

Experiment BI-6 The Arduino Claw Lab

Equipment Required

PC or Mac Computer

IXTA data acquisition unit and power supply

USB cable

Arduino UNO with Claw

FT-220 hand dynamometer

iWire-B3G biopotential cable and electrode lead wires

Alcohol swabs

Disposable ECG electrodes

Optional C-ISO-SC5 EEG Electrodes

Hardware Setup

Connect the iWire-B3G to the iWire1 port on the IX-TA.

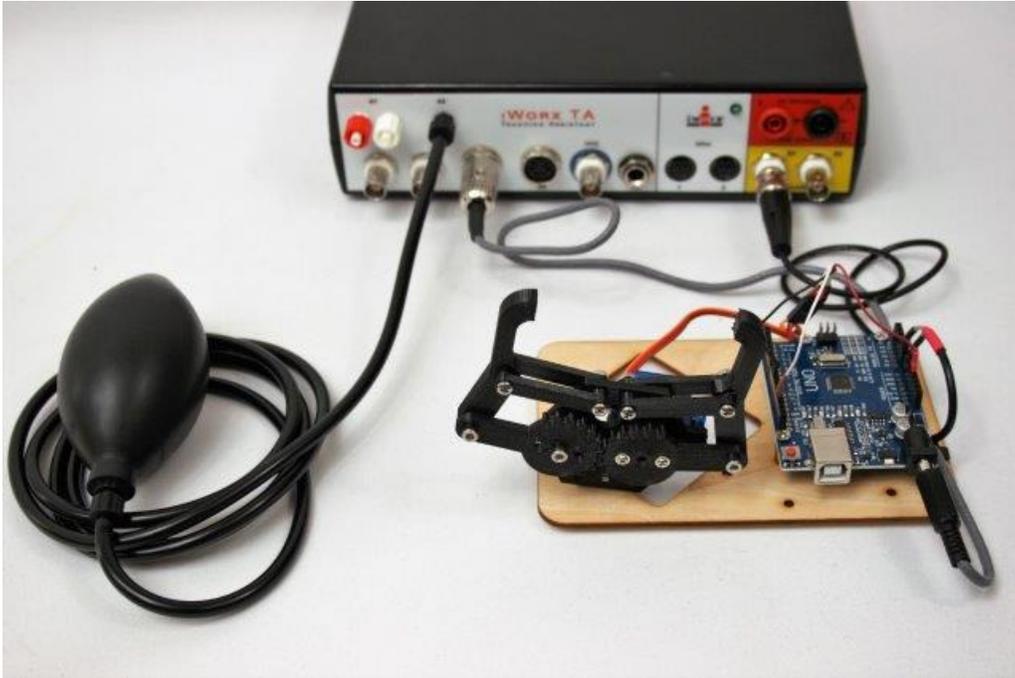
Note - Connect the iWire-B3G to the IXTA prior to turning it on.

Connect the FT-220 to the A2 port.

Start the Software

1. Click on LabScribe
2. Click Settings → BioInstrumentation → Arduino Claw
3. Once the settings file has been loaded, click the **Experiment** button on the toolbar to open any of the following documents:
 1. Appendix
 2. Background
 3. Labs
 4. Setup (opens automatically)

