EE 477 Final Project

1. Frequency Domain Equalization (FDE)

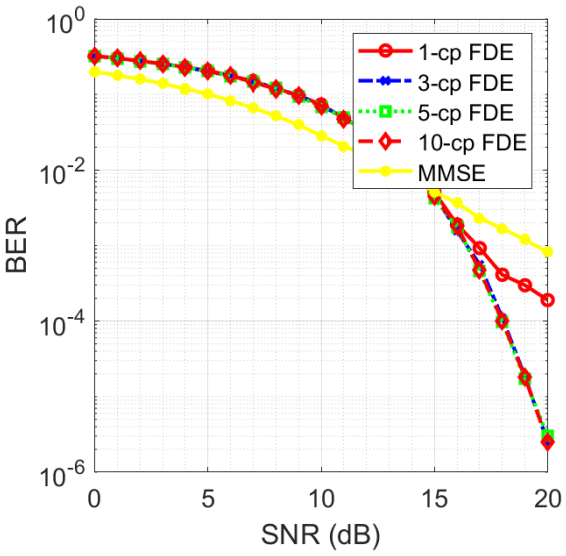

Fig. 1: BER performance comparison between 1, 3, 5 and 10 cyclic prefix (cp) FDE and 10-tap MMSE equalization methods.

As the cyclic prefix increases, firstly we see a better BER performance but after 3-cp it doesn't seem to differ that much.

In this type of equalization, before the ISI channel, we add a cyclic prefix to the channel coefficient vector. This is because we want to do a circular convolution using linear convolution function conv().

The ISI and AWGN channel calculations will be the same but in the equalization, the received signal vector is trimmed to get rid of the cyclic prefix. Then, FFT of this vector is calculated. By dividing this vector with FFT of the channel coefficient vector, an estimation of FFT of the transmitted vector is calculated, and IFFT of it will be an estimation of the transmitted vector. The rest is the detection algorithm that we are used to.

2. Channel Estimation

The method in [1] is utilized to make a ML single shot channel coefficient estimate. The RMSE values between the estimated channels and the true channel are 0.17, 0.047 and 0.19 for 5, 10 and 20-pilot symbols respectively.

The cases given in Fig. 2 can be ordered according to their BER performances as 20-pilot, 5-pilot, 10-pilot, 0-pilot. I don't know what I did wrong but trained cases seems to be superior over the ideal case.

Actually, the only trick I did was related to the case of 5-pilots. At the beginning, since the length of the channel is same with the number of pilot symbols, it was resulting in singular matrices in the calculations. To overcome this, in case of any singular matrix, both the number of pilot symbols and the number of symbols in a single frame will be scaled by 2. For example, instead of 5 pilots for 1000 symbol, it uses 10 pilots for 2000 symbols, and then the algorithm will be able to calculate a good approximation of the channel.

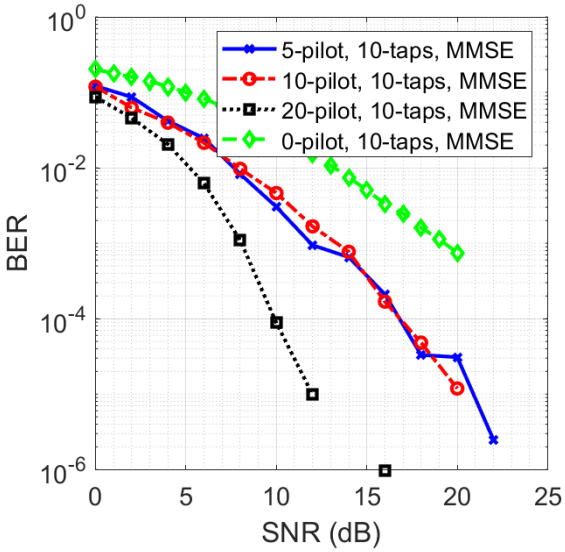

Fig. 2: BER performance comparison between 0, 1, 3, 5 and 10-pilot MMSE equalization methods.

REFERENCES

[1] Ding, B. L. Z. BP Lathi, Zhi Ding-Modern Digital and Analog Communication Systems-Oxford University Press (2009). Signal, 6, 1, p. 689.