Drones and Autonomous Systems Laboratory

Ball balancing on the beam class 4

-Final Project

DONGBIN KIM –

Ph.D. Candidate

Mechanical Engineering,
University of Nevada, Las Vegas

1. Introduction – Final Project

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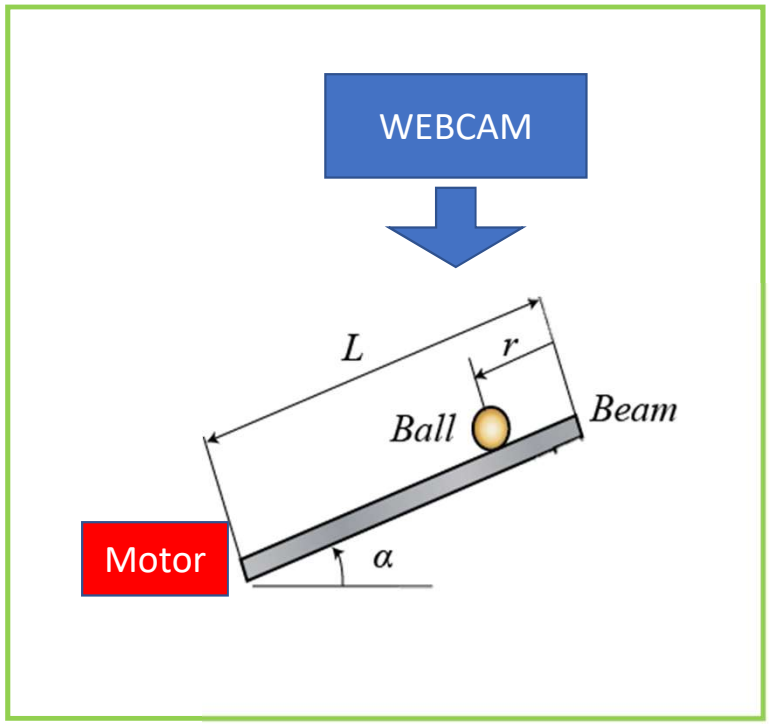

Final Project

1. Hardware selection : Camera, Motor, and Beam
2. Computer Simulation via MATLAB with integrated information of motors and beam
3. Chose the language : C++ or Python
4. Select control loop frequency
5. Make your own **ball and beam system**

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1. Introduction – example

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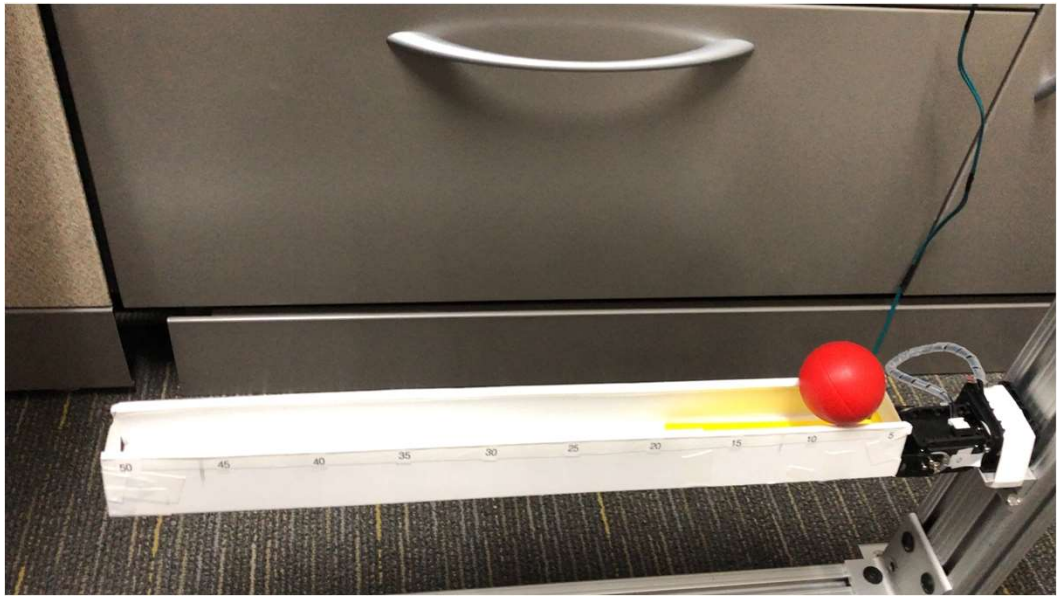

(Test Video)

