Biomedical Signal Processing
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Lecture - 30
Waveform Analysis (Contd.)

So, after signal length, let us see for the ECG form analysis and first we create that motivation of that.

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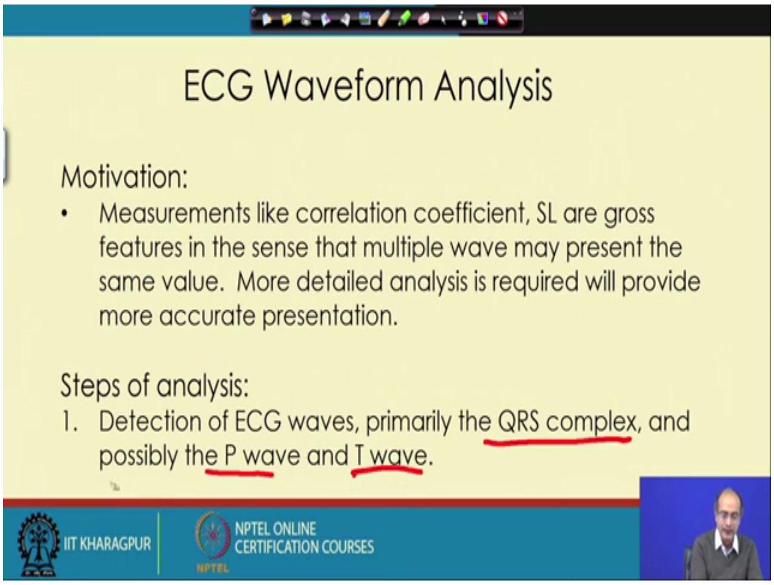

And there are measures like correlation coefficient and signal length; however, they provide actually the gross picture of that situation. Because there could be multiple waves which can give raise to same value of the correlation coefficient or signal length. And that actually gives that idea that if we want to get more accurate answer. We need to have better measurements and we need to have more detailed analysis of this wave forms.

So, from that point of view, some scales are suggested to do that part first thing is that detection of the ECG waves and primarily the QRS complex because we know the QRS complex is the one which has the most energy. So, they can be detected with much more confidence and along with the QRS complex using that the information by the location of the QRS complex, we can possible get the P and the QT wave.

Now, this P and the T wave, we are suggesting possibly the reason is sometimes, they become more difficult to get because of noise as well as due to different abnormalities, they may not be actually that you will be not able to find them clearly, they may get actually almost lost in the that noise. So, primary thing that we should get QRS complex and with the help of that if possible we would take the P and T wave for our analysis.

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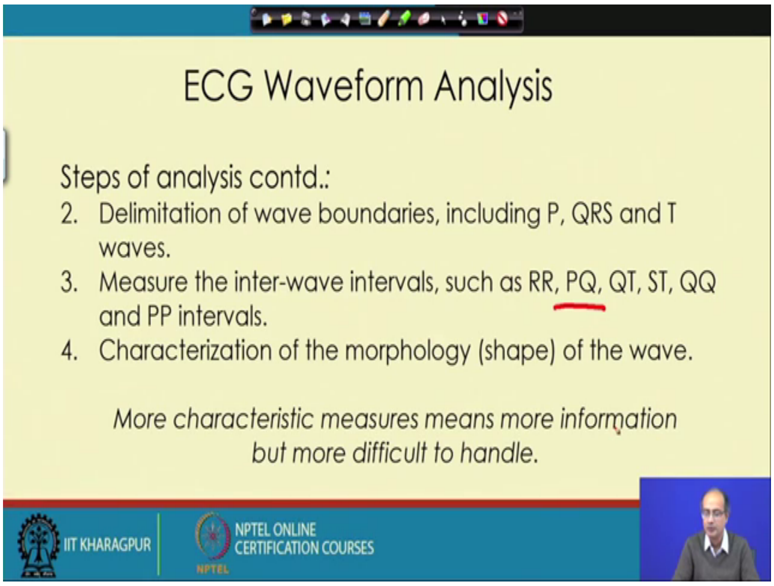

So, the next step is that delimitation of the wave boundaries including the P QRS T waves. So, using the information of the location QRS we try to draw the boundary where the signal energies are located. So, instead of trying to find out the period layer we are interested to get the boundary of P, QRS, T; that means, what is the starting point of P and where the T gets. So, we are interested is that because that the part where the that action potential of the that muscles tissues they are present.

So, we are looking at that and next part is that measure the inter wave intervals now all kinds of the measurements get can out of the that the ECG signal, RR interval, PQ interval, QT interval, ST interval, QQ interval, PP interval. So, we can think of all possible intervals, we are measuring and that actually gives us the idea that how these energies are placed or misplaced in the signal. So, though it will not give us the exact nature; that means, the intensity of the waveform, but any elongation any contraction of the each of these components that will be visible by the these measurements.

