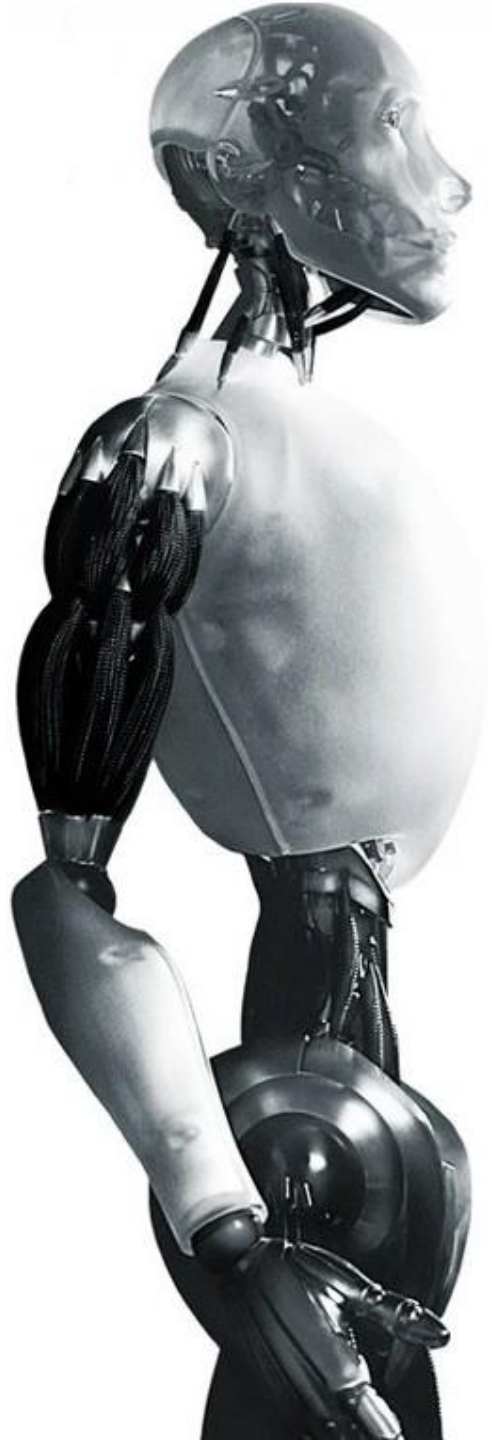
Disclaimer

These slides are intended as presentation aids for the lecture. They contain information that would otherwise be to difficult or time-consuming to reproduce on the board. But they are incomplete, not self-explanatory, and are not always used in the order they appear in this presentation. As a result, these slides should not be used as a script for this course. I recommend you take notes during class, maybe on the slides themselves. It has been shown that taking notes improves learning success.

Reading for this set of slides

- Craig – Intro to Robotics (3rd Edition)
  - Chapter 1

Please note that this set of slides is intended as support for the lecture, not as a stand-alone script. If you want to study for this course, please use these slides in conjunction with the indicated chapters in the text books. The textbooks are available online or in the TUB library (many copies that can be checked out for the entire semester. There are also some aspects of the lectures that will not be covered in the text books but can still be part of the homework or exam. For those It is important that you attend class or ask somebody about what was covered in class.