Arduino UNO and Claw Setup

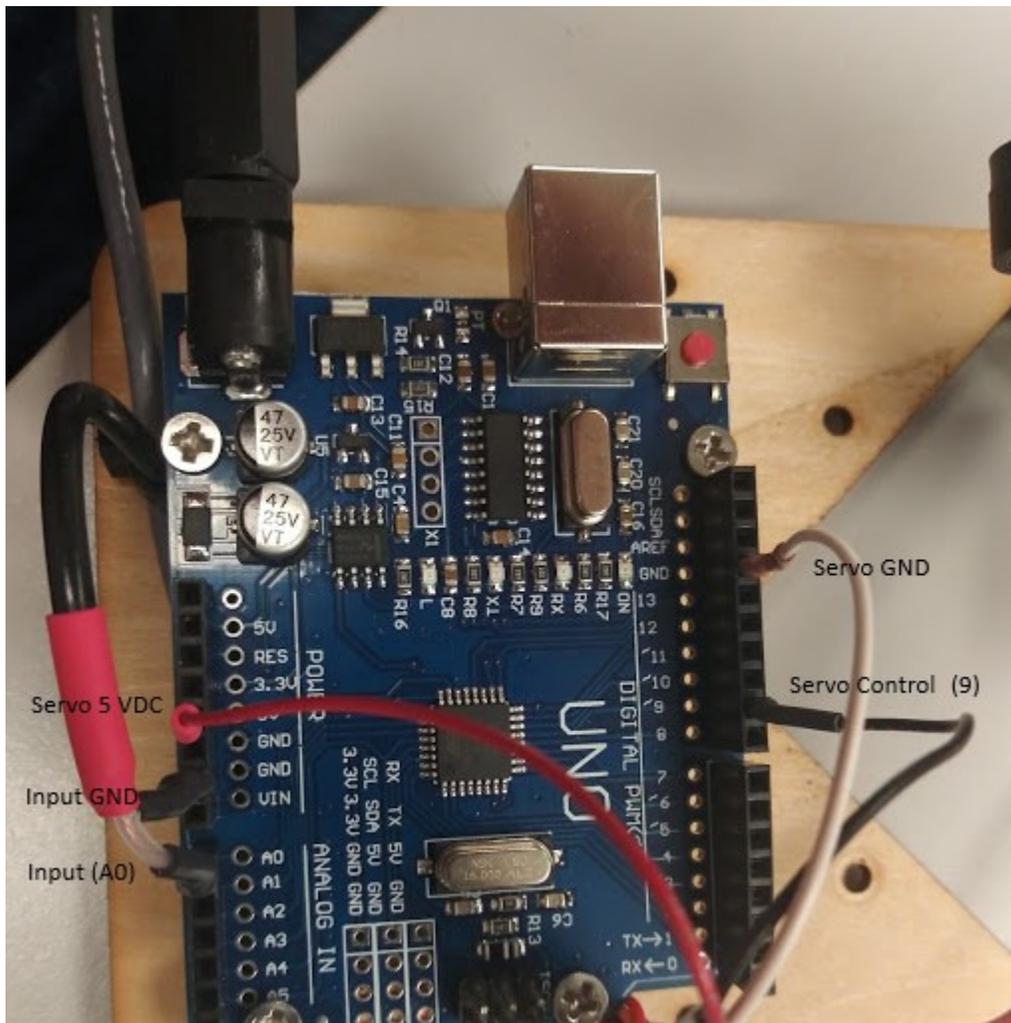


- The Claw and the UNO board are powered from the +5V available on the A5 port.
- The BNC cable is plugged into the Stimulator S1 output. This connects the S1 output to the A0 input on the UNO.
- The FT-220 is plugged into the A2 port.

The UNO board is wired up as follows:

The Servo is connected to the 5V ground and pin 9 (servo control).

The BNC cable is connected to the A0 input and ground.



Arduino Code:

```
#include <Servo.h>
Servo servo1;
int analogPin = A0; // the analog pin that the sensor is on
int analogValue = 0; // the value returned from the analog sensor
int servoPin = 9;
int servoAngle = 45; // servo position in degrees

void setup()
{
  servo1.attach(servoPin);
```

```

servo1.write(servoAngle);
delay(50);
}

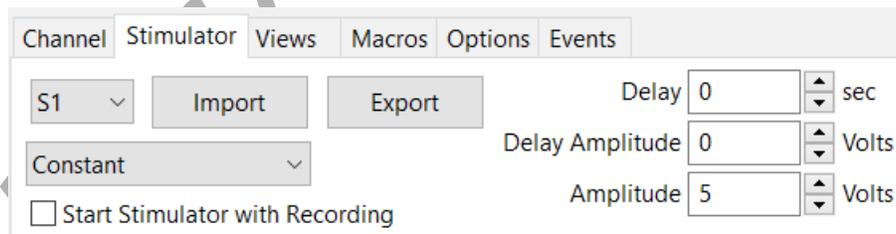
void loop()
{
  analogValue = analogRead(analogPin); // read the analog input (value between 0-1023)
  if(analogValue>511){
    servoAngle+=1;
  }
  else{
    servoAngle-=1;
  }
  servoAngle=constrain(servoAngle,45,130);
  servo1.write(servoAngle); // write the new position of the servo
  delay(12); // wait
}

```

LabScribe Settings

Stimulator Setup

The stimulator is setup in constant mode with an amplitude of 5V.



Macro Setup

We need to create 2 macros, one to fire the stimulator and other to stop the stimulator.

The screenshot shows the 'Macro' tab in the software. The 'Current Macro' is 'stimFire'. The 'Operations' section is set to 'Stimulator S1' with the action 'Fire'. There are buttons for 'Update', 'Remove', and 'Add'. A list on the right shows 'stimFire' with 'Up' and 'Down' arrows, and 'S1: Fire:' is selected.

