HyPaSCoRe Localization:
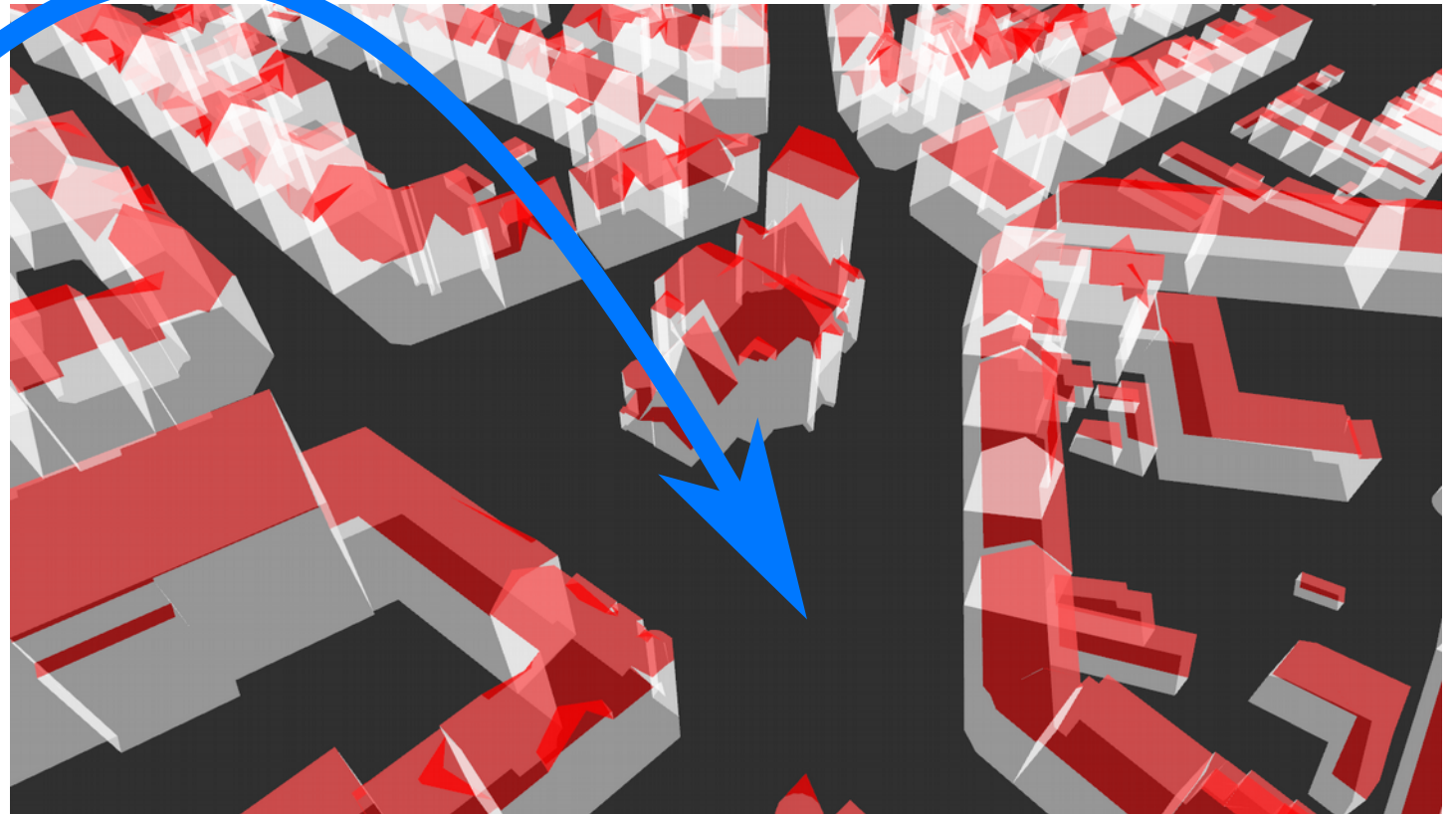
A **Hy**brid **P**robabilistic **a**nd **S**et-Membership-based **Co**arse