Project Example

1. Hardware selection :
   Dynamixel MX-28, Sony playstation camera, foam board
2. Chose the language : Python, ROS
3. PID Feedback Control.
4. 100Hz Control loop

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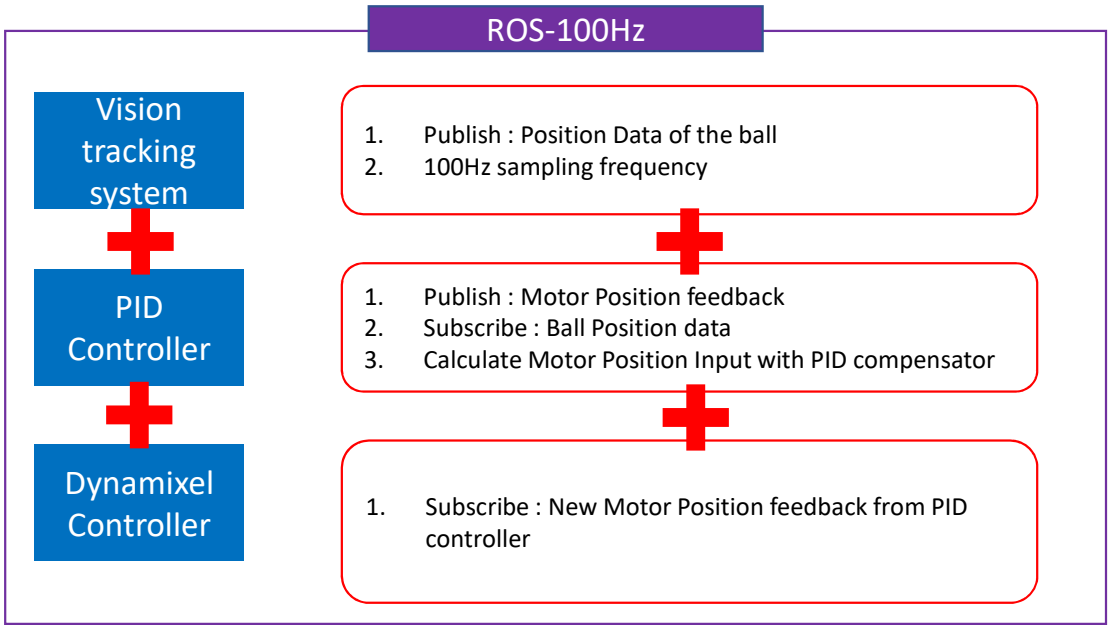

(Control system scheme)

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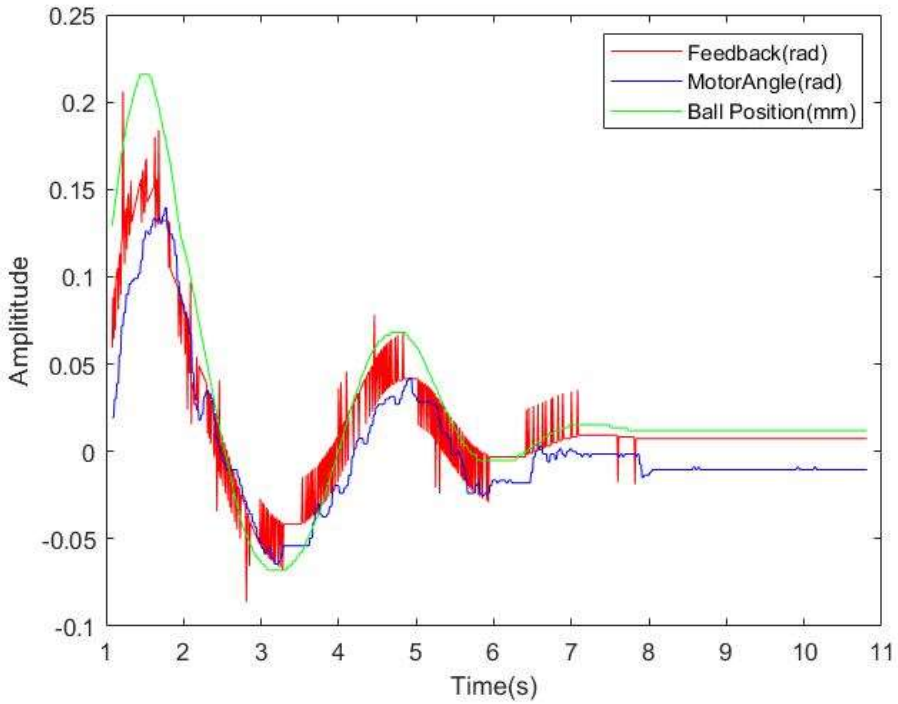

