Nav2 Beam Skipping Feature Evaluation

Release 0.1.0-alpha

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DATASET: DIFF DRIVE SIM 60M

1.1 Dataset information

This is a synthetic dataset created recording a simulated robot wandering around a 450m^2 office environment for 24 hours.

The simulated diff-drive robot is modelled after a Kobuki platform featuring an RPLidar A1, an 8m range 2D lidar. The simulation was performed using Gazebo Classic.

The dataset was recorded in a single run, and it consists of a single continuous bagfile with a duration of 24 hours. During this time the robot is periodically sent navigation goals to reachable locations to ensure it keeps moving around the environment.

The robot covers approximately 24 km during those 24 hours, with an average speed of about 0.28 m/s.

The robot model was configured to introduce small imperfections in the odometry to cause a small amount of drift and emulate conditions closer to real-world.

The simulated environment is populated with static obstacles (furniture), but the localization map intentionally excludes them to evaluate the systems under test in a condition where unmapped obstacles perturb the estimation.

The localization map used to evaluate the localization performance with this dataset is the one shown below.
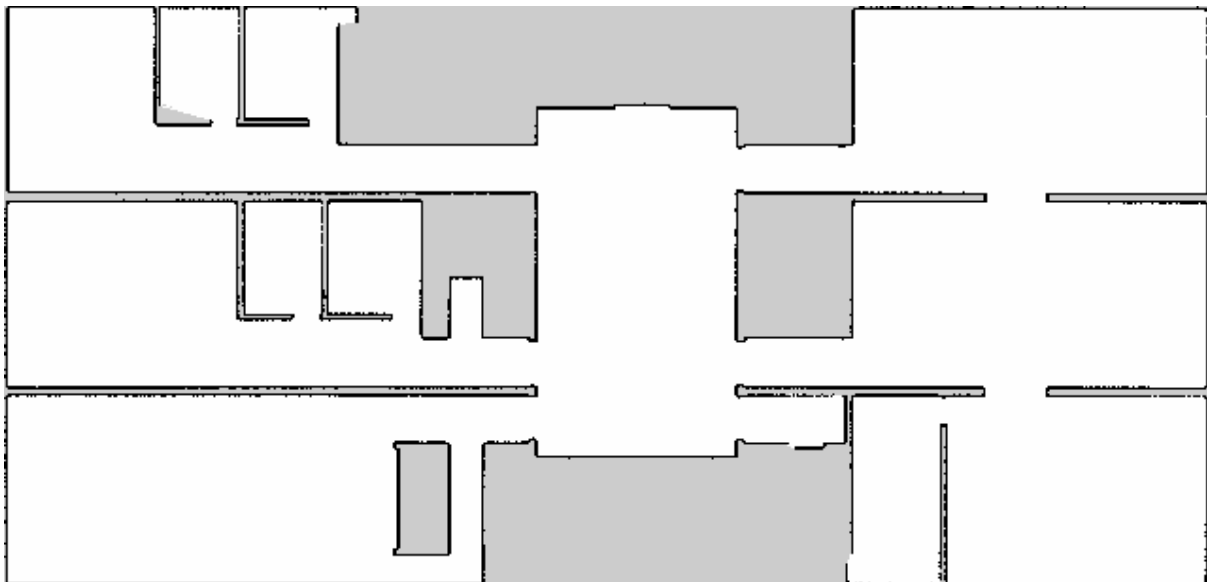

Fig. 1: Localization map used to evaluate the localization performance with the Diff Drive Sim 60m dataset.