and **Re**fined Localization
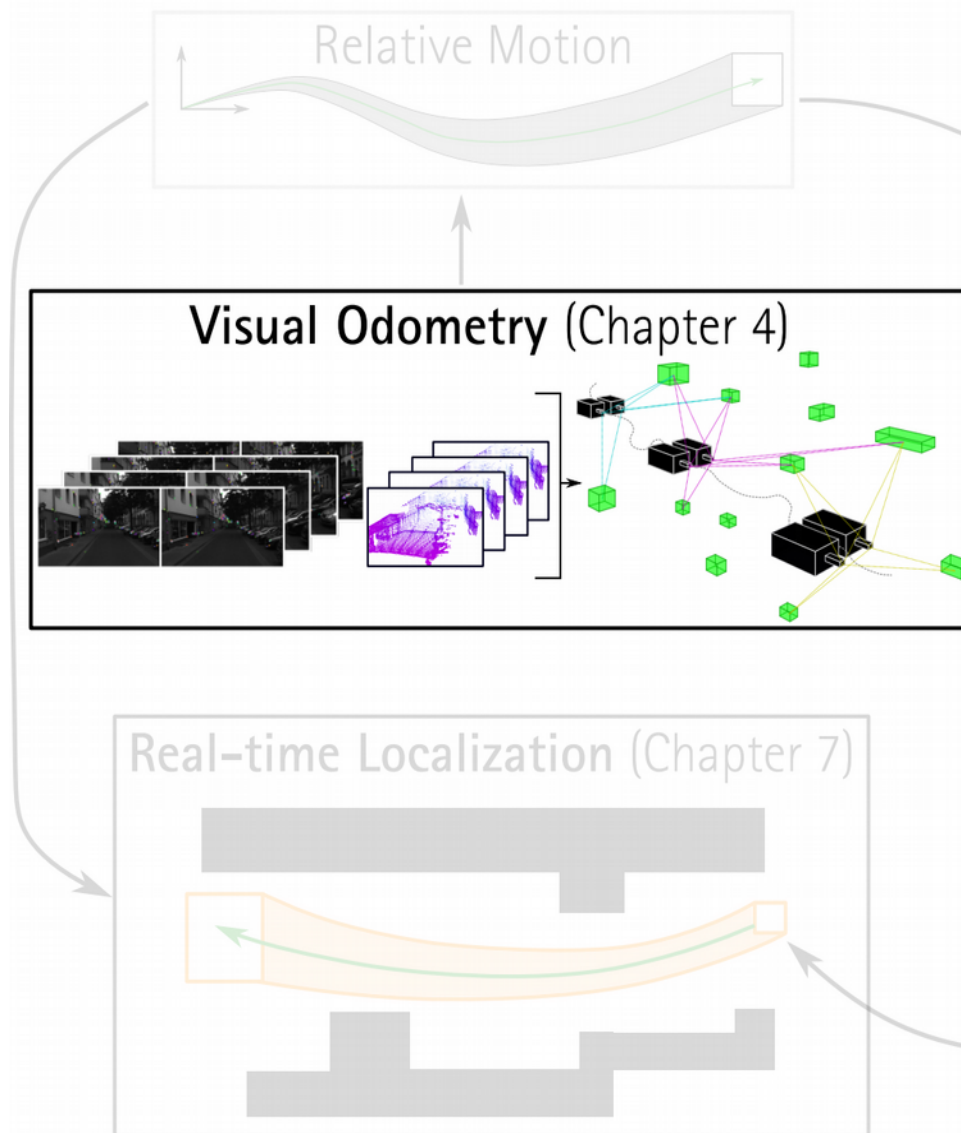
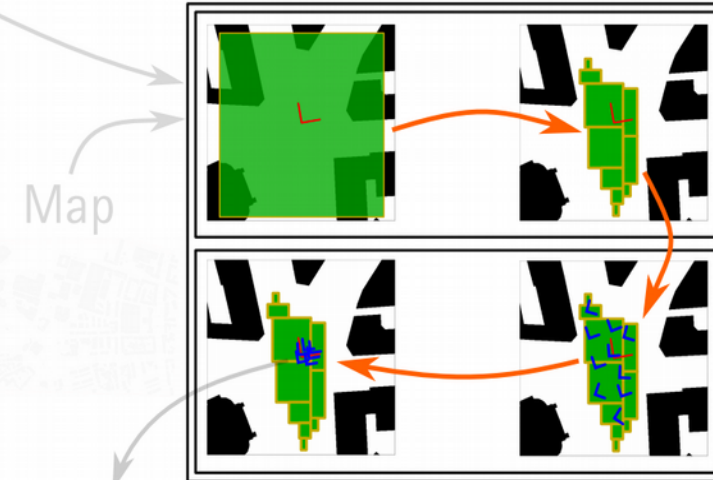Aaronkumar Ehambram

