Development of a Control System and User Interface for the Quanser Shake Table II

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Introduction

- Shake tables are often used to simulate earthquakes to test the performance of structures under seismic loads. This research focused on implementing the Quanser Shake Table II—a valuable tool for conducting small-scale experimental vibration tests.
- The original hardware and software system has, at best, 12 bits of resolution. However, using the NI compactRIO with LabVIEW, 16 bits of resolution can be achieved. Therefore, using compactRIO and LabVIEW to control the shake table can produce better results for vibration testing compared to the original configuration.
- Without a controller, it would be more difficult to predict how a system responds. Introducing a closed-loop control system allows the user to better predict the shake table response by moving the shake table in the way the user desires.

Goals

- Simulate displacement-based control system in MATLAB.
- Implement a working control system on the actual shake table.
- Further develop the user interface of the LabVIEW program that allows the user to set the motion of the shake table, such that users can easily input a sine wave, random excitation, or even upload their own input file.
- Enhance programming skills by participating in LabVIEW workshop training and CLAD exam.

Importance of the Closed-Loop System

- Allows the system to produce the desired user output

Rise Time, Overshoot, Settling Time and Steady-State Error*

Development of a Graphical User Interface (GUI) in NI LabVIEW

- The GUI makes it easy for a user to input a file and for a corresponding voltage signal to be produced.

Implementation and Results

- With the implementation of a PID controller, the shake table can now move according to the user’s input without the stage unexpectedly drifting.

Future work

- Modify the user interface of the main LabVIEW program that handles both the user input and control parameters for the shake table, so that users can intuitively work with it.

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<tr>
<th>Rise Time</th>
<th>Overshoot</th>
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<th>S-S Error</th>
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<tbody>
<tr>
<td>Kp Decrease</td>
<td>Increase</td>
<td>Small Change</td>
<td>Decrease</td>
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<tr>
<td>Ki Decrease</td>
<td>Increase</td>
<td>Increase</td>
<td>Eliminate</td>
</tr>
<tr>
<td>Kd Small Change</td>
<td>Decrease</td>
<td>Decrease</td>
<td>No Change</td>
</tr>
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Effects of PID gains on system response

* Source: MATLAB & Simulink Control Tutorials
  http://www.mathworks.com/help/getstart/control-system.html