

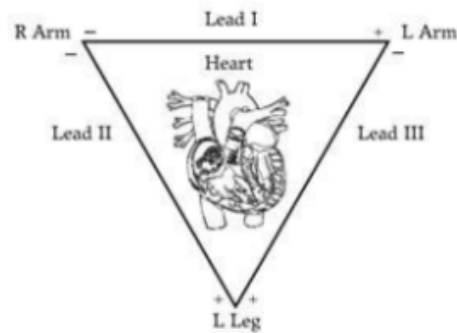
Lab 10: ECG

Purpose: To be able to measure and identify each wave of the heartbeat.

Procedure:

Fig. 10-1: The EKG

Electrocardiogram electrodes are attached to a subject in specific arrangements known as leads. Alternating leads can affect the amplitude of the EKG wave components. Einthoven's triangle (Figure 10-2), named for the "father of electrocardiography", illustrates the three leads that are normally used to record EKGs. Three electrodes are normally attached to obtain an EKG.



Note: This figure shows only the "differential" leads (+ and -). The ground lead is off to the side on the inside of the right ankle.

Fig. 10-2: Einthoven's triangle

Willem Einthoven stated that at any given instant, the potential (or amplitude) of any wave in lead II is equal to the sum of the potentials in leads I and III. Einthoven also found the following relationship to exist concerning the amplitudes of the R waves of the QRS wave complex of all three leads:

$$\text{Lead I} + \text{Lead III} = \text{Lead II}$$

This equation is known as Einthoven's Law.

NOTE: Make sure you dress accordingly for this lab to allow ease of electrode attachment. You will need to arrange yourselves in groups to be able to obtain a copy of ECG recordings from laptop computer running the Iworx program. Everyone in your group should do a Lead II recording (10-A), and at least one person in your group should do all three leads (10-B). However, if you are **organized**, you will be able to do 10-A and 10-B **at the same time**. Simply record Lead II first (10-A), then shift the lead wires to record Lead I and finally Lead III (10-B). If time allows, and you are organized, everyone in your group may be able to do all three leads.

