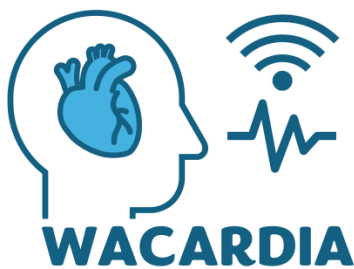


**Standard Operating Procedures for WACARDIA MATLAB program to use  
Shimmer sensors and Heartbeat Detection tasks**



Ian Kleckner, PhD, MPH  
Associate Professor  
University of Maryland Baltimore

Version 2024/09/12

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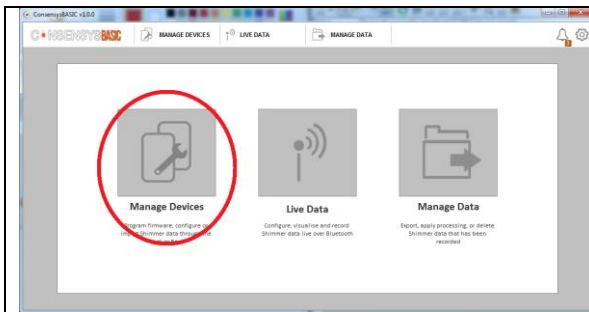
Remove the physiological sensors ..... 27

## PREPARING THE SHIMMER MOBILE SENSORS

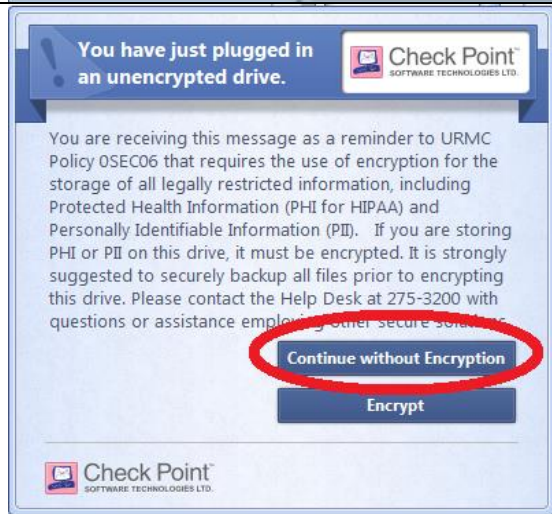
**THE RED TEXT MEANS: DO THIS ONLY ONCE PER SHIMMER SENSOR, NOT EVERY TIME BEFORE THE SUBJECT COMES TO THE LAB (UNLESS THE SENSOR DOES NOT WORK PROPERLY)**

**To save time, keep a single set of sensors for in-lab use only so you don't have to do this often.**

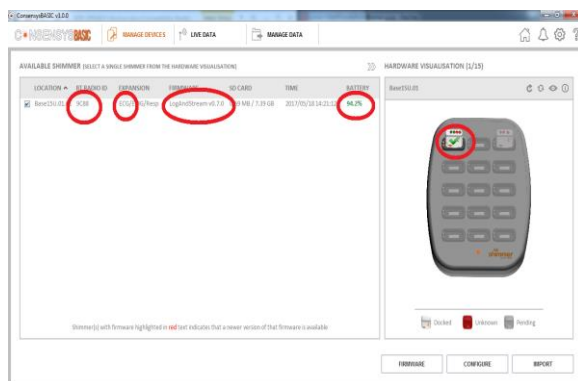
		<ol style="list-style-type: none"> <li>1. Plug Shimmer dock into the surge protector (if not already plugged in)</li> <li>2. Plug Shimmer dock USB into the computer</li> </ol>
		<ol style="list-style-type: none"> <li>3. Plug Shimmer sensors into dock (use one ECG and one EDA/GSR)</li> </ol>
		<ol style="list-style-type: none"> <li>4. Turn the devices on by <b><u>flipping the orange switch up</u></b>. You'll know it is on because the lights on the front will illuminate</li> </ol>
		<ol style="list-style-type: none"> <li>5. Open Consensys (Start menu...type Consensys, press Enter)</li> <li>6. Choose ConsensysBASIC and click LAUNCH NOW at the bottom left</li> </ol>



7. Click on “Manage Devices”



8. If you get this message requesting that the Shimmer Mobile Sensor be encrypted, choose **Continue without Encryption**

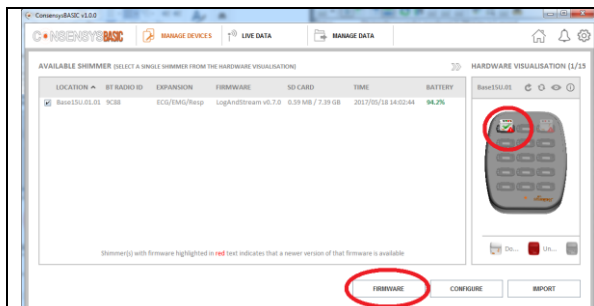


1. For each of the two sensors, write down the following on the data sheet
  - a. Bluetooth (BT) radio ID, e.g., 91E0
  - b. FYI the BT ID is also on the back of the sensor itself in a black rectangle
  - c. Expansion (e.g., ECG or EDA/GSR+)
  - d. COM port from Bluetooth settings (instructions in the next section with black text)
2. Check that the following are valid
  - a. Firmware should be LogAndStream. If not then repeat prior instructions using the FIRMWARE button
  - b. Battery should be at least 20% before the participant wears the device
3. Close the Consensys program by clicking the X in the top right corner of the window
  - a. Click **Yes** to exit

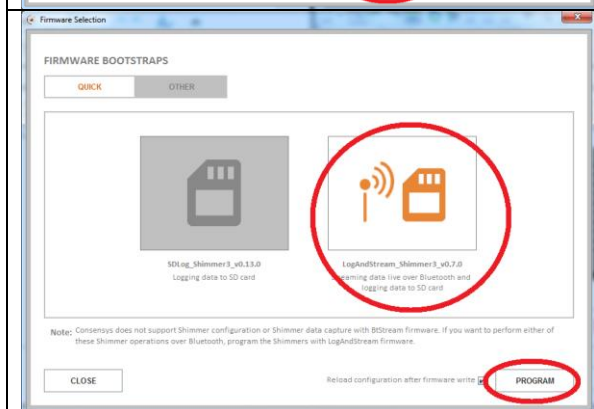
On the computer, set up the FIRMWARE for the in-lab devices

**THE RED TEXT MEANS: DO THIS ONLY ONCE PER SHIMMER SENSOR, NOT EVERY TIME BEFORE THE SUBJECT COMES TO THE LAB (UNLESS THE SENSOR DOES NOT WORK PROPERLY)**

**To save time, keep a single set of sensors for in-lab use only so you don't have to do this often.**



1. Open the Consensys program (see above) if not already open
2. Click on the Shimmer device (or both if possible) and click FIRMWARE
3. FYI, at this window you can check the Firmware version and see whether it needs to be changed or not



4. Choose LogAndStream\_Shimmer to ensure that the device can stream data via Bluetooth
5. Click PROGRAM
6. Wait until process is complete
7. Click DONE
8. Do NOT encrypt the device, if asked by Windows

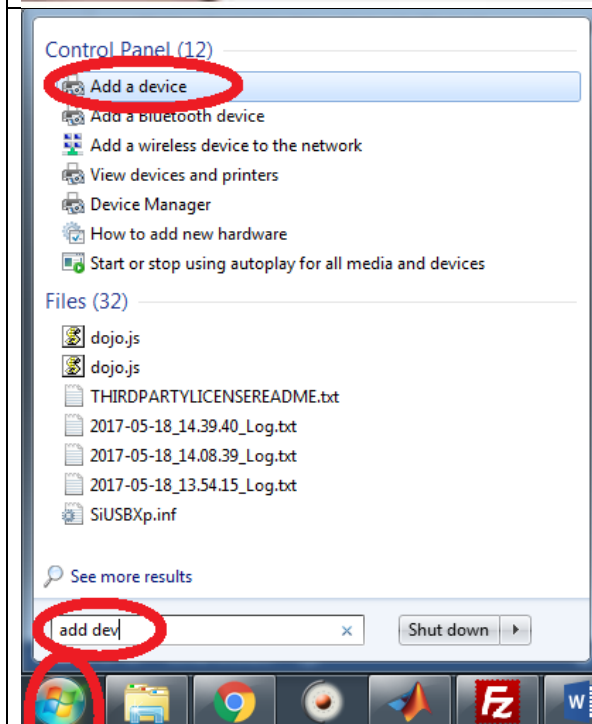
## Windows 7 and older: Set up devices for Bluetooth connection with computer

