Shrini's Crew

Camera platform stability for use in UAV remote sensing

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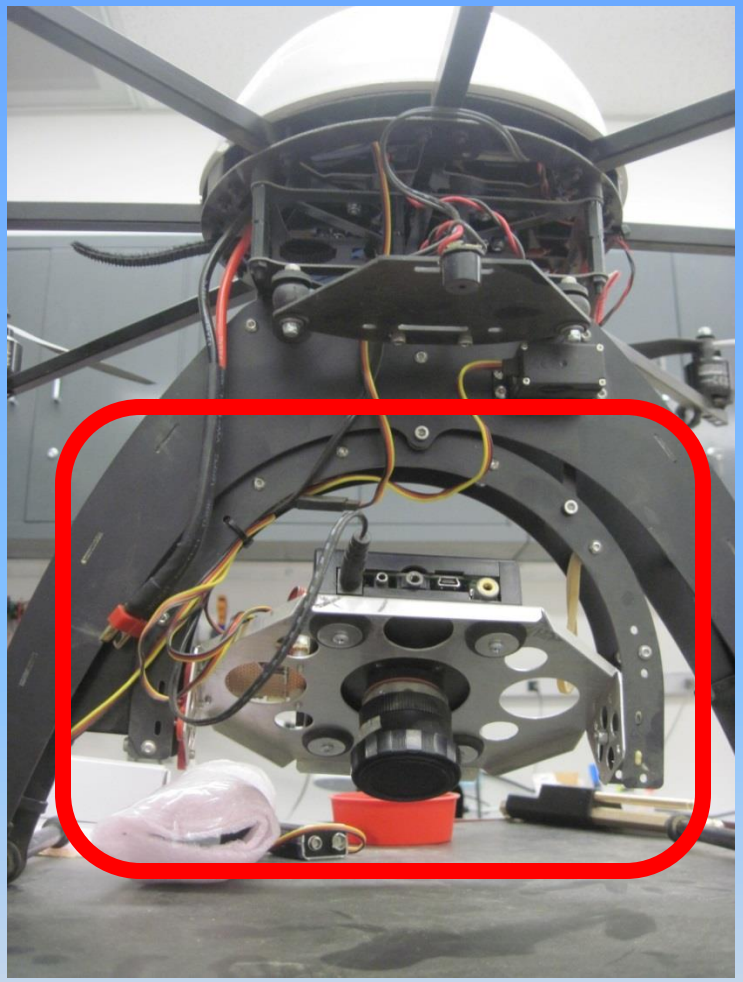
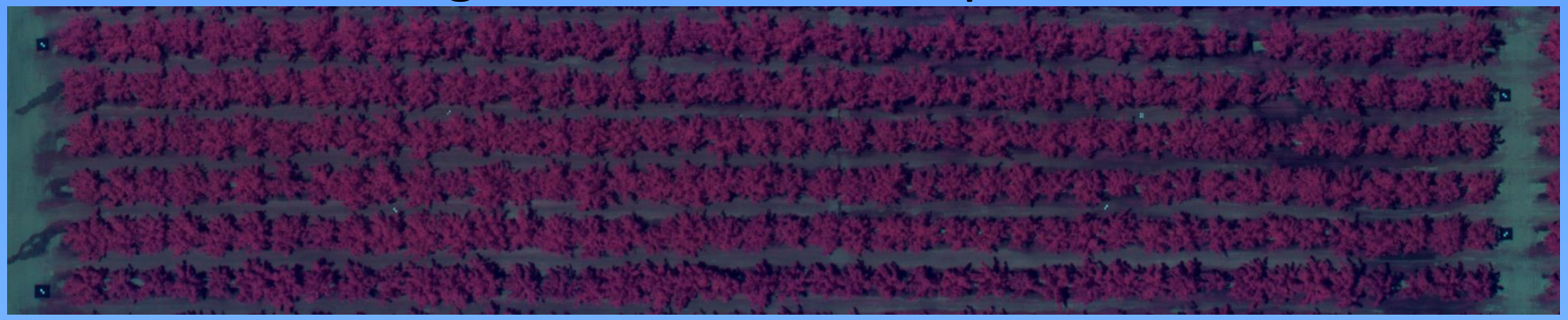
Camera Platform

