WORKSHEET

U5.2 Proportional control

Feedback control · University · about 30 min

Name _____ Class _____ Date _____

What this lesson is about

One gain, the whole trade-off, and the steady state error it cannot remove.

- What the gain means
- Turning it up
- Where the overshoot is
- The steady state error
- Choosing Kp by hand

Questions

6 marks in all

1. A proportional controller has Kp = 1.5 percent per cm. What command, in percent, does an error of 12 cm produce? [1 mark]

2. The error is in centimetres and the command in percent. What are the units of Kp? [1 mark]

3. This drive does not move below 15 percent. With Kp = 2, what is the largest error in cm that proportional control alone leaves uncorrected? [1 mark]

4. In the lesson's turning cell at Kp = 4, the error trace falls fast, crosses zero, comes back and crosses again before settling. What does that say? [1 mark]

- ☐ **A** The gain is too high: fast but underdamped
- ☐ **B** The gain is too low
- ☐ **C** There is steady state error
- ☐ **D** The sensor is biased

5. Why does a low-gain proportional controller stop short of the target and stay there? [1 mark]

- ☐ **A** It needs an error to produce a command, and the command for a small error is below the drive's dead band
- ☐ **B** The integral has wound up
- ☐ **C** The sensor filter delays the last few centimetres
- ☐ **D** The sign of the error is wrong

6. Put the lesson's hand-tuning recipe for Kp in order. [1 mark]

Number the lines 1 to 3 to put them in the right order.

___ `Halve that value`

___ `Start low, around 1`

___ `Double it until the robot overshoots or wobbles`

The task: find a gain that works

Settle 30 cm from the wall, within 5 cm, and stay there from ten seconds onwards. Print the `kp:` you chose.

```
from bugbot import *
connect()

KP = 1.0
TARGET = 30.0
```

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

Do it on the robot

www.bugbotlab.com/learn/u5-2-proportional/

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

Challenges

1. In the turning cell, find the gain at which it first overshoots, to the nearest 0.5.
2. Find the gain below which the distance loop never gets within 5 cm. Explain it with the dead band.
3. Run the same gain from 100 cm away and from 5 cm away. Does the same number suit both?