

SLAM Theory

"SLAM (Simultaneous Navigation and Mapping) means explore and map the unknown environment while estimating the pose of the robot itself by using the mounted sensors on the robot"

⇒ Encoders & IMU are typically used for Pose estimation.

↳ Pose can be estimated without the encoder but only using the inertial sensor.

⇒ The estimated pose can be corrected once again with the surrounding environment information obtained through distance sensor or the camera used when creating the map.

↳ This pose estimation methodologies includes Kalman filter, Markov localization, Monte Carlo localization ~~and~~ so on.

⇒ Also, a method of recognizing the environment by attaching markers has been proposed.

* Kalman filter → {Optimal estimation algorithm}

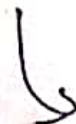
↳ It was used in NASA's Apollo Project and was developed by Dr. Rudolf E. Kalman.

⇒ His filter was a recursive filter that tracks the state of an object in a linear system with noise.

↳ The filter is based on the Bayes Probability which assumes the model and uses this model to predict the current state from the previous state.



Then an error between the predicted value of the previous step and the actual measured present value obtained by measuring instrument is used to perform an update step of estimating more accurate state value.



{The filter repeats above process and increases the accuracy}

⇒ However, the Kalman filter only applies to linear systems.

⇒ EKF (Extended Kalman Filter) modified from Kalman filter are widely used.

⇒ There are also many Variants such as UKF (Unscented Kalman Filter) which improved the accuracy of EKF.

⇒ Fast Kalman filter improved speed and these are still being researched today.

★ Particle Filter

⇒ Particle filter is most popular algorithm in object tracking.

↳ Example Monte Carlo localization using particle filter.

⇒ Because robots and sensors are also nonlinear, particle filters are often used for pose estimation.

⇒ Particle filter is a technique to predict through simulation based on try and error method.

⇒ When using SLAM, the robot's odometry value and the measurement values using the distance sensor are used to estimate the robot's current pose.

