MCHE 470: Robotics

Fall 2013 - Mini-Project 3b

Assigned: Thursday, October 16th
Due: Friday, November 8th, 5pm

Grading: This assignment is worth 8 points. (Mini-Project 3 is worth 10 total.)

Assignment Introduction:

In class, we have seen that input shaping can be used to reduce oscillation. In this mini-project, you will document the benefits of input shaping and do a qualitative comparison between shaped and unshaped point-to-point moves. We will also address how input shaping is affected by variations in move distance and system frequency.

Using the scale bridge crane in the ***C.R.A.W.LAB***, you will modify several parameters and then hold a move button so that the crane executes the desired velocity profile. You will use input shaping principles to create point-to-point moves for both unshaped and shaped commands. Figure 1 shows what the crane will be doing. Holding down a button will generate a step input. This is then convolved with the impulse sequence that you will design and input into a parameter set called "No Shaper Stop". This results in a pulse in velocity command; however, due to the inertia of the crane and motor limitations, the actual velocity profile is trapezoidal. Note that the negative impulse at t_f is used to bring the crane to a stop despite holding down the move button. Modifying t_f changes the length of the velocity profile and therefore the total move distance. Figure 2 shows the same idea, but using a ZV input shaper. Note that the last two impulses are like the first two except but are negative in amplitude.

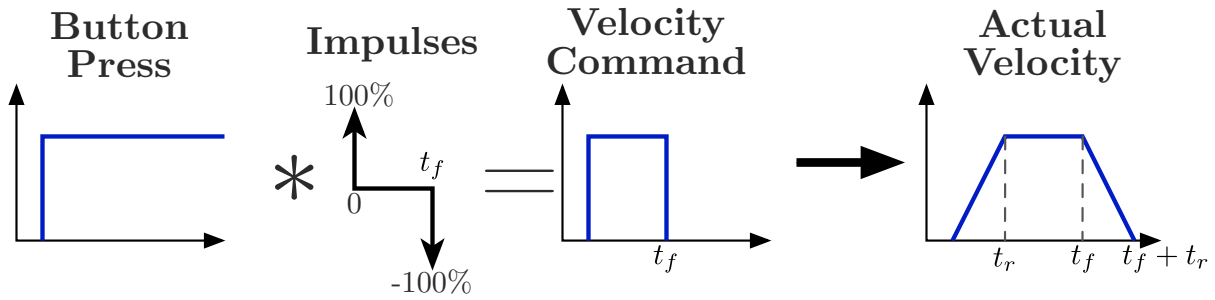

Figure 1: Convolution Using "No Shaper Stop"

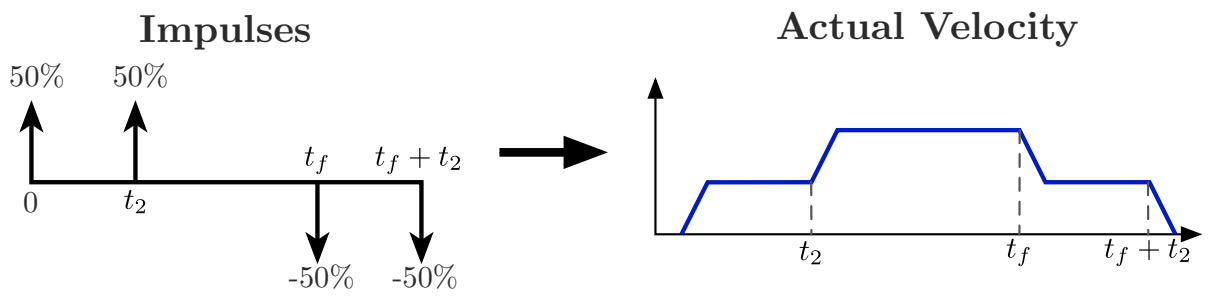

Figure 2: Convolution Using "ZV Shaper Stop"

Mini-Project Tasks:

Schedule a time to visit the ***C.R.A.W.LAB*** using the link below.

http://vaughan.youcanbook.me

Part 1 - Variation in move distance:

a. Move the crane using "No Shaper Stop" with 100% speed and t_f = 700ms, 1100 ms, and 1600ms. Use 0.8m cable length.
b. Repeat step 1 using **one** ZV shaper of your own design that you think will best minimize the amplitude of residual oscillation.

Part 2 - Variation in system frequency:

a. Move the crane using "No Shaper Stop" with 100% speed and t_f = 1500ms. Do this for cable lengths of 0.7 m, 1.0 m, and 1.3 m**.**
b. Repeat step 1 using **one** ZV shaper of your own design that you think will best minimize the amplitude of residual oscillation for **all** cable lengths.
c. Repeat step 1 using **one** non-ZV shaper (like the ZVD you learned about in lecture) of your own design that you think will best minimize the residual oscillation for **all** cable lengths.

