**Optical Wireless Communications for Beyond 5G Networks and IoT**
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**Lecture - 15**
**Part - 3**
**Higher order CSK**

So, just now we have seen the probability of error or SER Symbol Error Rate for four CSK constellation.

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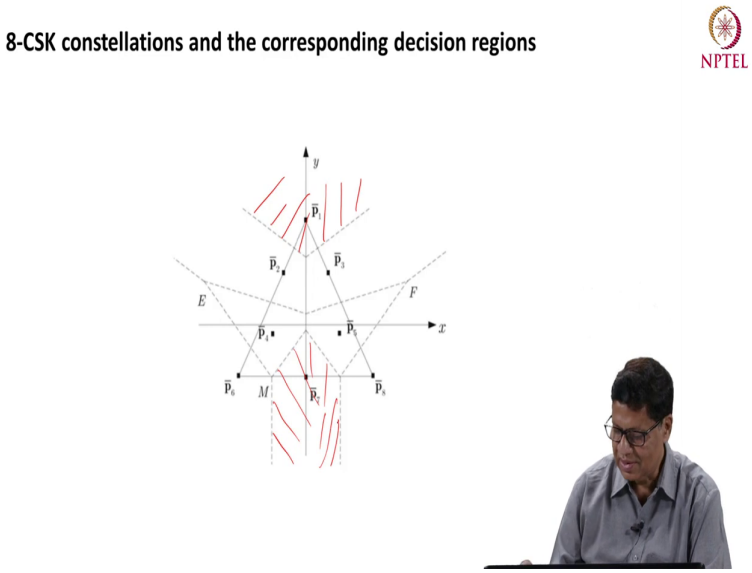


Now this is for the 8-CSK constellation and here in this diagram we have shown the decision regions. So, for P 1 this is the decision region for example. For P 7 this is the decision region.

Similarly, for other constellation points so, in the similar way one can calculate the probability of symbol error rate for 8-CSK system.

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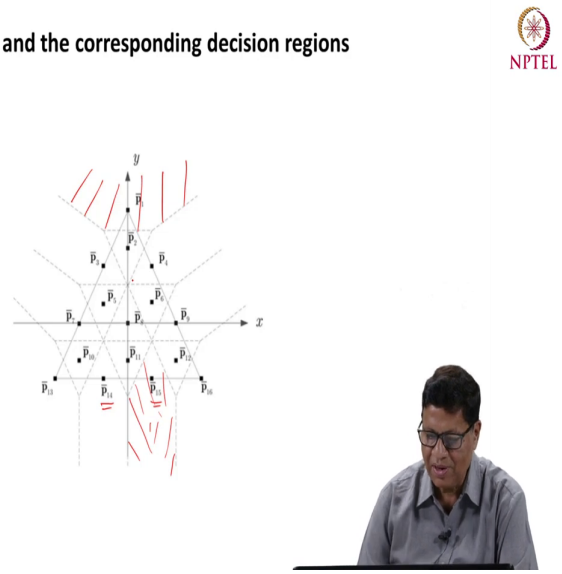


And this is example of a 16CSK constellation diagram and corresponding decision regions. So, actually some of the decision regions are you know of same shape. So, you will get same value of probability error for example, P 2, P 5, P 6. So, these are of same and then there are P 4 and P 9 they have different shape. So, you need to calculate probability of error for each one of them and then sum them up take the average.

So, this is for example, for P 1 and P 14 and P 15 they have same decision regions. So, you will get same value here, which is the decision region for you know P 15. So, similarly you can calculate the probability of error for each of the decision region and then total probability of error can be calculated.

