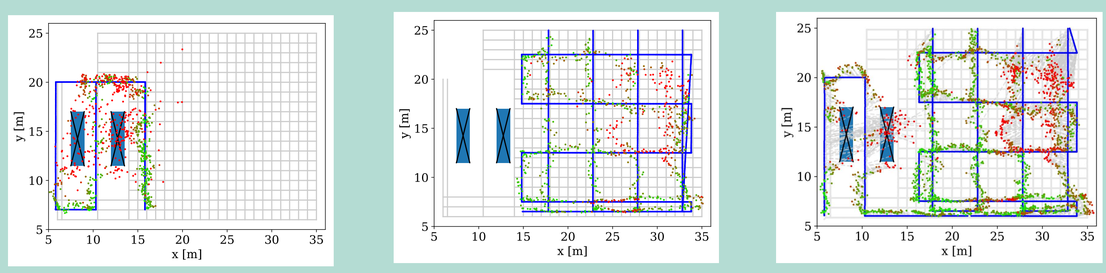
Generalization: Can the algorithm interpolate previously unseen positions that are close to previously learned positions?



The test trajectories are in between the training trajectories, at different scales and both orthogonally and at an angle of 45°.

Environmental scaling: Does the accuracy scale with area?

Scale transition: Does the algorithm tolerate transitions between optical feature scales?



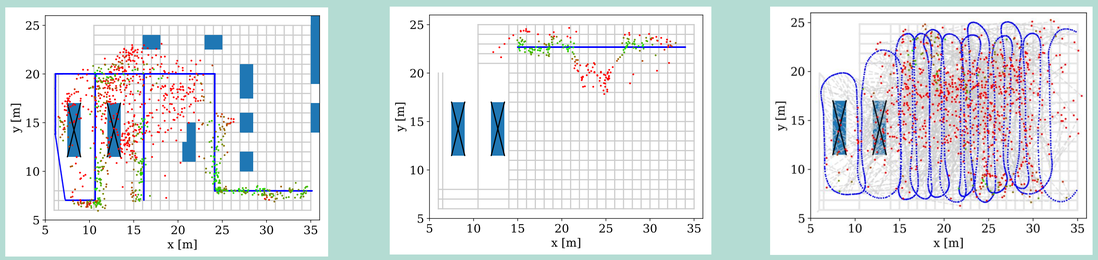
Differently scaled trajectories show how distances influence the algorithm's accuracy (camera pointed left).

OPTICAL ISSUES

Volatility: How robust is the algorithm against features which are not in the training dataset, or have moved?

Ambiguity: Does the algorithm tolerate ambiguous (i.e., repetitive or untextured) features in environment?

Motion artifacts: How do blurry images, unsteady angles or new view points influence the prediction performance?



Left: Volatile. Middle: Ambiguous. Right: Motion.

The shown results were obtain with the representative CNN-based approach PoseNet by Kendall et al. (2015).

Get the whole dataset from http://iis.fraunhofer.de/warehouse or scan the QR code.

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