Lab 1: Blinking the LED

Part 1: Simulink and Arduino Installation

Objective:

For Part 1, you will check that you have installed the Arduino software and Simulink properly on your computer.

Simulink Arduino Library Installation:

- Install "Arduino Support from Matlab" package and "Arduino Support from Simulink" package from the following links

  http://www.mathworks.com/hardware-support/arduino-matlab.html

  http://www.mathworks.com/hardware-support/arduino-simulink.html

Arduino Mega 2560 Drivers' Setup:

- Connect your Arduino Mega board to the computer using the USB cable. Your computer will attempt to search for the necessary drivers online.
  - o If your computer cannot find the right drivers, you'll have to do the following:
    - Go to Device Manager and look for your Arduino Mega board (Arduino Mega 2560). Your Arduino board will be under Ports (COM & LPT). Otherwise, it may be listed as "Unidentified Device" under 'Other Devices'.
    - Right click on Arduino Mega (or "Unidentified Device") and select "Update Driver and Software"
    - Select "Browse my computer for driver software"
    - Set the location of the driver package
    - You will receive a prompt letting you know Windows cannot verify the publisher of the driver, select "Install this driver software anyway."
    - Windows will then install the necessary drivers for the Arduino Mega from this folder. A message will appear when the driver software has installed.

The Arduino drivers can also be installed from the Arduino website (www.arduino.cc).

Simulink Setup:

In order to ensure that your computer can properly communicate with the Arduino board, please build and run the following Simulink diagram using the steps below:

1) Open MATLAB then open a new Simulink model.
2) Find and assemble the required blocks.
   - Pulse Generator is under View->Library Browser-> Simulink->Sources
   - Digital Output is under View->Library Browser-> Simulink Support Package for Arduino Hardware->Common
3) Change the output pin to 13, which is connected to the onboard LED. This is done by double clicking on the Digital Output block.
4) Double click on the Pulse Generator to change the amplitude to 1, the Period to 10, and the pulse width to 50%.
5) Right click on the background and select 'Model Configuration Parameters' go to 'Solver' on the right hand menu and type 'inf' into the 'Stop time' spot so that the model will keep running. Make sure the solver options are set to "Fixed-step" and "discrete (no continuous states)".   The "Fixed-step size" should be 0.05. This is how fast in seconds the control loop will execute. In this case every 50 milliseconds it will execute the Simulink code. Go to 'Hardware Implemention' and set "Set host COM post" to be manually and set the COM port number. (For mac user, type 'ls /dev/cu.usb*' at the terminal to find out COM port number)
6) Under the tools menu go to 'Run on Target Hardware' and click 'Prepare to Run'. In the window that pops up you will need to select Arduino Mega 2560 in the drop down for Target Hardware.
7) Click "Deploy to Hardware" icon.

At this point the on board LED connected to pin 13 should start blinking on and off. If not, check the debugging section below.

Debugging
- If an error occurs indicating that there is no driver, follow the directions on the screen.
- If MATLAB cannot find the board find COM port number from the device manager and in 'Configuration Parameters' set the port manually to the correct number.
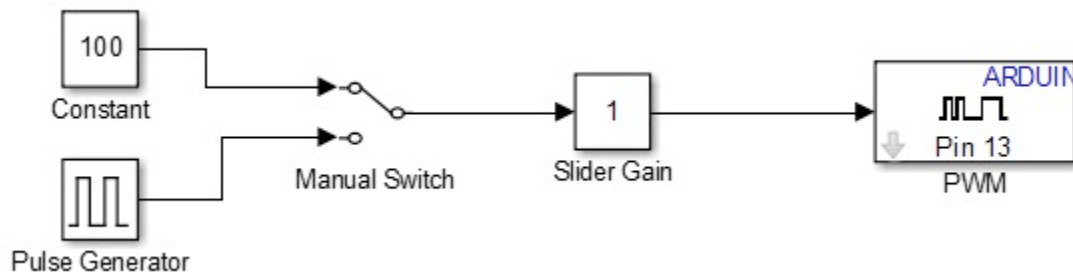- Some errors appear on the MATLAB workspace screen - if something is not working, check here.

Part 2: External Mode, PWM, Manual Switches and Slider Gain

Objective

For Part 2, improve the diagram from part 1 to give the user the ability to change the parameters involved in blinking the LED.

Procedure

Modify your Simulink diagram to the following

- Pin 13 can also be set as a PWM instead of just an on/off digital output – replace the Digital Output block with the PWM block
- The "Slider Gain" can be found in View->Library Browser-> Simulink-> Math Operations
- The "Manual Switch" can be found in View->Library Browser-> Simulink ->Signal Routing
- The "Constant" can be found in View->Library Browser-> Simulink -> "Commonly Used Blocks"

Once the diagram is finished, in the Simulink toolbar, set Simulation mode to External. This allows you to change the values on the Slider Gain and the Manual Switch while the Program is running.

- When you use external mode you can change parameters while the system is running however this has a large impact on the performance.
    - Due to the communication bandwidth, the fastest you can run in this mode and still meet your control loop time is approximately 30 milliseconds
- The code can be run much faster (in the orders of 1 or 2 milliseconds) if external mode is not used.

Run the code and experiment with the setup. Observe the effects on the Arduino LED when changing the value of the Slider Gain, Manual Switch, and the Pulse Generator.

- While running the simulation, you can change the position of the switch by double clicking on the switch
- You can change the gain of the Slider Gain while running the simulation by double clicking it.
- Adjusting the Pulse Generator, experiment with all three parameters. Which increases brightness? What is the approximate range over which you can observe a difference? [Note: These parameters will be addressed in a later lab on PWM]

Debugging – cannot connect to device or cannot download code

- If you cannot connect to the device or there is an error when trying to download the code usually this means external mode was enabled and the simulation was stopped with the stop button or the USB cable was unplugged while being connected to the device. In this case you have a couple things to try that may successfully close the serial port
    - Reset the device with the reset button or disconnect/connect the serial cable (this sometimes works)
    - Close and restart Matlab (this usually works)

- Make sure the COM port is correct in the "Model Configuration Parameters"

Checkpoint:

To complete Lab 1 you will need to show the ability to control the blink of the LED in one program with both the 'manual switch' and the 'slider gain'.