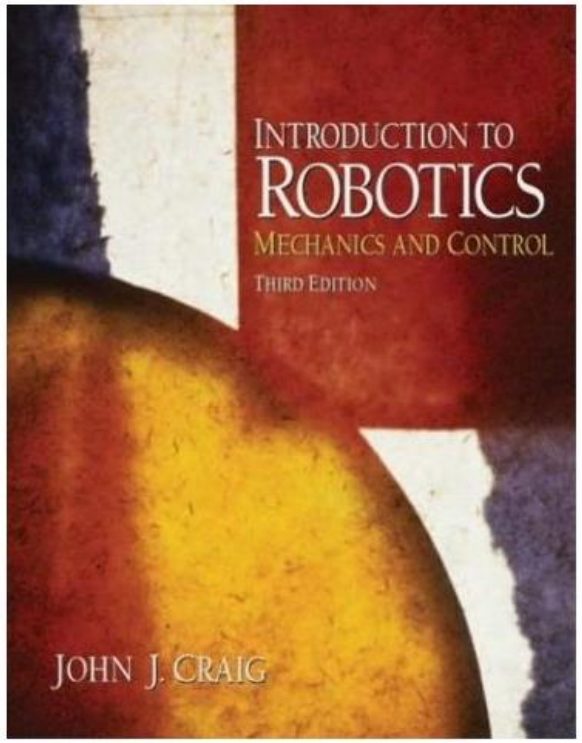


Robotics

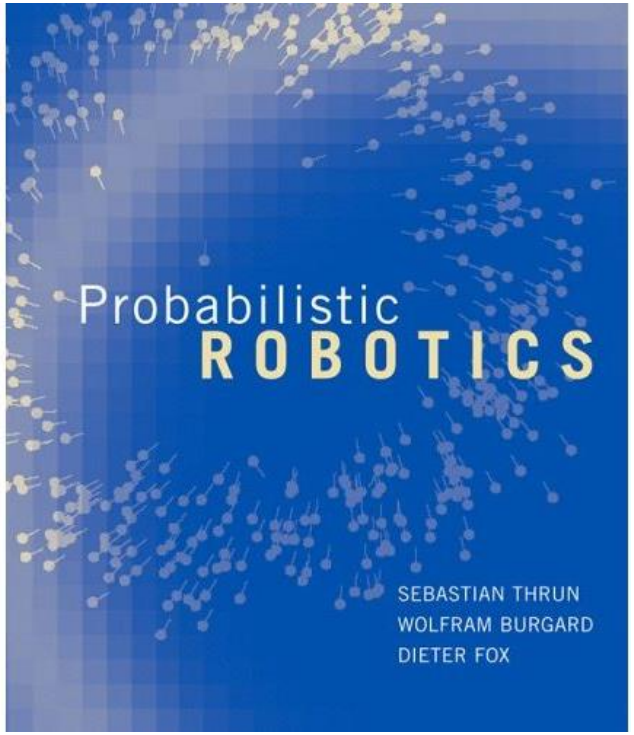
Our First Task: Hold Still!

TU Berlin

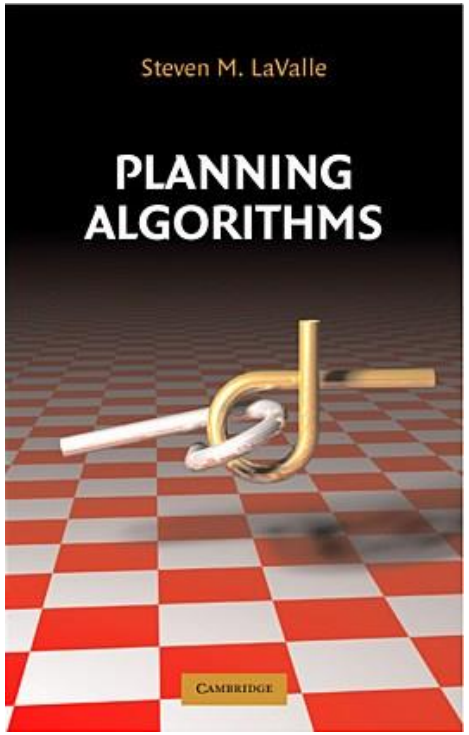
Oliver Brock



In the library



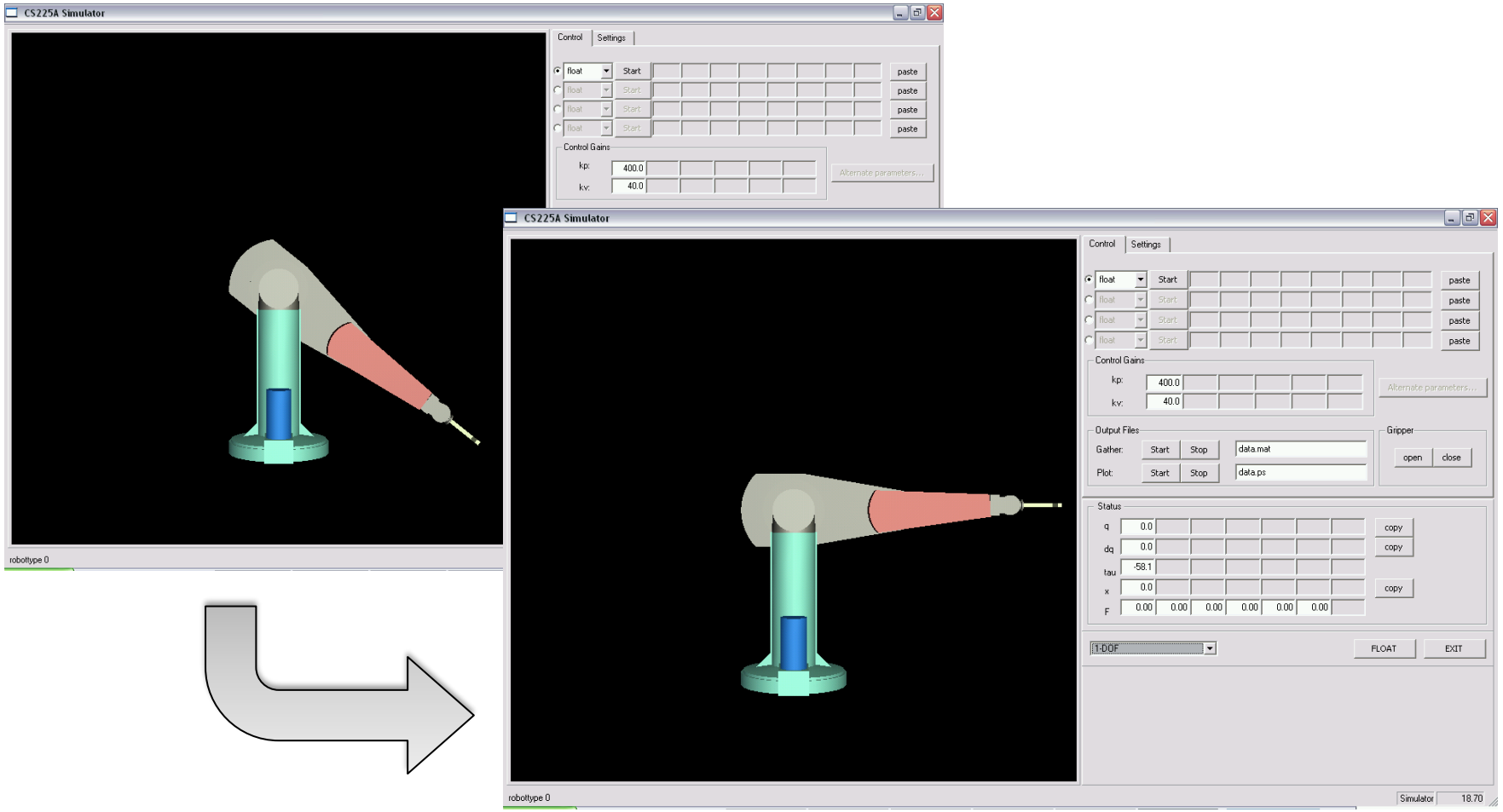
In the library
http://www.probabilistic-robotics.org



