Technion – Israel Institute of Technology



HW2

Autonomous Navigation and Perception

086762

|  |  |  |
| --- | --- | --- |
| Alon Spinner | 305184335 | alonspinner@gmail.com |
| Dan Hazzan | 308553601 | danhazzan@campus.technion.ac.il |

April 12, 2022

# Question 1 – Theoretical questions

Given:

And assume motion and observation models are:

{ where }

## Objective function explicitly for the above considered setting:

## Derive a recursive formulation that expresses :

Given:

1. In the objective function formulation J, we assume a set of known actions. The value of uses a policy to create actions as such, actions are generated online and can be optimized inline.

# Hands-on tasks – question 1

Given:

1. Mobile robot navigating in a 2D environment.
2. Motion and observation models ( are given by:

We decided to implement a “Kalman filter” (ProbabilisticRobotics chapter 3.2.1).

From the question we can tall that:

1. linear function in its arguments with added Gaussian noise
2. linear function in its arguments with added Gaussian noise

Now, when we know we hold the 3 above we can tall that the posteriors are Gaussian and can apply Kalman filter algorithm shown (from “ProbabilisticRobotics” book) below:

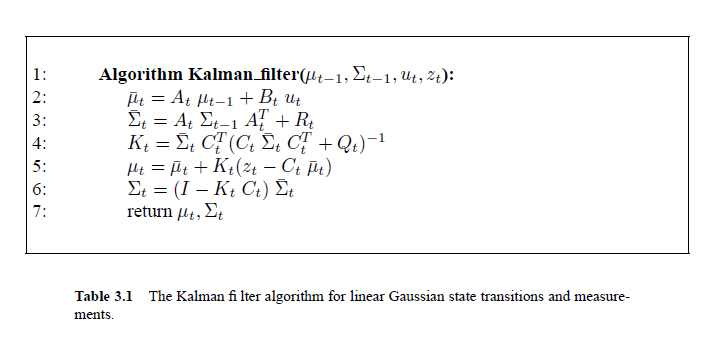


Figure 1: Kalman filter algorithm

Given a robot state and action we can generate the next state i.e such:

## 

According to the observation model we can generates an observation i.e such:

1. Julia
2. Julia

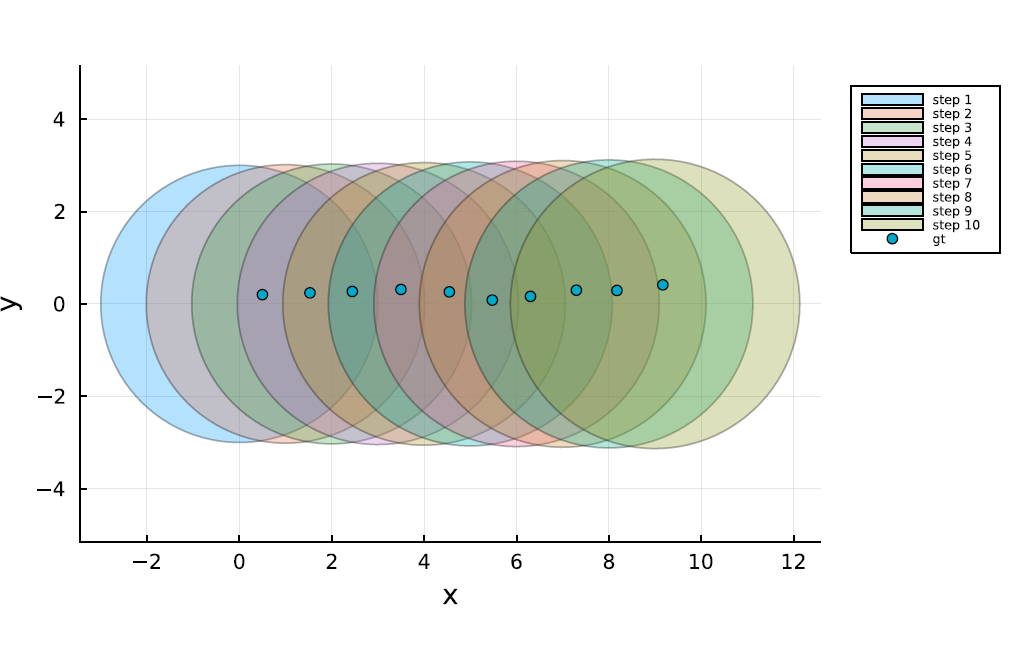
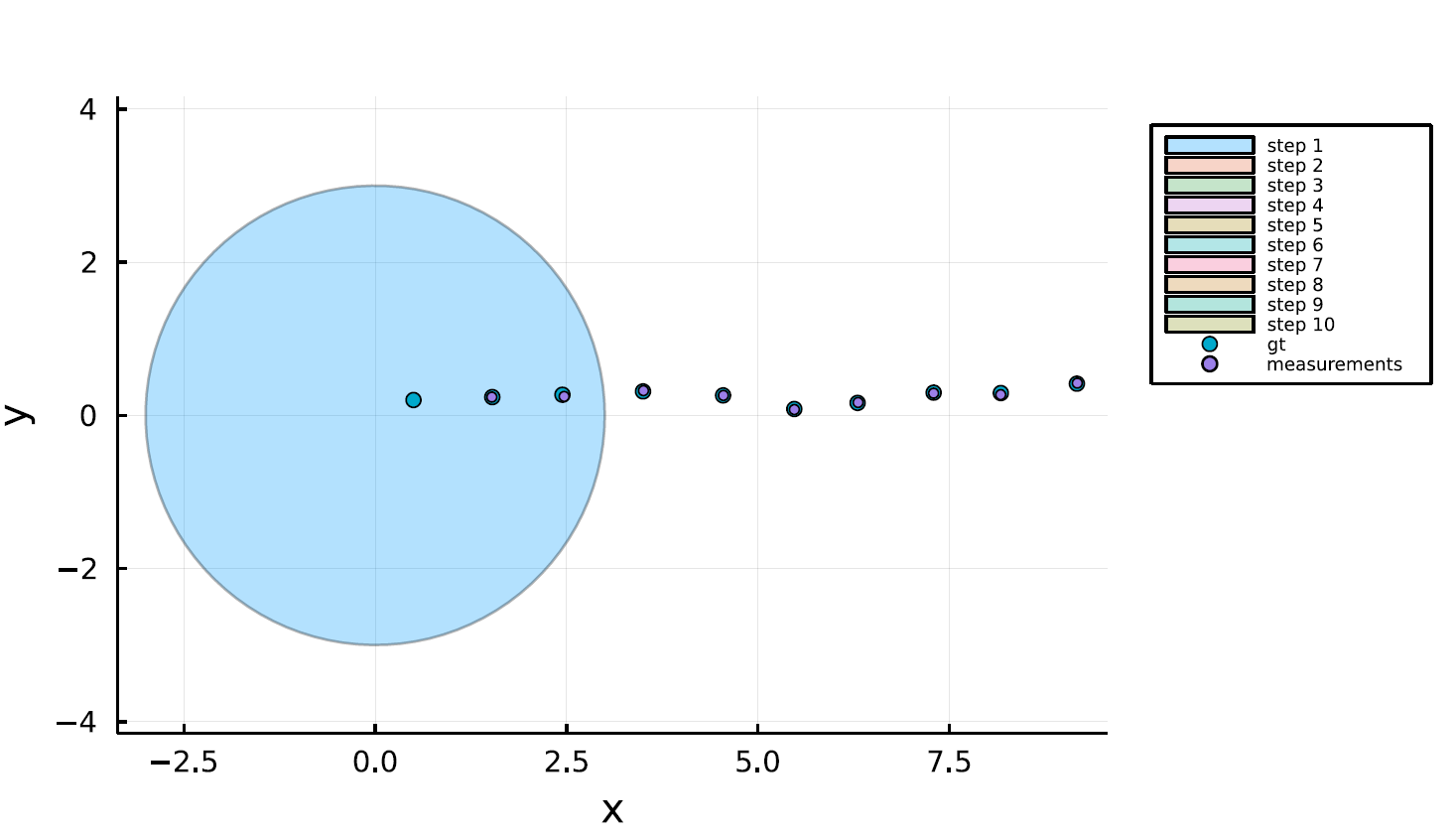


