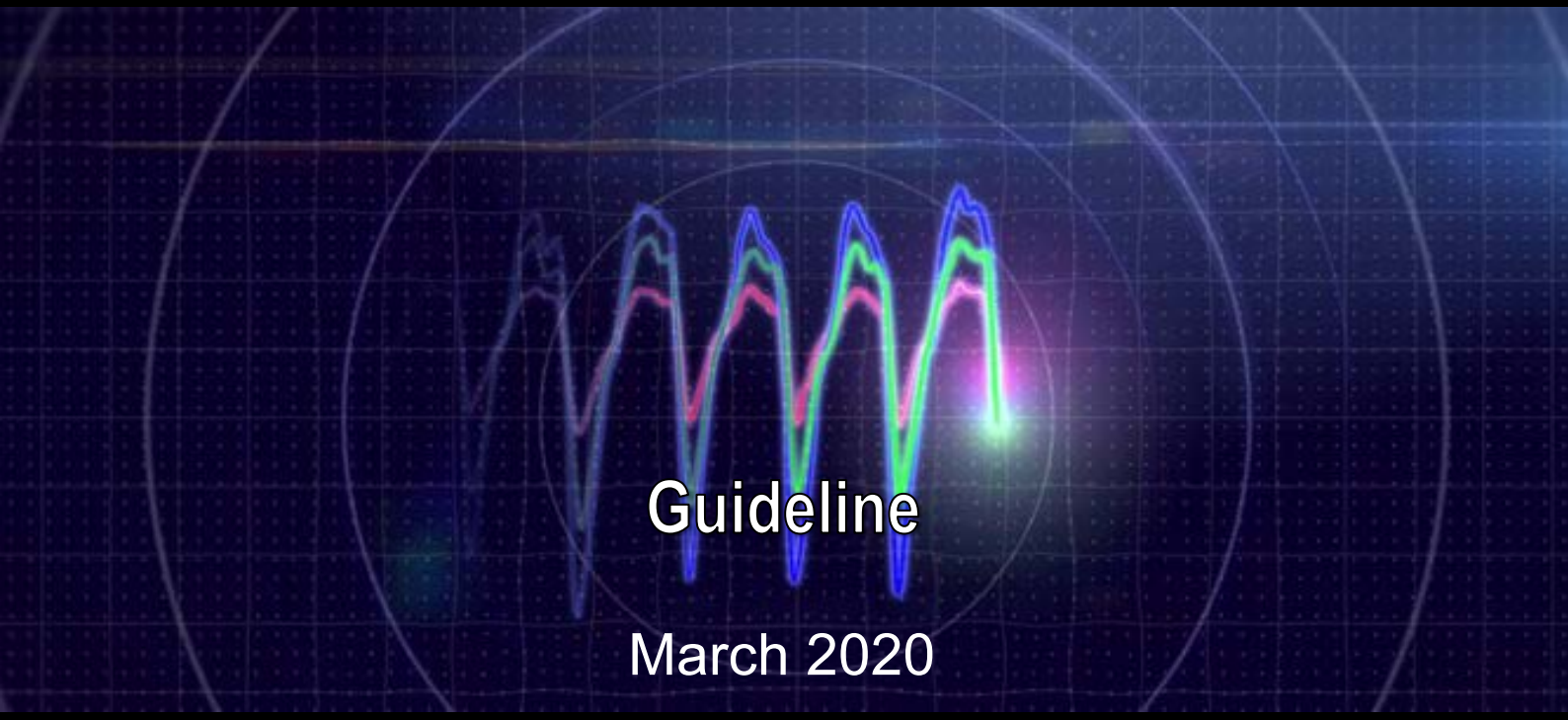
Opto-physiological Monitoring Set-up

(DISCO4 BOX)



Guideline

March 2020

Photonics Engineering and Health Technology Research

Loughborough University

Contents

Overview of Opto-physiological Measurement System

The Opto-physiological Measurement System (namely DISCO4 BOX), as illustrated below on ***Figure 1.***, captures Opto-physiological (PPG) Signals from the optoelectronic patch sensor (namely Carelight sensor) during experimental measurements. All data sets from the sensor are collected by the means of the 4-channel DISCO4 BOX and the simulation software of Carelight Sensor is performed by LabVIEW GUI.

