Universidade de Aveiro

Mestrado em Robótica e Sistemas Inteligentes

Perceção e Controlo

Lesson 3: Kalman Filter

Academic year: 2024/2025 Nuno Lau

1. Write a python script that implements the functions:

```
def update(mean1, var1, mean2, var2):
      new_mean = #enter your code here
      new_var =  #enter your code here
      return [new_mean, new_var]

def predict(mean1, var1, mean2, var2):
      new_mean = #enter your code here
      new_var =  #enter your code here
      return [new_mean, new_var]
```

   implementing the basic operations of computing the new gaussians that result from measurement integration (update) and motion (predict), given the previous estimate, measurement belief and the motion model parameters.

2. Write a python script that implements a Kalman filter that estimates the value of a measure of a constant value. The measure includes noise.
   - 2.1. Use a noise generator to add noise to a constant value and check the output of your filter.
   - 2.2. Experiment with different values in the noise generator and in the noise that is estimated by the filter.
   - 2.3. Instead of a constant value, use a value changes every step by the same amount. Check the effects on the output of the filter. Test different values for measurement noise and process noise.
   - 2.4. Use the CiberRato tools and a Kalman filter to estimate the orientation of a stopped robot using the compass sensor.
   - 2.5. Use the CiberRato tools and a Kalman filter to estimate the distance to the front wall using a stopped robot.

3. Write a python script that implements a Kalman Filter that may have a state vector with several dimensions and also an actuation vector. Use matrix notation.
   - 3.1. Check your implementation on the estimation of the position and velocity of a free moving body. Measures can only read the value of the position (with noise).
   - 3.2. Use the CiberRato tools to estimate the orientation of a robot that always send symmetrical actuations to the wheel motors.
   - 3.3. Use the CiberRato tools to estimate the distance to the front wall of a robot that moves slowly towards that wall.