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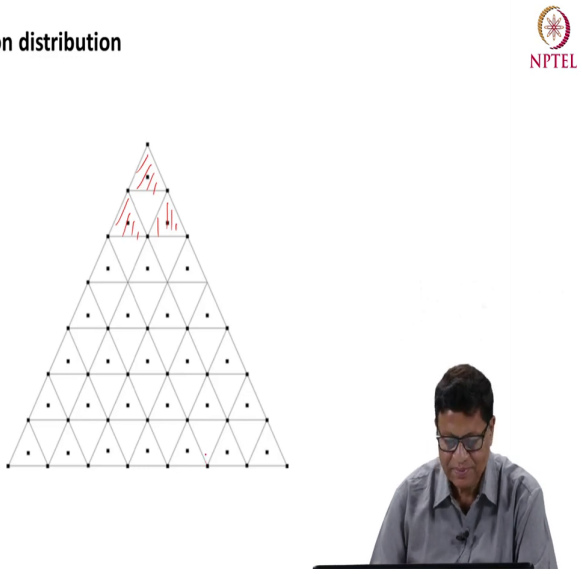


This is for a 16 4 CSK constellation points. So, basically if you see the constellation diagram and the decision regions is same for all the points. So, you calculate for any one point and then one can find out the constellation point and the total probabilities or symbol error rate for a 64 CSK constellation distribution.

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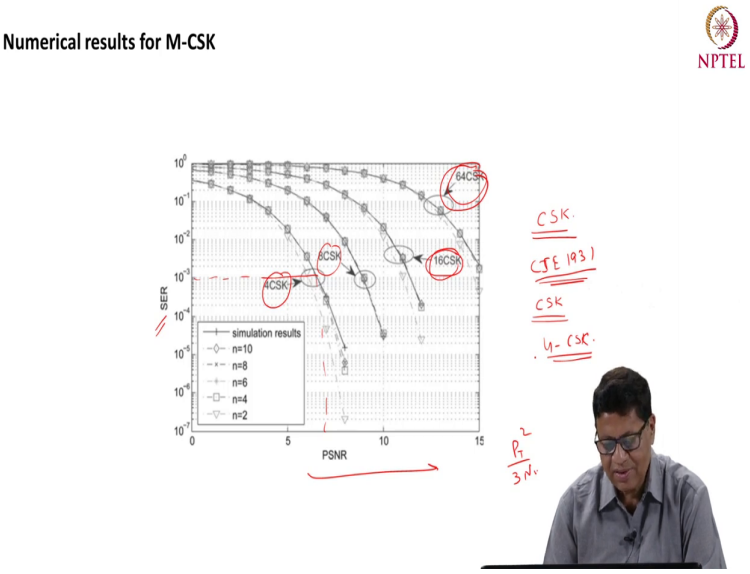


And if I plot those curves because that integral is difficult to solve so, you have to solve it numerically and this is a result for different CSK. This is 4CSK, 8CSK, 16CSK, and 64CSK and these are the simulation and analytical results. So, the dashed lines are analytical results and the hard lines are sim simulation results.

So, in this side you have the PSNR which is given as P T square over 3N naught and this side you have the symbol error rate for different constellation diagrams. So, for 4 CSK for example, to be 10 raise to the power minus 3, you require close to 7 or 8 db of SNR and as you increase the value of m on the number of points because the distance between the Euclidean between the two constellation points or the Euclidean distance gets reduced.

Hence, you require more PSNR, or more power for the signal to get ten to the power minus 3 and the same holds for 16CSK and 64CSK. So, this with this we complete the discussion of

CSK modulation. So, in this lecture we understood about the CIE diagram, which is one ninth third chromaticity diagram, there you can map any color to x y coordinates and then we discussed the advantage of CSK, the block diagram of a CSK system and we also calculated the symbol error probability for a 4CSK system.

And also discussed you know how to calculate or how to find out the decision regions for 8CSK or 16CSK and then we have seen a comparative study of you know different M-CSK in this particular diagram. So, this completes the discussion of color shift keying and also towards the end one of the TA of the course will explain how to simulate a CSK system using MATLAB. So, you will get a chance to understand how to simulate a CSK system.

Thank you.