Design of Time-Limited Pulses
EE321 Term Project
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1 Overview
In this project, we coded and verified [1]. More specifically, our implementation has three components.

1.1 Spectrum generation
We used a modified version of the DFT algorithm to get an accurate estimate of the spectrum from simple DFT calculations.(as described in Chapter 13-9 of [2])

1.2 Using Matlab’s inbuilt optimization routine to optimize weight coefficients for minimizing MSE(Mean Square Error)
Matlab’s fmincon function was used to reduce the MSE(Equation 3, [1]) subject to the constraint that out-of-band-energy is lesser than the original out-of-band-energy for the truncated square root pulse.

The proposed algorithm in Equations 6 − 9 in [1] was not implemented directly as the value of the step size $\mu_0$ was not specified. Different schemes exist for estimating $\mu_0$ and $\mu$ which would give different results. Moreover, those schemes are implemented in Matlab’s inbuilt routine.

1.3 Symbol Error Probability Estimation
The symbol error probability was estimated once using the technique in [3], and again by a brute force enumeration. The values were found to be very close.

2 Results
Figure(1(a)) shows a plot of the spectra of BTRC, RC, and POLY pulses. This is seen to be in good agreement with the plot in Fig 1, [1].

The Table 1 lists the out of band energy values for the time limited square root Nyquist pulses. They can be seen to be in close agreement with values in Table 1 , [1].

Sample values of SEP for $\frac{\tau}{T} = 0$ have been tabulated in Table 2. These can be compared with Table IV,(11).

3 Discussions and Comments
• Due to space limitations, only a single value of $\frac{\tau}{T}$ and $\alpha = 0.35$ was simulated.

<table>
<thead>
<tr>
<th>Pulse Type</th>
<th>Out of Band Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raised Cosine</td>
<td>4.3314e-5</td>
</tr>
<tr>
<td>Better Than Raised Cosine</td>
<td>5.0858e-4</td>
</tr>
<tr>
<td>Poly</td>
<td>1.7910e-3</td>
</tr>
</tbody>
</table>

Table 1: The out of band energy corresponding to different time truncated pulses
• The SEP values in the table 2 correspond to the approximation of the original time limited pulse in the cosine basis and not the original pulse itself. This was done to ensure compatibility with values presented in [1].

• The optimization we ran did not use information about the first derivative of the objective function (as opposed to the implementation in [1]). Even then, the default ‘active-set’ algorithm in Matlab using the objective function values directly, gave good results and sometimes better SEP performance and lower MSE values.

References

