Massachusetts Institute of Technology

Robotics: Science and Systems I
HP 1662AS Logic Analyzer/Oscilloscope Overview

Introduction

The oscilloscopes used in RSS are the HP/Agilent 1662AS. Those of you who have taken 6.002 or have previous experience with scopes likely used an analog scope, or at least one with a knob for most functions. Our scopes are digital, using menus instead of dedicated knobs. For example, instead of twisting a knob to change the sec/div, you have to navigate to a menu, select sec/div, and then twist the single knob on the front. To select an option, scroll over it using the arrow keys to the left of the screen and press the 'Select' button. The item that will be selected is highlighted in white, while the currently selected option is shown in grey. When you select an item, one of two things will happen. Either a menu will pop up that you can scroll through to select the option you want, or a little dial icon (side-profile) will appear, at which point twisting the knob will change the value. The scope is controlled via seven menus, described below.

- System

- Scope Channel

- Scope Display

- Scope Trigger

- Scope Marker

- Scope Auto-Measure

- Scope Calibration

System

To use the scope, we have to select the 'Scope' option from the system menu. The system menu is always in the top left corner and presents three options:

- System - control the ports and hardware setup for the scope

- Analyzer - logic analyzer used for debugging digital circuits

- Scope - oscilloscope functionality (this is what we're looking for)

Scope Channel

The scope channel menu allows you to change the measurement settings for the scope channels. 'Volts/div' controls the scale of the y-axis and 's/div' controls the scale of the x-axis. The properties listed below can be changed only one channel at a time, so you have to select the channel using the 'Input' option (C1 or C2).

- **Volts/div** controls the displayed amplitude of the measured signal. For example, if there are six voltage divisions (three positive and three negative, centered around 0) and you have a signal that is 24V peak-to-peak (-12V to +12V), then 'volts/div' must be at least 4V/div in order to see the whole signal. Our scopes display three divisions above and below the offset voltage.

- **Offset** sets the offset voltage for the scope. The offset changes where the voltage measurement is centered. Using the example above, if our signal is 24V peak-to-peak, but ranges from 0V to +24V, then we would need to put the offset at +12V in order to view the signal.

- **s/div** controls the visible time scale of the measured signal. If our signal described above has a period of 128ms peak-to-peak and our scope has eight time divisions, then s/div would need to be at least 16ms/div. With a setting of less than 16ms/div, say 12ms/div, we wouldn't see the whole signal. With a value greater than 16ms/div, say 32ms/div, we would see two periods of the signal (in general this is what you want, but if you go too far, then you might miss some of the details).

Scope Display

The display menu allows you to change the way the input signal is shown on the the screen.

- **Mode** changes how the signal is displayed.

  - **Normal** displays the raw measured signal. What is displayed is exactly what was sampled.
  - **Average** displays the average signal across a configurable number of periods. Try this mode while viewing the PWM signal and moving the joystick around.
  - **Accumulate** displays the integral of the signal across a period.

- **Connect Dots** changes whether measurements are connected in a continuous line or displayed individually. The connected mode may be easier to read and follow.

- **Grid** toggles the grid for viewing the signal on/off. Unfortunately, the axes on this scope are not labeled (or we haven't figured out how to label them – if you do, let us know).

Scope Trigger

The trigger menu allows you to configure your own triggers. The scope includes an auto-trigger that works for most circumstances, but you are welcome to play with the different trigger settings. The options described below all correspond to the Edge trigger.

- **Mode/Arm** allows you to select the method used for triggering. There are four modes available: Edge, Pattern, Immediate, and Arming. For our purposes, we just want to use the Edge trigger (all of the others are more complex than we need, but feel free to experiment).

- **Source** controls the input channel currently being adjusted.

- **Level** allows you to adjust the voltage at which the trigger will fire.

- **Slope** changes the edge of the signal that triggers. Positive will cause the trigger to occur on the rising edge, whereas negative will cause the trigger to occur on the falling edge.

- **Count** changes the number of times the above conditions must be met before the trigger fires.

- **Auto-Trig** turns on/off the auto-trigger (leaving auto-trigger on is fine for our purposes).

Scope Marker

The scope marker menu allows you to measure both the amplitude (in volts) and period (in seconds) of the input signal.

- **VMarkers** are used to measure the amplitude of the signal. The scopes we use provide two markers, Va and Vb. Each marker can be set to any point along the y-axis. The voltage difference between the two markers is displayed on the scope. Thus, to measure the amplitude of the signal, or a piece of the signal, put Va at the bottom of the desired region and Vb at the top and read off the difference.

- **TMarkers** are used to measure the period of the signal. Unlike the VMarkers, there is only a single TMarker. The marker can be set to any value between triggers of the signal. The output shown will tell the time difference between the marker and the trigger. To measure the duration of a peak in a square wave that is triggered on the rising edge, you would shift the marker to the falling edge and read the output.

Scope Auto-Measure

The auto-measure menu displays statistics of the current signal, including the period, width of the pulses, height of the pulses, and other timing information. All you have to do is select the input, and it does the rest of the work for you!

Scope Calibration

Don't worry about this menu. The calibration for the scopes should be fine.