# 16-662 – Robot Autonomy

## Sense – Plan – Act

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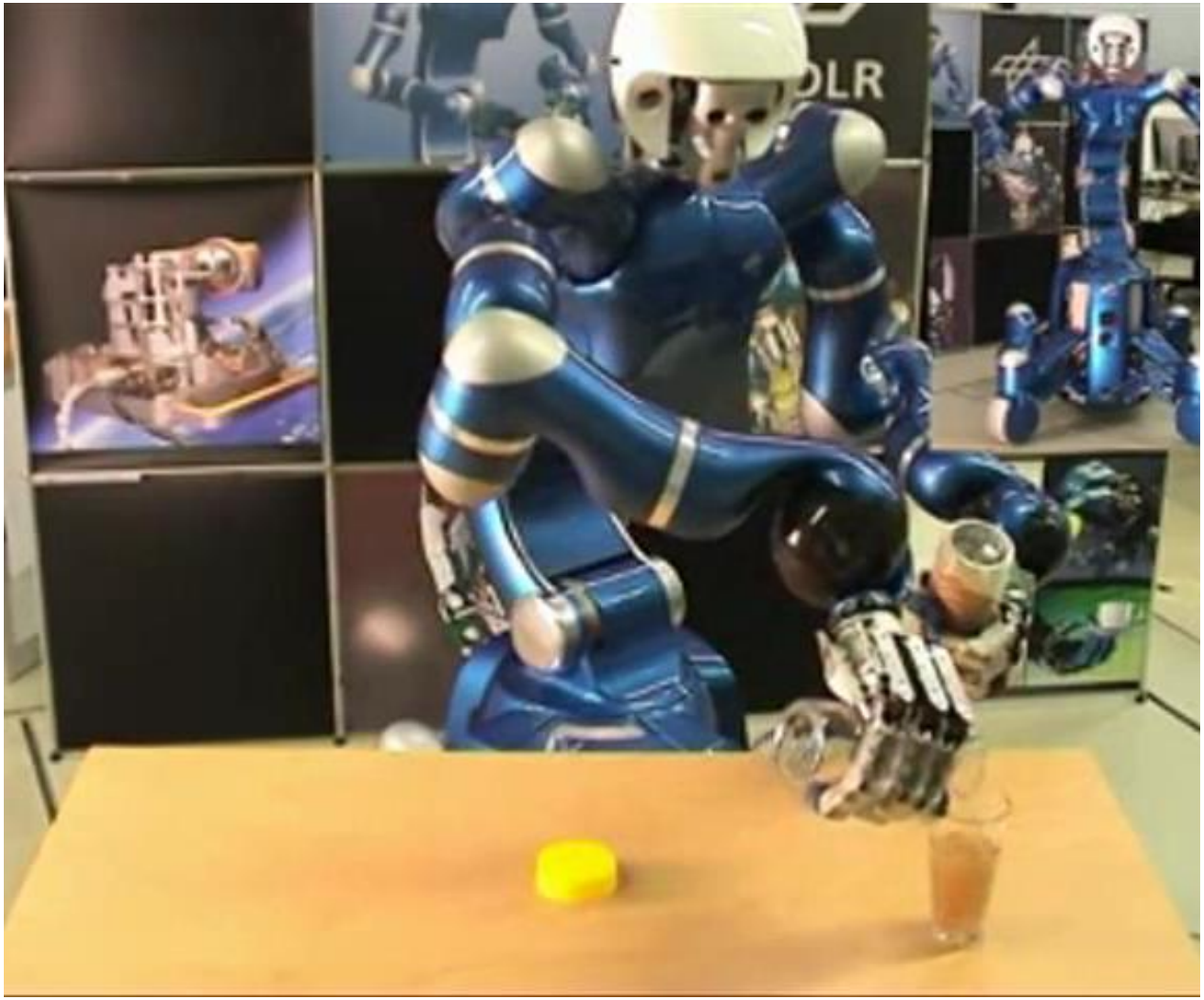
# Today's Lecture

- Class Content
  - What information do we need to plan?
  - Perception-action loop
  - What and how to perceive

- Class Goals
  - Differences between open loop control and closed loop control
  - Different sensors available to perceive the world
  - Difficulties involved in sensing

# What information do we need?




Video from the DLR (German Airospace Center)

# What information do we need?

## Autonomous Robotic Manipulation (ARM-S)

*Autonomous Wheel Replacement*

**PI:** Drew Bagnell, Martial Hebert, Nancy Pollard

**Team:** Chris Dellin, Tom Galluzzo, Moslem Kazemi, Matt Klingensmith, Michael Koval, Jean-Sebastien Valois, Arun Venkatraman