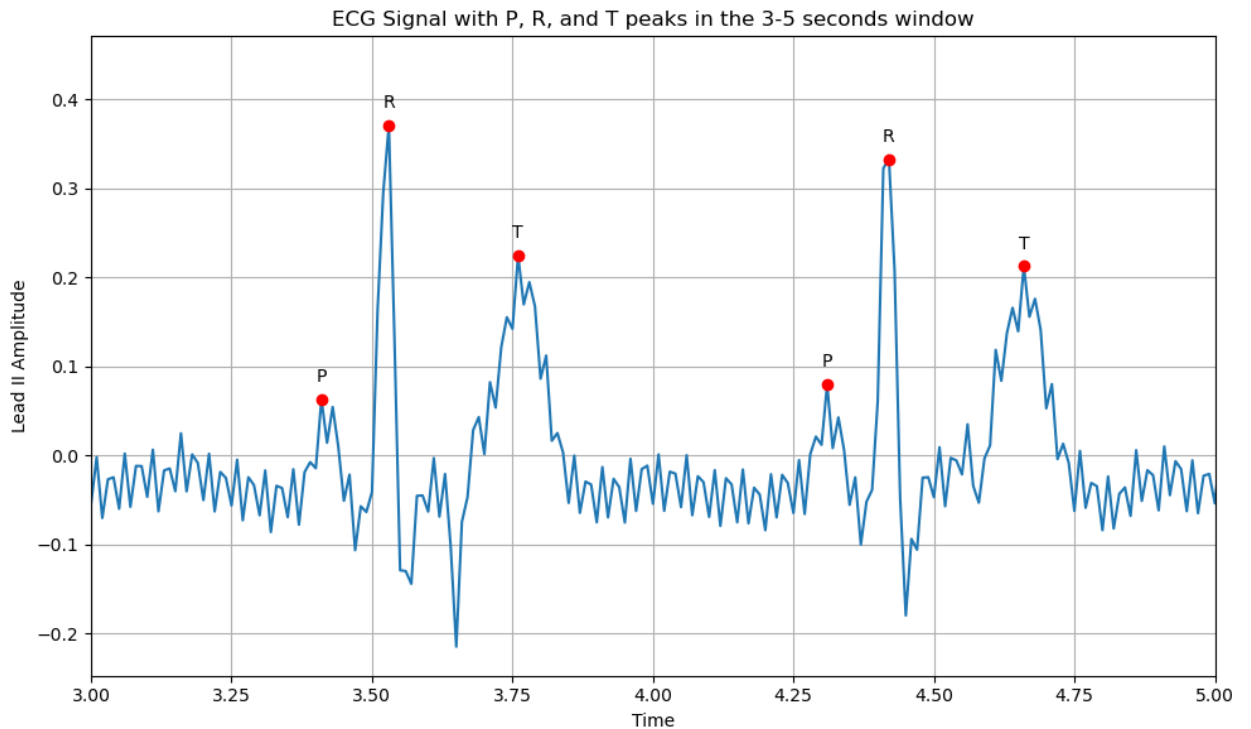
10-A: Recording the EKG – Lead II

Procedure

1. To get things started:
 - **Before you turn anything on**, be sure the **IWX/214 unit** is plugged in, and that the IWX/214 unit is connected to the laptop by USB cable.
 - Be sure that the **C-AAMI-504 EEG cable** is inserted into the isolated inputs of Channels 1 and 2 of the IWX/214. Be sure that the **three color-coded lead wires** are correctly inserted in the lead pedestal of the C-AAMI-504 EEG cable. Insert the connectors on the red, black, and green electrode lead wires into the color-coded matching sockets on the lead pedestal of the ECG cable. The white and brown lead wires can be removed and neatly placed in the Iworx case, you do not need them for Lab 10, but after the week is over they will need to be replaced.
 - Once everything is connected, **FIRST turn on the laptop** and allow it to **fully boot up before** you turn on the IWX/214 unit. Once the Iworx unit is on, the red indicator light on the Iworx unit should light up and you may hear the USB chime from the laptop if the laptop does not default to mute (many are set to default to mute).
2. Open the Labscribe3 program by **clicking on the Labscribe3 icon** on the desktop. As soon as the program opens, you should see a window pop-up that says "**Hardware found IWX214:2008-1-24**," click "OK."
3. In the second from the top row (the row that says "File Edit View Tools Settings Advanced External Devices Help"), click on the "**Settings**" tab. About one third of the way down the drop-down window should be a tab called "**Human Heart**." Click on that tab and that should lead you to a tab called "**ECG-HeartSounds**." Click on that tab and the main window will look like this after you close the pdf file:

5. Remove the disposable ECG electrodes from its envelope and **snap the lead wires** onto the electrodes while the electrodes are still on the plastic shield. Instruct the subject to **remove all jewelry** from their wrists and ankles. Use an alcohol swab to **clean** a region of skin on the subject's right wrist, and the inside of both ankles. Let the area **dry**.
6. **Apply the black (-1) electrode** to the scrubbed area on the right wrist. Repeat Steps 5 and 6 for the inside of the left ankle and the inside of the right ankle, so that the following Lead II is arranged:
 - the **black (-1)** lead is attached to the **right wrist**,
 - the **red (+1)** lead is connected to the **left ankle**,
 - the **green (C or ground)** lead is connected to the **right ankle**.
7. Instruct the subject to **sit quietly** with their hands in their lap. If the subject moves, the ECG trace will move off the top or bottom of the screen. If the subject moves any muscles in the arms or upper body, electromyograms (EMGs) from the muscles will appear on the ECG recording as noise.
8. Click on the **Record** button, located on the upper right side of the LabScribe **Main** window. The signal should begin scrolling across the screen. If the ECG appears upside down in Lead II (upside down P, R and T waves), click on the upside down triangle on the far left of "**∇A1:ECG 0.3-35Hz**," then click on the first option "**Invert**." This should correct the image of your Lead II ECG to be "right side up," but do this **ONLY ONCE**.
9. When you have a suitable trace, type **<Subject's Name> Lead II** in the **Mark box** to the right of the **Mark button**. Press the **Enter** key on the keyboard after the recording has started to attach the comment to the data.
10. Click on the **AutoScale** tab at the upper margin of the **ECG** channel (look for the row that says on the left "**∇A1:ECG 0.3-35Hz**" the **AutoScale** tab is the second icon after "Hz," it looks like a magnifying glass with a **↑** symbol on it). Your recording should look like the figure in step #4. If the ECG waves appear too compressed (too close together), consider clicking the tab above the "**Mark**" tab that looks like a snow-capped pyramid. When the mouse is on top of this tab, it will say "**Half Display Time**." Clicking this tab will spread out your ECG patterns for step 11. If you overdo that last step, reverse it by clicking on the tab that looks like double pyramids ("**Double Display Time**") just to the right of the Half Display Time tab.
11. Record for approximately one minute and then click **Stop** to halt recording. **Label** one set of the five ECG waves (P, Q, R, S and T). Notice that every cycle is similar but not identical, and the distances between the QRS complexes may alter slightly.

Results:



Discussion: For another experiment, I would want to see the difference between a heartbeat of someone with caffeine in their system compared to no caffeine. Would the waves be condensed or would there just be more heartbeats?

Conclusion: This lab was a simple yet dense one due to the amount of information you collect using simple technology. The ECG tells us so much information about our heart's health and by collecting our own data there seems to be no problems.