Procedure:

Figure 3 shows the shaper design interface of the GUI.

1. Use the "No Shaper Stop" and any of the five "Custom Shapers" available in the drop down menu (A).
2. Click "**Show**" (B) to display the shaper.
3. Modify the number of impulses using (D).
4. Use (E) and (F) to modify the impulse amplitudes and times. The first impulse should occur at time = 0. To bring the crane to a stop, the last n impulses should mirror the first n impulses, but with negative amplitudes.

5. The graphical representation will reflect the shaper that you have designed. When you are ready, click "**Save**" (C).
6. Return to the main window and select your designed shaper from the drop down box.

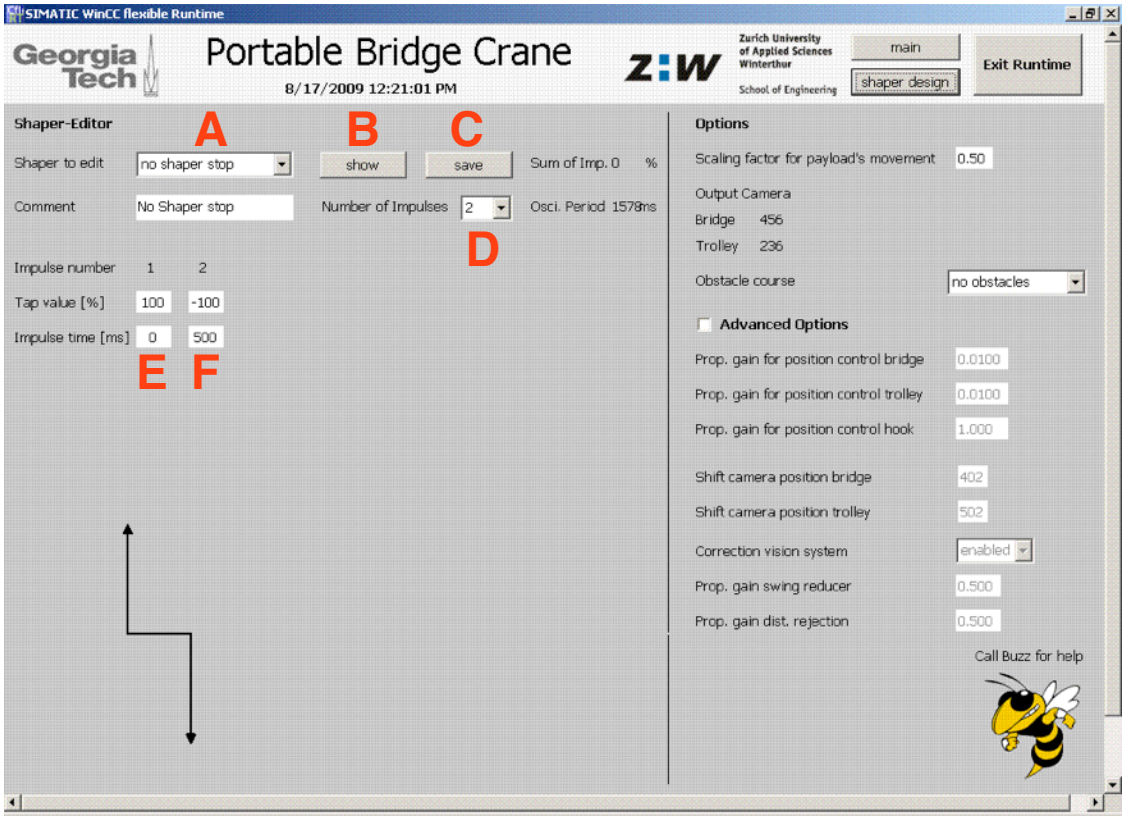

Figure 3: Shaper Design Interface

Deliverable: A *very* short (less than 2 pages of text, figures and plots excluded) report detailing your process and conclusions. It should include discussion covering:

Part 1:
Compare the residual oscillation excited by unshaped and ZV-shaped commands for all distances. Explain any trends in the data and make reasonable conclusions. You must justify and explain your design for the ZV shaper. Include appropriate and relevant plots.

Part 2:
Compare the residual oscillation excited by unshaped and ZV-shaped commands for all cable lengths. Explain any trends in the data and make

reasonable conclusions. You must justify and explain your selection and design of the ZV and ZVD shaper. Include appropriate and relevant plots.

Submission: Hard copy to me or slid under my office door (Rougeou 225)

OR

Emailed pdf:

- to joshua.vaughan@louisiana.edu
- with email subject line and filename `TeamX-MCHE470-Proj3`