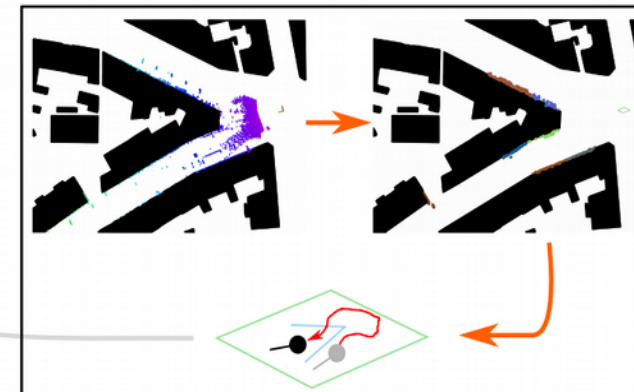# Goal

Overview

Relative Motion

Localization in Building Map

Coarse Localization (Chapter 5)

Map

Visual Odometry (Chapter 4)

1. Module

2. Module

Refined Localization (Chapter 6)

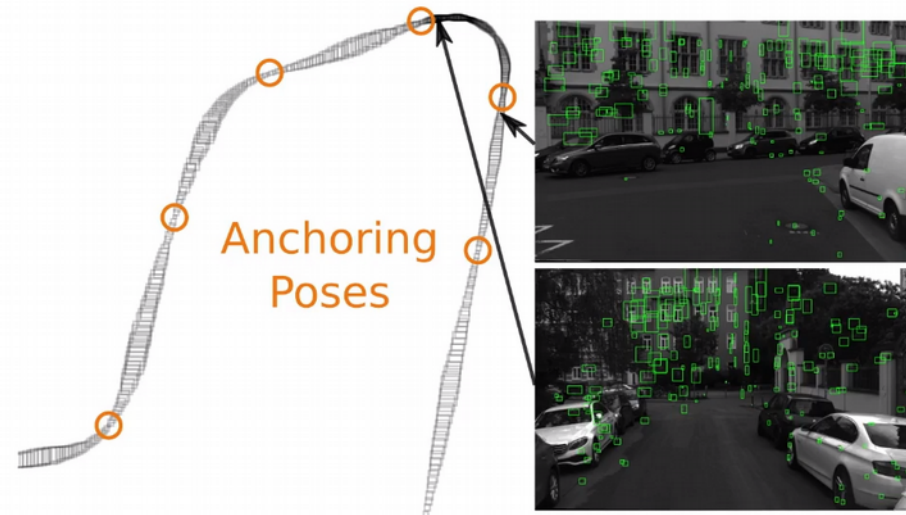Real-time Localization (Chapter 7)
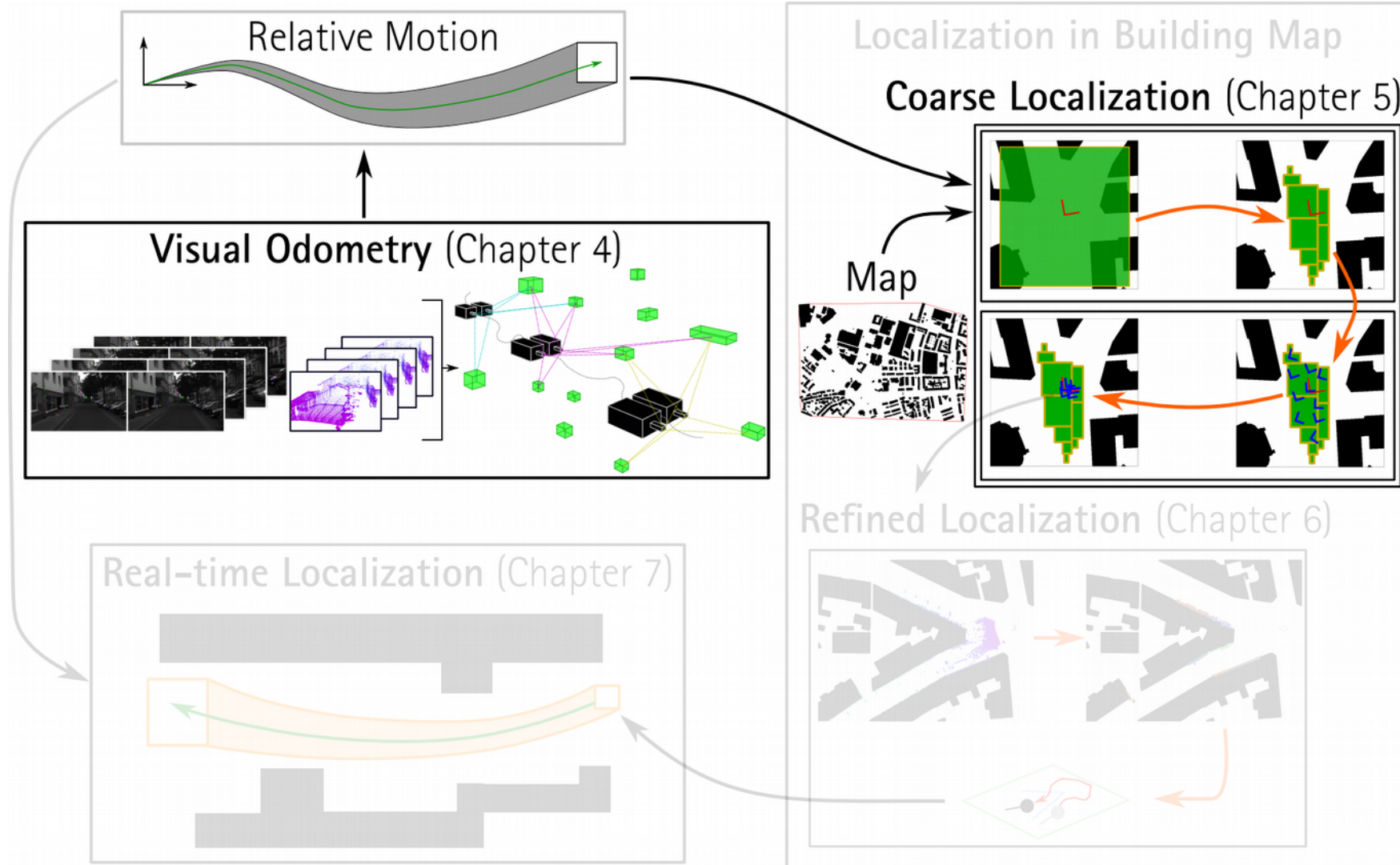
3. Module

