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ECE251 Assignment 5 explanation

1. Instead of explicitly program in the decision regions, I decided instead to find the constellation point with minimum distance to the received sample. This increases simulation time but makes the simulation more robust and easier to transfer to non-standard constellations.
2. –
3. – See pages 2 and 3.
4. – The match is pretty good especially for higher EbNos. For lower EbNo, there is as much as an 8% discrepancy between theoretical and simulation. This may be due to the theoretical over-estimation from the Union Bound simplification, as I understand the over-estimation error is inversely proportional to EbNo.
5. –
6. I chose the bandwidth of the RX LPF to be 1100Hz (fc = 550Hz), which accounts for the 1000Hz main-lobe bandwidth as well as the 10% extra bandwidth from the RC filter. I also had to divide y(t) by the peak value of the filter to get the right scaling on the output so the sampled signal would fit in the decision regions. This has to do with the scaling of the filter impulse response and that I’m passing the signal through one RC filter instead of 2 SRRC filters. This also boosts the power of the received signal by 9dB, but that’s okay since we’ve already received the signal.
7. There is approximately a 0.3dB shift in the EbNo plots for case 1 (SRRC) and case 2 (RC and LPF), indicating that case 2 produces a slightly higher bit error rate for corresponding EbNo. This shift is due to the excess noise power that the LPF produces that the SRRC does not. This difference is quantified as the total power of the filter multiplied by the noise power. When my script is run, it puts into command line the vector of differences (in dB) between the LPF noise power and the SRRC noise power. The resulting difference is .3604 dB which matches up with the visual shift in the EbNo plot between the two cases.