(Results)

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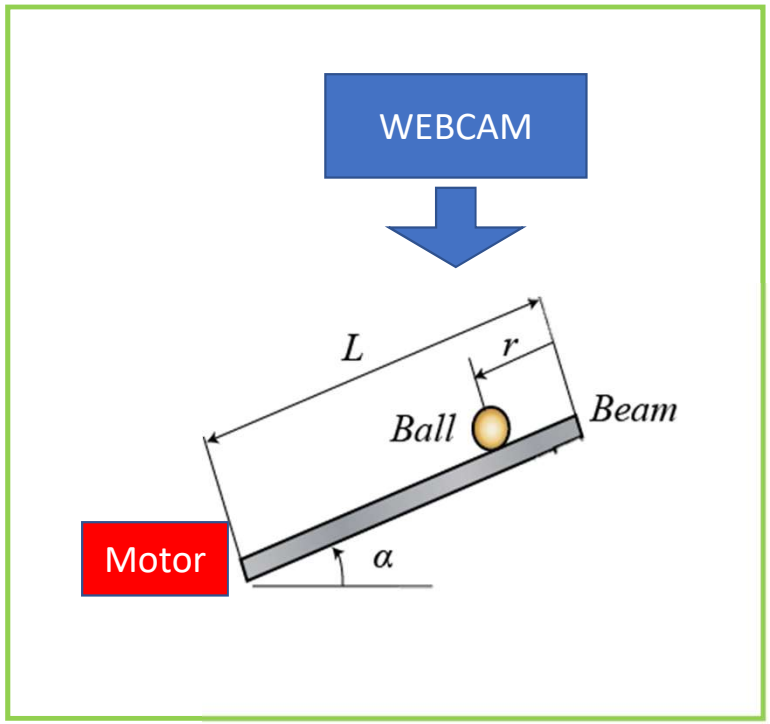

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2. Hardware Selection – Camera

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Camera Selection

- Every USB Camera has different frame rate (30Hz ~)
- Different resolution
- Some camera product has own Software Developer's Kit (SDK)
- Compatible to your computer environment

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2. Hardware Selection – Motors

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(Robotis Dynamixel)

(DC-Motors)

(Step Motors)

Motor Selection

- Every motor requires different approach to control, and connect to the computer environment
- Robotis Dynamixel : Provides velocity, position, and torque control. But latency exists
- DC-Motors : Velocity control by voltage input. Easy and portable
- Step-Motors : Pulse-Width-Modulation(PWM) Control, Position, Velocity control.

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2. Hardware Selection – Beams

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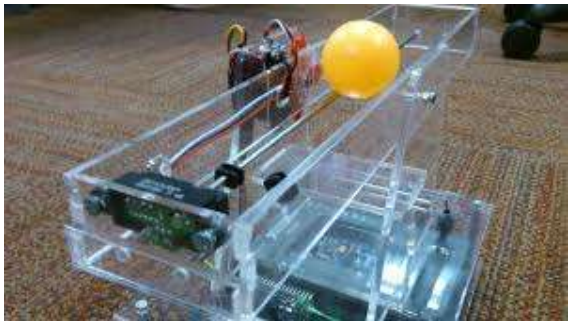
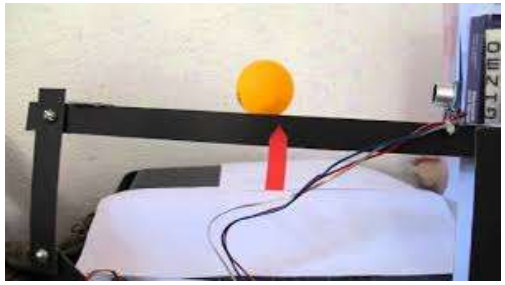
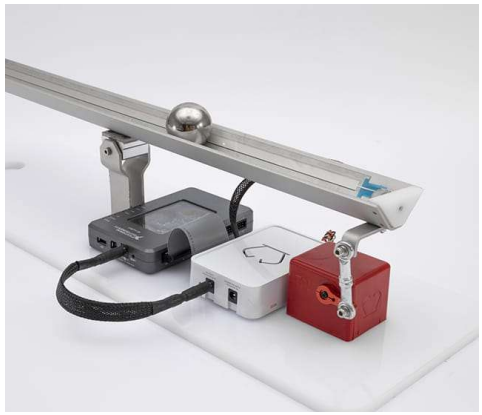