Next we look at that the characterization of the shape of the signal. So, that next part would be that how the signal looks like. So, that part will be done and in this way that we could actually get better measurement there is a hope that we get more information about the signal more closely looking at that signal, but it is having one problem that they are more difficult to handle the reason is not just that we have to do the more computation the main challenge is when we are taking more and more measurement we need to think of the reliability of those measurements, if we fail in finding out the location of anyone of them for example, we are talking about the PQ segment. Now, if we cannot faithfully find out the location of P and Q that measurement will be corrupted by errors and that can actually change the whole scenario.

We are taking that as a feature to describe the signal and we expect that that will give us when get full information about the signal, but in that case if we get more noise that can actually update the whole strategies that is why we should keep in mind that more the measurements, it becomes more to handle. So, that is the meaning of that actually word.

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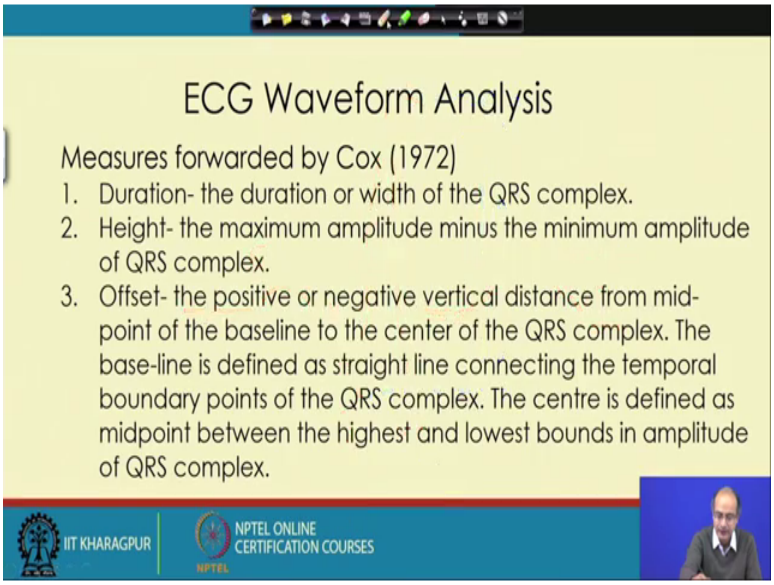

So, now let us look at one such scheme proposed by Cox in 1972, they are given a very simple scheme, but quite affective what they have the suggested the duration of the width of QRS complex should be the first feature.

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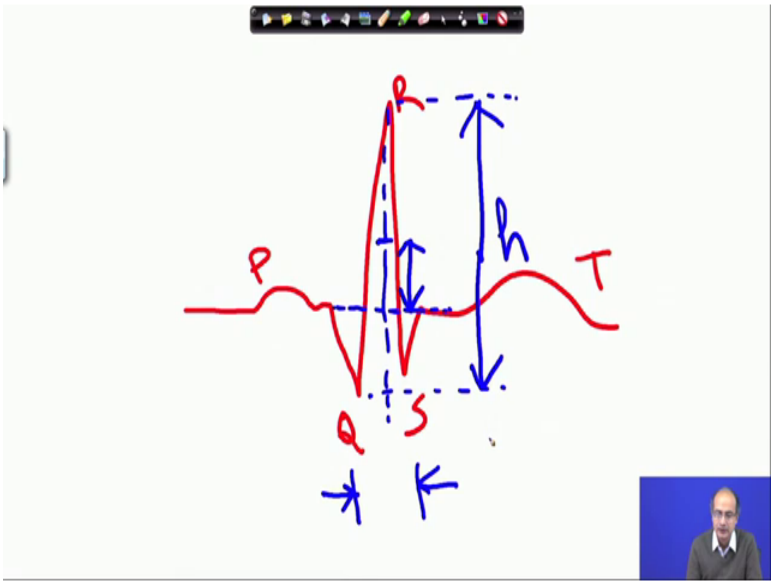

Now, let us look at the picture again. So, that it becomes clear easier to us that there is our P wave followed by the QRS complex and then P. So, this is P, QRS and T and the width of it QRS complex we can take that this is the width starting from Q to S. So, that gives us the width of the signal that is the first actually point next we look at.

The height means when we are talking about the height that we have the lowest point is Q and highest point is R. So, this is the height of the wave H. So, this is the height of the wave and then we can look at that more thing, we would look at something called offset. So, let us look at the picture to get what is the offset that we have isolitric or isopotential line is here and the midpoint of the edge the midpoint of edge is somewhere here. So, that the difference of that midpoint of edge and that base line these two actually is taken as the offset..

So, these are the 3 important the point that is taken let us look at the definition that the positive or negative vertical distance from the midpoint of the baseline to the center of the QRS complex the baseline is defined as straight line connecting the temporal boundaries of the QRS complex and the centre is defined as the midpoint between the highest and the lowest boundaries in amplitude of QRS complex.