Visual Odometry – Video

Interval-based Visual-Inertial LiDAR SLAM with Anchoring Poses

Aaronkumar Ehambram, Raphael Voges, Claus Brenner, Bernardo Wagner

Anchoring Poses

Real Time Systems Group
Institute for Systems Engineering
Leibniz Universität Hannover

Coarse Localization – Motivation

Coarse Localization – Video
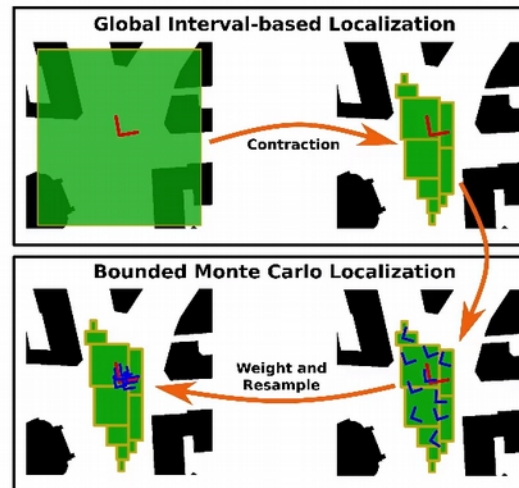

Global Localization in Urban Environments - A Hybrid Interval-Probabilistic Approach

Aaronkumar Ehambram, Luc Jaulin, Simon Rohou, Bernardo Wagner

Real Time Systems Group
Institute for Systems Engineering
Leibniz Universität Hannover