The simulated environment used to record the Diff Drive Sim 60m dataset is shown below.
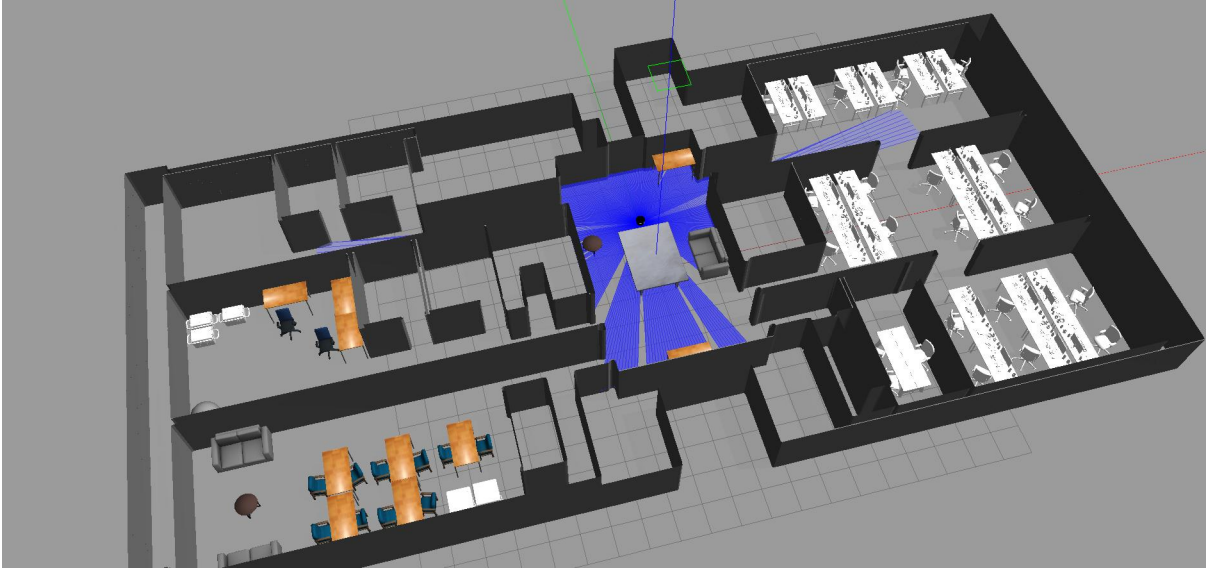
Fig. 2: The simulated environment used to record the Diff Drive Sim 60m dataset.

1.2 simulated_hq_kobuki

Bagfile metadata:

```
Files:          rosbag2_2024_08_19-19_26_22_0.mcap
                rosbag2_2024_08_19-19_26_22_1.mcap
Bag size:       106.2 MiB
Storage id:
Duration:       3599.880000000s
Start:          Jan  1 1970 01:25:33.513000000 (5133.513000000)
End:            Jan  1 1970 02:25:33.393000000 (8733.393000000)
Messages:       472204
```

Evaluation results:

Table 1: APE metrics aggregated across all iterations of `simulated_hq_kobuki` for the Likelihood field sensor model.

Implementation	Likelihood field sensor model			
	median	mean	std	worst-case
Likelihood Field	0.066 m	0.076 m	0.047 m	0.254 m
Likelihood Prob	0.582 m	1.145 m	2.502 m	18.803 m
Beam Skip	0.034 m	0.037 m	0.026 m	0.201 m

Table 2: Average CPU and peak Resident Set Size (RSS) values.

Implementation	Likelihood Field	
	cpu	rss
Likelihood Field	7.9%	37 MB
Likelihood Prob	7.9%	37 MB
Beam Skip	7.8%	38 MB

DATASET: OMNI DRIVE SIM 30M

2.1 Dataset information

This is a synthetic dataset created recording a simulated omni-drive robot wandering around the AWS Robomaker Bookstore World for 24 hours.

The simulated omni-drive robot is modelled after a customized Robomaster EP featuring an RPLidar A2, a 12m range 2D lidar. The simulation was performed using Gazebo Sim.

The dataset was recorded in a single run, and it consists of a single continuous bagfile with a duration of 24 hours. During this time the robot is periodically sent navigation goals to reachable locations within the map to ensure it keeps moving.

