



U6.2 Predict and correct

State estimation · University · about 30 min

Name _____

Class _____

Date _____

What this lesson is about

The shape every filter has: a model that guesses forward, a measurement that pulls it back.

- On the robot
- Why predict at all
- What a model is
- The residual

Questions

7 marks in all

1. Put one tick of the lesson's fusion loop in order.

[1 mark]

Number the lines 1 to 4 to put them in the right order.

```
___ measured = START_GAP - distance()
___ est = 0.9 * est + 0.1 * measured
___ plot("estimate", est)
___ est += flow()[1] * DT
```

2. Three ticks of predict and correct with made-up sensor values. What does it print?

[1 mark]

```
DT, START_GAP = 0.1, 110.0
est = 0.0
for speed, d in ((20.0, 107.0), (20.0, 103.0), (20.0, 104.0)):
    est += speed * DT
    measured = START_GAP - d
    est = 0.9 * est + 0.1 * measured
    print(round(est, 2))
```

3. What is measured - est called?

[1 mark]

4. The plotted innovation is consistently positive. What does that say?

[1 mark]

- ☐ A The model is biased and the filter is fighting it
- ☐ B The filter is working well
- ☐ C The measurement noise is larger than expected
- ☐ D The blend weight is too large

5. Why does predict and correct keep up with a moving robot better than a low pass filter on the distance [1 mark] alone?
- ☐ A The prediction uses a measurement of the motion, so the correction only fixes a small residue
 - ☐ B It uses a smaller alpha
 - ☐ C It uses two sensors, which halves the noise
 - ☐ D It runs the loop faster
6. The correct step is changed to $est = 0.98 * est + 0.02 * measured$. What is the filter now trusting? [1 mark]
- ☐ A Mostly the flow prediction, so drift is corrected only slowly
 - ☐ B Mostly the wall measurement, so the estimate is noisy
 - ☐ C Both equally
 - ☐ D Neither, the estimate stops updating
7. The robot has no velocity sensor. What does the lesson suggest as the model for the predict step? [1 mark]
- ☐ A The commands sent, through the kinematics from U2
 - ☐ B A copy of the last measurement
 - ☐ C A low pass filter on the measurement
 - ☐ D No prediction; correct only

The task: predict, then correct

Drive at least 40 cm towards the wall, running predict and correct, plotting `measured` and `estimate`, and print `my y: . position()` is not allowed.

```
from bugbot import *
connect()

DT = 0.1
START_GAP = 110.0
est = 0.0
```

Plan your program here, then type it in and press Run.



Do it on the robot

www.bugbotlab.com/learn/u6-2-predict-and-correct/

The simulator checks it and tells you when it passes. Nothing to install, no account.

Challenges

1. Plot the innovation as well. Is it centred on zero?
2. Set the blend to 0.5 and to 0.02 and compare. What is each one trusting?
3. Break the prediction on purpose by multiplying the flow by 1.2. Where does that show up?