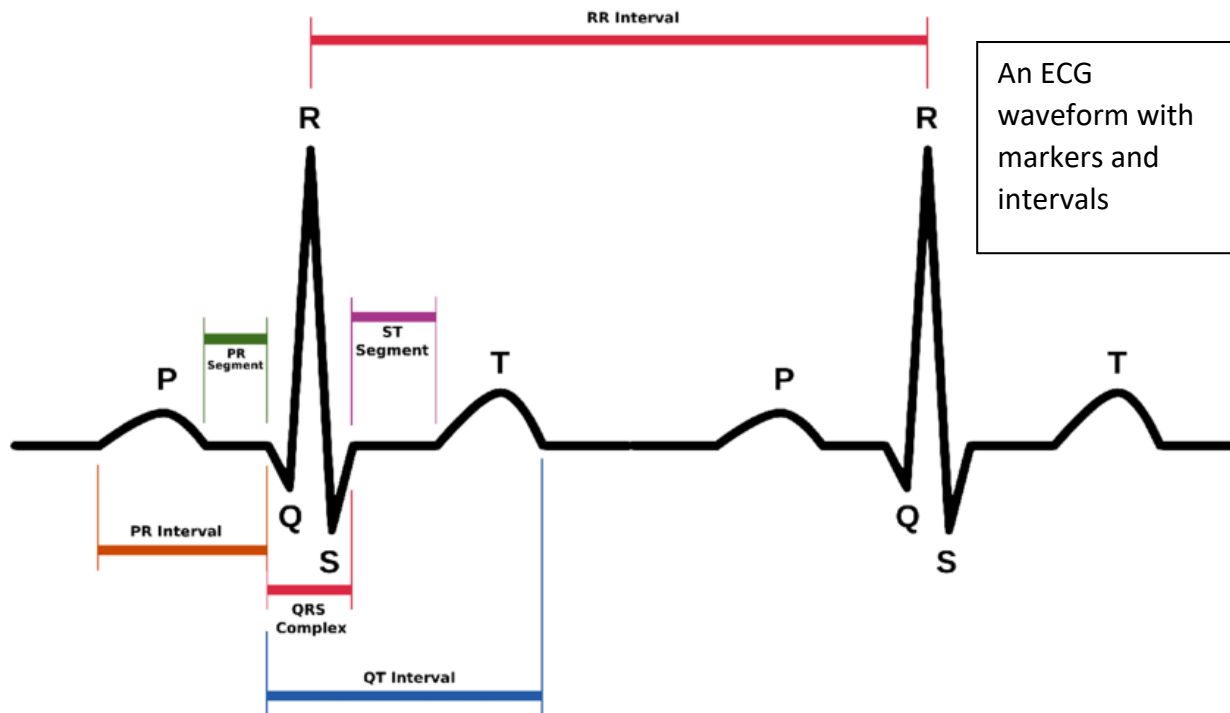


First Year Engineering Problem Solving Labs - Final Project:

Engineering Problem #1: Analysis of an Annotated ECG Signal

1. Understanding the problem

For this problem, my goal is to analyse each patients' ECG reports and comment on what the data illustrates about the patients' relative cardiac health. I will focus my analysis on the measures of the heart rate and the average PR-interval. The relevant information that I am given are the ECG reports for the patients, background knowledge on ECGs, a labelled diagram of an ECG cycle, and a website to refer to for more information. To solve this problem, I will have to use the fundamental knowledge of MATLAB, plotting graphing, analysing graphs, analysing ECG reports, calculating the heart rate, and calculating the PR-interval.



2. Devising a plan

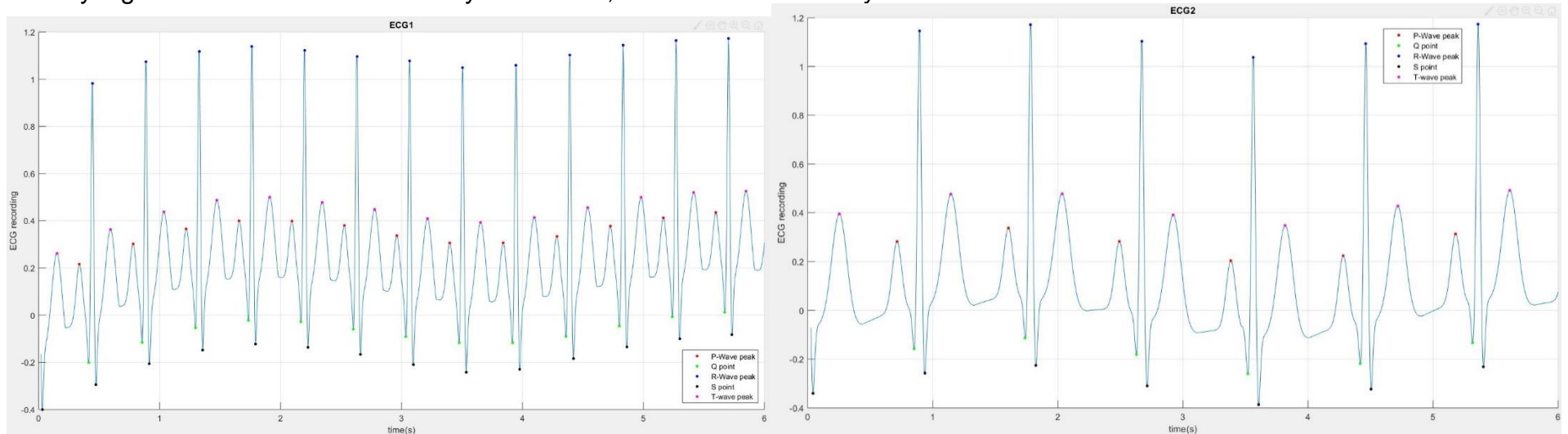
- Load the files.
- Plot the ECG report of patient using the ECG recordings(y-axis) and time(x-axis) columns.
- Use for loop and conditional statements that evaluates the marker column at every point.
- Locate and plot the P-wave peak, Q point, R-Wave peak, S point, and the T-wave point on the graph.
- Use the above diagram and the linked website to calculate the heart rate