The screenshot shows the 'Macro' tab in the software. The 'Current Macro' is 'StimOff'. The 'Operations' section is set to 'Stimulator S1' with the action 'Off'. There are buttons for 'Update', 'Remove', and 'Add'. A list on the right shows 'StimOff' with 'Up' and 'Down' arrows, and 'S1: Off:' is selected.

Events Setup

We need to create some events, One to fire the stimulator when the amplitude goes high and the other to stop the stimulator when the amplitude goes low.

- We will create 2 events that look at the force channel first

The screenshot shows the 'Events' tab in the software. The 'Current Event' is 'Force-Start'. The 'Channel' is 'Force' and 'When event occurs' is 'run macro stimFire'. The 'Type' is 'Positive Edge'. The 'Threshold High Value' is 752.793 and the 'Threshold Low Value' is 741.401. The 'Enabled' checkbox is checked and the 'Priority' is 50. There are 'Enable Events' and 'Disable Events' lists. A waveform is shown at the bottom.

Enable Events	Disable Events
Force-Start	Force-Start
Force-End	Force-End
EMG-Start	EMG-Start
EMG-End	EMG-End

Channel Stimulator Views Macros Options Events

Advanced ▾

Current Event: Force-End ▾ Rename New Delete Save

Channel Force ▾ When event occurs: run macro StimOff ▾

Mark the record when this event occurs

Type	Negative Edge ▾	Enable Events	Disable Events
Threshold High Value	770 ▾	Force-Start	Force-Start
Threshold Low Value	765 ▾	Force-End	Force-End
Enabled	<input checked="" type="checkbox"/>	EMG-Start	EMG-Start
Priority	50 ▾	EMG-End	EMG-End

iWorx Sample

Experiment BI-6: The Arduino Claw Lab

Exercise 1: Use FT-220 to control the Claw

Aim: To control the Claw using the FT-220.

Procedure:

1. Click on the Record button, the signal should begin scrolling across the screen.

***Note:** If the user clicks the Record button and there is no communication between the iWorx unit and computer, an error window will appear in the center of the Main window. Make sure the iWorx unit is turned on and connected to the USB port of the computer. Click OK and select the Find Hardware function from the LabScribe Tools menu.*

2. Click on the AutoScale All button on the LabScribe toolbar, to Autoscale all the channels.

3. Squeeze the FT-220 bulb.
4. The Claw should start to close.
5. Let go of the FT-220 bulb, the Claw will open.
6. Try to control the opening and closing of the Claw using the FT-220.



You can change the delay in the Arduino sketch to make the Claw close slower or faster.

Exercise 2: Use EMG to control the Claw

Aim: To control the Claw using the FT-220.

Procedure:

Instead of using the FT-220, use the iWire-B3G to measure the EMG from the arm.

1. To trigger from the EMG signal, we will first calculate the RMS value of the EMG (Channel C1).
2. Channel C2 is setup to smooth the RMS data.
3. Events to trigger the Claw from the EMG signal have been created in the settings file. See the Setup document for more information.
4. The Events have been disabled for the first exercise.
 - Go to the Preferences Dialog Box and the Events Tab, to enable the EMG events.

Channel Stimulator Views Macros Options Events

Advanced ▾

Current Event: **EMG-Start** ▾ Rename New Delete Save

Channel Smooth ▾ When event occurs: run macro stimFire ▾

Mark the record when this event occurs

Type	Positive Edge ▾	Enable Events	Disable Events
Threshold High Value	0.07 ▾	Force-Start	Force-Start
Threshold Low Value	0.06 ▾	Force-End	Force-End
Enabled	<input type="checkbox"/>	EMG-Start	EMG-Start
Priority	50 ▾	EMG-End	EMG-End

Channel Stimulator Views Macros Options Events

Advanced ▾

Current Event: **EMG-End** ▾ Rename New Delete Save

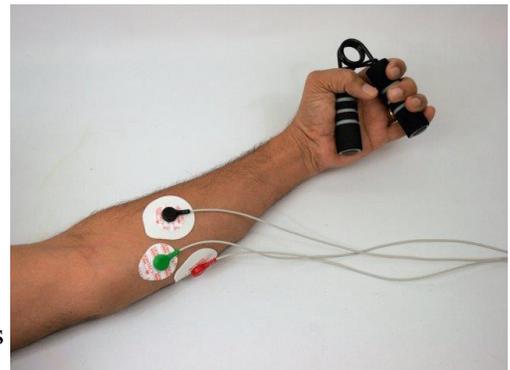
Channel Smooth ▾ When event occurs: run macro StimOff ▾