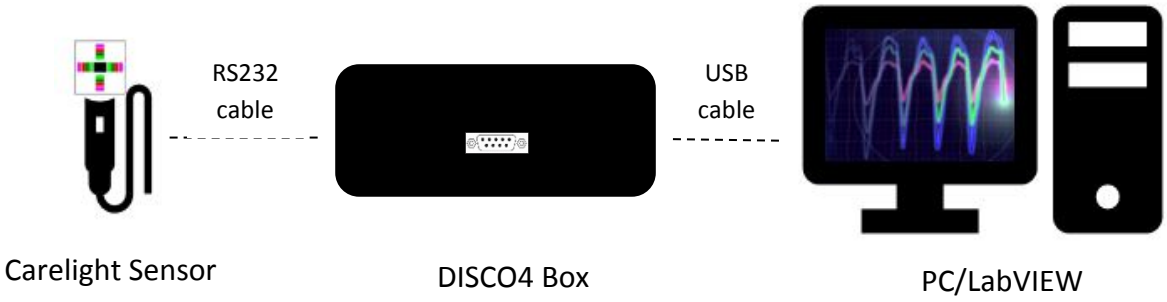


Figure 1*. The DISCO4 BOX Measurement System*

Opto-Electronic Patch Sensor (OEPS) - Carelight Sensor

Loughborough University's Carelight is a wearable Opto-Electronic Patch Sensor (OEPS) that offers continuous monitoring of vital signs including Heart Rate, Respiration Rate, Heart Rate Variability, Blood Pressure, Temperature and Oxygenation levels.

The OEPS consists of Light-emitting diodes (LED's) as multi-wavelength illumination sources (LEDs of green 525 nm, orange 595 nm, red 650 nm and IR 870 nm (JMSienna Co., Ltd., Palo Alto, CA, USA) that convert electrical into light energy and a low-profile PiN photodiode (BPW34SR18R, Osram, GmbH) as a photodetector that converts electrons as light energy into an electrical current. The Carelight sensor operates in reflectance mode (LED's and photodetector are placed side-by-side where the later collects the light reflected from various path length underneath the skin composites).

Electronics for Optoelectronic Patch Sensor - DISCO4 BOX

As illustrated on ***Figure 2.*** The DISCO4 BOX consists of:

- an Electronics Board (DISCO4, Dialog Devices Ltd., Reading, Berkshire, UK)
- a Multifunction Data Acquisition USB Device (DAQ, USB-6009, National Instruments Co., Novato, CA, USA)
- a power box