Free online
http://planning.cs.uiuc.edu


PUMA 500
UNIMATE

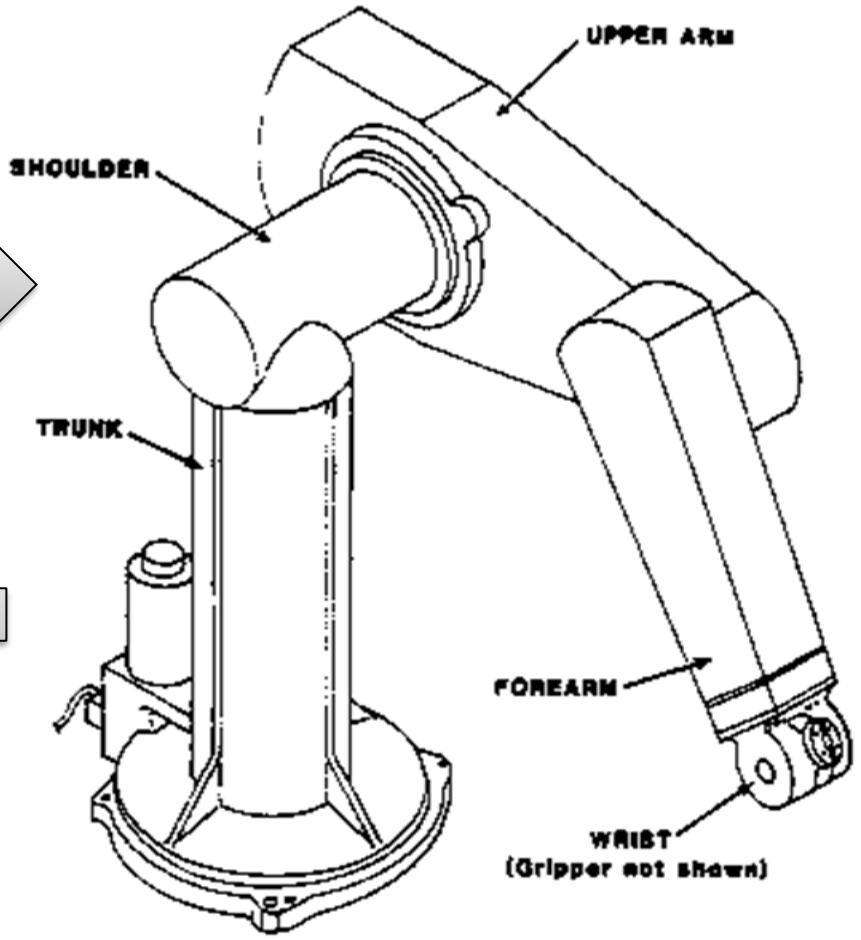
Our Task: Hold Still!