Mark the record when this event occurs

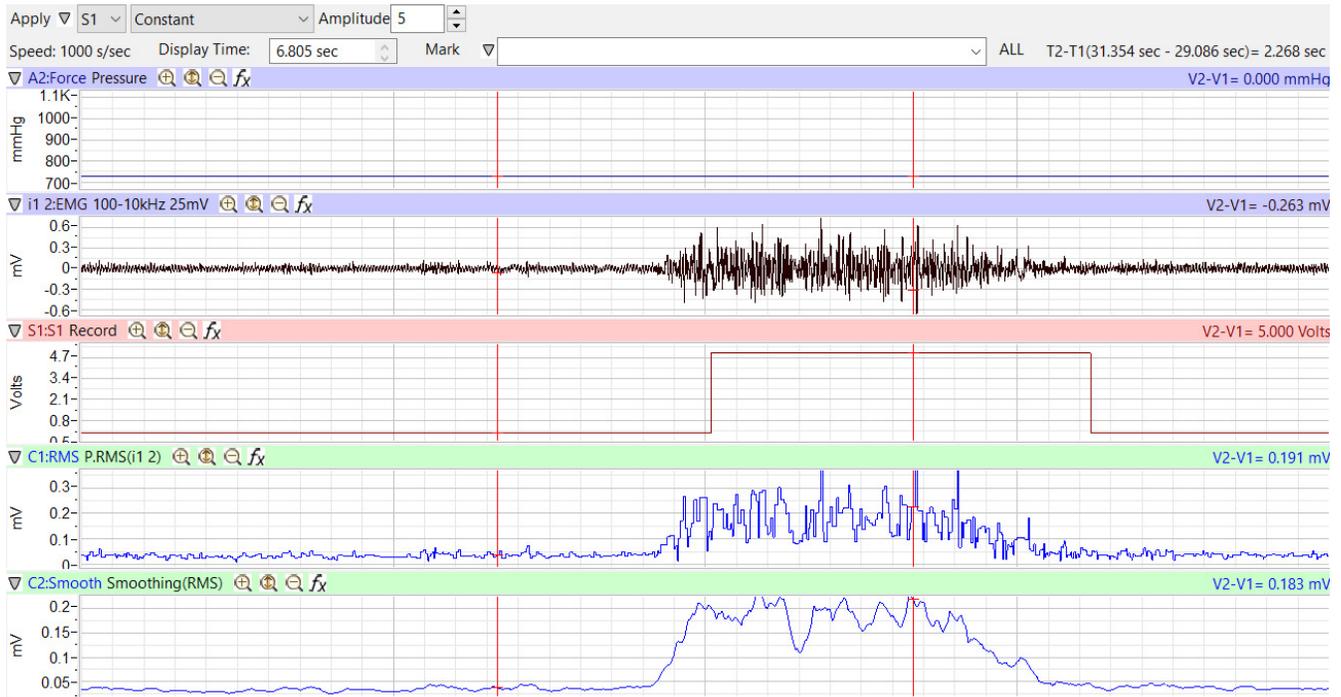
Type	Negative Edge ▾	Enable Events	Disable Events
Threshold High Value	0.07 ▾	Force-Start	Force-Start
Threshold Low Value	0.06 ▾	Force-End	Force-End
Enabled	<input type="checkbox"/>	EMG-Start	EMG-Start
Priority	50 ▾	EMG-End	EMG-End

Connecting the Subject

- Plug the Red, Black and Green snap leads into Channel 1 of the iWire-B3G.
 - Place EMG electrodes on the fore arm of the subject. Connect the snap leads to the electrodes.
1. Start Recording data.
 2. When the person squeezes their grip, The EMG signal is recorded on Channel i1:2 EMG.
 - The RMS value is calculated on the RMS channel and it is then smoothed on the smoothing channel.



- The data on the smooth channel is used to trigger the event, which will send a signal to the claw to open or close.



Optional Exercises:

- Use EEG to control the Claw
- Try to change the strength of the squeeze to change the speed of the Claw
- Try to output the raw EMG on the stimulator and then filter RMS and smooth the data on the breadboard **before** sending it to Arduino

Video link - <https://youtu.be/OIPA8GRRnZQ>