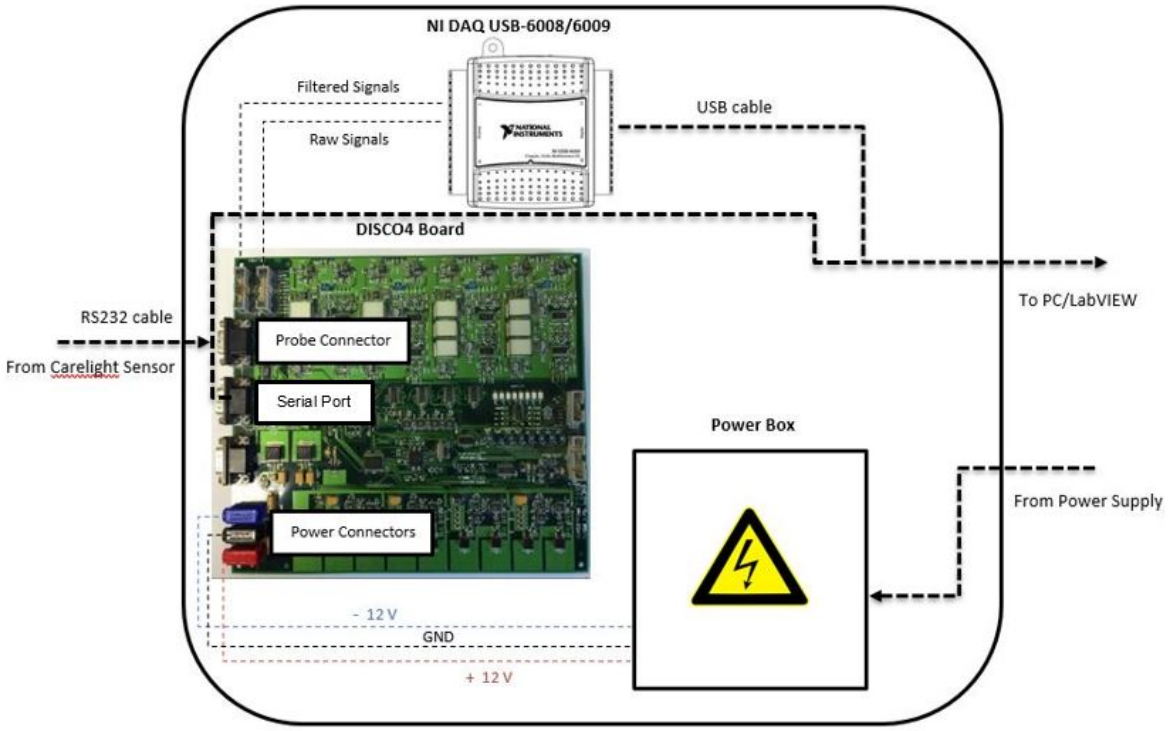


Figure 2*. DISCO4 BOX Electronics Architecture*

- The **DISCO4 board** implements a four-wavelength opto-physiological measurement system that provides all the necessary analogue signal processing to perform multi-channel Photoplethysmography (PPG).

- The **USB-6009** provides basic DAQ functionality for the portable measurements and the Analogue-to Digital Conversion (ADC) for the captured PPG signals.

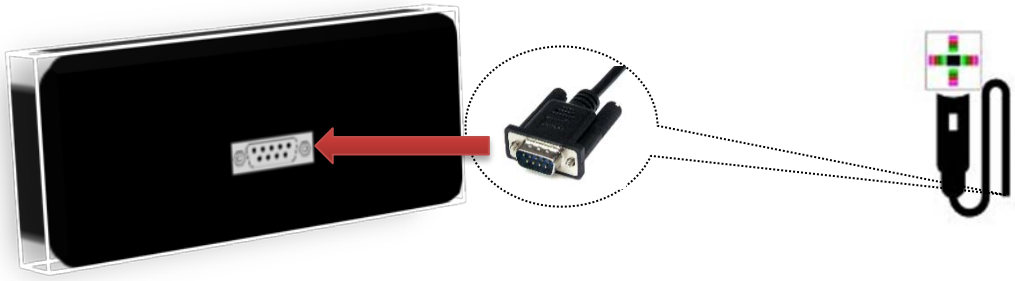
- The **power box** is an electronic internal device that converts the 220 voltage to the required voltage (12 V) and current type DC that is suitable for the operation of the DISCOA Board.

Measurement Software

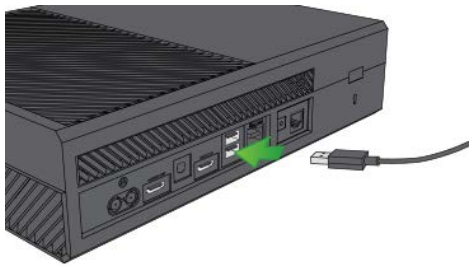
The Measurement software is a customised development tool used through the LabVIEW GUI (National Instruments Co., USA). It depicts the waveforms obtained from the Carelight Sensor, it calculates the Heart Rate (bmp), Oxygen Saturation (SpO_2%), Respiration Rate and automatically adjusts the LED intensity.

Hardware Setup Steps

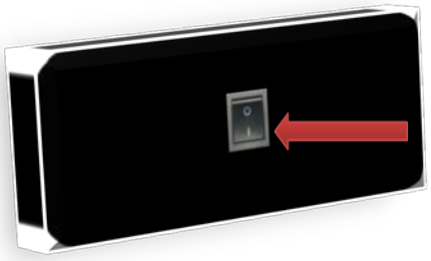
1. Connect the Carelight Sensor probe to the RS-232 (serial port) connector located in the front side of the DISCO4 BOX:



2. Plug in the USB cable from the DISCO4 BOX to a PC USB port on the PC system unit, if it is not already connected:



3. Turn on the power switch positioned on the back side of the DISCO4 BOX:



4. Ensure that the LED's on the sensor are dimly lighted as soon as you switch on the DISCO4 BOX:

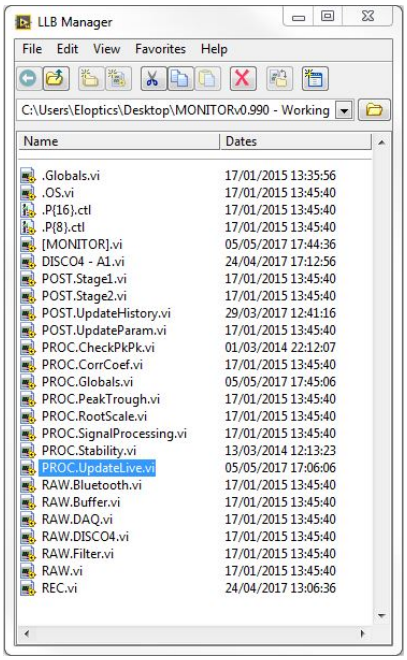
*LED's **before** turning on the switch* *LED's **after** turning on the switch*

Software Setup Steps

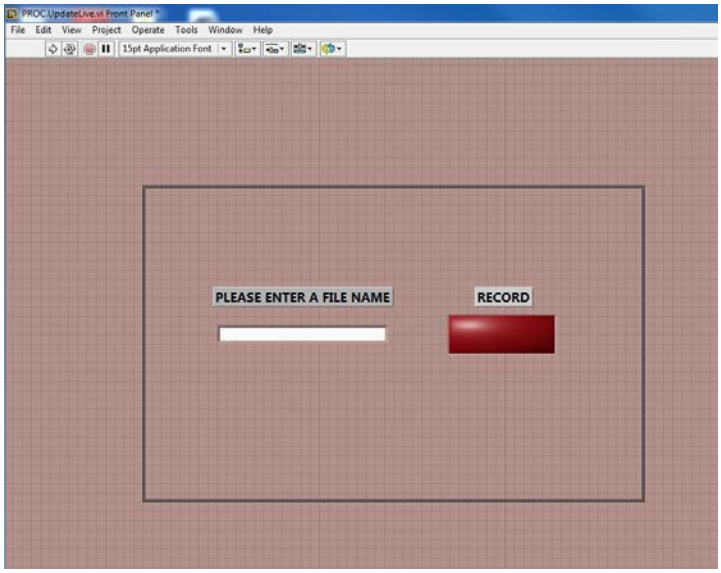
1. First start by double clicking on the **"MONITORv0.990 - Working.llb"** icon on the PC desktop to open the Carelight Sensor Software.

2. A short delay occurs, wait for LabVIEW Software to initialise and load until the LabVIEW Library File (LLB) "**LLB manager"** window appears.

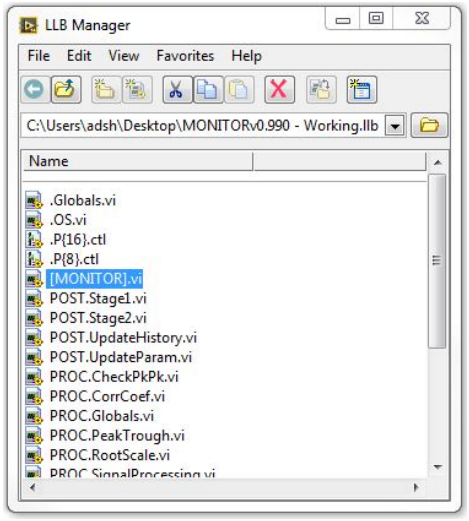
3. Once the LLB manager window shows up select the **"PROC.UpdateLive.vi"** virtual instrument (VI) option and double click on it.



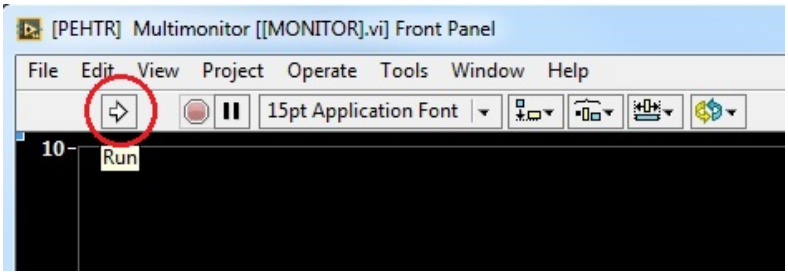
4. The **PROC.UpdateLive.vi Front Panel** window appears. Enter a file name (e.g. Student's name) on the designated text box.