Figure 2: Ground Truth trajectory and the correspondence propagated beliefs

Its Hard to see in figure 3, but the covariance does exist after the first step.

As expected, the covariance is much smaller than the covariance in section iii.

Figure 3: Ground Truth trajectory and the correspondence posterior beliefs



# Hands-on tasks – question 2

The observations are derived from:

We know from the question that the measure come from the closest beacon:

Given the gaussian noise we’ll get:

## Julia

1. We can see the update of the covariance changes according to the existence of the observation. In figure 4 we can see the covariance getting bigger each step, as the uncertainty getting higher. In figure 5 the observations shrink the uncertainty as long .

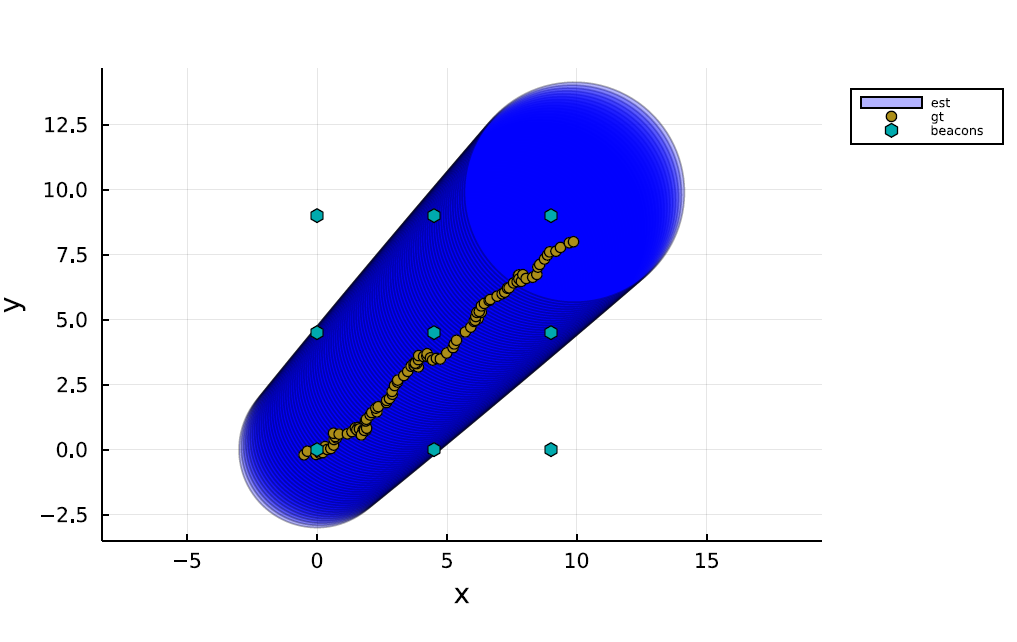


Figure 4: Ground Truth trajectory w. Beacons and the correspondence propagated beliefs. Dynamic .

Chart

Description automatically generated

Figure 5: Ground Truth trajectory w. Beacons and the correspondence posterior beliefs. Dynamic .