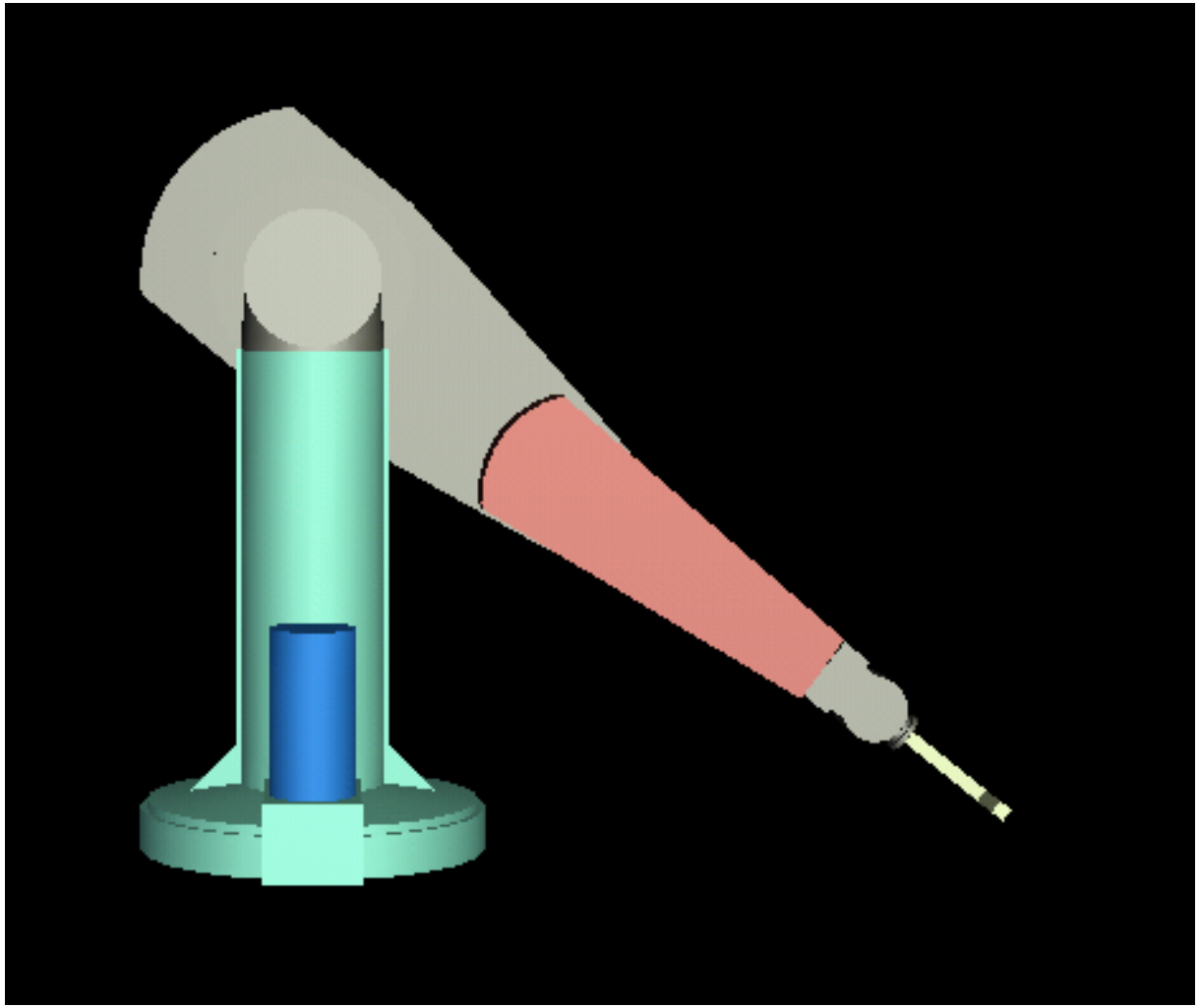
The Interface

torque / force τ (tau)
(really: current)
[Drehmoment, Kraft]

