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ECE251 Assignment 4 explanation

1. –
2. I calculated Es as the average of the squared symbol magnitudes, as per the definition. To scale the signal magnitude such that Eb is as desired for the given EbNo, I scaled the signal by a square-rooted conversion factor. Square rooted because I’m trying to scale a magnitude to fit an energy ratio.
3. –
4. –
5. I used detections corresponding to the four graph quadrants as we discussed in class for 4QAM.
6. To calculate properly the number of bit errors for each symbol error, I simply added together the absolute value of the real and imaginary errors and divided by 2. E.g.   
   TX: -1-j   
   RX: 1+j  
   |-1-1|+|-j-j| = 2+2 = 4  
   4/2 = 2 bit errors  
     
   TX: 1+j  
   RX: -1+j  
   |1+1|+|j-j| = 2 + 0 = 2  
   2/2 = 1 bit error
7. –
8. My simulation largely matches my calculated theoretical, although there is a slight deviation the larger the SNR gets. This could be explained by the tendency of the theoretical value to underestimate the error rate due to the approximations we made in the derivation, although I’m not sure if the discrepancy is supposed to be this large. After checking against the results from this forum post: <http://www.dsplog.com/2007/11/06/symbol-error-rate-for-4-qam/>, my theoretical results for SER vs SNR seem about equal with theirs, although their simulation results seem to match more closely to their theoretical. Please advise.