1. Since the relation between the changes are barely seen, like we can see in figure 6.

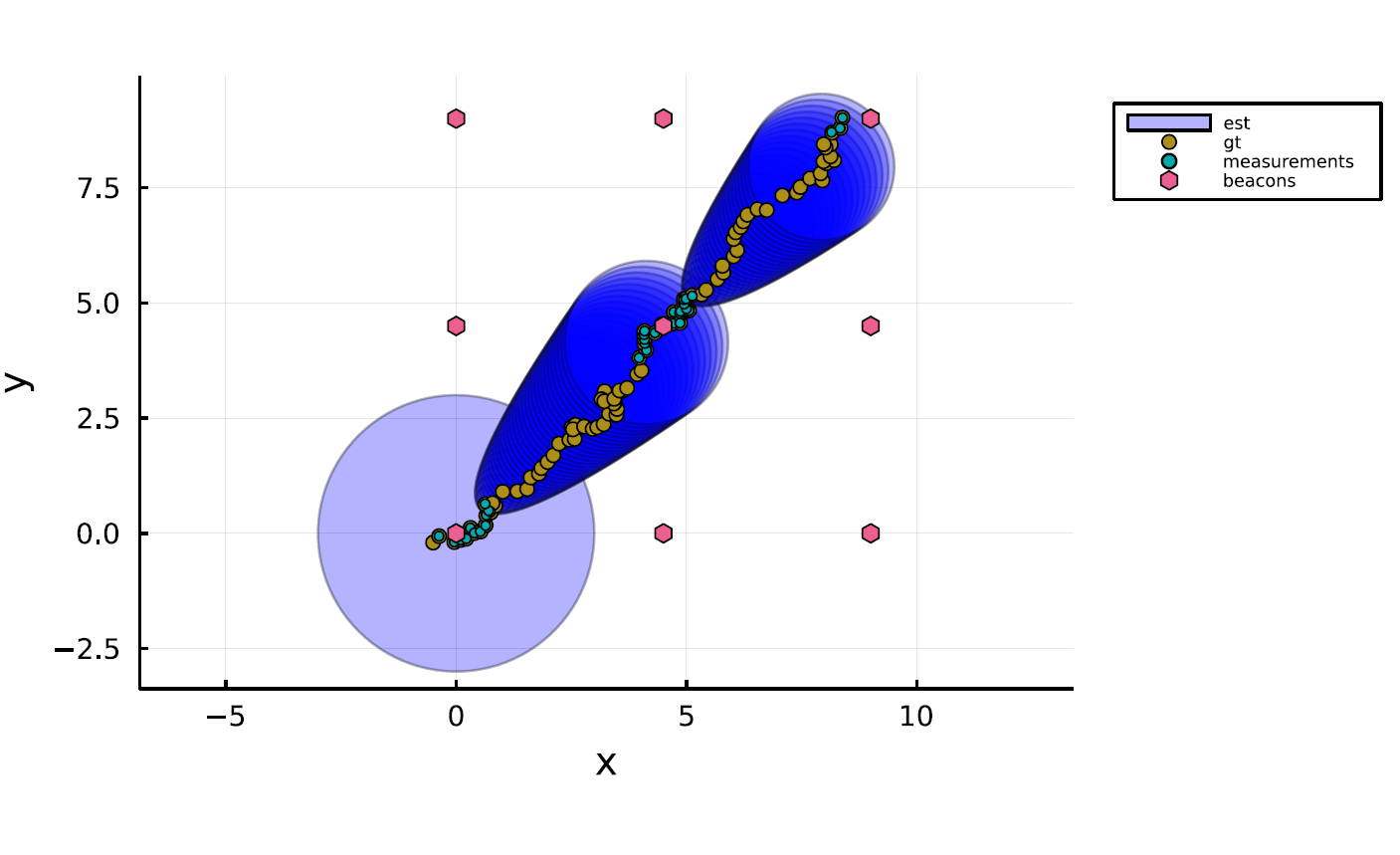


Figure 6: Ground Truth trajectory w. Beacons and the correspondence posterior beliefs. Fixed .

1. Alon$@#$@#$@@#

Chart, line chart

Description automatically generated

1. Alon$@#$@#$@@#

Chart, line chart

Description automatically generated