**THE RED TEXT MEANS: DO THIS ONLY ONCE PER SHIMMER SENSOR, NOT EVERY TIME BEFORE THE SUBJECT COMES TO THE LAB (UNLESS THE SENSOR DOES NOT WORK PROPERLY)**

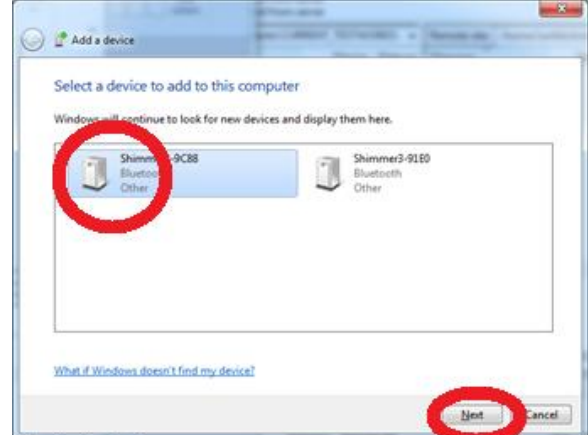
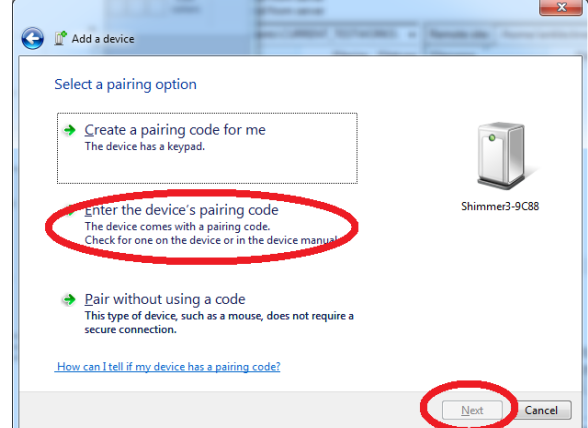
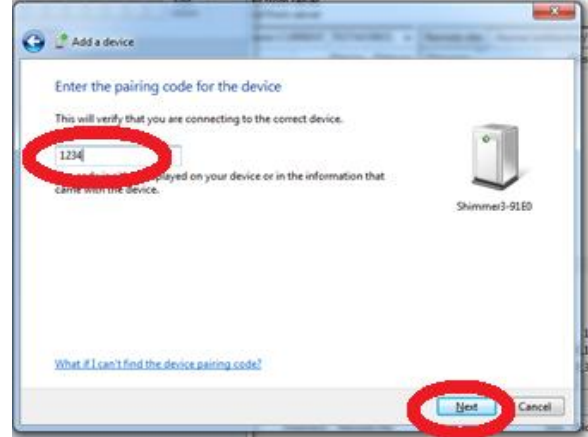
**To save time, keep a single set of sensors for in-lab use only so you don't have to do this often.**



If you are using a USB Bluetooth Dongle (probably yes) then make sure that is inserted as it will affect the COM ports that each Shimmer is assigned to



1. Click the Start button (or press the Windows button on the keyboard)
2. Type add device
3. Click the Add a device option that appears

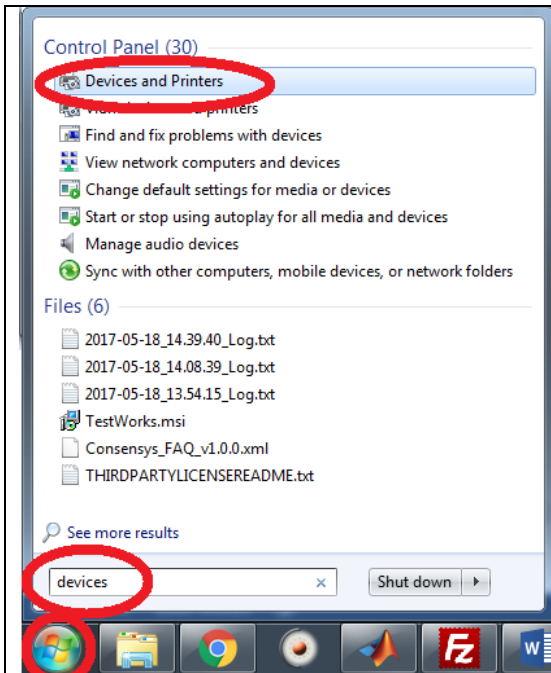
	<ol style="list-style-type: none"> <li>1. The nearby Shimmer Sensors that are ON should appear here <ol style="list-style-type: none"> <li>a. If they do not appear here, you must ensure your computer has Bluetooth capabilities (e.g., using a USB dongle), and perhaps you need to enable Bluetooth</li> <li>b. One setup in the lab uses a Bluetooth USB dongle and once it is plugged in then Bluetooth is enabled</li> </ol> </li> </ol>
	<ol style="list-style-type: none"> <li>2. Click enter the device's pairing code</li> <li>3. Click Next</li> </ol>
	<ol style="list-style-type: none"> <li>4. Enter the pairing code: 1234</li> <li>5. This pairing code is the same for all Shimmer Sensors</li> <li>6. Click Next</li> </ol>
	<ol style="list-style-type: none"> <li>7. Repeat this process for any other Shimmer Sensors that need to be streamed to the computer <ol style="list-style-type: none"> <li>a. FYI, the sensors that are given to participants to take home do NOT need to use Bluetooth</li> </ol> </li> </ol>

## Check COM port for Shimmer sensors

You only need to do this once per computer + Bluetooth dongle + Shimmer sensor combination



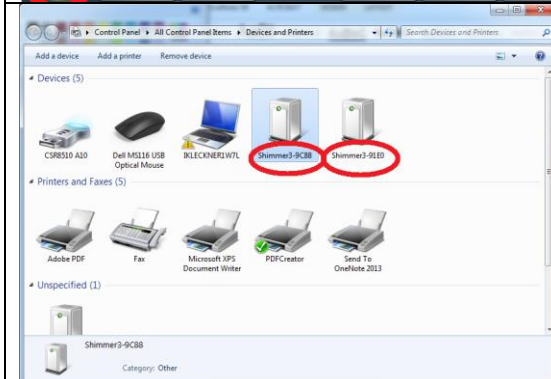
Windows 7—e.g., the laptop in PEAK Lab



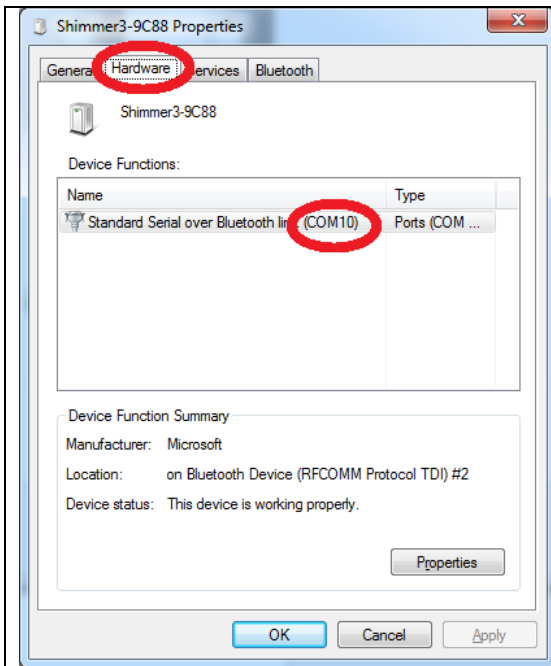
Click the Start button (or press the Windows button on the keyboard)