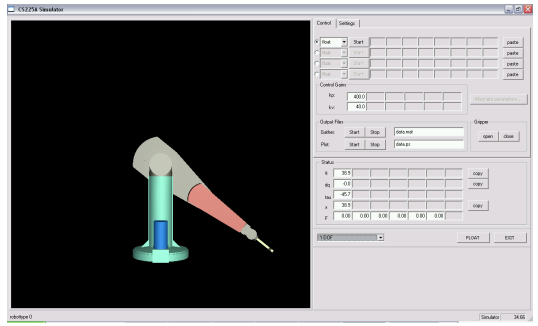
joint positions:
configuration *q*

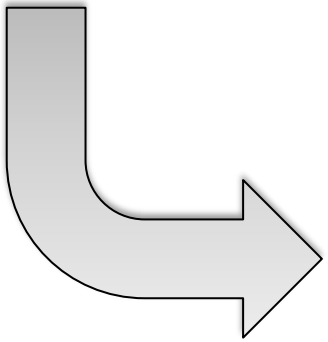


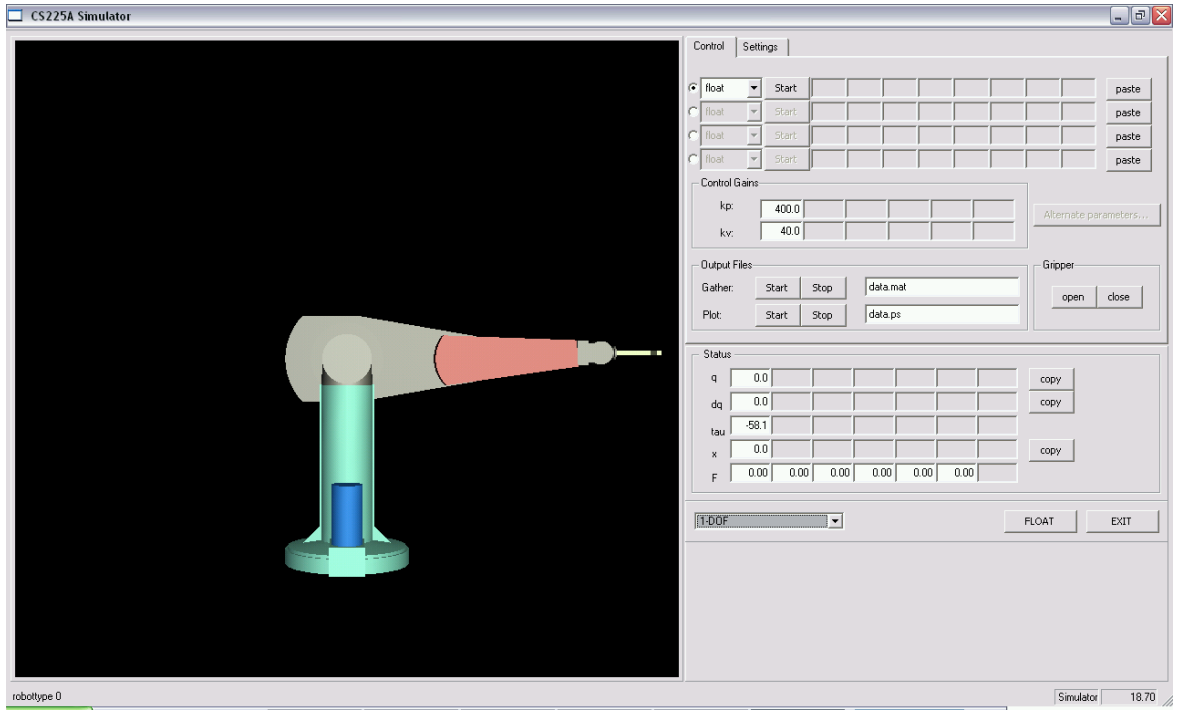
Don’t fall. Hold still!



