www.I-CubeX.com

BioFlex User Guide

Warning

The BioFlex sensor is to be used only with extreme caution according to the following instructions. It is intended for research purposes only and not intended for any medical purposes whatsoever.

1. The BioFlex sensor must only be plugged into a battery powered, wireless I-CubeX digitizer (eg. the Wi-microDig or Wi-miniDig) manufactured by Infusion Systems and not any other digitizer.
2. The BioFlex sensor must only be connected as shown in the diagram on the wireless digitizer.
3. The wireless digitizer used with the BioFlex sensor must only be powered by a common 9V battery as used in consumer goods or an I-CubeX BatteryPack.
4. Only I-CubeX sensors may be connected to the wireless digitizer that is used for interfacing the BioFlex.
5. When using the BioFlex sensor, I-CubeX products may not be connected in any way to the electrical power grid or any other high voltage source.

Any violation of these instructions nullifies any warranty (express or implied) and nullifies any liability or culpability (express or implied) of Infusion Systems Ltd.. Any violation of these instructions can result in electrocution, severe injury, or even death.

Using the sensor with the Wi-microSystem not only ensures electrically safe operation but also enables you to use the sensor without being tethered to your computer or MIDI device.

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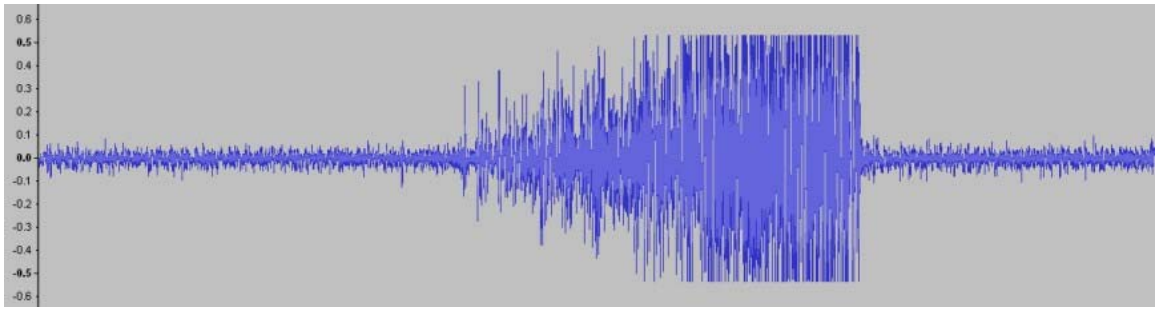
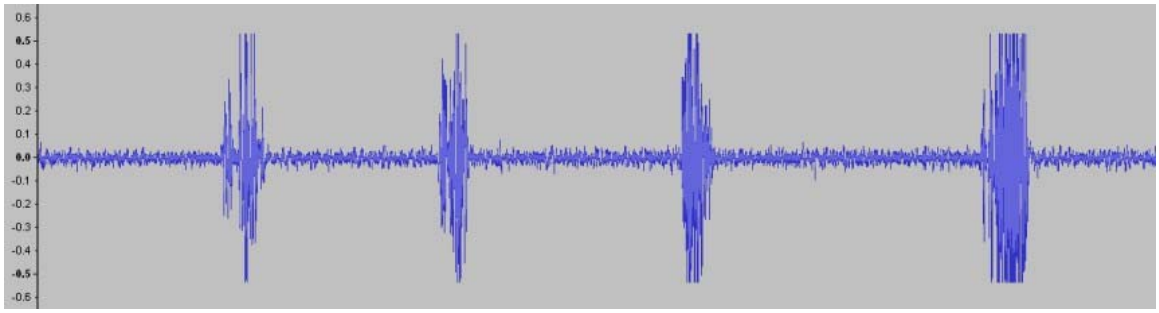
Introduction

The BioFlex is a sophisticated bioelectric signal acquisition device that is designed to capture muscle EMG (muscle electrical energy) signals and convert these signals into a form usable by a computer for interactive applications. The EMG is an AC (alternating current) burst that is generated as a result of muscle contraction. The figure below shows the actual EMG signal generated when you wear the BioFlex on your forearm and squeeze your fingers into a fist. As you continue to squeeze harder, the voltage generated becomes quite large, and in this data display, the large EMG signal hit the rails – it exceeded the input capacity of the display software. Upon relaxation, the EMG abruptly falls back to baseline activity.