Type devices

Click the Devices and Printers option that appears



Double click on each of the Shimmer Devices that you just paired



Click the **Hardware** tab

Check the COM port number (here it is 10) and write this down on the **Datasheet**

You will need to use this COM port number in a few minutes

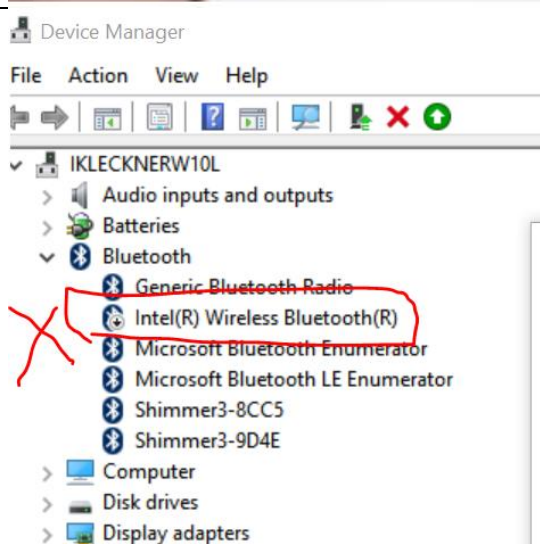
Repeat these two steps for the other Shimmer Sensor



## Windows 10



If you are using a USB Bluetooth Dongle (probably yes) then make sure that is inserted as it will affect the COM ports that each Shimmer is assigned to



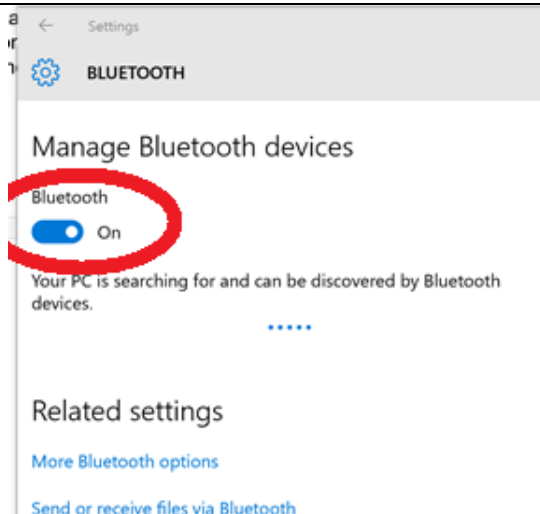
If there is integrated AND external Bluetooth then disable the integrated Bluetooth using the device manager (**Windows button...type device manager**)

Right click on the integrated Bluetooth and click Disable

Press the **Windows** button on the keyboard or click the Windows icon in the lower left hand corner

Type **Bluetooth** into search

Hit **enter** to open Bluetooth settings



Click to turn on Bluetooth

Your PC is searching for and can be discovered.

- Shimmer3-8CC5 Paired
- Shimmer3-91E0 Paired
- Shimmer3-91FB Paired
- Shimmer3-9C88 Paired
- Shimmer3-9C8C Paired
- Shimmer3-9F7E Paired

Related settings

[More Bluetooth options](#)

[Send or receive files via Bluetooth](#)

Devices should be paired

Click More Bluetooth Settings near the bottom

COM Ports

This PC is using the COM (serial) ports listed below. To determine whether you need a COM port, read the documentation that came with your Bluetooth device.

Port	Direction	Name
COM11	Incoming	Shimmer3-8CC5
COM12	Outgoing	Shimmer3-8CC5 RNI-SPP
COM14	Outgoing	Shimmer3-91FB RNI-SPP
COM15	Outgoing	Shimmer3-9C8C RNI-SPP
COM16	Outgoing	Shimmer3-9F7E RNI-SPP
COM17	Incoming	Shimmer3-9C88
COM18	Outgoing	Shimmer3-9C88 RNI-SPP
COM19	Incoming	Shimmer3-91E0
COM20	Outgoing	Shimmer3-91E0 RNI-SPP
COM7	Incoming	Shimmer3-91FB
COM8	Incoming	Shimmer3-9C8C
COM9	Incoming	Shimmer3-9F7E

Add... Remove

OK Cancel Refresh

Click on COM Ports tab to see list of devices

The COM we want has RNI-SPP in the name

Ex: EDA Shimmer is 91E0, COM16

Ex: ECG Shimmer is 9C88, COM18

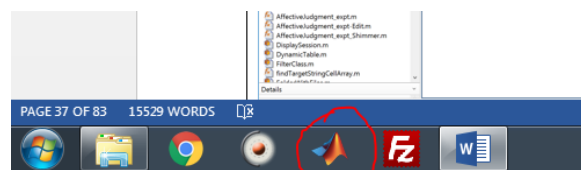
Check the COM port number (here it is 14) and write this down on the **Datasheet**

You will need to use this COM port number in a few minutes

## Test connection with Shimmer Sensors

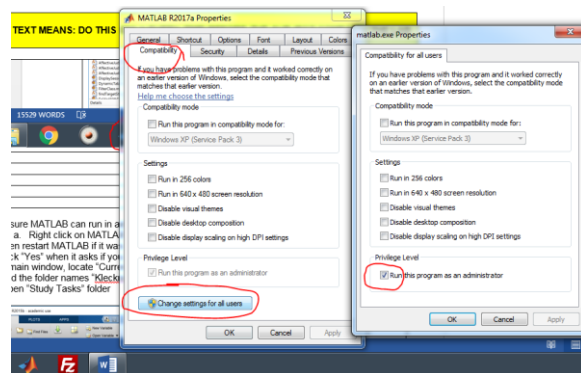


If you are using a USB Bluetooth Dongle (probably yes) then make sure that is inserted as it will affect the COM ports that each Shimmer is assigned to



Open MATLAB

- Use the shortcut on the computer desktop or taskbar
- Or click Start...type **matlab** then hit **Enter**

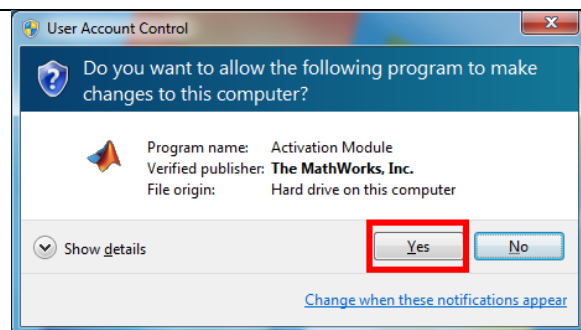


**Only do this once per computer**

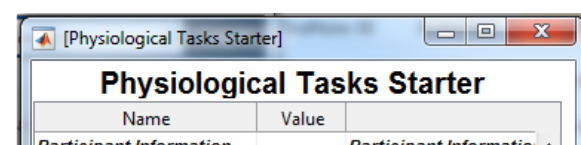
Ensure MATLAB can run in administrator mode (only needs to be done once per computer)

Right click on MATLAB shortcut...Properties...Compatibility...Run as administrator