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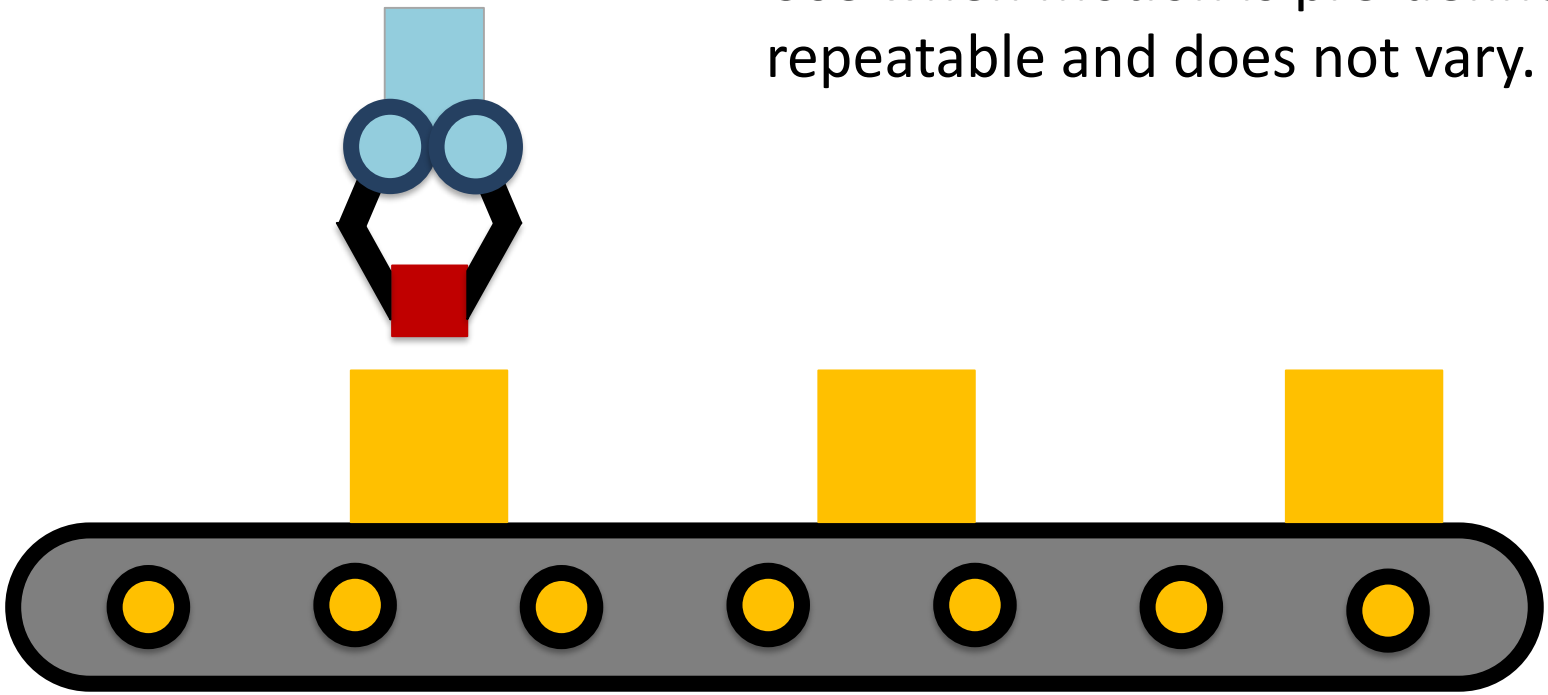
# Open Loop Control

