

Mobile Robot Localisation Using an Extended Kalman Filter

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Project Overview

- Autonomous cars use sensors to locate their position in the world. Standard techniques for this localisation behaviour, such as GPS, are however plagued with connection issues and suffer large measurement errors. Localisation from more stable techniques such as odometry – calculating location based on wheel rotations – also suffer as small sensor and motor noise quickly cumulates over time into large location errors
- This project aims to implement an off-the-shelf Extended Kalman Filter on a two-wheeled differential-drive vehicle in both software simulation and on a real world robot, producing an accurate belief of the vehicle's (x, y) location as it randomly roams an environment



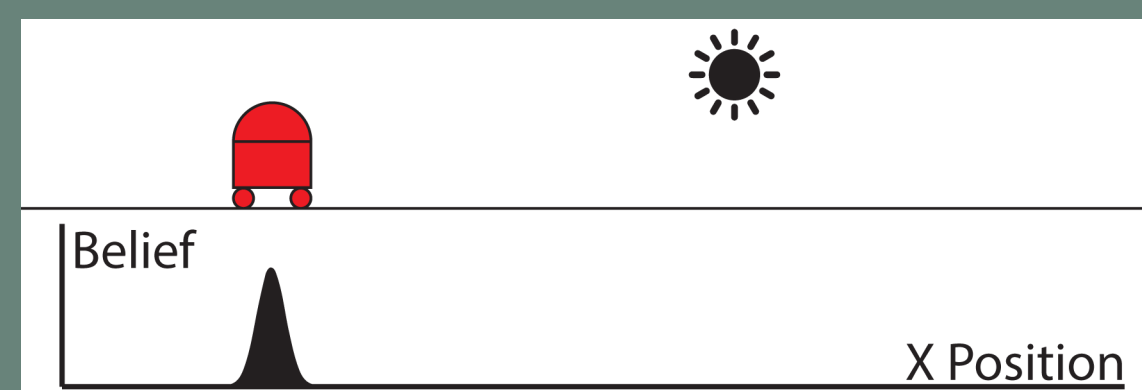
[1]

Extended Kalman Filter (EKF) Localisation

- An optimal way of combining two Gaussian distributions
- Combines odometry with a feature-based measurement model to increase certainty of location

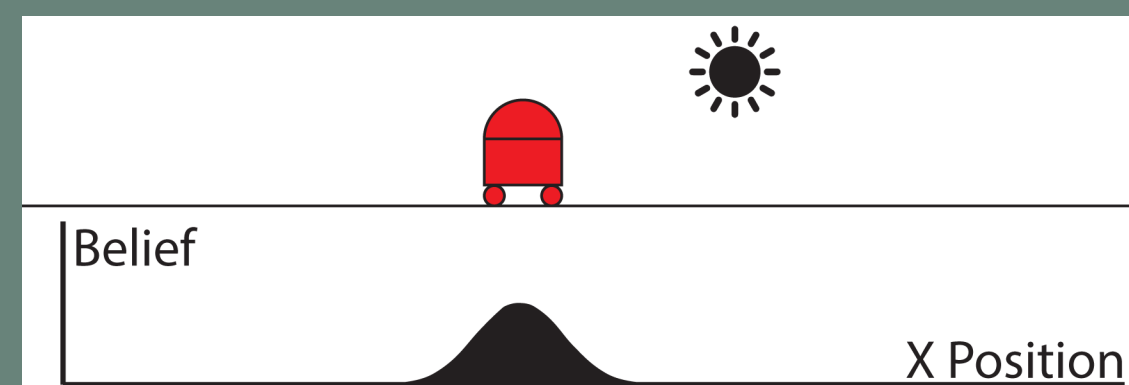
1: Initial Pose Estimation

- Prior belief of location in the world
- Location represented as a unimodal Gaussian distribution



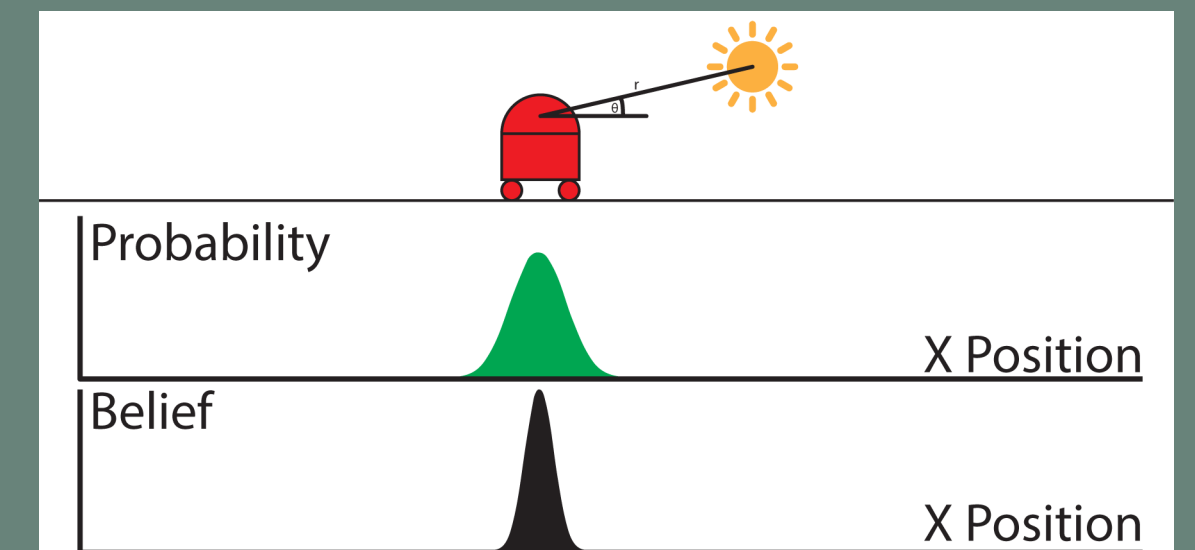
2: Prediction Step

- As the robot moves, odometry information predicts the new location
- Small errors in sensors and motors however decrease the certainty of its position, broadening its belief distribution



3: Correction Step

- Measurement to a nearby light feature gives a different probability density of the vehicles possible position (green)
- Folding this measurement into step 2's prediction gives a more confident and accurate posterior belief (black)



Loop

Extensions

- Implement return to base behaviour
- Use 360 degree panoramic camera with simple feature detection to calculate measurements to multiple coloured landmarks in the correction step
- Comparison of different measurement methods

[1] <http://static01.nyt.com/images/2012/10/28/automobiles/28JPSELF/28JPSELF-articleLarge.jpg>

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