Then restart MATLAB if it was already running

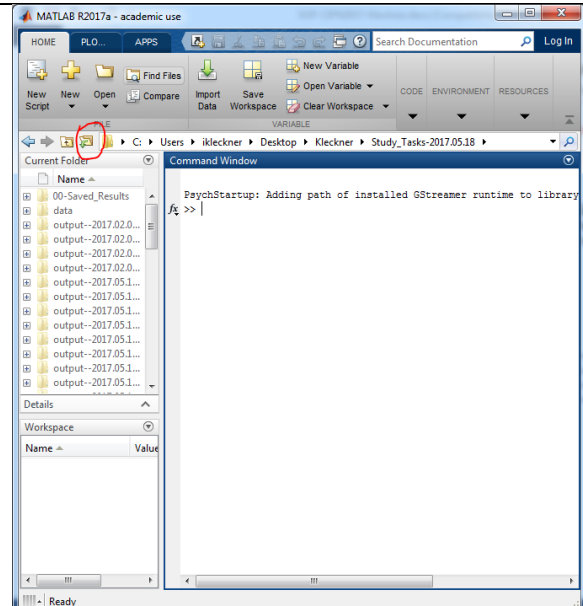
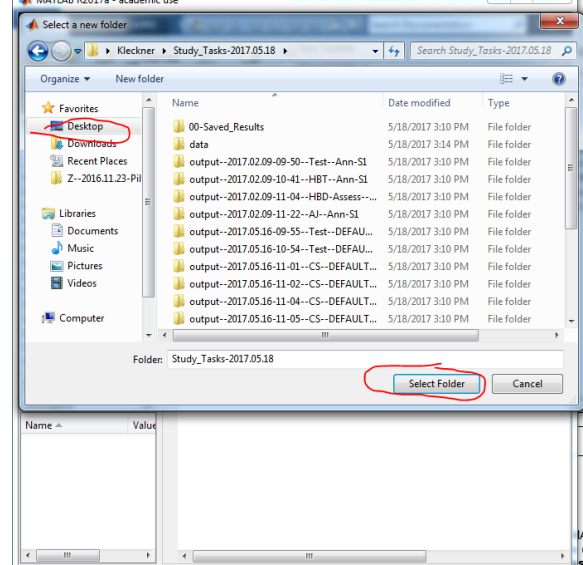
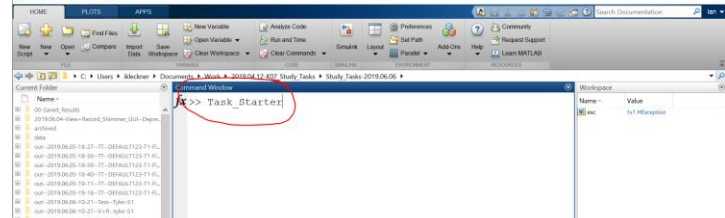


Click "Yes" when it asks if you want MATLAB to make changes to the computer



MATLAB may be set up with the proper directory and to automatically open the **Task\_Starter** program

If a window like this does NOT open, then complete the following 3 steps in red to open it.

	<p>In main window, click <b><u>Current Folder</u></b> on left side of screen</p>
	<p>Go to <b><u>Desktop</u></b></p> <p><b><u>Kleckner</u></b></p> <p><b><u>Study_Tasks-2019.06.12</u></b> (or most recent folder of a similar name)</p> <p>Click <b><u>Select Folder</u></b></p>
	<p>In the command window, type <b><u>Task</u></b> and hit <b><u>tab</u></b>, it will complete the command for you to <b><u>Task Starter</u></b></p> <p>Hit <b><u>Enter</u></b></p>

Physiological Tasks Starter

Name	Value	Desc
<b>Participant Information</b>		
PP_Number	1	Number in the study (1, 2, 3, ...)
Timepoint	1	1, 2, or 3
<b>Shimmer Connection</b>		
Use_ECG	<input checked="" type="checkbox"/>	** Acquire ECG data
COM_ECG	18	COM port for Shimmer with ECG
Sampling_rate_ECG_Hz	512	Sampling rate for ECG in Hz for NON-HBD tas
Use_EDA	<input checked="" type="checkbox"/>	** Acquire EDA data
COM_EDA	9	COM port for Shimmer with EDA
Sampling_rate_EDA_Hz	64	Sampling rate for EDA in Hz (also must be set
<b>ECG R Spike Detection</b>		
Minimum_RR_interval_sec	0.5000	Minimum duration between consecutive ECG f
Minimum_R_Prominence_mV	1	** Minimum height of ECG R spike(mV)
<b>View and Record Shimmer</b>		
Event_name	Test	** Name of the event (Test, 6MWT, Biodes)
Plot_update_period_sec	0.5000	Time between plot updates (sec)
Plot_viewable_duration_sec	8	Visible region of plot (sec)
Test_duration_sec	Inf	Duration of test (sec)
Write_data_to_file	<input checked="" type="checkbox"/>	Write Shimmer data to text file
<b>Tactile Test</b>		
Site_of_test	L_Finger	** Name of the test site (e.g., left finger, right tc
<b>Heartbeat Detection</b>		
Number_of_trials_HBD	25	Number of trials

Task to run: View\_and\_Record\_Shimmer

Go!

Close Figs

Clear All

Ian Kleckner, URCC  
v.2019.06.25

Type in subject number (1, 2, ...)

Type in timepoint (1, 2, or 3)

Type in COM port for Shimmer ECG (e.g., 10) obtained from Windows Bluetooth settings (steps above)

Type in COM port for Shimmer EDA (e.g., 8) obtained from Windows Bluetooth settings (steps above)

At bottom left, set **Task to run to**  
**Test Shimmer Sensors**

Click **Go!** at bottom right

If you want to edit the DEFAULT values in the Task Starter, edit the file Task\_Starter.m

In the command window, type **edit Task\_Starter.m**

In the window that opens, edit the values shown in the picture to the left. E.g., to change the default COM port for the Shimmer ECG, you would edit this code around line 123 (might differ by code version). You would change 11 to a different value.

```
specsTable.addRow('NUMERIC', 'COM_ECG', 11, 'COM port for Shi
specsTable.addRow('NUMERIC', 'Sampling_rate_ECG_Hz', 512, 'Sa
```

Then Save the file (**Ctrl+s**), exit the Task\_Starter (click the **x** in the top right), and start it again by typing **Task\_Starter** then hitting **Enter** in the MATLAB command window.

Command Window

```
fx>> edit Task_Starter.m
```

Task\_Starter.m

```
120
121
122 specsTable.addRow('HEADING', 'Shimmer Connection', NaN, '', NaN,
123 specsTable.addRow('BOOLEAN', 'Use_ECG', true, '** Acquire ECG
124 specsTable.addRow('NUMERIC', 'COM_ECG', 11, 'COM port for Shi
125 specsTable.addRow('NUMERIC', 'Sampling_rate_ECG_Hz', 512, 'Sa
126
127 specsTable.addRow('BOOLEAN', 'Use_EDA', true, '** Acquire EDA
128 specsTable.addRow('NUMERIC', 'COM_EDA', 9, 'COM port for Shin
129 specsTable.addRow('NUMERIC', 'Sampling_rate_EDA_Hz', 64, 'Sa
130
```

Watch the MATLAB command window for progress for how the computer is connecting to the Shimmer devices

**This takes approximately 20 sec**

**If there are any issues here (red text in MATLAB window) then check the following**



- Computer's Bluetooth is on (press the Windows button, type Bluetooth, hit enter, and turn it on)
- Shimmer devices are on
- RealTerm software installed on computer
- Shimmer source code is in MATLAB directory where Kleckner/Study\_Tasks files are
- Try turning the Shimmer devices OFF...waiting 5 sec...then turning them ON again
- Try restarting MATLAB (type **exit** at the command window then hit **enter**)
- Call Ian or email him

