

Probability: Motivation

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Why probability in robotics?

- Often state of robot and state of its environment are unknown and only noisy sensors available
 - Probability provides a framework to fuse sensory information
 - Result: probability distribution over possible states of robot and environment
- Dynamics is often stochastic, hence can't optimize for a particular outcome, but only optimize to obtain a good distribution over outcomes
 - Probability provides a framework to reason in this setting
 - Result: ability to find good control policies for stochastic dynamics and environments

Example 1: Helicopter

- State: position, orientation, velocity, angular rate
- Sensors:
 - GPS : noisy estimate of position (sometimes also velocity)
 - Inertial sensing unit: noisy measurements from
 - (i) 3-axis gyro [=angular rate sensor],
 - (ii) 3-axis accelerometer [=measures acceleration + gravity; e.g., measures (0,0,0) in free-fall],
 - (iii) 3-axis magnetometer
- Dynamics:
 - Noise from: wind, unmodeled dynamics in engine, servos, blades

Example 2: Mobile robot inside building

- State: position and heading
- Sensors:
 - Odometry (=sensing motion of actuators): e.g., wheel encoders
 - Laser range finder:
 - Measures time of flight of a laser beam between departure and return
 - Return is typically happening when hitting a surface that reflects the beam back to where it came from
- Dynamics:
 - Noise from: wheel slippage, unmodeled variation in floor