Coarse Localization – Comparison to AMCL

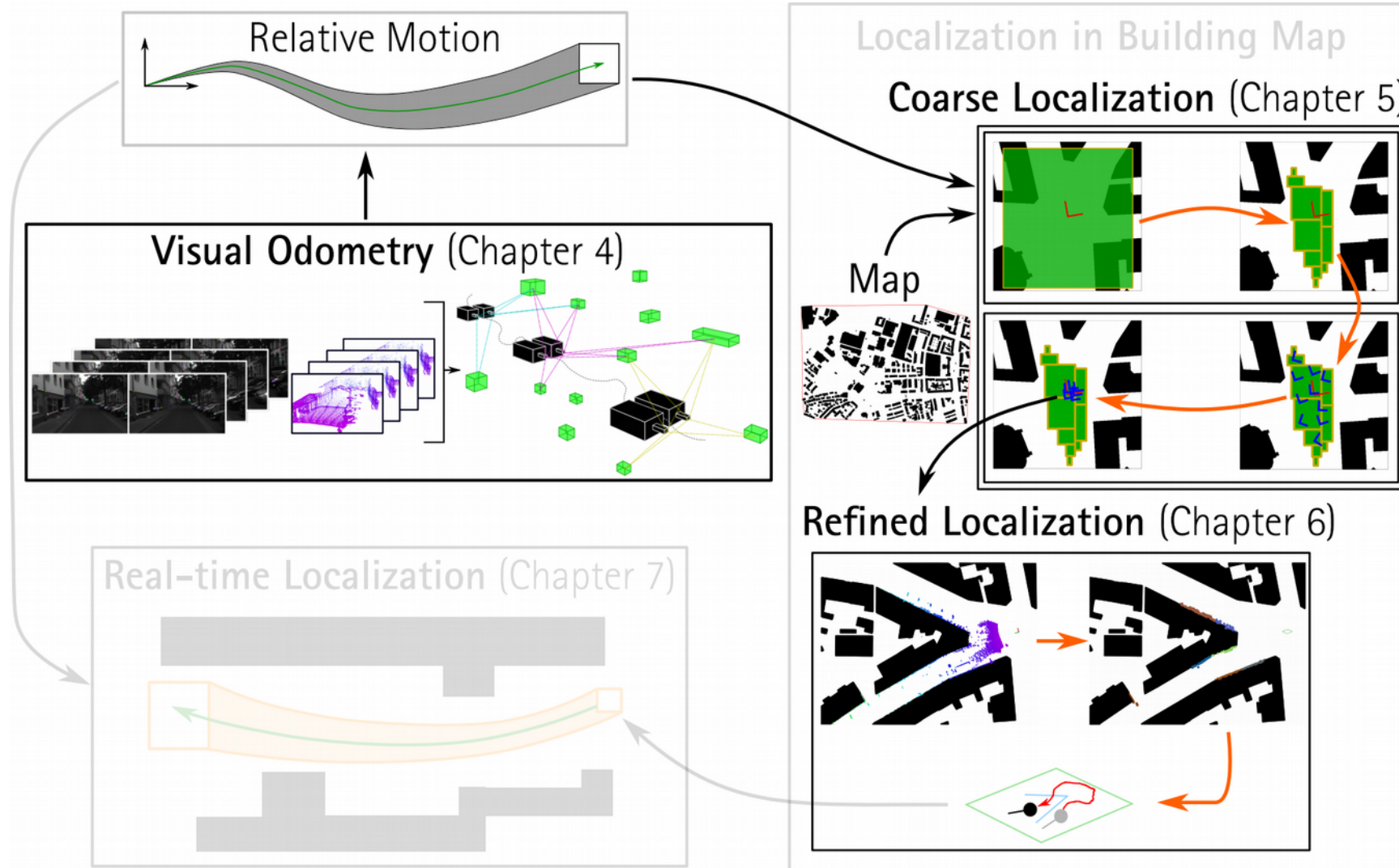| Dataset	Average driven distance until convergence		Standard deviation of driven distance until convergence		Successful runs		Average particle distance after convergence		Average operation time per frame	
	Ours	AMCL	Ours	AMCL	Ours	AMCL	Ours	AMCL	Ours	AMCL
T_1	**124.07** m	354.37 m	70.28 m	325.78 m	**100 %**	95 %	2.11 m	3.49 m	0.046 s	0.061 s
T_2	**287.76** m	443.08 m	109.55 m	277.16 m	**100 %**	70 %	1.83 m	3.14 m	0.063 s	0.094 s
KITTI 0018	**638.33** m	1224.44 m	11.75 m	666.58 m	**100 %**	75 %	3.67 m	7.74 m	0.068 s	0.155 s
KITTI 0027	**453.86** m	1705.46 m	73.75 m	956.57 m	**100 %**	80 %	3.97 m	5.74 m	0.071 s	0.236 s

Run each dataset with each method 20 times → all results are averaged from all 20 runs