This next figure shows EMG bursts generated by individual finger twitches. The BioFlex is very sensitive and can pick up the signals produced by subtle movements and gestures.



BioFlex set-up

The BioFlex band is configured with a 40 cm elastic band designed to hold the sensor module in place on the arm or leg. The sensor module has 3 gold sensor contacts that are designed to contact the skin and capture the electrical signals from the underlying muscles.

Sensor contact adjustment

The gold sensor contacts work for most people with simple skin contact. Your skin should be clean and free of oily substances such as suntan lotion. Some users have very dry skin and this can make it difficult for the sensor contacts to capture a good signal. Users with very dry skin will get better BioFlex operation by putting a little tap water on the skin where you will wear the unit, dry off the excess water and then apply the sensor band.

The band includes a 1 meter cable with a connector that plugs into the Wi-microDig unit. This allows the Wi-microDig unit to be worn at a distance from the band (e.g. on the belt) and allows freedom of motion of the arms or legs.

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BioFlex use

The band has a cambuckle that allows for adjusting the fit of the band around the arm. The easiest way to put on the band is to first slip the tongue of the elastic into the open cambuckle, then slip the loose band onto the arm and tighten the elastic when the band is in the desired position, and then latch the cambuckle closed.

BioFlex Max patch
To start enjoying your BioFlex - position the band as shown in this photo, with the gold sensor contacts on the inside surface of your forearm.
Assuming that you have already verified that your Wi-microDig is functioning with an input device using the I-CubeX Editor, now:

- launch the BioFlex Max patch
- plug your BioFlex into the Wi-microDig
- connect the Wi-microDig battery
- note that the red pilot light is lit

With the BioFlex screen in view, first select your input com port in the top center box. Allow a few seconds for the Bluetooth connection to be established – and the blue light should appear on your Wi-microDig.
Next, verify that the “min” and “max” sliders on the left of the screen are set to 0 and 511 respectively.
To activate the patch, click on the EMG (On/Off) box at the upper left. Sometimes it is necessary to toggle between Reset and EMG (On/Off) in order to start the program.

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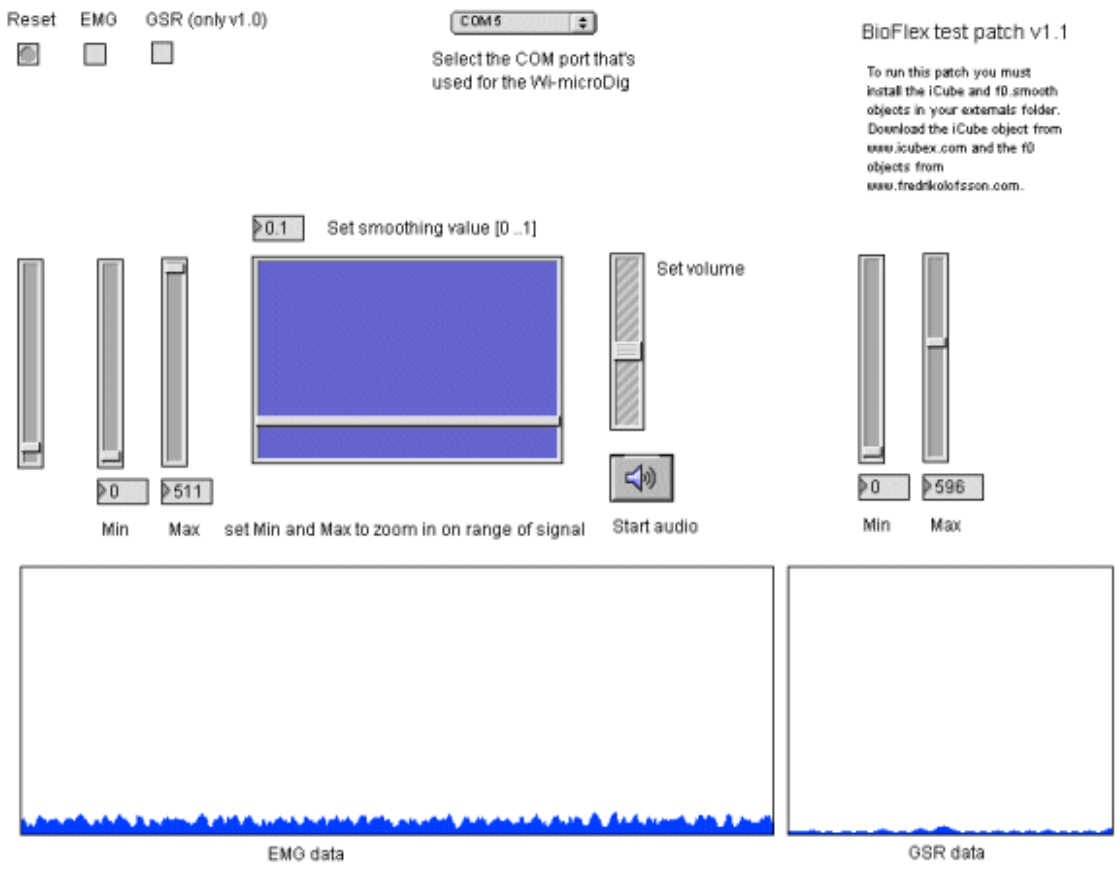