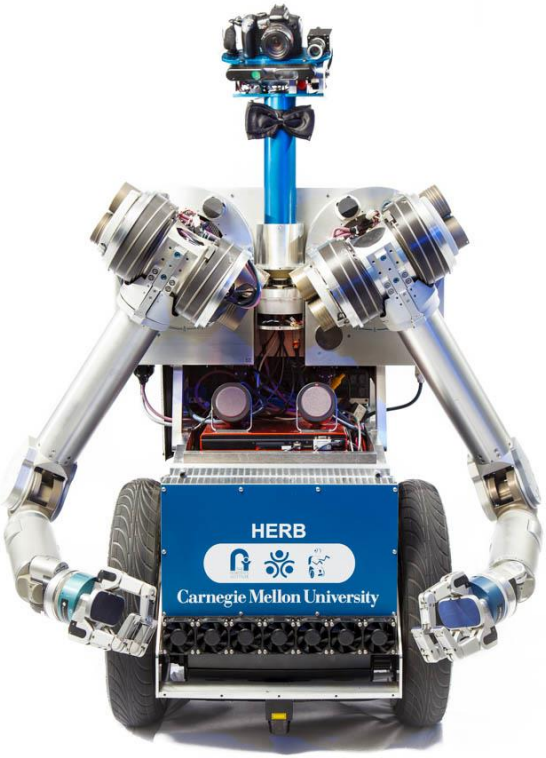
## Examples

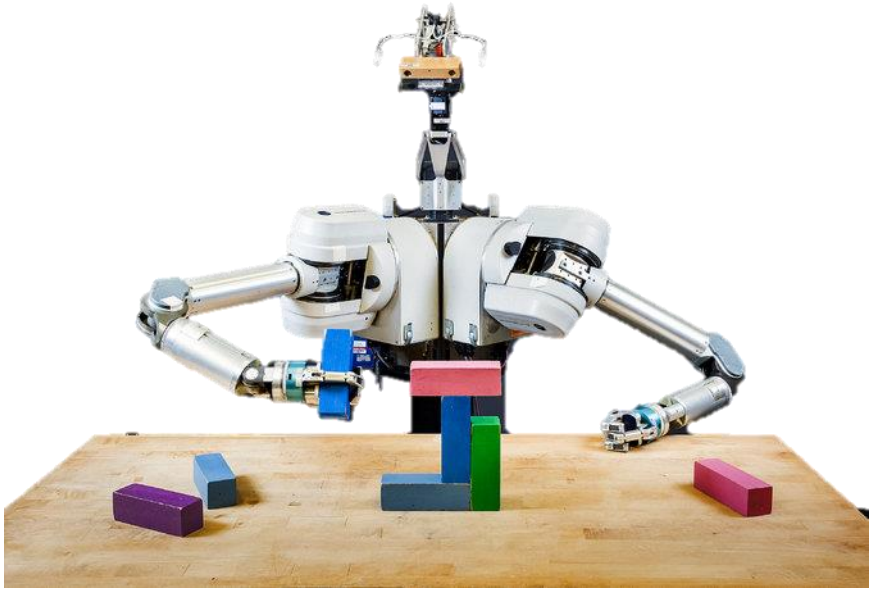
Use when motion is pre-defined, repeatable and does not vary.



# Closed Loop Control

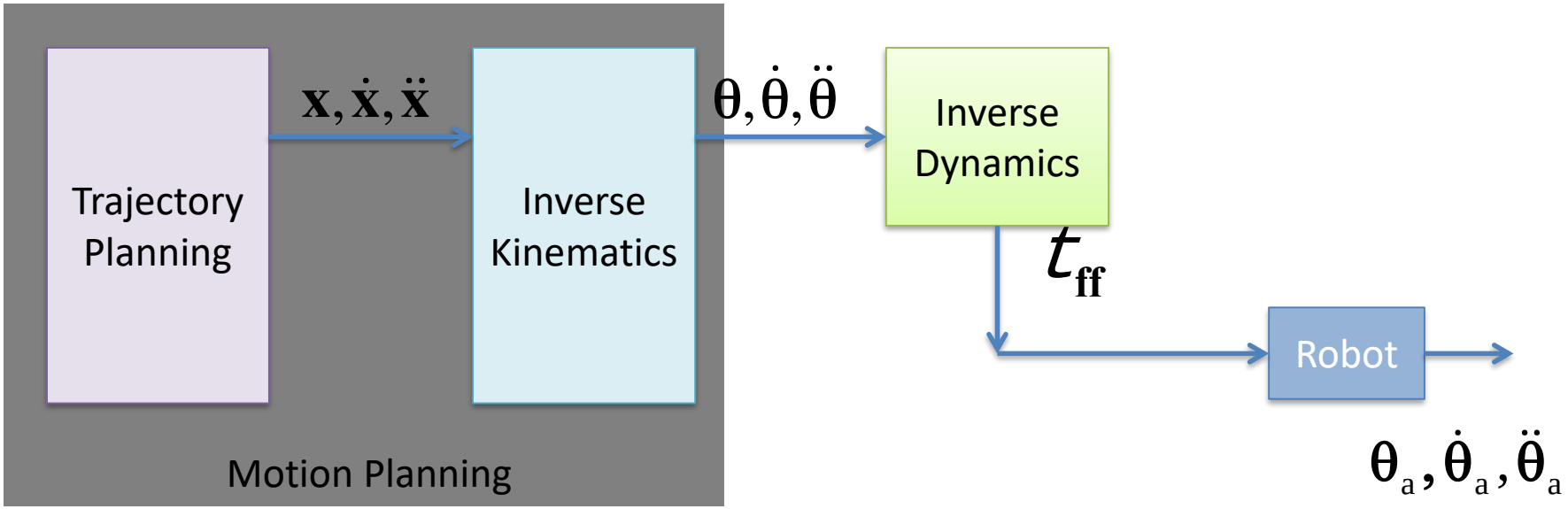
# What and How to Perceive?



