Problem 10.32 In this experiment, we simulate the effect of various mismatches in the communication system and their effect on performance. In particular, modify the MatLab scripts of the two preceding problems to:

(a) Simulate the performance of a system using rectangular pulse shaping at the transmitter and raised cosine pulse shaping at the receiver. Comment on the performance degradation.

(b) In the case of matched root-raised cosine filtering, include a complex phase rotation exp(jθ) in the channel. Plot the resulting eye diagram for θ being the equivalent of 5, 10, 20, and 45°. Compare to the case of 0°. Do likewise for the BER performance. What modification to the theoretical BER formula would accurately model this behaviour?

Solution

(a) We can create this mismatch by inserting the statements:

```
pulseTx = ones(1,Fs);

pulseRx = [  0.0064    0.0000   -0.0101    0.0000    0.0182   -0.0000   -0.0424 ...
             0.0000    0.2122    0.5000    0.6367    0.5000    0.2122   -0.0000 ...
            -0.0424    0.0000    0.0182   -0.0000   -0.0101    0.0000    0.0064 ];
Delay = floor((length(pulseTx)-1)/2 + (length(pulseRx)-1)/2 + 1);
Eb    = sum(pulseTx.^2);
```

And by modifying the statements

```
S    = filter(pulseTx,1,[b_delta zeros(1,Delay)]);
De = filter(pulseRx,1,R);
```

Then we obtain the performance shown below. Part of the loss seen is due to the filter mismatch but part of it is also due to a timing error; with the arrangement of the simulation the optimum sampling point for the data falls between the discrete samples. This sampling time loss could be recovered by interpolation.

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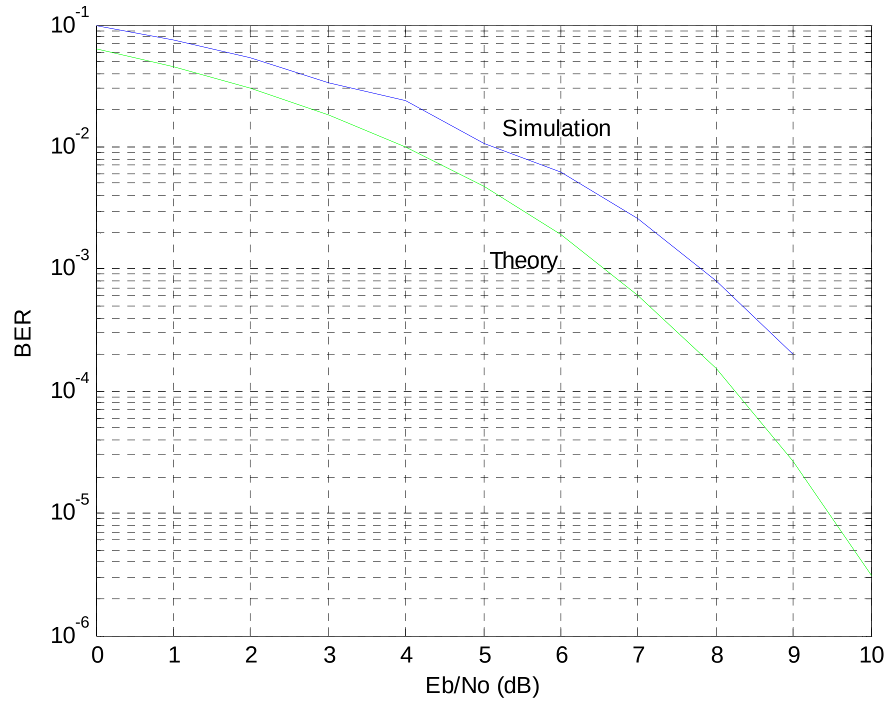
Problem 10.32 continued



(b) Implementation of the phase rotation requires simulation of the complete complex baseband. To do this we must modify the channel portion of the simulation to the following

```
%--- add Gaussian noise ----
Noise = sqrt(N0/2)*(randn(size(S))+j*randn(size(S)));
R  = S + Noise;
R  = R*exp(j*10/180*pi);
R  = real(R);
```

Where we have now included the quadrature component of the noise. Note the receiver only uses the in-phase portion (real part) of the signal to characterize this degradation. The resulting performance for rotations of 10, 20 and 45° are shown below. Note that the 45° rotation results in a 3 dB loss in performance.

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Problem 10.32 continued