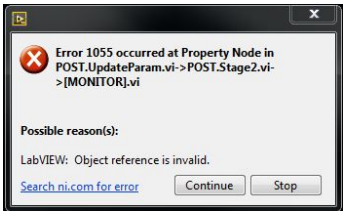
5. On the LLB manager select now the **"[MONITOR].vi"** virtual instrument (VI) option and double click on it.

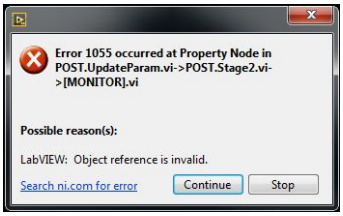


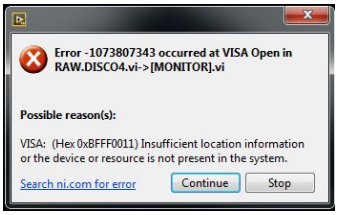
6. The **Multimonitor Front Panel** window appears in its default layout. Press **"Run"** on the toolbar.



7. Ignore the following three Error Messages to arise by clicking on **Continue** one by one.

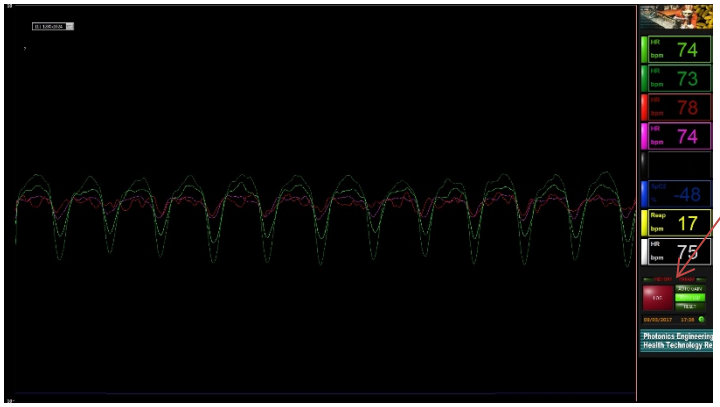




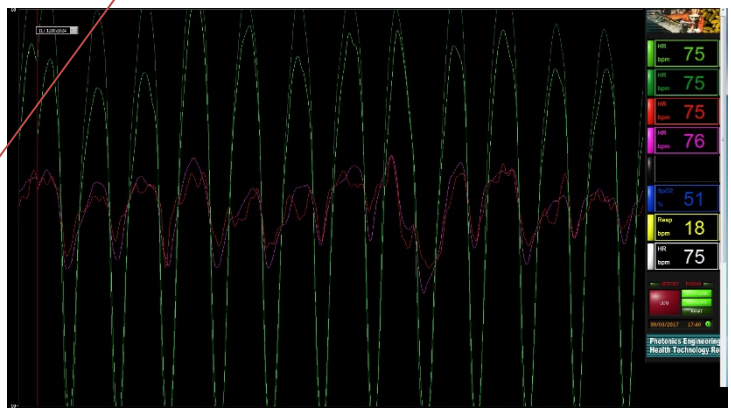


8. At this point the LED's should be fully lightened for multi-wavelength illumination. Place the Carelight Sensor against a specific location of a human body, i.e., forehead, palm, earlobe and wrist, to obtain the waveforms corresponding to the 4 different wavelength channels.