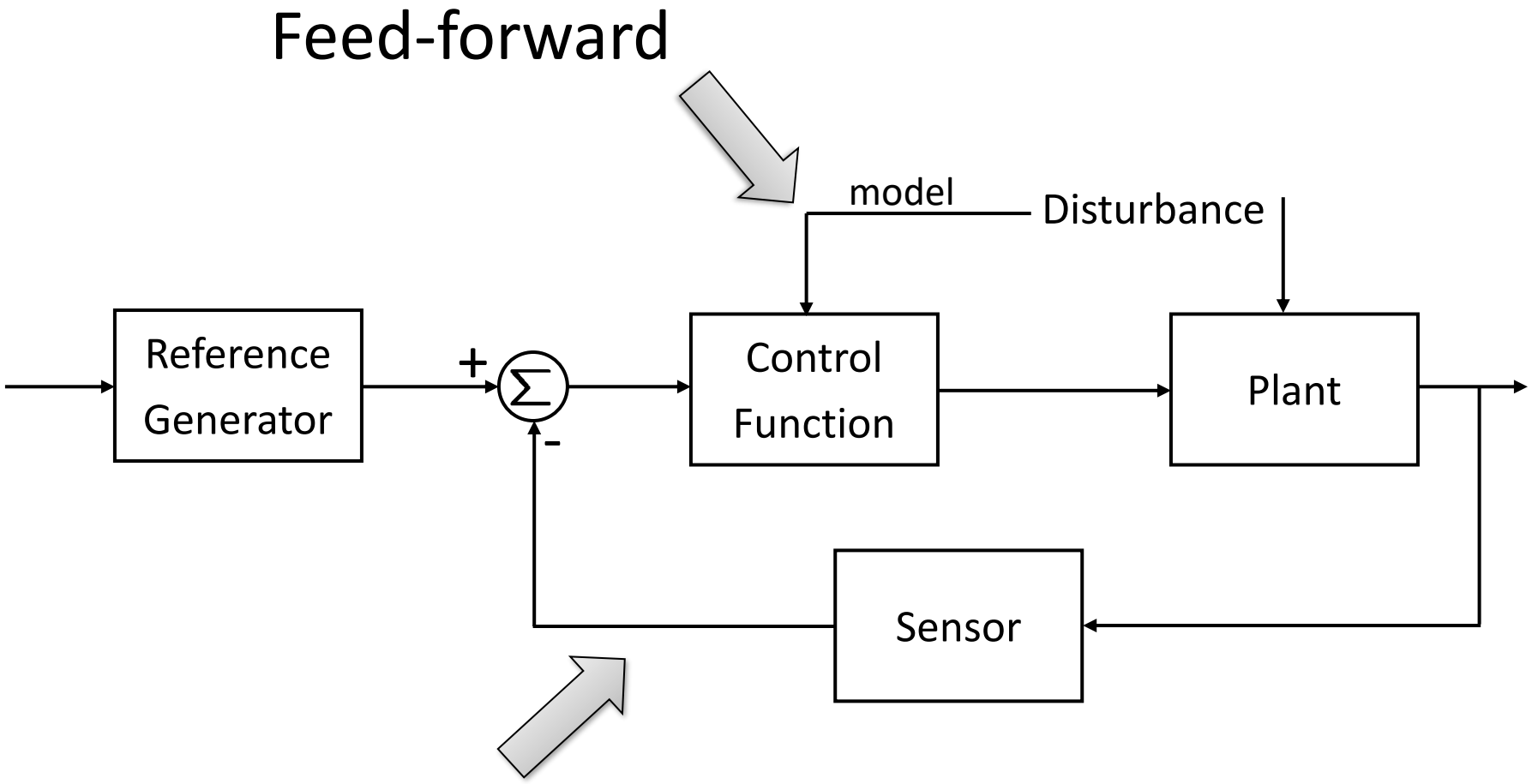
Let’s try…






CS225A Simulator
Control
Settings
float
Start
paste
Control Gains
kp:
400.0
kv:
40.0
Alternate parameters...
Output Files
Gather:
Start
Stop
data.mat
Plot:
Start
Stop
data.ps
Gripper
open
close
Status
q
0.0
dq
0.0
tau
-58.1
x
0.0
F
0.00
copy
1-DOF
FLOAT
EXIT
robottype 0
Simulator
18.70

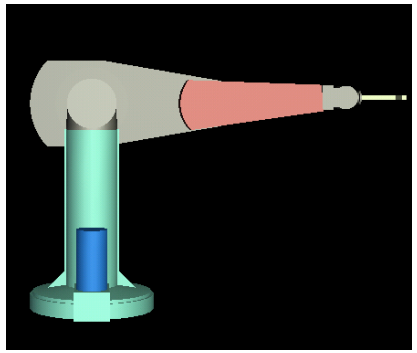
A Simple Controller [Regler]