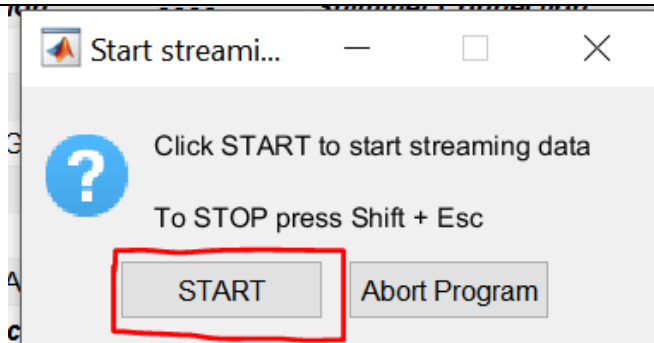
```

rsrs > iKleckner > Desktop > Kleckner > Study_Tasks-2017.05.18 >
Command Window

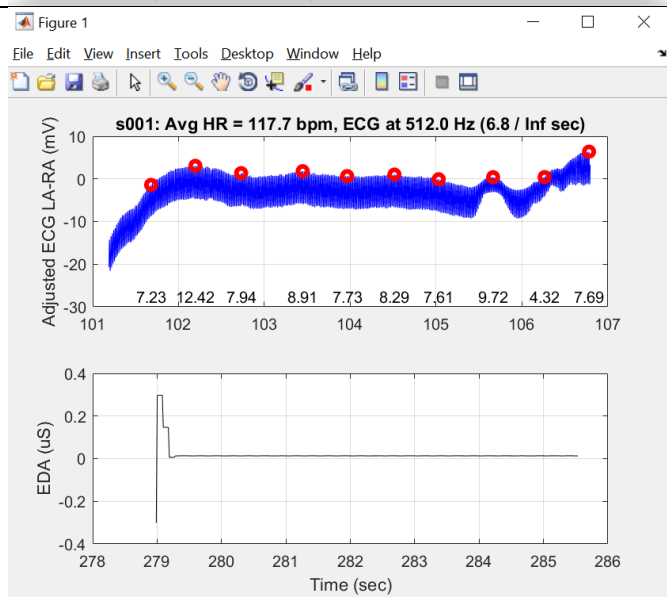
-----
Attempting to connect to ECG Shimmer, this may take 10 sec...
Firmware version LogAndStream v0.7.0 Detected for Shimmer COB
Battery Voltage: 4143[mV]
Real Time Clock on Shimmer: 22-May-2017 21:16:50.

Successfully connected to ECG Shimmer!
setsamplingrate - Shimmer Sampling Rate is set to 512Hz
setsamplingrate - ExG Rate is set to 1000Hz
setsamplingrate - WR Accel Rate is set to 400Hz
setsamplingrate - Gyro Rate is set to 533.3333Hz.
setsamplingrate - Mag Rate is set to 220.00Hz

-----
Attempting to connect to EDA Shimmer, this may take 10 sec...
Firmware version LogAndStream v0.7.0 Detected for Shimmer COB
fx >>
  
```



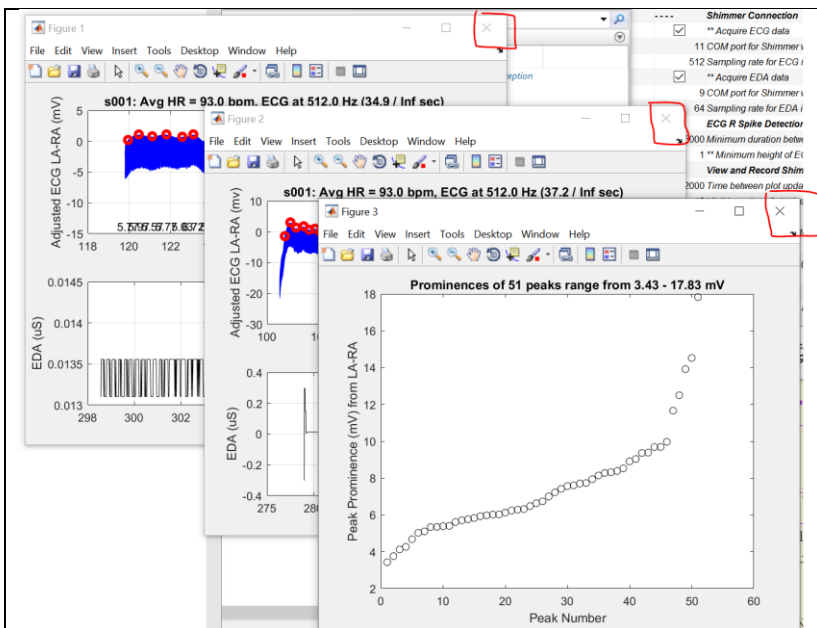
Click **START**



A new windows opens up and shows data from the sensors. If anything appears, that is a success

You can watch the number of seconds in the recording until it reaches the goal or you can **hold Shift+Esc for a couple seconds to exit**





Now you know that MATLAB can successfully connect to both Shimmer ECG and Shimmer EDA devices! Of course, these data are just noise because the electrodes are not connected to anything.

When the program is complete, **close all three figures** showing data, or click **Close Figs** in the Task Starter

```

Command Window
setsamplingrate - Mag Rate is set to 220.00Hz

-----
Attempting to connect to EDA Shimmer, this may take 10 sec..
Firmware version LogAndStream v0.11.0 Detected for Shimmer C
Battery Voltage: 3912[mV]
Real Time Clock on Shimmer: 12-Jun-2019 13:34:38.

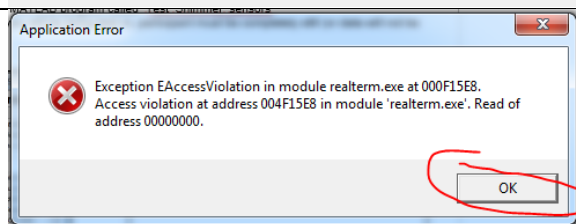
Successfully connected to Shimmer device!
setsamplingrate - Shimmer Sampling Rate is set to 64Hz
setsamplingrate - ExG Rate is set to 125Hz
setsamplingrate - WR Accel Rate is set to 100Hz
setsamplingrate - Gyro Rate is set to 64Hz.
setsamplingrate - Mag Rate is set to 75.00Hz
Warning: Default character vector does not match any button
character vector name.

Starting continuous signal monitoring for Inf sec

** To stop recording early press Ctrl + Esc **

User stopped recording via keyboard.

fx All done!>> close all
  
```



If you ever see this message, just click **OK**

It is **no big deal**, and you don't need to document it. It's just a side-effect of exiting the MATLAB programs early, so it's bound to happen sometimes.

## PREPARE SHIMMER SENSORS, ELECTRODES, AND STRAPS



The Shimmer ECG has four wires: **red, green, black, and white**

The brown lead receptacle (on the left) is not used here



Plug the Shimmer ECG leads into each of four round **Medline ECG electrodes**

Attach a **long chest strap** to the Shimmer ECG



Plug the Shimmer EDA leads into each of two square **Vermed ECG electrodes**(here, used for EDA)

Attach a **short arm strap** to the Shimmer EDA








Plug the Shimmer sensors back into the dock so their battery will remain charged

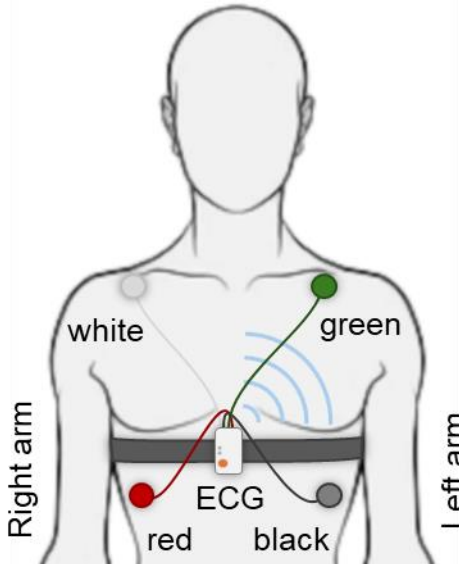

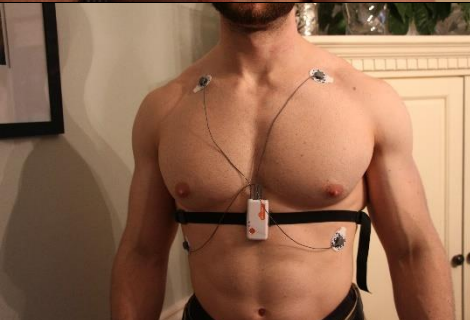


## **SUBJECT ARRIVES**

- Offer them a drink of water (also helps improve signal quality)
- Offer them a bathroom break
- Ask them to wash their hands lightly with little / no soap

### **Place Shmmer ECG (chest)**

		Thread belt through clasp
		Secure belt around waist
		Move belt up to below the chest  (above the chest is fine too, just make sure the ECG leads aren't under tension)
		Snap the heart rate monitor into plastic harness
		Snap each of four sensors into the head of the wires

		<p>The locations of the four sensors should follow the colors: <b>red, green, black, and white</b>. The locations may be moved slightly to fit the body and clothing</p> <ul style="list-style-type: none"> <li>• White on right collarbone</li> <li>• Green on left collarbone</li> <li>• Red on right rib</li> <li>• Black on left rib</li> </ul>
		<p>Ensure your skin is clean by rubbing with an alcohol pad and gauze pad (if needed) and letting the skin dry</p>
		<p>All four sensors in place, you may add medical tape on the wires to keep them in place</p> <p>Make sure the wires are not under tension because that will introduce noise</p>

## TEST SHIMMER ECG AND EDA DATA QUALITY

1. Signal quality is best when the participant is still (either standing, seated, or lying down)
2. If the task involves movement (e.g., walking), this step should involve the participant standing still
3. High quality data can still be obtained during ambulatory tasks such as walking as long as appropriate measures are taken (e.g., taping ECG leads to the skin so they do not tug on the electrodes or Shimmer device while moving).