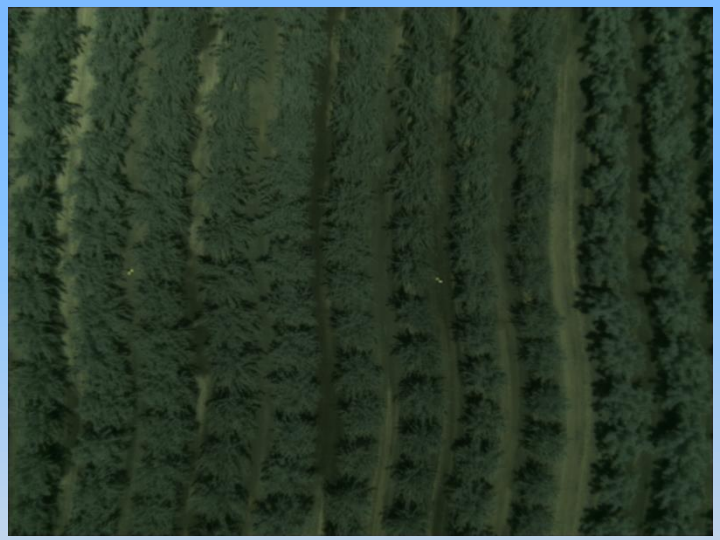


Primary goal of this project is to determine what is causing the distortion in image data that is captured during flight.

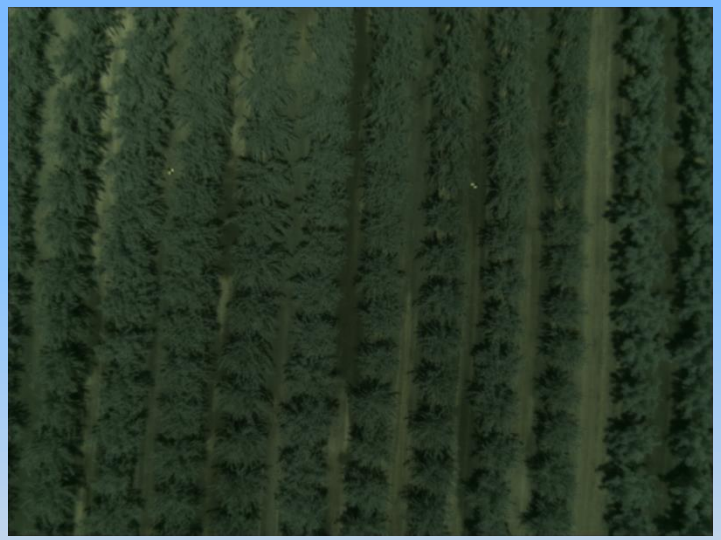
Automated Image Processing
Agricultural Data Acquisition



Mosaic image using image processing software.
Microsoft Research Image Composite Editor (ICE)