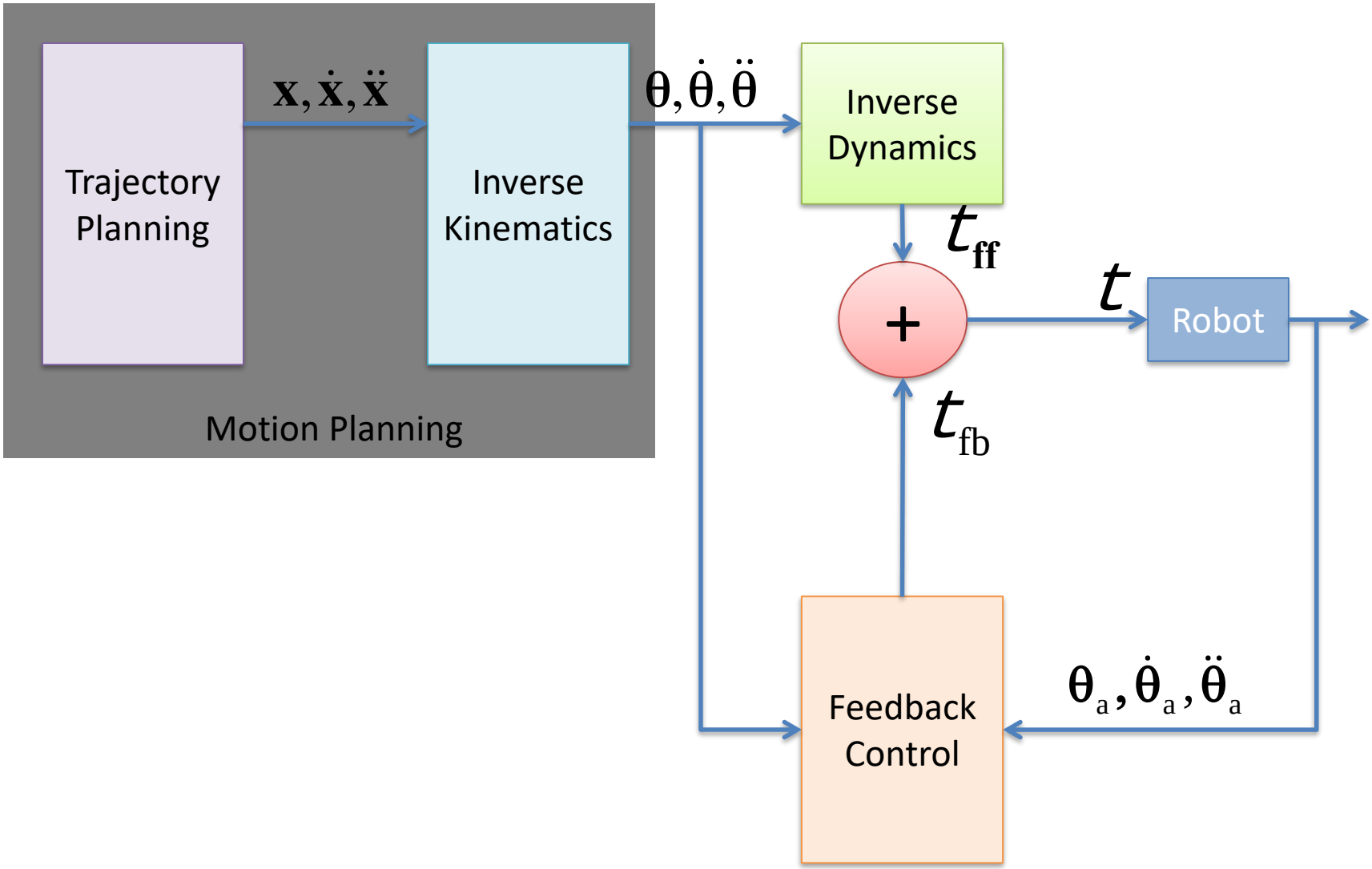
# What and How to Perceive?

**Feedback on Joint Positions**



# What and How to Perceive?

## Feedback on Joint Positions



# What and How to Perceive?

## Sensors in the Hand

Vision:

- Monocular cameras
- Stereo camera: Bumblebee

www.lhup.edu/

Resolution: 648x488
Frequency: 48 FPS

# What and How to Perceive?

## Sensors in the Head

Vision:

- Monocular cameras
- Stereo camera: Bumblebee
- RGBD camera

Infrared for depth information

Resolution: 640x480
Frequency: 60 Hz