EKF Localization

Open-source Automated Driving Stack „Autoware Hands-on“

https://github.com/virtual-vehicle-research/aa274_autoware_ws
Agenda

• Demonstration
  • Autoware: Autonomous Driving Stack
  • Autonomous Racing: Localization / Sensor Fusion / Extended Kalman Filter
Localization / Roborace / Croix-en-Ternois

Autonomous Racing Graz
Localization pipeline

- **Map loader** [*points_map_loader]*
  - PCD loader from map

- **Voxel Grid Filter** [*voxel_grid_filter]*
  - Downsampling lidar data
  - Leaf size: 2m (60MB/s → ~1MB/s)

- **Lidar based localization** [*ndt_matching]*
  - NDT matching
  - Input: /localization/downsample/pointcloud, /devbot/odom
  - Output: /localization/pose_estimator/pose

- **EKF Localization Fusion** [*ekf_localizer]*
  - Input: /localization/pose_estimator/pose, /devbot/twist
  - Output: /localization/pose_twist_fusion_filter/pose_with_covariance
EKF Localizer
EKF Localizer / Interface

Input:
/devbot/twist ... twist from Devbot (velocity, yaw_rate)
/localization/pose_estimator/pose ... position from localization (lidar or noisy GPS data)

Output:
/localization/pose_twist_fusion_filter/pose ... localization output

Ground truth:
/devbot/pose
Localization modes

1) **GPS based localization with noisy gps data:**

   `/localization/pose_estimator/pose: RTK-GPS + noise`
   roslaunch arg_demos arg_demo_localization.launch
   GPS noise

2) **Lidar based localization**

   `/localization/pose_estimator/pose: NDT-localization`
   roslaunch arg_demos arg_demo_localization.launch lidar_localization:=true

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*Extended Kalman Filter Settings*
Task 1: Localization only with Odometry

EKF input:
/devbot/twist (velocity, yaw_rate)

What do we expect?
Task 2: Localization with GPS

EKF input:
/devbot/twist (velocity, yaw_rate)
/localization/pose_estimator/pose (GPS ground truth)

What do we expect?
Task 3: Localization with GPS + Noise

EKF input:
/devbot/twist (velocity, yaw_rate)
/localization/pose_estimator/pose (GPS + noise)

Noise: $N(\mu, \sigma^2)$

What do we expect?
Task 4: Localization with Lidar

EKF input:
/devbot/twist (velocity, yaw_rate)
/localization/pose_estimator/pose (NDT localization)

Issues:
- Processing time
- Unknown localization quality
- Alignment GPS - Lidar map

What do we expect?
Thanks for your attention!
Questions?

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