Once the program is running, you will see the data trace scrolling across the “EMG data” window. If your BioFlex is making good contact with the skin the trace will look like the figure above with low baseline activity.

If your BioFlex is not fitted properly and one of the sensor contacts is not touching the skin, you will see high baseline activity scrolling across the window as shown below. If this happens you need to remove the BioFlex and reposition it making sure that all sensor contacts touch the skin.

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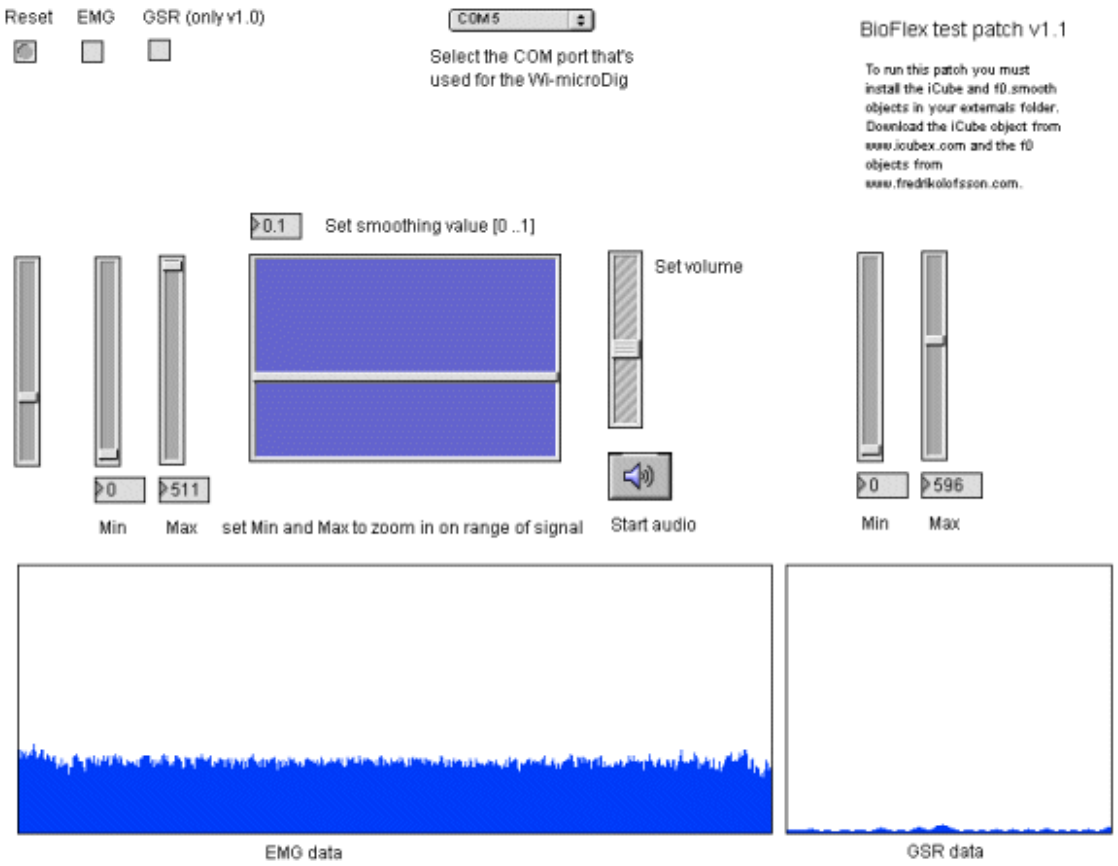