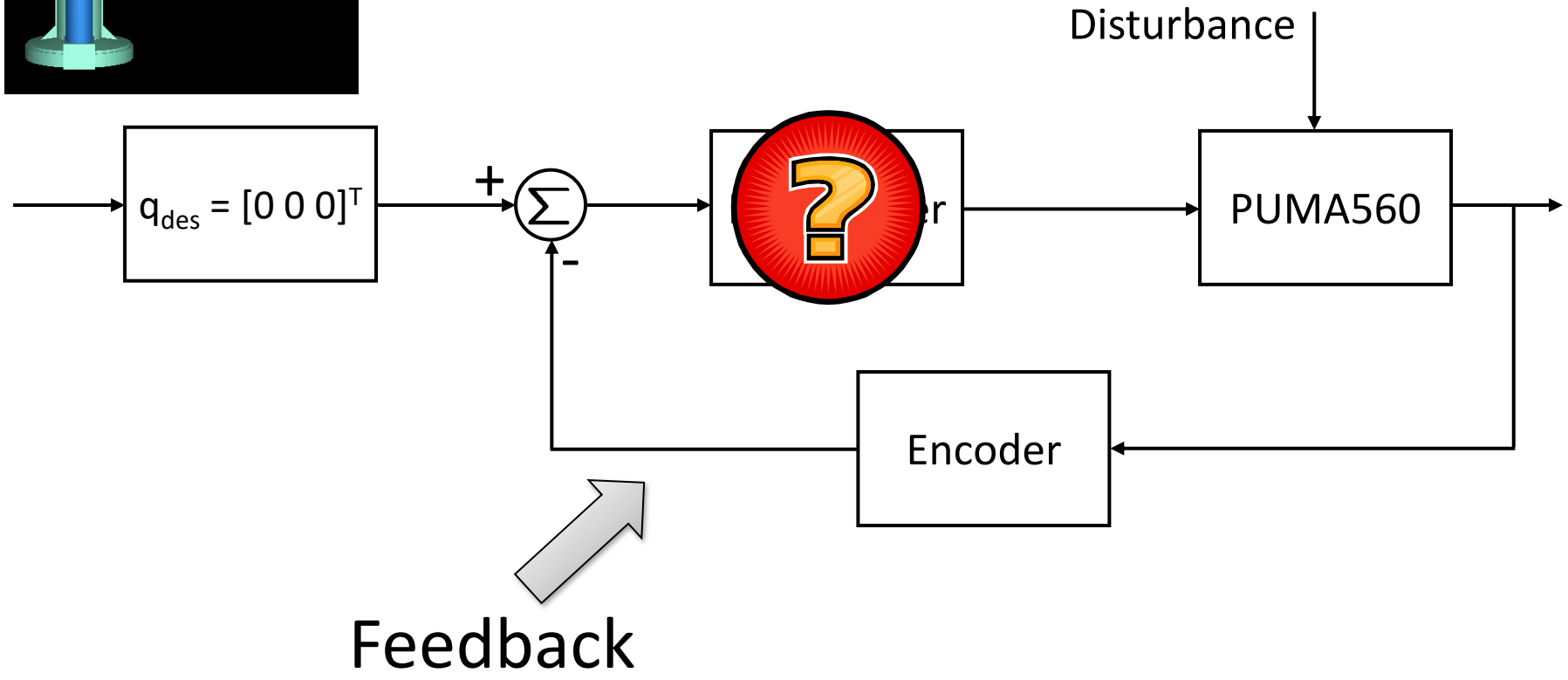


(we used proportional feedback or P control)

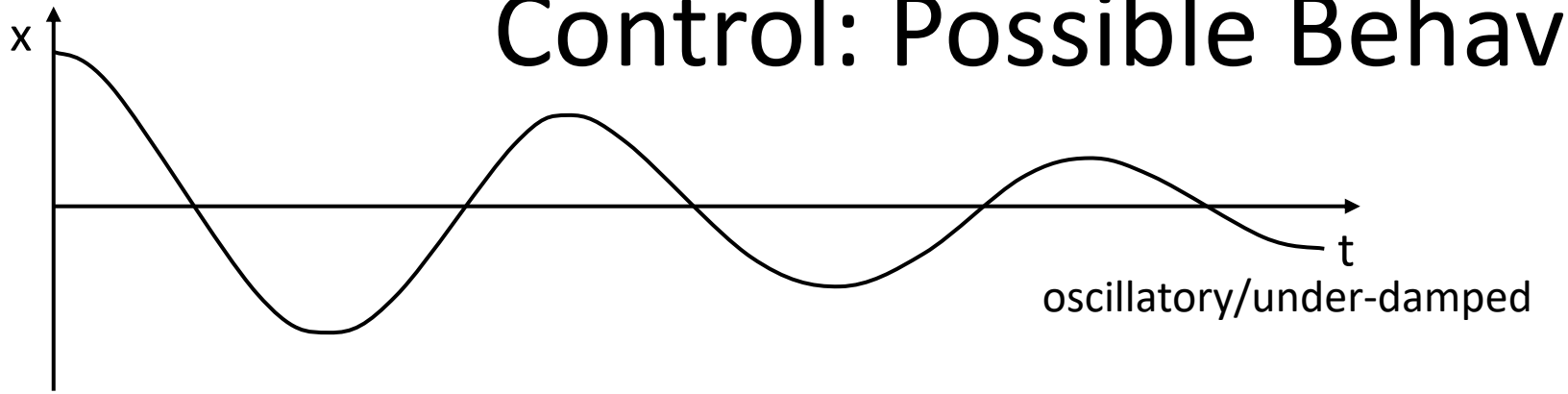
(also: closed loop – as opposed to open loop)

