Motivation

- Comparative study of SLAM algorithms available in ROS;
- Evaluation of the performance of these algorithms through simulation and real world experiments;
- Development of a 2D SLAM technique in ROS for low visibility indoor scenarios, e.g., due to smoke.

Maps

- 1r5map
  - 12.24 x 11.67m
- MRL Arena
  - 4.57 x 4.04m
- Photo of the MRL Arena

Evaluated Algorithms

HectorSLAM
  - Heavy scan-matching and no odometry (S. Kohlbrecher et al., 2011).
Gmapping
  - Rao-Blackwellized Particle Filter (G. Grisetti et al., 2007).
KartoSLAM
  - Graph-based SLAM by Karto Robotics.
CoreSLAM
  - Simple Particle Filter SLAM approach with 200 lines-of-code (B. Steux et al., 2010).
LagoSLAM
  - Graph-based SLAM with a Linear Approximation for Graph Optimizer developed (L. Carlone et al., 2011).

Simulation Experiments

- HectorSLAM
- Gmapping
- KartoSLAM
- CoreSLAM
- LagoSLAM

Error Estimation (2D Simulation)

- 1r5map
  - HectorSLAM: 7.4581
  - Gmapping: 5.3670
  - KartoSLAM: 5.4380
  - CoreSLAM: 171.5218
  - LagoSLAM: 9.3641

- MRL Arena
  - HectorSLAM: 0.4063
  - Gmapping: 0.4200
  - KartoSLAM: 0.5509
  - CoreSLAM: 11.8393
  - LagoSLAM: 1.4646

- Performance metric based on the k-nearest neighbor concept between the resulting map and the ground truth.
- CoreSLAM presented the highest error value.

Experimental Setup

- Stingbot
- Hokuyo URG-04LX
- Wimote
- Asus eeePC 1005C

Real World Experiments

- Map alignment between ground truth (red) and the resulting map (cyan) using Image Registration Matlab functions available in the Image Processing Toolbox.
- HectorSLAM
- Gmapping
- KartoSLAM

Error Estimation (Real World)

- HectorSLAM: 1.1972
- Gmapping: 2.1716
- KartoSLAM: 1.0318
- CoreSLAM: 14.7533
- LagoSLAM: 3.0264

- HectorSLAM, Gmapping and KartoSLAM achieved the best results.
- The poor results of CoreSLAM showed that its loop closure procedure rarely converges.
- In general, all techniques led to worse results than in simulation.
- KartoSLAM was the best performing technique in the real world, being the less affected by noise.

CPU Load Evaluation

- LagoSLAM presents the highest percentage of CPU usage.
- The computational load required by the other four approaches during the experiments are similar.

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