The robot covers approximately 45 km during those 24 hours, with an average speed of about 0.5 m/s.

The robot model was configured to introduce small imperfections in the odometry to cause a small amount of drift and emulate conditions closer to real-world.

Most but not all obstacles and furniture are mapped, and one of the walls is windowed and therefore invisible to the simulated lidar.

The localization world used to evaluate the localization performance with this dataset is the one shown below.
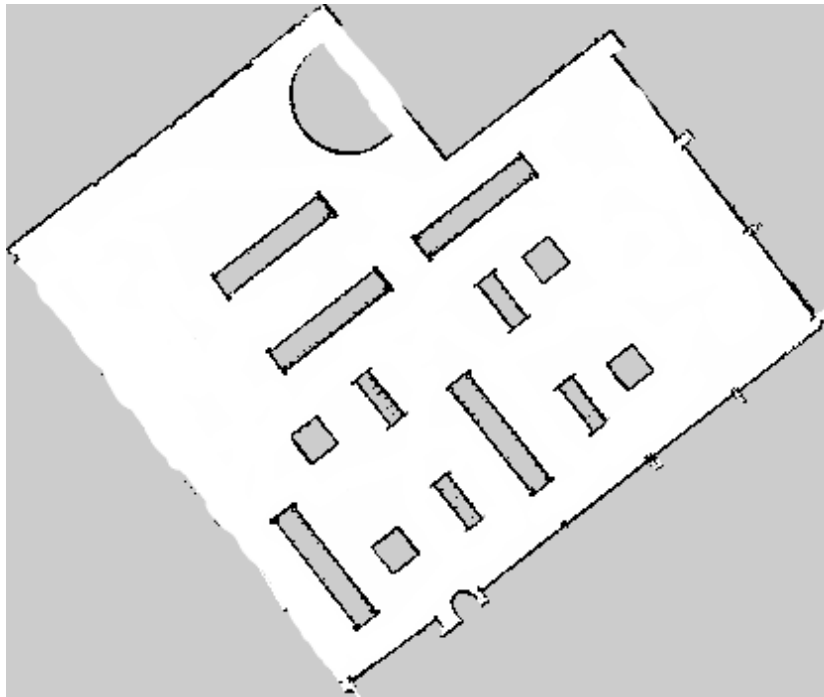

Fig. 1: Localization world used to evaluate the localization performance with the Omni Drive Sim 30m dataset.

The simulated world used to record the Omni Drive Sim 30m dataset is shown below. It differs from the localization world in that it is populated with obstacles and furniture. in that a few of the obstacles and furniture present in the simulated world are not present.

Fig. 2: The simulated environment used to record the Omni Drive Sim 30m dataset.

2.2 simulated_bookstore_robomaster

Bagfile metadata:

```
Files:            rosbag2_2024_08_21-14_41_25_0.mcap
                  rosbag2_2024_08_21-14_41_25_1.mcap
Bag size:         211.9 MiB
Storage id:
Duration:         3599.983000000s
Start:            Jan  1 1970 00:00:06.535000000 (6.535000000)
End:              Jan  1 1970 01:00:06.518000000 (3606.518000000)
Messages:         691727
```

Evaluation results:

Table 1: APE metrics aggregated across all iterations of `simulated_bookstore_robomaster` for the Likelihood field sensor model.

Implementation	Likelihood field sensor model			
	median	mean	std	worst-case
Likelihood Field	0.074 m	0.085 m	0.077 m	1.819 m
Likelihood Prob	0.025 m	0.028 m	0.053 m	2.325 m
Beam Skip	0.359 m	1.400 m	2.958 m	17.155 m

Table 2: Average CPU and peak Resident Set Size (RSS) values.

Implementation	Likelihood Field	
	cpu	rss
Likelihood Field	9.7%	36 MB
Likelihood Prob	9.5%	36 MB
Beam Skip	9.3%	37 MB