A Proportional Controller

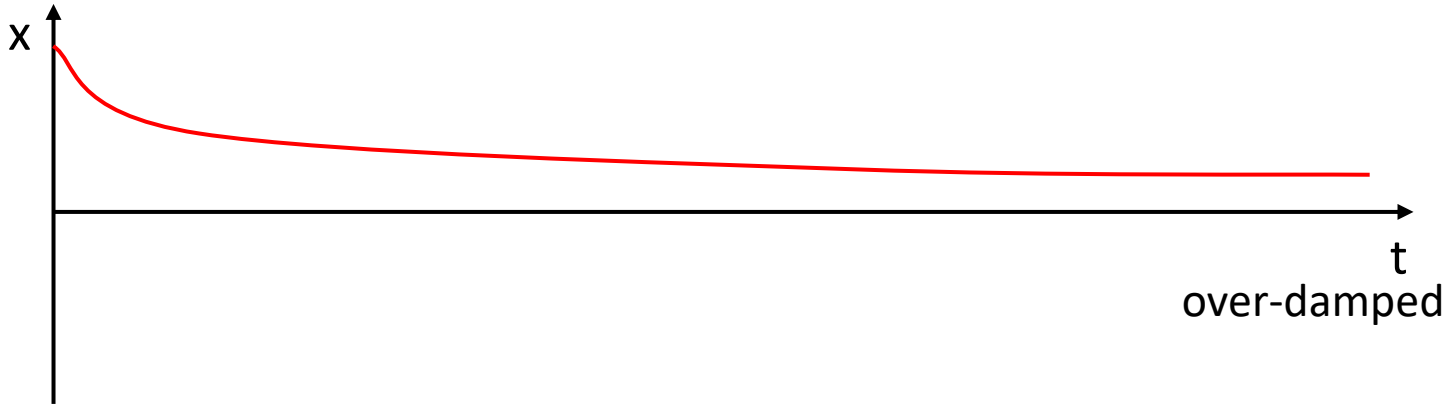




Control: Possible Behaviors



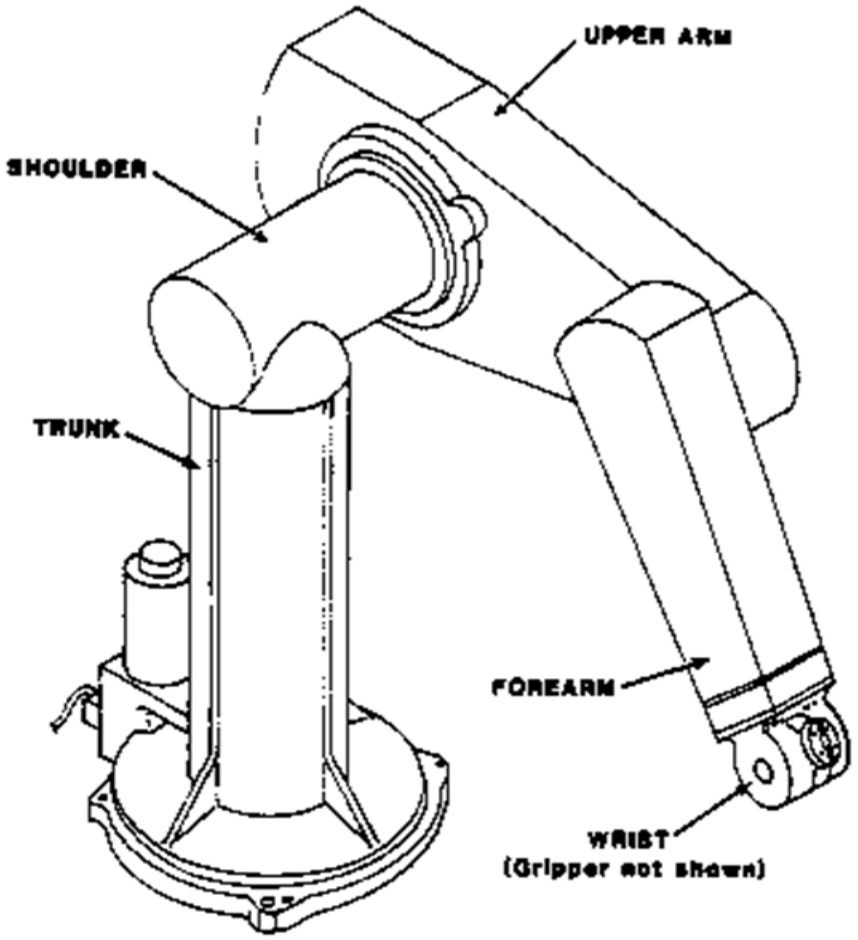
oscillatory/under-damped



over-damped

critically damped

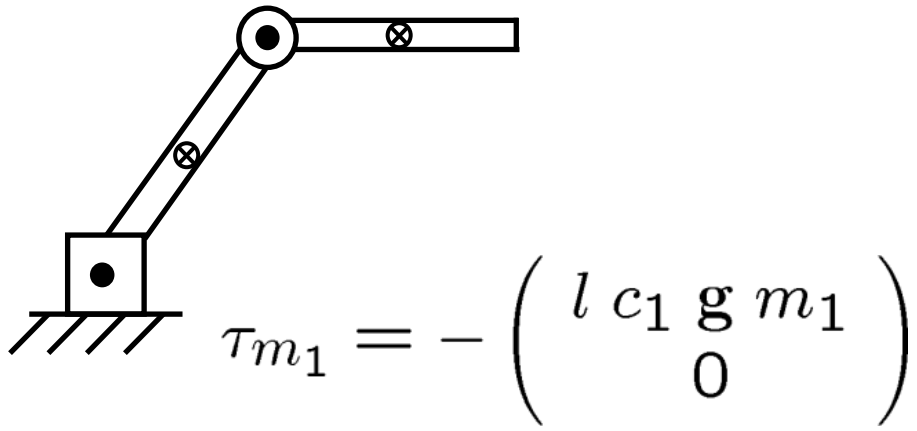
Possible Disturbances



- Gravity
- Inertia
- Centrifugal forces
- Coriolis effect
- Gears
- Actuator
- Friction
- Grasped object
- Contact
- …

What we need to solve the problem

- Fixed parameters of the robot
  - Kinematic
  - Dynamic
- Changing parameters
- Then we can:
  - Compensate gravity (feed-forward)
  - Reject error (feedback, P-controller)
- But: what happens when the robot moves?



$$\tau_{m_1} = -\begin{pmatrix} l\, c_1\, \mathrm{g}\, m_1 \\ 0 \end{pmatrix}$$