California State University, Chico

College of Engineering, Computer Science, and Construction Management

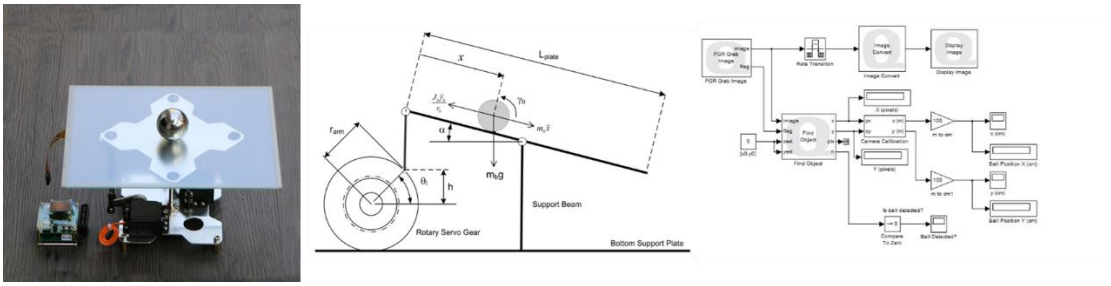
MECA 482 – Control System Design

Control System Design of Ball and Plate

The description of the project:

The ball and plate system consists of a plate which can be tilted by two servo motors or electric motors in two different angular orientations together with a ball rolling around on top of the plate. It is a known textbook example for testing different control [1] or artificial intelligence algorithms [2]. The project team's goal is developing a comprehensive solution explained more details in the deliverables section to control the ball's position (or velocity or acceleration) on the plate.

Sample High-Level Architecture:



Sample Ball and Plate System [3]

Deliverables:

- The team is expected to present their project (~ 5 mins) and build a web page which contains all deliverables in GitHub;
- The mathematical model of the system must be delivered using MATLAB/ Simulink;
- The team must show that the control algorithm facilitates the design requirements for ball and plate system;
- The system's simulation with the control system and mathematical model by connecting Coppelia Sim to MATLAB/ Simulink;
- Testing the algorithms on the physical system provided for the class;

Team and Plan:

- The team can use their cap-stone projects for MECA 482 – Control System Design class.

The team will consist minimum 3 students and maximum 5 students.

Notes:

1- Sample Simulink code of Ball and Plate [3]
2- Sample Control System Design Tutorials from University of Michigan, Ann Arbor [4]
3- Sample projects to interface Python and VREP [5] and sample video to interface MATLAB and VREP [6]

References:

[1] Subramanian, Raaja Ganapathy, et al. "Uniform ultimate bounded robust model reference adaptive PID control scheme for visual servoing." *Journal of the Franklin Institute* 354.4 (2017): 1741-1758.

[2] Muratore, Fabio, Michael Gienger, and Jan Peters. "Assessing Transferability from Simulation to Reality for Reinforcement Learning." *IEEE transactions on pattern analysis and machine intelligence* (2019).

[3] Retrieved from Internet, Feb 17, 2020, https://www.quanser.com/products/2-dof-ball-balancer/

[4] Retrieved from Internet, Jan 28, 2020, http://ctms.engin.umich.edu/CTMS/index.php?aux=Home

[5] Kildare, R., Hansen E., Leon, E., PID Control of Furuta Pendulum, Control System Design Project Fall 2019

[6] Pick and place application with Kuka KR16 Robot Using V-Rep, Retrieved from Internet, Jan 28, 2020 https://www.youtube.com/watch?v=CVoV08T0Aqo