**Physiological Tasks Starter**

Name	Value	Desc
<b>Participant Information</b>		
PP_Number		** Number in the study (1, 2, 3, ...)
Timepoint	1 ** 1, 2, or 3	
<b>Shimmer Connection</b>		
Use_ECG	<input checked="" type="checkbox"/>	** Acquire ECG data
COM_ECG	18	COM port for Shimmer with ECG
Sampling_rate_ECG_Hz	512	Sampling rate for ECG in Hz for NON-HBD tas.
Use_EDA	<input checked="" type="checkbox"/>	** Acquire EDA data
COM_EDA	9	COM port for Shimmer with EDA
Sampling_rate_EDA_Hz	64	Sampling rate for EDA in Hz (also must be set
<b>ECG R Spike Detection</b>		
Minimum_RR_Interval_sec	0.5000	Minimum duration between consecutive ECG R
Minimum_R_Prominence_mV	1 **	Minimum height of ECG R spike(mV)
<b>View and Record Shimmer</b>		
Event_name	Test	** Name of the event (Test, 6MWT, Blodex)
Plot_update_period_sec	0.5000	Time between plot updates (sec)
Plot_viewable_duration_sec	8	Visible region of plot (sec)
Test_duration_sec	Inf	Duration of test (sec)
Write_data_to_file	<input checked="" type="checkbox"/>	Write Shimmer data to text file
<b>Tactile Test</b>		
Site_of_test	L_Finger	** Name of the test site (e.g., left finger, right tc
<b>Heartbeat Detection</b>		
Number_of_trials_HBD	25	Number of trials

**Task to run**: View\_and\_Record\_Shimmer **Go!** **Close Figs** **Clear All** Ian Kleckner, URCC v.2019.06.25

Make sure the Event Name is still Test

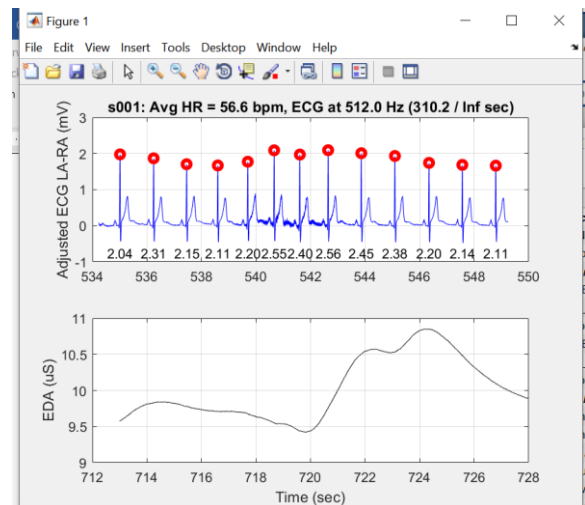
Click **Go!** in the MATLAB Physiological Tasks Starter to run the **View\_and\_Record\_Shimmer** program

**Start streaming...**

Click START to start streaming data  
To STOP press Shift + Esc

**START** **Abort Program**

Click **Start**



**Watch the signals from the ECG at the top**

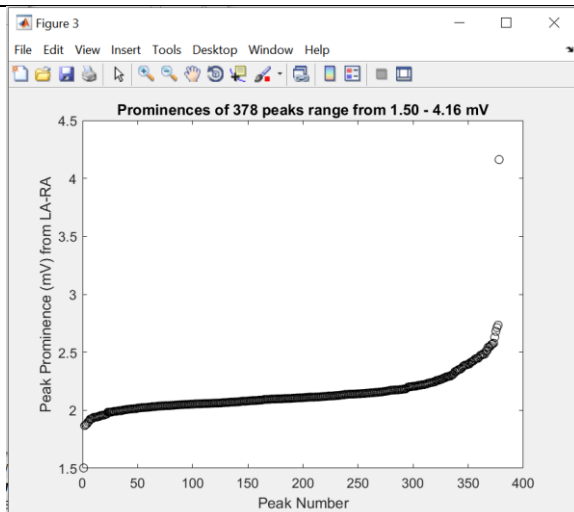
- There should be one red circle per R spike (heartbeat)
- Read the prominence values under each R spike to get a sense of its minimum value
- You can also see the T wave after each R spike
- This signal here looks good in terms of signal to noise ratio
- If there is excessive noise or artifacts, then try the following:
  - Ask the subject to sit still and upright with feet on the floor
  - Consider replacing or repositioning the electrodes after another rougher alcohol and gauze wipe
  - If the electrodes are on a region with a lot of subcutaneous fat then move them

closer to a near-superficial bone (ribs or clavicle)

- Re-initialize the Shimmer sensor (new firmware, new settings. See above instructions in red text)

#### Watch the EDA signal at the bottom

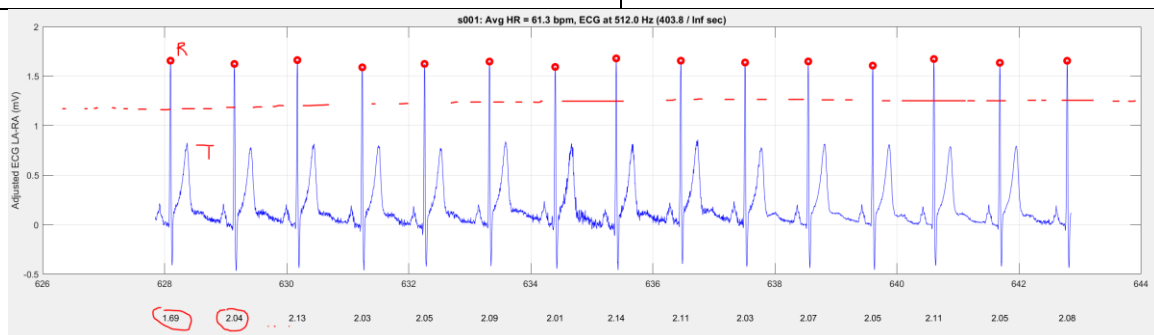
- Should look smooth and decreasing over time
- There will be some transient “responses” that increase the signal substantially over the course of a few seconds
- Ask the participant to take a big breath and hold it for a couple seconds, you should see a rise in EDA over the next few seconds after the breath hold
- If the signal does not look something like this
  - Reposition the electrodes
  - Re-initialize the Shimmer sensor (new firmware, new settings. See above instructions in red text)



**Find the best prominence value** that would have captured nearly all of these R spikes and go slightly smaller

- From this plot it would be 1.5
- But this is only if the subject is sitting in this position

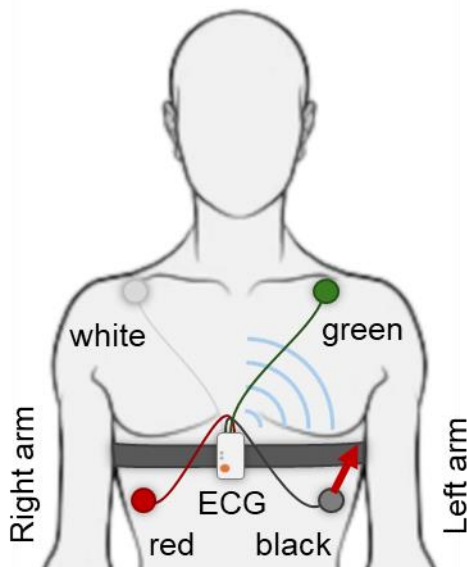
This should be small enough to catch EVERY ECG R spike, but large enough to NOT catch noise spikes



To determine the best prominence value you should **think of drawing a horizontal line through the ECG data that is between the tops of the R spikes and tops of the T waves**. Specifically, so that spikes ABOVE the line are R spikes and T waves never cross the line

These data are high quality in that the horizontal line at approximately 1.25 mV is much lower than every R spike and much higher than every T wave

The prominence values are shown at the bottom of this plot (first two are circled)



If the T-wave is very large then it might interfere with detection of R spikes.