Average Particle Error: Error (here only translation shown) of the average particle compared to ground truth
Convergence point: The driven distance after which the average particle error drops below 5 m
Successful run: The estimation converges before trajectory ends

Conclusions:
- Our method converges faster (on average - NOT always!!)
- AMCL does not always converge, our method always converges (successful runs)

Coarse Localization – We can do better
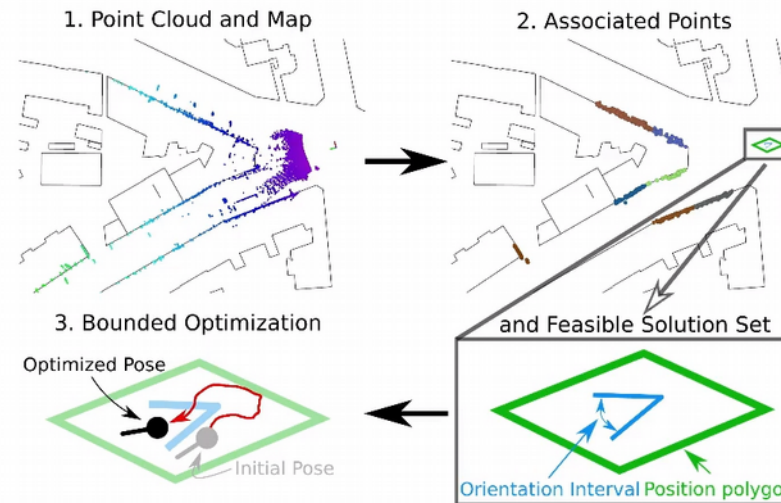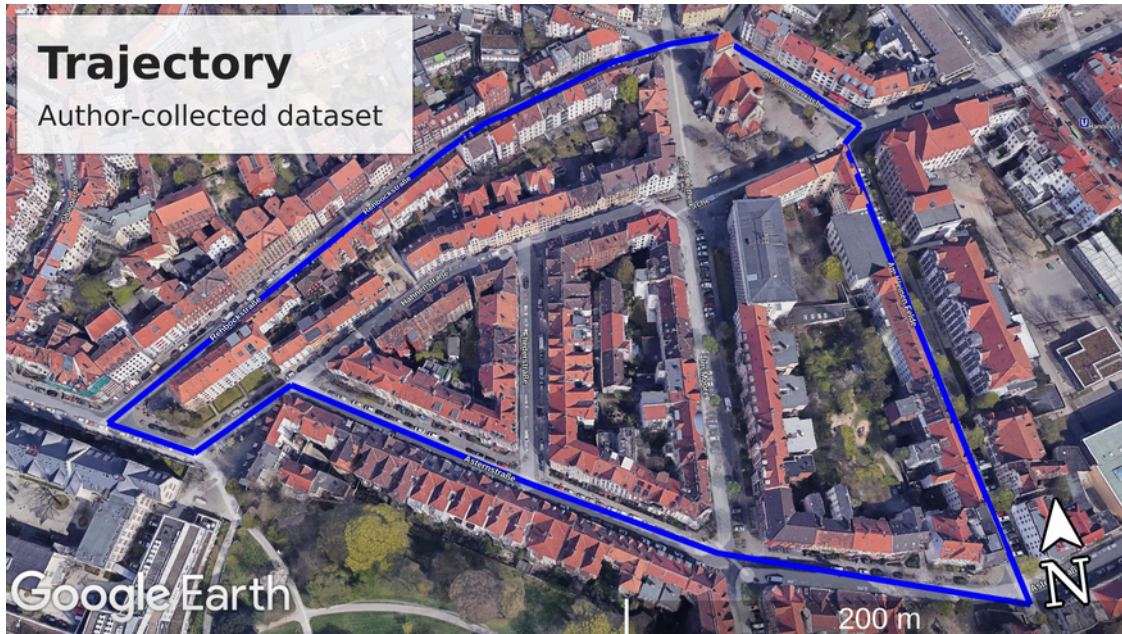
Refined Localization – Video

Refined Localization – Experimental Results

Trajectory
Author-collected dataset

Method	Hybrid Localization		MCL
Encloses ground truth pose	99.8 %		–
Average radius of smaller side	0.91 m		–
Average radius of larger side	4.2 m		–
Average orientation interval radius	1.8°		–
Optimization	Bounded	Unbounded	–
Translation RMSE	**0.237** m	0.241 m	0.81 m
Average orientation error	**0.339°**	0.343°	0.75°
Largest translation error	**2.83** m	2.994 m	4.67 m
Largest orientation error	**2.921°**	5.935°	6.1°
Result outside feasible pose sets	0.0 %	0.725 %	–

TABLE I: Evaluation of T_1 with LOD2 Map.