(Acrylic Beam)



(Paper Beam)



(Steel Beam)

Beams Selection

- You can choose any types of materials to build the beam
- Acrylic
- Steel
- Foam board
- Paper
- Robust enough not to break by the motor torque

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3. Language Selection – ROS

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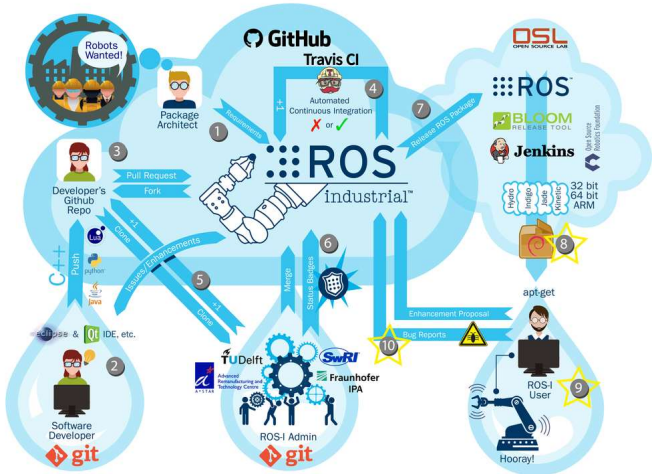

Language Selection

- ROS : Robot Operating Systems
- Languages : C++ and Python (2.7 only, no 3.x version)
- Choose the language that you feel comfortable with.
- ROS Tutorials should have been done.

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4. Control Loop Scheme

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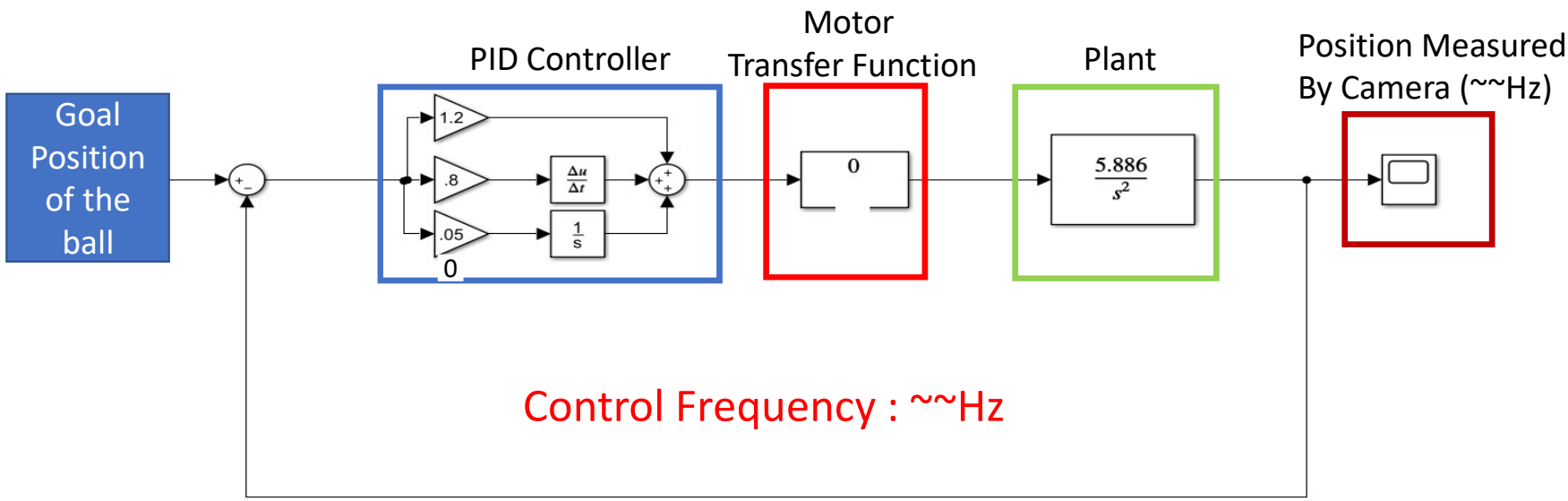

Control Loop Scheme

- PID Control, Motor transfer function, Plant is in the loop
- Sampling frequency, control frequency should be defined

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5. Homework

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Final Project

1. With given hardware, build your own ball and beam systems
2. Identify sampling rate, control frequency
3. Submit the simulation result via MATLAB (Equation of motions, Transfer Functions of the system, Motor transfer function, Units)
4. Submit experimental results, videos

DASL
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