So, with that that we get 3 important actually measurements to describe the QRS complex the first is widths next is height to together these that how much energy is concentrated in that and how quickly the changes are happening and whether it is symmetric or not we know it is not symmetric in most of the cases.

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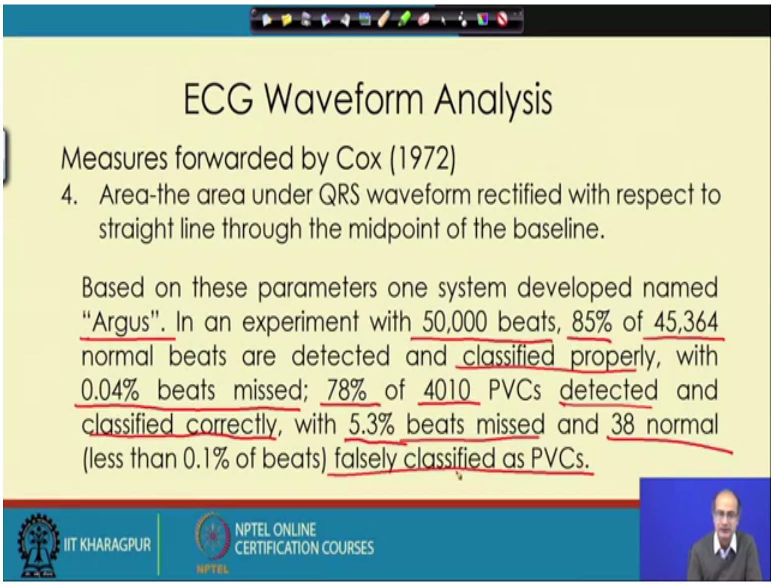

So, how much is the asymmetric that offset is giving a measure of that. So, let us see is the area under the QRS waveform rectified with respect to the straight line through the midpoint of the baseline.

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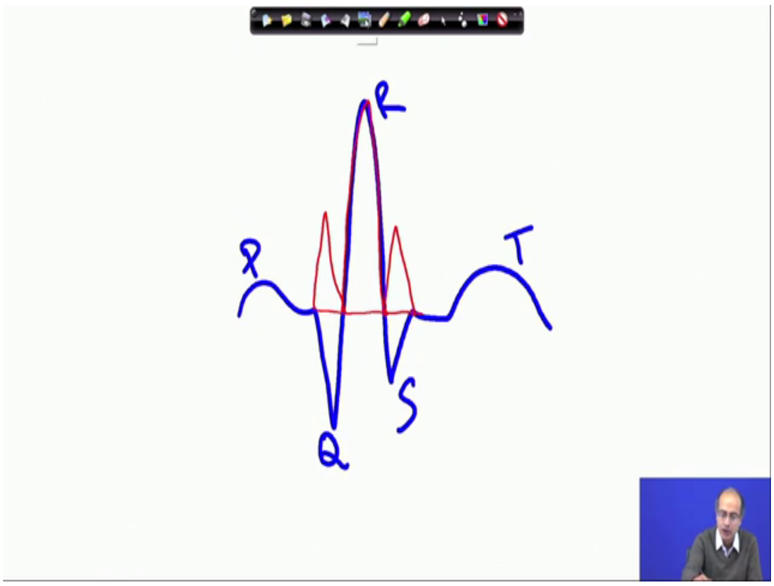

So, what is suggesting if we have a QRS complex P, QRS, T. So, if we can think of that the midpoint of base line that with respect to that if we rectify the signal; that means, these parts should become positive now this part would be also positive and this part is already positive; so, the area under this actually that plot that is actually taken as another measure which gives us some notion of actually the energy in the signal.

So, based on these they have designed a system named Argus that and they have done a extensive experiment with 50,000 beats out of which that 85 percent that is 543 64 are normal beats were detected and classified properly and with 0.04 beats are missed. So, this gives some idea that when we go for a complex plan that how the things become difficult the first part of it is to find out that every cycle and the first step of it is to find out the width that is the R wave.

And even for the normal signal 0.04 percent beats they are beats; however, the good part of it that those we could find that the beats properly for those cycles all of them that we could actually properly classify next we look at the PVCs that 4010 of the PVCs that is that out of 78 percent are detected and classified properly and that 5578 percent; 5.3 percent beats are missed and 38 normal are falsely classified as PVCs ok.

So; that means, point one percent of the beats they are actually falsely classified as PVCs so; that means, both that positive error and negative error both are present we could get a reasonable accuracy, but it is far from ideal in this case. So, that motivated to do more research we have just presented that what is the strategy to take care of these and how we can actually attempt to solve these kind of problem and design a system which can actually analyze the ECG signal and thereby we can separate out the different kind of that that different kind of signals that we stop here this section.

Thank you.