Institute of Robotics, University of Innopolis

Intelligence Mobile Robotics
Homework 03
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1 Task One

The main objective of this task is to get a proper understanding of EKF (Extended Kalman Filter) localization. Design a relationship between the current and successive pose of **differential drive robot**.

1. What is the state variables vector for the robot (x_k)?
2. Design the system model (Φ_k)
3. A sensor that attached to the robot gives the distances to each of the visible landmarks. Hence, range can be obtained to each sensor as follow. Assume, p_x^i and p_y^i are the distances on x and y direction respectively. $r = \sqrt{(p_x^i - x)^2 + (p_y^i - y)^2}$ where i depicts i^{th} landmark. Relative orientation to each landmark $\phi = \arctan(\frac{p_y^i - y}{p_x^i - x}) - \theta$. Using this information try to obtain the measurement model ($h(\bar{x}_k^-)$)? Here, it is assumed that current position of the robot as x and y and heading of the robot as θ. You may change these two formulas adhere with your design. Also, you may decide the positions of the landmarks based on your configuration space. Only constrain is that you should have at least 3 landmarks.
4. Write down all the assumptions about errors of the filter?
5. The robot should route through two paths: straight line and taking a turn. Draw P_k changes over time for each of the paths where at least 4 timestamps would be enough: start position, end position and a few in between start and end position. **Importance: EKF should be implemented by yourself. You may use any programming language.**

2 Task Two

Id	Name
01	Sabirova Adelya
02	Ahmed Nawaz
03	Andrey Stepanov
04	Arslan Siddique
05	Aydar Ahmetzyanov
06	Dmitriy Desyatkin
07	Lyailya Aminova
08	Maksim Rassabin
09	Oleg Balakhnov
10	Sami Sellami
11	Valeriya Skvortsova
12	Victor Massague Respall

In hw-02, you've touched upon a step into a tracking problem especially into data association. Here you're going to move a step ahead and try to incorporate data association into tracking. Each of you is provided with an image sequence of a scenario. After browsing your image set, try to seek an object which is moving through a few images (at least 5 images) continuously. Locate a bounding box for a chosen object which can be done either manually or automatically. Assuming an object is not going away from the initial bounding box, try to find some feature points for the background using any feature descriptor. Now assume those feature points are the landmarks for the robot you have developed for the task one. Update EKF for as suited for this task. Assume robot is moving on a straight line. If you want to make any additional assumptions please state them as well. Please explain how you detected the feature points and why you decided so.

3 Submit

What should you turn in? Please, upload the single zip file which includes your source code (task 01 and task 02) and report for both tasks.

4 Deadline

The deadline: April 15, 23:54:59 GMT+3.