Distorted image



Normal image

Approach

Analyze hardware and software

Model the system dynamics

Identify possible root causes of problems

Acquire data to verify and quantify problems

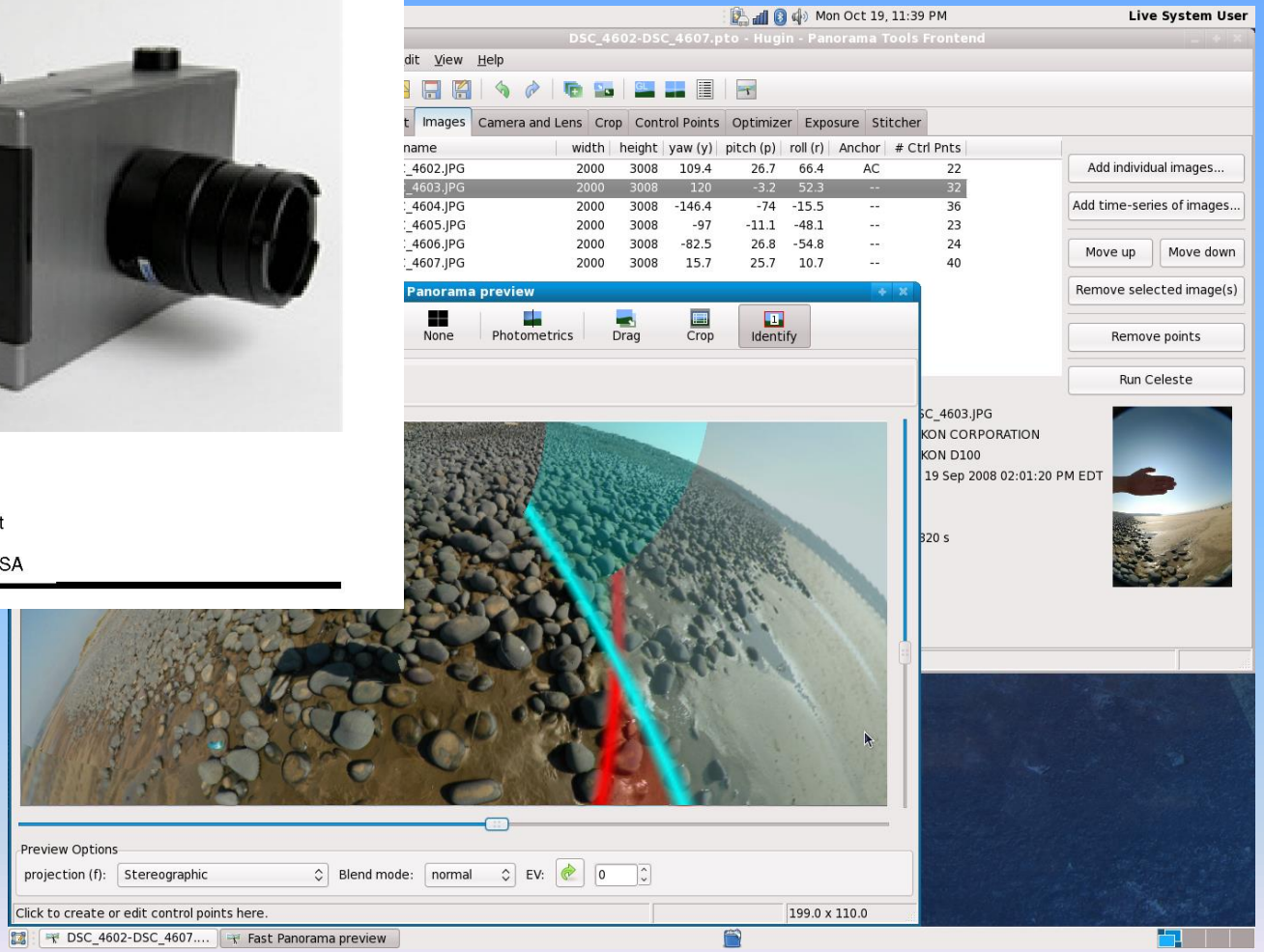
- Develop tests procedures
- For real-time data