Now that you are running with a good low noise baseline with the BioFlex on your forearm, try a few hand gestures and motions. Notice that some gestures produce large deflections on the EMG data trace and other gestures do not. That's because you are monitoring only certain muscles with the BioFlex in its current position. If you squeeze your fingers into a fist and then release, you'll see something like the data trace below. Each time you make a fist it will create a "mountain" trace on the display. This trace looks quite different than the raw data trace shown at the beginning of this document – because it is summation or envelope display that is showing the total energy from EMG data.

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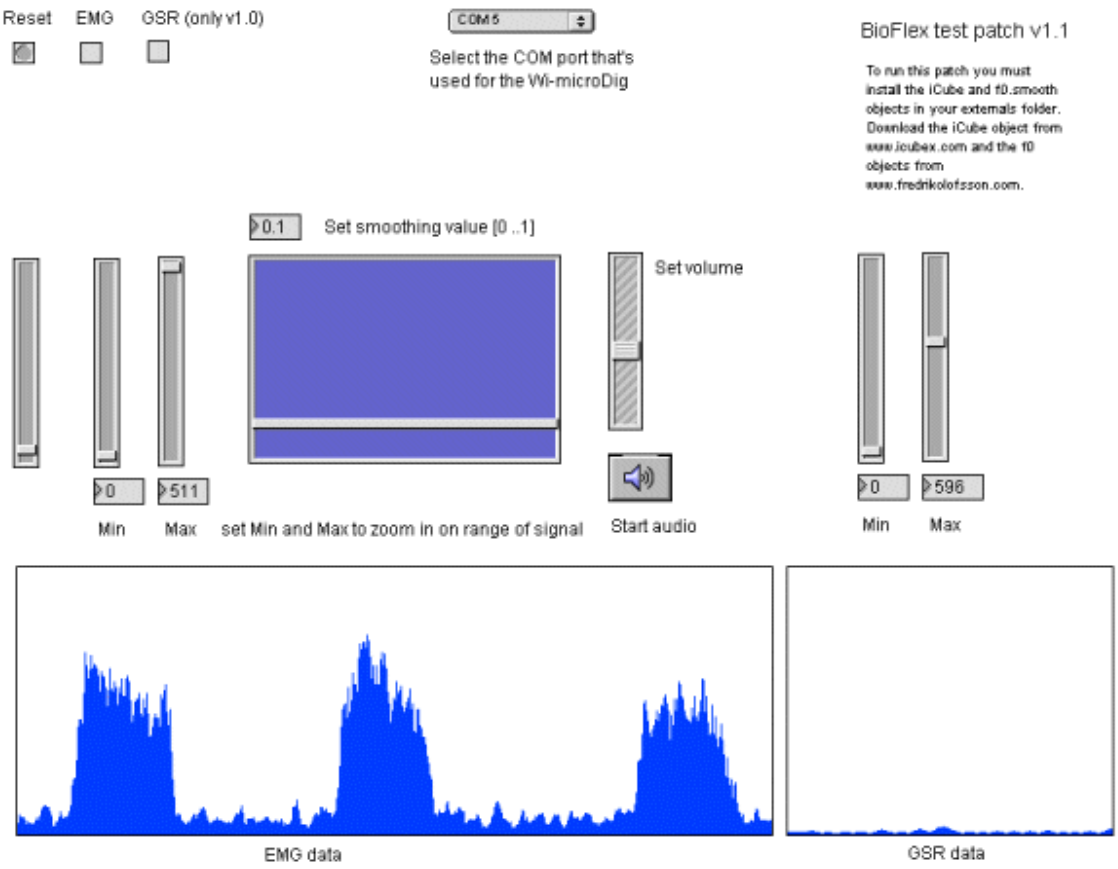