**If needed: to reduce the T-wave, try moving the lower left (black) electrode up**

**Physiological Tasks Starter**

Name	Value	Description
<b>Participant Information</b>		
PP_Number	1	** Number in the study (1, 2, 3, ...)
Timepoint	1	** 1, 2, or 3
<b>Shimmer Connection</b>		
Use_ECG	<input checked="" type="checkbox"/>	** Acquire ECG data
COM_ECG	11	COM port for Shimmer with ECG
Sampling_rate_ECG_Hz	512	Sampling rate for ECG in Hz for NON-HBD
Use_EDA	<input checked="" type="checkbox"/>	** Acquire EDA data
COM_EDA	9	COM port for Shimmer with EDA
Sampling_rate_EDA_Hz	64	Sampling rate for EDA in Hz (also must be :)
<b>ECG R Spike Detection</b>		
Minimum_RR_Interval_sec	0.5000	Minimum duration between consecutive EC
Minimum_R_Prominence_mV	1.2500	** Minimum height of ECG R spike(mV)
<b>View and Record Shimmer</b>		
Plot_update_period_sec	0.2000	Time between plot updates (sec)
Plot_viewable_duration_sec	15	Visible region of plot (sec)
Test_duration_sec	Inf	Duration of test (sec)
Write_data_to_file	<input checked="" type="checkbox"/>	Write Shimmer data to text file
<b>Tactile Test</b>		
Site_of_test	Finger	** Name of the test site (e.g., left finger, right
<b>Heartbeat Detection</b>		
Number_of_trials_HBD	60	Number of trials
Sampling_rate_ECG_HBD_Hz	1024	Sampling rate for ECG in Hz for HBD only

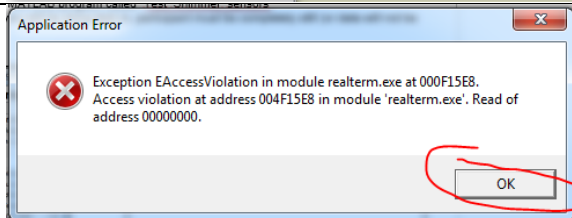
Task to run: View\_and\_Record\_Shimmer

Go! Clear

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v.2019.06.12

If needed, update the Prominence value in the Task Starter

The default value is 1 mV and this **default value can be changed** by editing Task\_Starter.m, if desired (see instructions above in red)

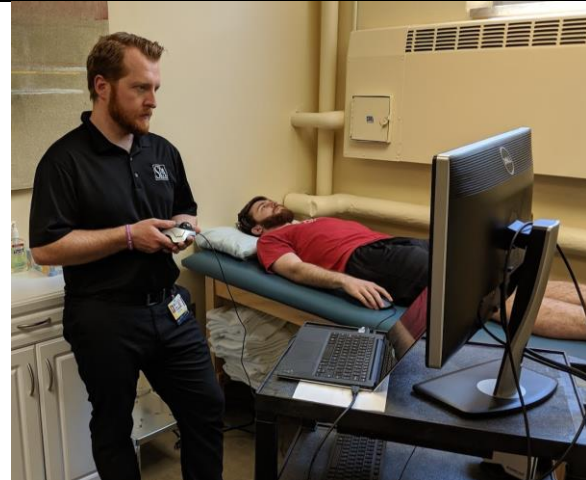


If you ever see this message, just click **OK**

It is **no big deal**, and you don't need to document it. It's just a side-effect of exiting the MATLAB programs early, so it's bound to happen.



## HEARTBEAT TRACKING TASK



Have the participant lay down on the table and make them comfortable with pillows or towels (e.g., under their neck, knees, etc.)

The participant can start the trial when they are ready by clicking the mouse button

They do not have to view the monitor during the test, but they may like to view the monitor during instructions

[Physiological Tasks Starter]

### Physiological Tasks Starter

Name	Value	Desc
<b>Participant Information</b>		
PP_Number	----	Participant Information
Timepoint	1 ** Number in the study (1, 2, 3, ...)	
Shimmer Connection	----	Shimmer Connection
Use_ECG	<input checked="" type="checkbox"/>	** Acquire ECG data
COM_ECG	18	COM port for Shimmer with ECG
Sampling_rate_ECG_Hz	512	Sampling rate for ECG in Hz for NON-HBD tas
Use_EDA	<input checked="" type="checkbox"/>	** Acquire EDA data
COM_EDA	9	COM port for Shimmer with EDA
Sampling_rate_EDA_Hz	64	Sampling rate for EDA in Hz (also must be set
ECG R Spike Detection	----	ECG R Spike Detection
Minimum_RR_Interval_sec	0.5000	Minimum duration between consecutive ECG f
Minimum_R_Prominence_mV	1 **	Minimum height of ECG R spike(mV)
View and Record Shimmer	----	View and Record Shimmer
Event_name	Test_Laying	Name of the event (Test, 6MWT, Biodex)
Plot_update_period_sec	1	Time between plot updates (sec)
Plot_viewable_duration_sec	8	Visible region of plot (sec)
Test_duration_sec	Inf	Duration of test (sec)
Write_data_to_file	<input checked="" type="checkbox"/>	Write Shimmer data to text file
Tactile Test	----	Tactile Test
Site_of_test	L_Finger	** Name of the test site (e.g., left finger, right tc
Heartbeat Detection	----	Heartbeat Detection
Number_of_trials_HBD	50	Number of trials

Task to run: View\_and\_Record\_Shimmer

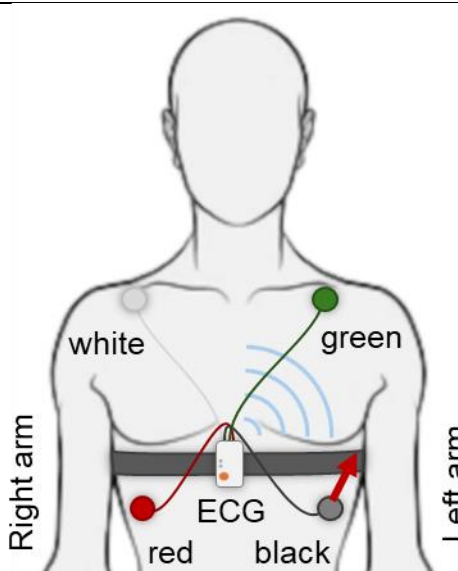
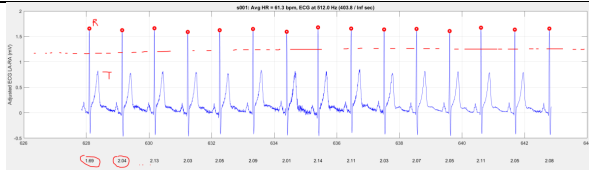
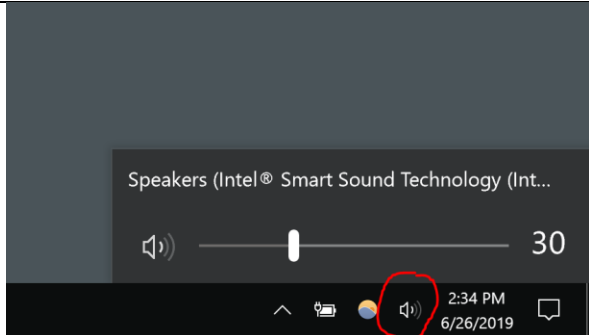
Go! Close Figs Clear All