Develop and implement system solutions

Evaluate results

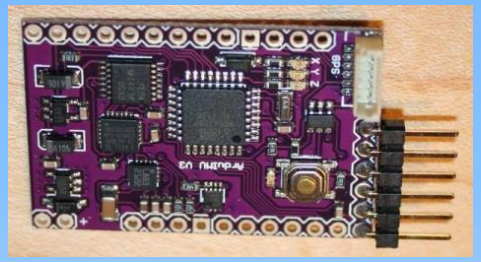
Imaging/Camera Systems

Analysis of Problems and Possible Root Causes



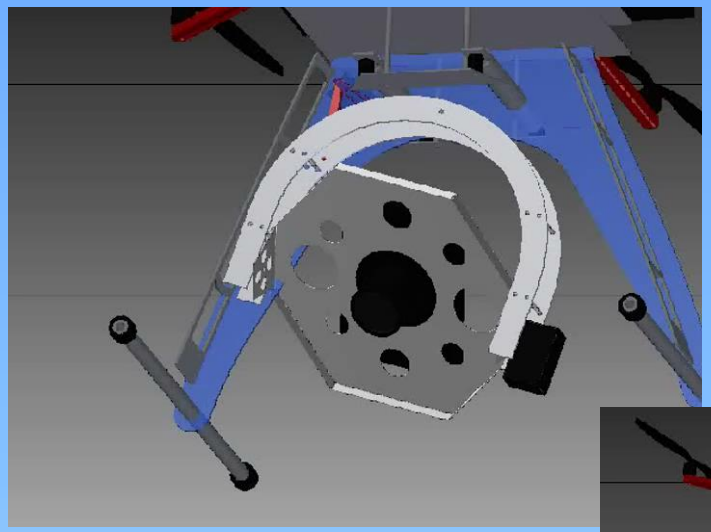
Hardware

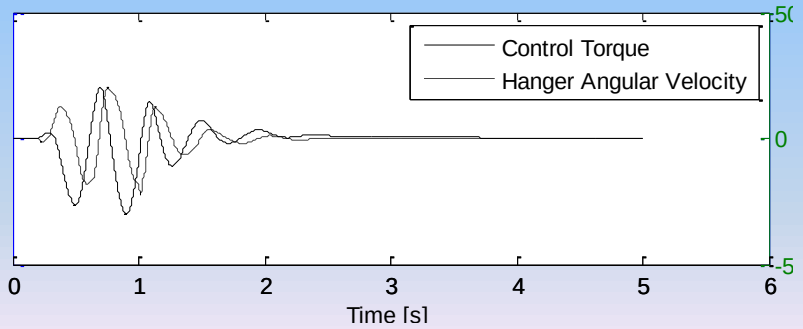
- Controller
- Sensors
- Servos
- Camera
- Mechanical Systems