Now that you are familiar with basic EMG signals, you can modify the display to view the data in different ways. Try experimenting with the “min” and “max” sliders on the left of the screen. If you enter a “min” setting of 40 and “max” of 250, you can lower the baseline out of view and increase the amplitude of the EMG burst to about full scale. Basically, these settings allow you to scale the EMG response to the data window. If you squeeze your hand into a fist three times, the EMG data now looks like the display below:

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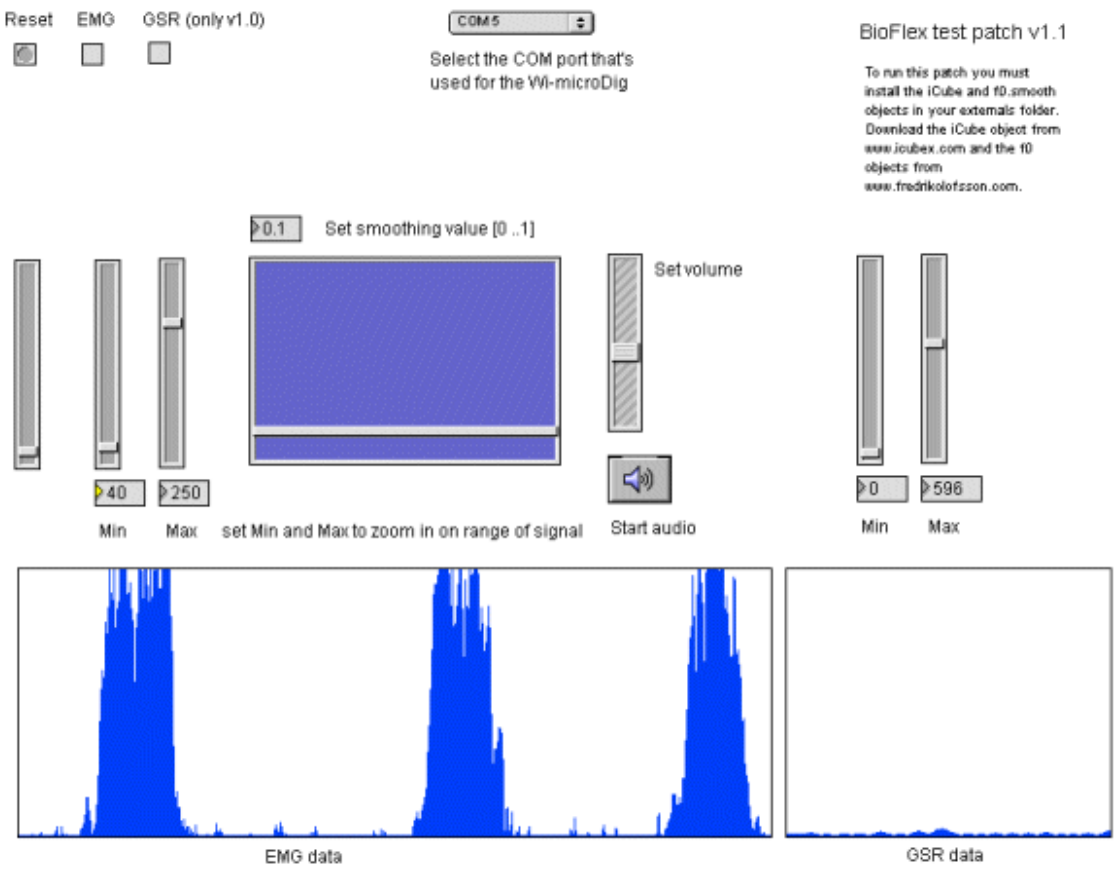

The “max” setting of 250 has effectively increased the amplitude of the EMG burst. Feel free to experiment further with the “min” and “max” settings. The screen below shows several fast bursts that were produced by small finger twitches.