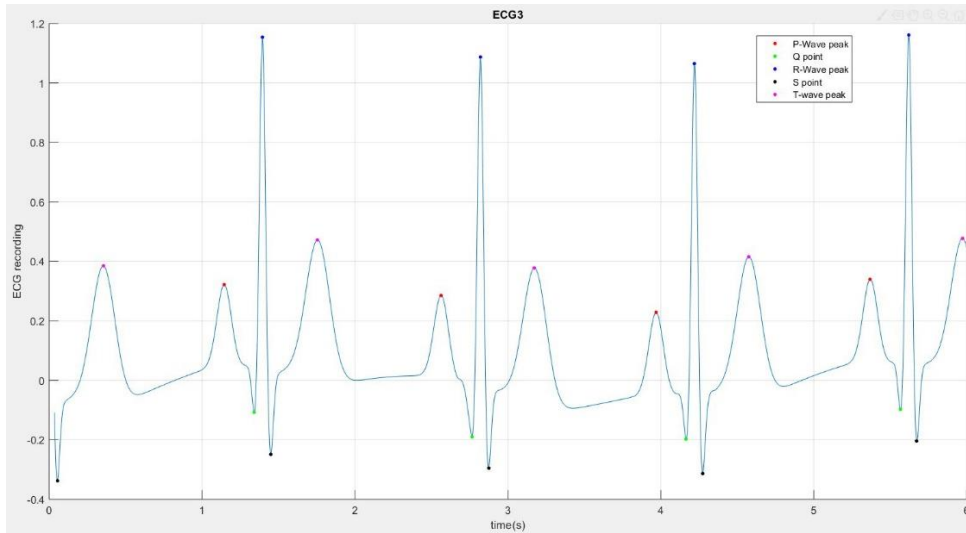
- vi. Use for loops to calculate the average PR interval.
- vii. Analyse the plot and the calculations to comment on the patients' cardiac health using the linked website.
- viii. Repeat steps i-vi for all the patients.

For this problem, I have assumed that the PR interval lies halfway between the T-Wave peak and the P-Wave peak, and half way between the P-Wave peak and the Q point.

3. Carrying out your plan

To solve this problem, I used my processes from step two. I also used several MATLAB skills such as for loops, conditional statements, plotting graphs, labels for plots, and more to achieve my plan. From this, I was able to calculate the heart rate; both PP and RR rate to check for consistency. I was also able to estimate the average PR interval. The following images represent the plots of each ECG. A file of my MATLAB script is also attached with the submission. From my plan from step 2ii), I initially plotted the whole matrix but the result was not very suitable to analyse. Thus, I adapted and made the domain of the graphs to 6 seconds I chose this because the domain is not very big that it becomes hard to analyse the data, and it is not extremely small that it becomes hard to follow trends in the data.





4. Looking back

I know that I have adequately addressed the problem because I have achieved my goal and the requirements of the problem statement. I know I have achieved my goal because I was successfully able to analyse each patients' ECG reports, measure the heart rate and the average PR-interval, and comment on what the data illustrates about the patients' relative cardiac health. I know this because I manually calculated and estimated the results to assure the output of the code is accurate. From this, I was able to learn the fundamentals of analysing an ECG report and the concepts of the cardiac system. I also learned that MATLAB can be used to extrapolate lots of data very quickly and can be used in engineering problem solving by utilizing methods such as for loops, conditional statements, plotting graphs, labelling plots, and many more. MATLAB can also make it easier to calculate results as there will be fewer chances of error in calculations and they are computed quickly too. Modifications that I made to the existing plans were that I chose to plot the ECG reports over an interval of 6 seconds. This is because the domain is not very big that it becomes hard to analyse the data, and it is not extremely small that it becomes hard to follow trends in the data. From my analysis of the graphs, I made an assumption that the PR interval lies halfway between the T-Wave peak and the P-Wave peak, and half way between the P-Wave peak and the Q point. As the graph follows the same trend, I decided to calculate the heart rate on only one PP and RR interval.

Thus, from my calculation and analysis, I was successfully able to calculate the heart rate and the PR interval for each patient. Patient1 has a heart rate of about 135 bpm and a PR interval of about 0.13 seconds which shows that the patient1 has sinus tachycardia and a normal PR interval. Patient2 has a heart rate of about 67 bpm and a PR interval of about 0.3 seconds which shows that patient2 has normal heart rate, and first-degree heart block or trifascicular block. Patient3 has a heart rate of about 42 bpm and a PR interval of about 0.49 seconds which shows that patient3 has sinus bradycardia, and first-degree heart block or trifascicular block.