System Dynamics

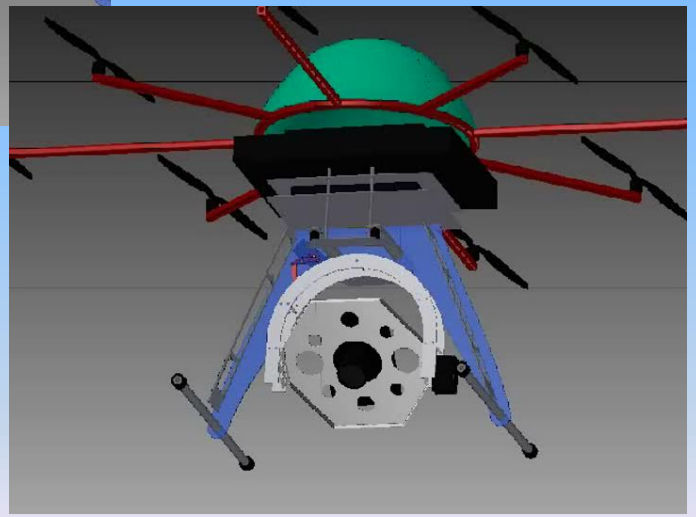
- Modeling





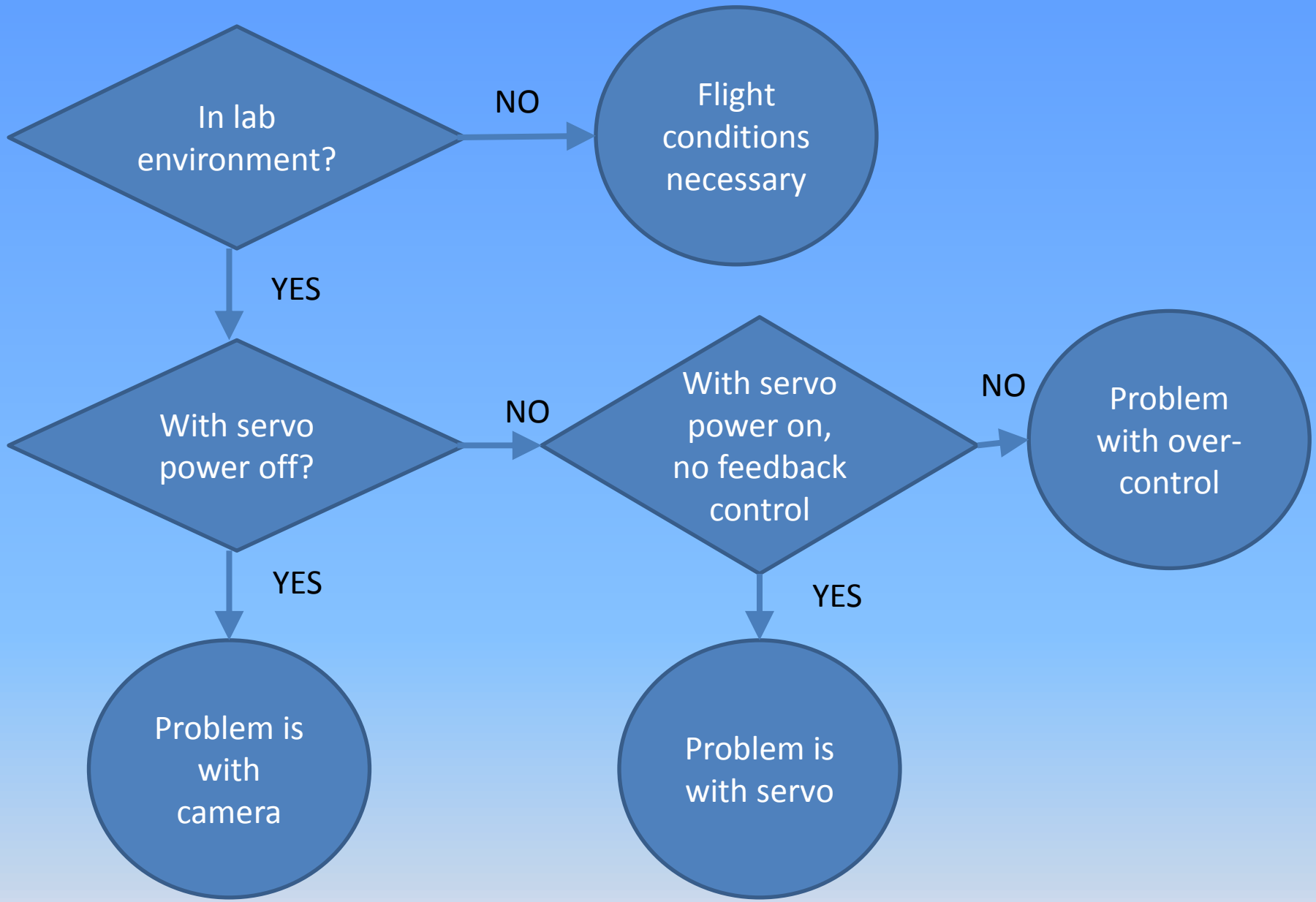
Software

- Controller Code
- Camera Configuration
- Composite Imaging



Possible sources of distortion

- Camera
- Flight conditions too dynamic
- Feedback control
  - Mechanical
    - Soft bushings
    - Long moment arm for roll servo
    - servo twitch
  - Software
    - Control code is faulty (can’t keep up, wrong parameters, need derivative term, etc.)


In lab environment?
NO
Flight conditions necessary
YES
With servo power off?
NO
With servo power on, no feedback control
NO
Problem with over-control
YES
YES
Problem is with camera
Problem is with servo

Experimental Findings

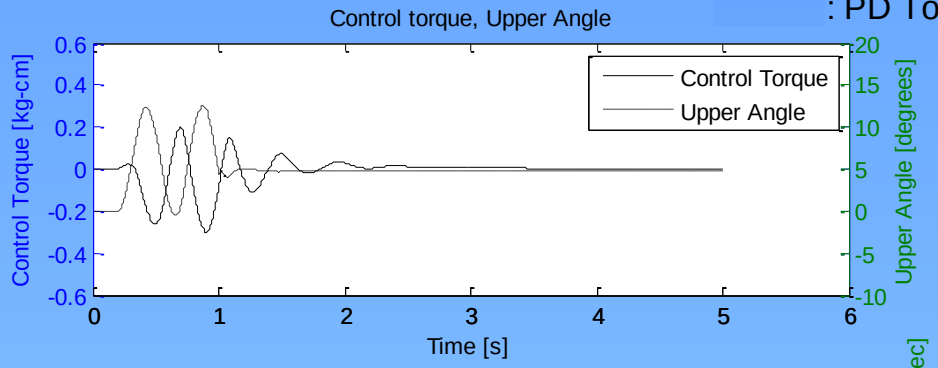
- Control loop timing
- Camera capture command placed inside loop
  - Hardware Cable Constructed to Trigger Camera
  - Developed software to coordinate acceleration data with picture numbers for ICE analysis
  - No longer have distorted images!
  - Not sure why yet, investigation of possible root causes is necessary.
    - The command signal now sequential in time relative to the stabilization control.

