State Estimation for Robotics

2 aspects of robot navigation: state and control

State of robot: Position, orientation, and velocity. These will give a complete description of the robot’s motion over time.

Gauss developed the least squares method to minimize effect of measurement error in prediction problems. The least squares method works best under the assumption that the measurement errors follow a normal distribution.

Control: Configuring the robot to behave the way we want it to behave (depending on the application).

Least squares method to minimize impact on of normally distributed errors.

Kalman

1. Observability, state can be inferred from a set of measurements in a dynamic system.
2. Kalman filter: A framework that allows the robot to estimate its state optimally, even with measurement noise.

Kalman filter is a classic technique for linear systems whereby measurements are corrupted by Gaussian noise (noise that follow the normal distribution).

Real sensors have associated uncertainty, so every measurement derived from such sensors are subjected to uncertainty. Two categories of sensors: interoceptive (measurements triggered by internal stimuli) and exteroceptive (measurements triggered by external stimuli). Some examples of interoceptive sensors include accelerometers, gyroscope, and wheel odometer. Exteroceptive sensors refer to sensors like camera, and laser. Typically, making use of both types of sensors can give us the best state estimate of the robot.

2-D and 3-D localization and mapping.

Three – Dimensional Geometry

Remarks section

What is Bayesian inference?

What does the author mean by probability moment?

The author mentions four types of probability moments: mean, covariance matrix, skewness, and kurtosis.