9. Select **Auto Gain** from the panel on the right.

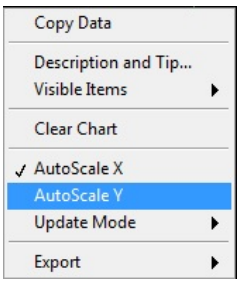


*Waveform **before** auto gain*

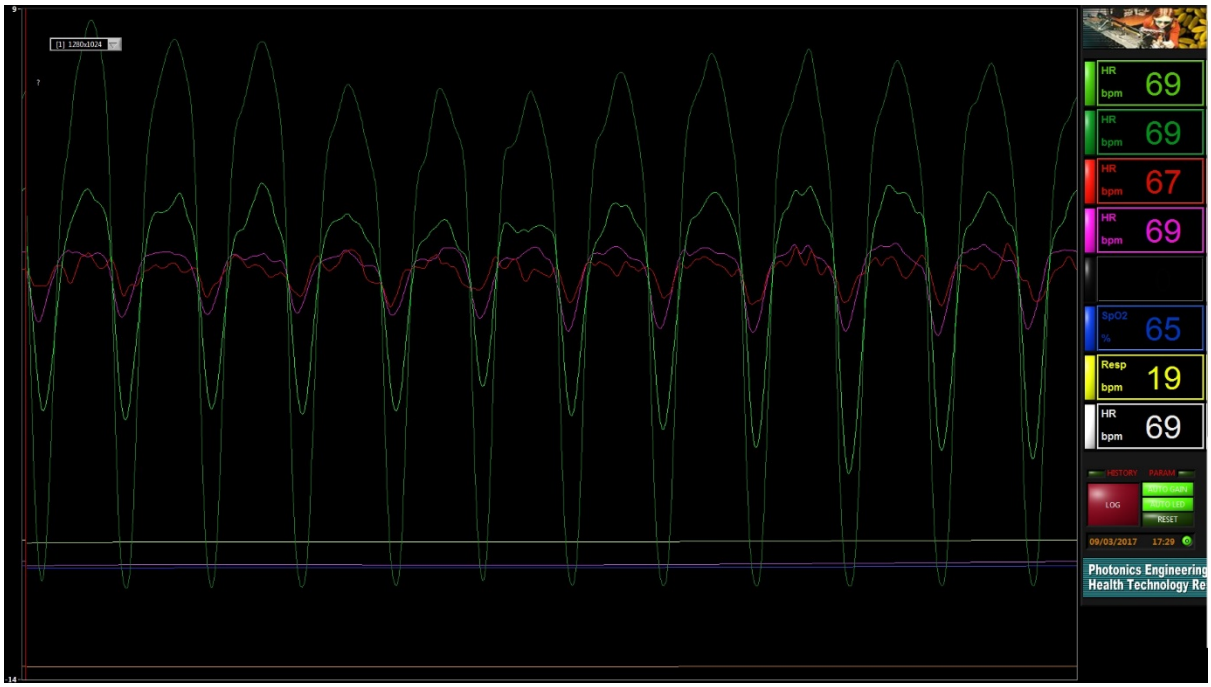


*Waveform **after** auto gain*

10. Right-click on any point of the main window and select **Autoscale Y**.



11. The wave formed signals, obtained from the Carelight Sensor, should now look like this:

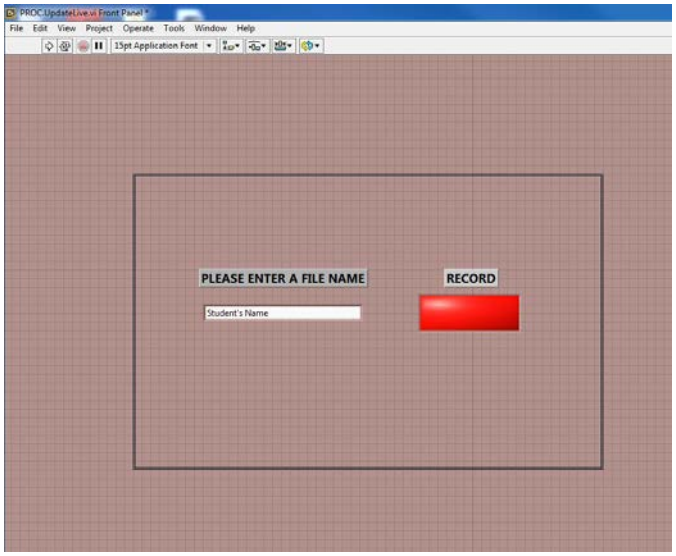


The four different coloured waveforms correspond to the four LED Illumination Sources:

- Light Green: green (525 nm)
- Green: orange (595 nm)
- Red: red (650 nm)
- Pink: IR (870 nm or 905nm)

On the right-hand side of the panel the calculated Heart Rate (bmp) is depicted for each of the four LED illumination sources per the LED illumination mentioned above.

12. To **Save Data,** on the **PROC.UpdateLive.vi Front Panel** window (**step 4**), press the **RECORD** button (turning to bright red) to start recording the measurements.



To S**top Recording** press the **RECORD** button again. Once the recording function has been stopped, a file with the file name chosen earlier (**step 4**) will be created. The measurements are saved with the file extension .txt in the folder located in **Desktop > Student Measurements**

13. To terminate the measurement procedure, press **"Abort Execution"** on the toolbar