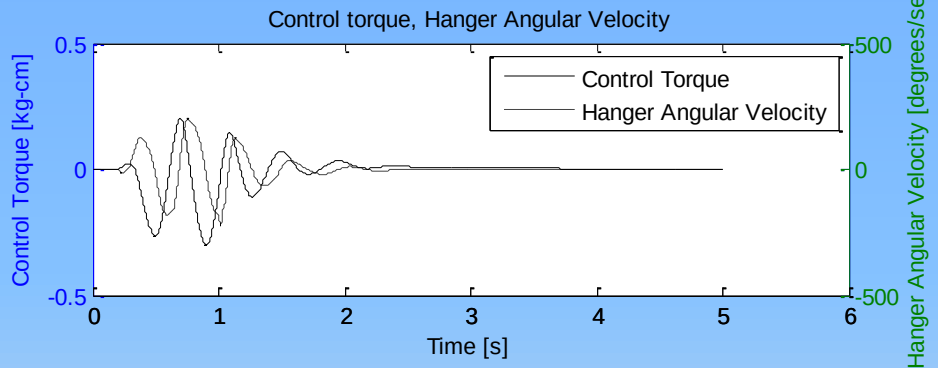
System Modeling

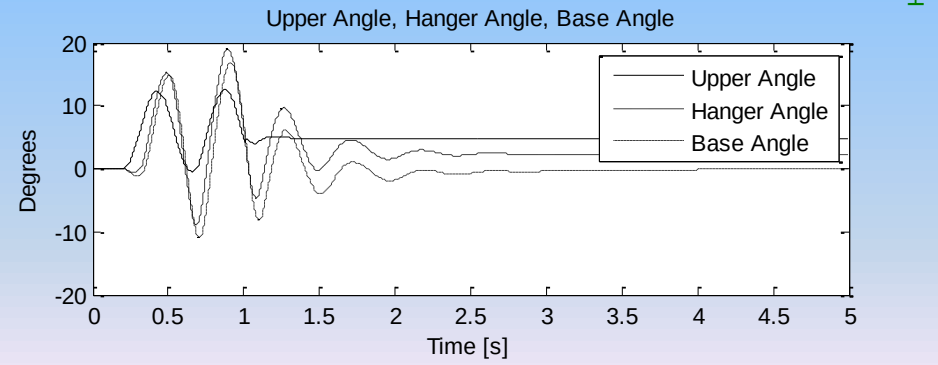
- Model the system to aid in understanding the effects of tuning system design parameters on the quality of the camera stabilization control.