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Because the ECG signal can change when they are lying down, check the signal again

Set sampling rate back to 512 Hz

Set the Event Name to **Test\_Laying**

	<p>Adjust electrode position if needed to reduce T wave, etc.</p>
	<p>Adjust the prominence if needed</p>
	<p>Make sure the computer volume is on and audible to the participant (try Volume=30 to start)</p>

Physiological Tasks Starter

Name	Value	Description
<b>Participant Information</b>		
PP_Number	1	** Number in the study (1, 2, 3, ...)
Timepoint	1	** 1, 2, or 3
<b>Shimmer Connection</b>		
Use_ECG	<input checked="" type="checkbox"/>	** Acquire ECG data
COM_ECG	11	COM port for Shimmer with ECG
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Use_EDA	<input checked="" type="checkbox"/>	** Acquire EDA data
COM_EDA	9	COM port for Shimmer with EDA
Sampling_rate_EDA_Hz	64	Sampling rate for EDA in Hz (also must be ...)
<b>ECG R Spike Detection</b>		
Minimum_RR_Interval_sec	0.5000	Minimum duration between consecutive EC
Minimum_R_Prominence_mV	1.2500	** Minimum height of ECG R spike(mV)
<b>View and Record Shimmer</b>		
Plot_update_period_sec	0.2000	Time between plot updates (sec)
Plot_viewable_duration_sec	15	Visible region of plot (sec)
Test_duration_sec	Inf	Duration of test (sec)
Write_data_to_file	<input checked="" type="checkbox"/>	Write Shimmer data to text file
<b>Tactile Test</b>		
Site_of_test	Finger	** Name of the test site (e.g., left finger, right
<b>Heartbeat Detection</b>		
Number_of_trials_HBD	60	Number of trials
Sampling_rate_ECG_HRD_Hz	1024	Sampling rate for ECG in Hz for HRD only

**Task to run** | **Go!** | Ian Kleckner, URCC  
HeartbeatTracking\_expt\_Shi... | **Clear** | v.2019.06.12

In the task starter program, choose the **Heartbeat\_Tracking\_Shimmer** task

Then click **Go!**

Follow on-screen instructions



The researcher should explain the task instructions by reading from the screen

**The researcher will make all responses for the subject**



## HEARTBEAT DETECTION TASK



Have the participant lie down on the table and make them comfortable with pillows or towels (e.g., under their neck, knees, etc.)

The participant can start the trial when they are ready by clicking the mouse button

[Physiological Tasks Starter]

### Physiological Tasks Starter

Name	Value	Desc
<b>Participant Information</b>		
PP_Number	1	** Number in the study (1, 2, 3, ...)
Timepoint	1	** 1, 2, or 3
<b>Shimmer Connection</b>		
Use_ECG	<input checked="" type="checkbox"/>	** Acquire ECG data
COM_ECG	18	COM port for Shimmer with ECG
Sampling_rate_ECG_Hz	512	Sampling rate for ECG in Hz for NON-HBD tas
Use_EDA	<input checked="" type="checkbox"/>	** Acquire EDA data
COM_EDA	9	COM port for Shimmer with EDA
Sampling_rate_EDA_Hz	64	Sampling rate for EDA in Hz (also must be set
<b>ECG R Spike Detection</b>		
Minimum_RR_Interval_sec	0.5000	Minimum duration between consecutive ECG f
Minimum_R_Prominence_mV	1	** Minimum height of ECG R spike(mV)
<b>View and Record Shimmer</b>		
Event_name	Test_Laying	** Name of the event (Test, 6MWT, Biodex)
Plot_update_period_sec	1	Time between plot updates (sec)
Plot_viewable_duration_sec	8	Visible region of plot (sec)
Test_duration_sec	Inf	Duration of test (sec)
Write_data_to_file	<input checked="" type="checkbox"/>	Write Shimmer data to text file
<b>Tactile Test</b>		
Site_of_test	L_Finger	** Name of the test site (e.g., left finger, right tc
<b>Heartbeat Detection</b>		
Number_of_trials_HBD	25	Number of trials

**Task to run**  
HeartbeatDetection\_expt\_Shi...

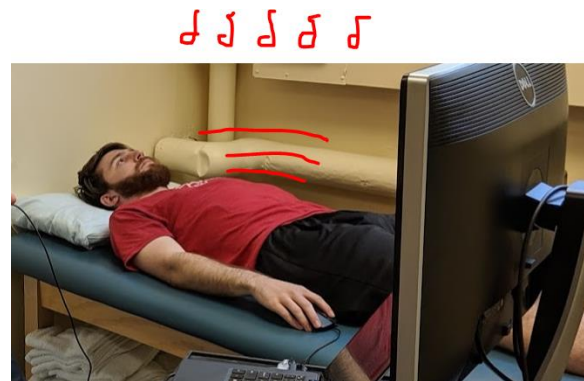
**Go!** **Close Figs** **Clear All**

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v.2019.06.25

In the task starter program, choose the **Heartbeat\_Detection\_Shimmer** task

Then click **Go!**

Follow on-screen instructions



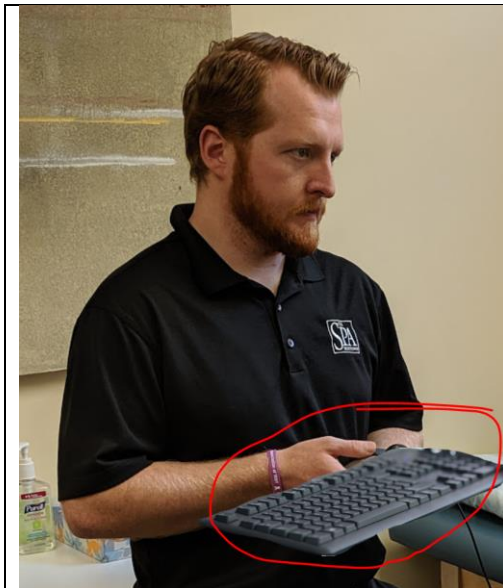
Perform a practice trial with beeps DURING heartbeats (this starts automatically before the first trial of the task)

Participants **may take their pulse** to hear beeps and feel heartbeats

Provide guidance that they can **breathe deeply, hold their breath, and exhale slowly** to increase pressure in the chest and feel their beating heart

Have them try this for a minute or two

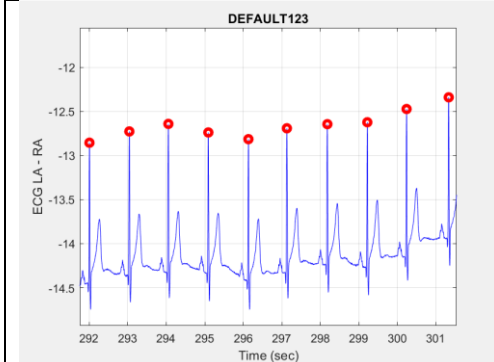
After the practice, they may not touch their bodies during the beeping



The participant will only make verbal responses for this task to make it easier and faster for them

The researcher will have their own **keyboard** to enter responses for the participant

**You can exit the practice by holding Shift + Esc**



**If there is a beeping mistake** during the trial (too fast, too slow, missed beat), the **researcher should hold Shift + Esc** to restart the trial

This task can also be done without the participant having to view anything. The researcher can enter responses for the participant while verbally asking the participant after each trial.

## REMOVE THE PHYSIOLOGICAL SENSORS

### General care and removal of sensors

- Please be careful, as these devices are very sophisticated and sensitive, as well as fragile and expensive



Never pull the wires, they might break



To remove the wires use one finger to push down on the electrode and the other fingernail to pry the sensor head off the electrode



Gently prying the sensor head away should make it pop off