Experiment Problem Set Four through Seven

Prior to all experiments: check your battery voltage! Charge if necessary.

Experiment 4. Determining stable Kp for V1 control
Due Wednesday, April 17, 2013

Set up an experiment with V1_REF at 0.3 m/sec, 5 seconds, PID control.

Set KP to 1.0 and KI=KD=0.

Open the System Identification tab and check V1/Yaw (which should bring up the V1 and V1_Ref traces).

Press the compute button and record rise time, settling time, overshoot, and steady state error.

Vary KP until the system becomes unstable (pick large steps in KP). Record rise time, settling time, overshoot, and steady state error for each value of KP.

NOTE: look for the KP where the system JUST becomes unstable. For instance, a gain of 100 will yield instability, but so will a gain of 50.

Plot rise time, settling time, overshoot, and steady state error versus KP. When overshoot begins, the system has crossed from over-damped to under-damped. Demark both the instability point and the under-damped point on your graph.

Look at your graphs and see if there is a point where increasing KP has little effect on some parameters. Where is this point? Explain.

Based on these graphs, pick a KP that you consider is the "best" value.

Write a brief report summarizing your observations.

Experiment 5. Determining stable Ki for V1 control
Due Monday, April 22, 2013

Set up an experiment with V1_REF at 0.3 m/sec, 5 seconds, PID control. Set KP to the value determined in experiment 4.

Set Ki to 1.0 and KD=0. (Note: this may be close to instability for Ki, especially depending on your value for Kp.

Vary Ki until the system becomes unstable. Record rise time, settling time, and overshoot for each value of Ki.

NOTE: look for the Ki where the system JUST becomes unstable. For instance, a gain of 100 will yield instability, but so will a gain of 50.

NOTE: steady state error will be zero for just about any value of Ki (although you may have to wait for a while on particularly small values of Ki). However, when stability begins to occur, the system won't settle and steady state error will become non-zero. This may be a good place to look when trying to evaluate stability.

Plot rise time, settling time, and overshoot versus Ki.

Look at your graphs and see if there is a point where increasing Ki has little effect on some parameters. Where is this point? Explain.

Fill in some points around the significant points in your graphs. Use this data to assist in selecting Ki.

Is the system's behavior ever over-damped?

Write a brief report summarizing your findings.

Experiment 6. Determining Kd for V1 control
Due Monday, April 29, 2013

Set up an experiment with V1_REF at 0.3 m/sec, 5 seconds, PID control.

Set Kp and Ki based on your previous experiments.

Set Kd to 1.0.

Assuming Kd = 1.0 isn't unstable, increase Kd until you find the instability point.

Take several values of Kd that are less than the instability point and plot steady state error, overshoot, rise time, and settling time.

You may see very little effect of Kd on these parameters; however, if you do, determine a good value of Kd and pick this for the remaining experiments.

Write a brief report summarizing your findings.

NOTE: these values of Kp, Ki, Kd will be used for the closed loop system identification experiment.