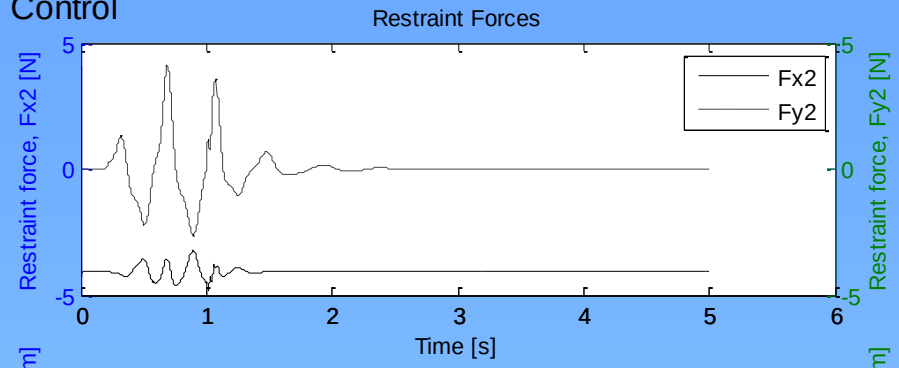
System Modeling

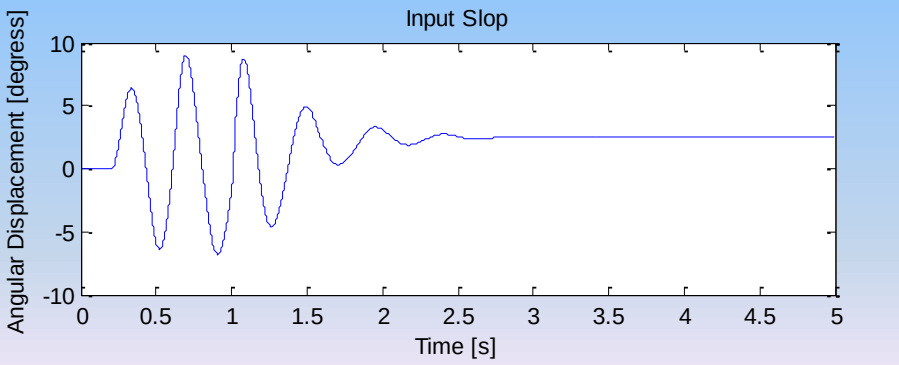
: PD Torque Control





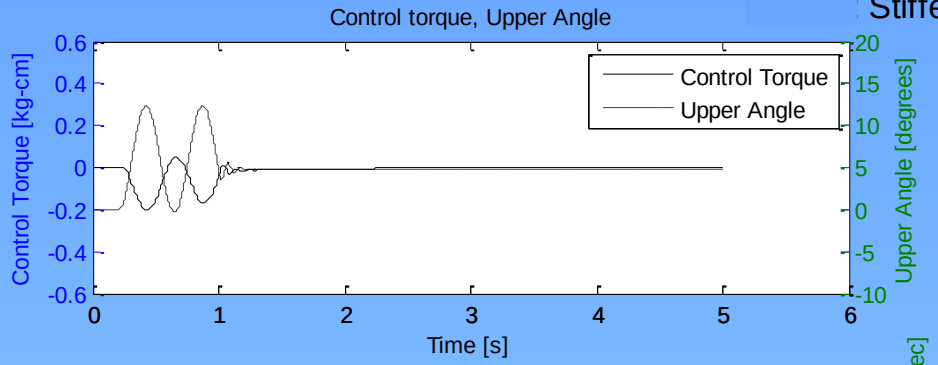


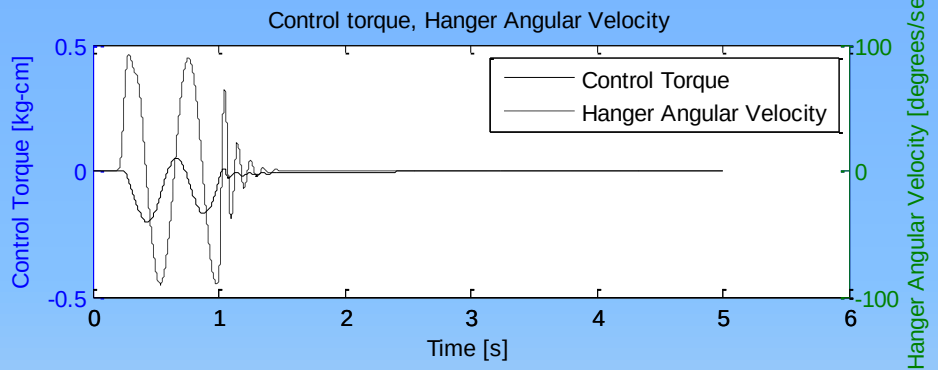


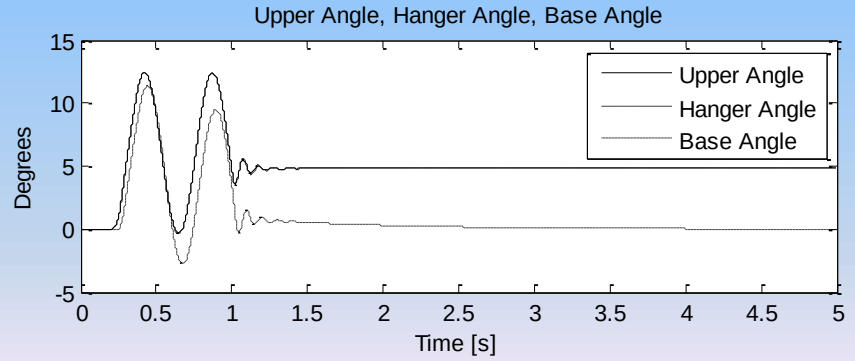


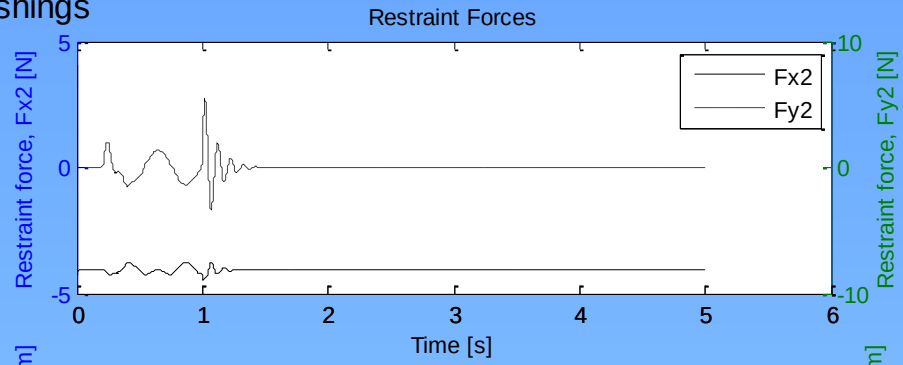
System Modeling

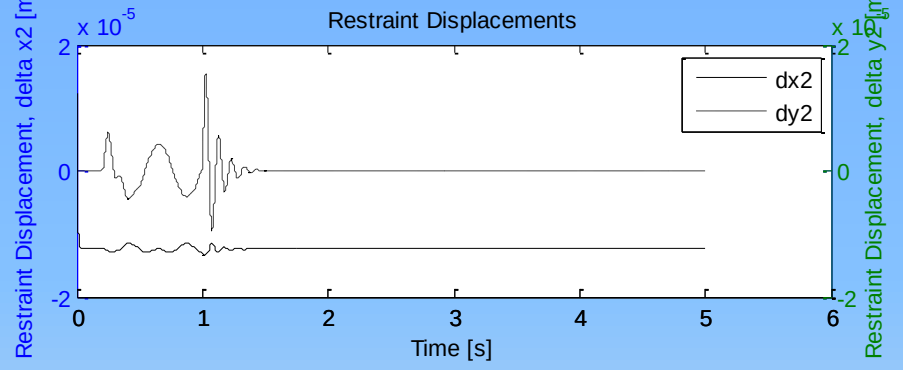