You can see from the data that each one of these EMG bursts is slightly different. There is data here that indicates something about the nuance of the finger gesture. This data is all usable for musical composition and performance. Algorithms are available that can map this EMG data to MIDI.

Included in this patch is a simple MIDI mapping algorithm. This algorithm assigns a MIDI note number to the amplitude of the EMG response that you see on the screen. Note repetition is preset at 10 per second. Go ahead and click on the “Start audio” button in the center of the screen.

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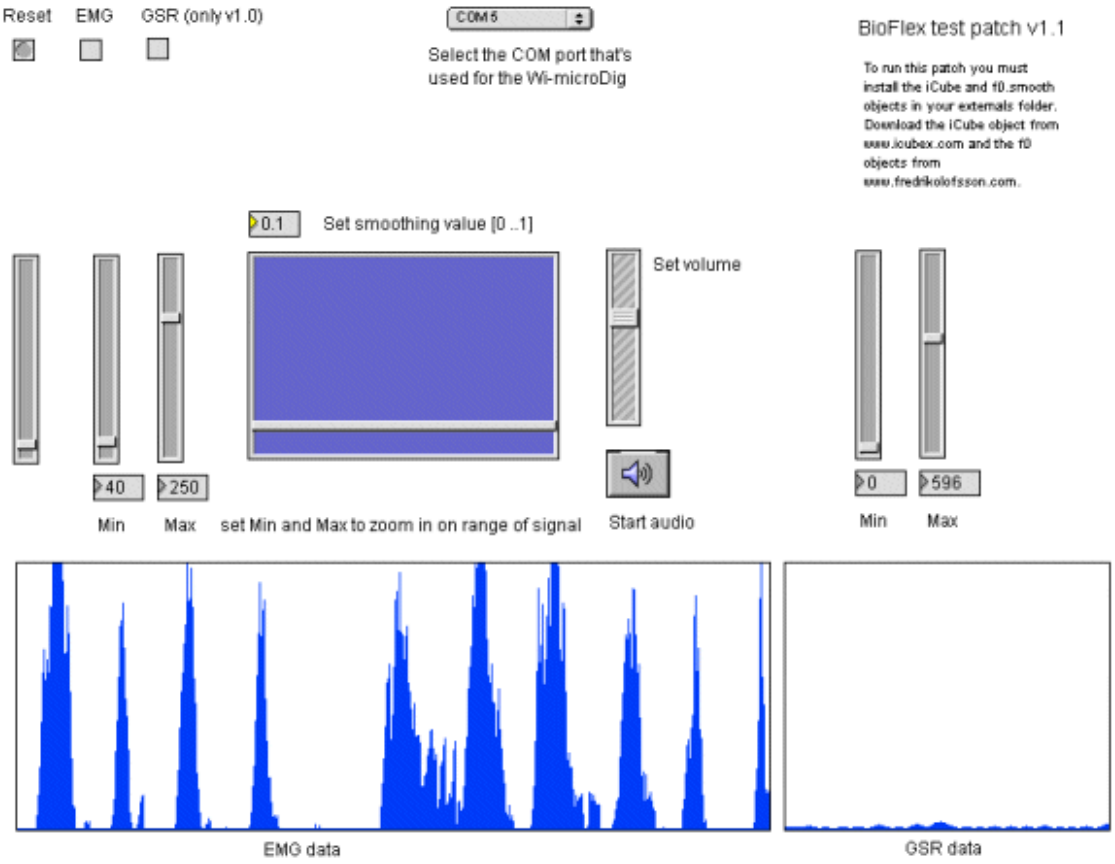

Now, your EMG data is translated into a cascade of musical notes. The high notes represent large amplitude EMG and the low notes small EMG.

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