HyPaSCoRe Localization – Overview
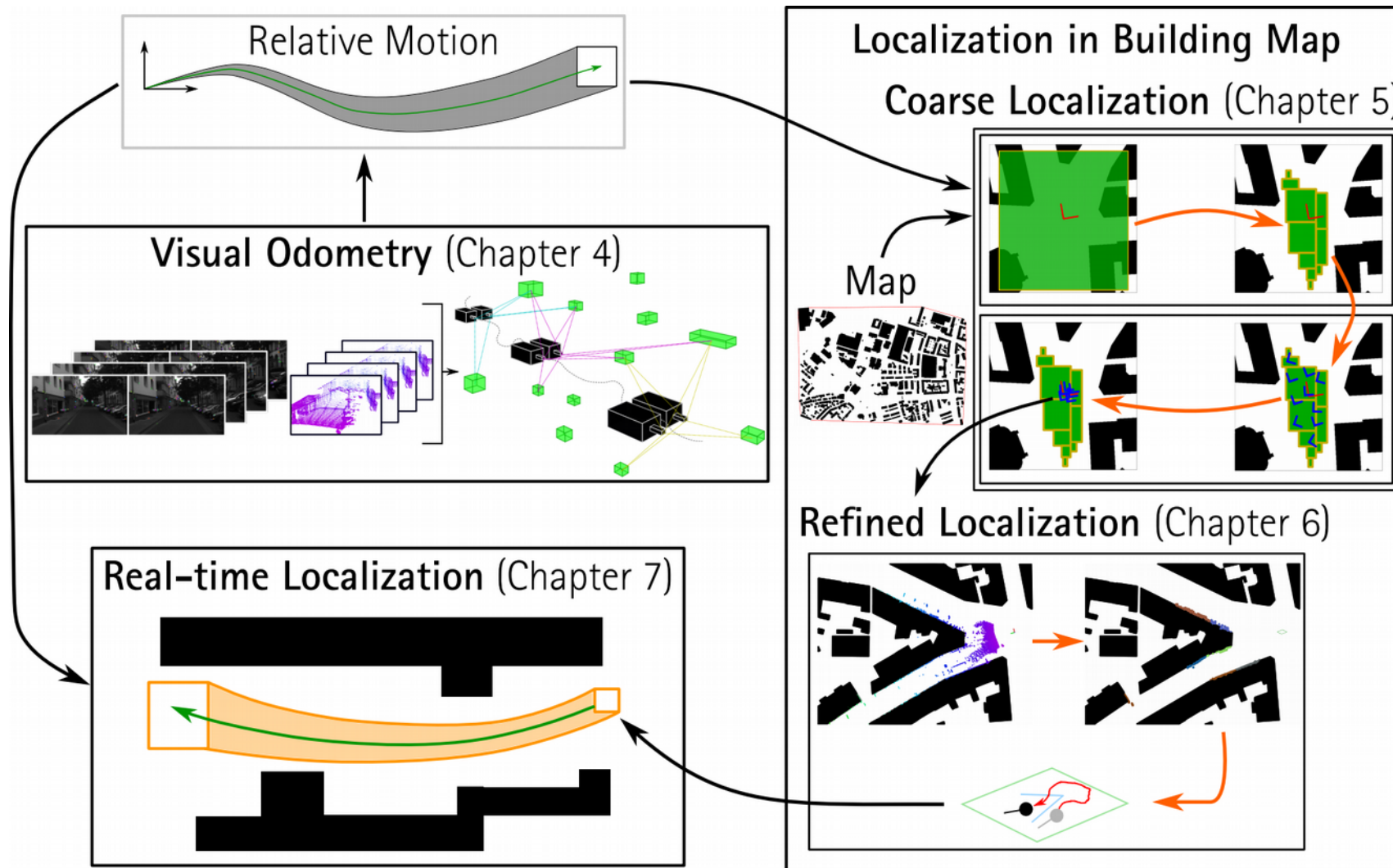
HyPaSCoRe Localization – Video

Summary

GitHub