Stiffer bushings

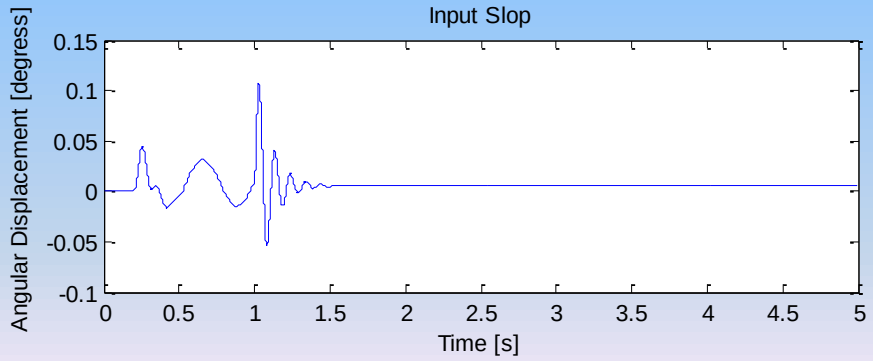












Conclusions thus far…

- Control algorithm directly impacts the image quality
  - Code iteration rate
  - Camera acquisition control
- System optimization - bushings
  - ~ 3 times faster
    - 1.5s down to 0.5s
- Overall project objective has evolved based on results

Questions?