Institute of Robotics, University of Innopolis

Intelligence Mobile Robotics
Homework 04
Ilya Afanasyev (Primary Instructor), Geesara Prathap (Teaching Assistant)

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1 Task One

Simultaneous localization and mapping (SLAM) is the problem of acquiring a map of an unknown environment, while simultaneously localizing the robot relative to the map. In this homework, you are going to incorporate mapping while localizing the robot; this is a continuation of the HW3. You should use the same robot model (HW3) for this homework as well.

1. Let's say we have n landmarks and now we need to incorporate those locations into the state vector (x_k). Design the x_k?
2. Design the system model (Φ_k)?
3. Derive an expression for $\bar{x}_k^-$ and P_k^- in general?
4. A sensor that attached to the robot gives the distances to each visible landmark. Hence, range can be obtained to each sensor as follow. Assume, m_x^i and m_y^i are the distances on x and y direction respectively. $r = \sqrt{(m_x^i - x)^2 + (m_y^i - y)^2}$ where i depicts i^{th} landmark. Relative orientation to each landmark $\phi = \arctan(\frac{m_y^i - y}{m_x^i - x}) - \theta$. Using this information try to obtain the measurement model ($h(\bar{x}_k^-)$)?
5. Write down all the assumptions about errors of the filter?
6. 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.

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

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.

3 Submit

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

4 Deadline

The deadline: May 7, 23:54:59 GMT+3.