EDC310

Practical Assignment 2

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Introduction

You are to develop a simulation platform[1] for a communication system transmitting information over an additive white Gaussian noise (AWGN) multipath channel.

Use the simulation platform developed in *Practical 1* to develop a simulation platform that includes the effect of multipath in the received signal, where the channel impulse response (CIR) length is $L = 3$. Determine the tth received symbol by

$$r_t = s_t c_0 + s_{t-1} c_1 + s_{t-2} c_2 + \sigma \left(\frac{\varkappa + j\varkappa}{\sqrt{2}} \right) \tag{1}$$

$$\sigma = \frac{1}{\sqrt{10^{\frac{E_b}{10N_0}} f_{bit}}} \tag{2}$$

where s_t is the tth transmitted symbol and $\mathbf{c} = \{c_0, c_1, c_2\}$ is the CIR. Moreover, σ is the noise standard deviation and $\varkappa$ is a sample drawn from a zero mean, unity variance Gaussian distribution.

Two CIR types should be used - static and one dynamic. The CIRs are given below:

$$\mathbf{c}_{static} = \{0.29 + j0.98, 0.73 - j0.24, 0.21 + j0.91\} \tag{3}$$

$$\mathbf{c}_{dynamic} = \{\frac{\varkappa + j\varkappa}{\sqrt{2 \cdot 3}}, \frac{\varkappa + j\varkappa}{\sqrt{2 \cdot 3}}, \frac{\varkappa + j\varkappa}{\sqrt{2 \cdot 3}}\} \tag{4}$$

$\mathbf{c}_{dynamic}$ is generated anew for every transmitted data block.

Methodology

For the practical, determine the SER and BER of the communication strategies. The procedure for the communication strategies is to generate a large set of bits and modulate the sequence into a sequence of symbols. The sequence of symbols is divided into blocks of length N = 200. The most probable transmitted symbols are then determined by using Decision Feedback Equalisation (DFE) or Maximum Likelihood Sequence Estimation (MLSE) using the given static or dynamic impulse response. The transmitted symbols are then converted back to a sequence of bits. The input sequence of bits and sequence of symbols are then compared to the transmitted bits and symbols to get the SER and BER. This should be done for the range [0; 15] dB.

[1] All software must be developed in *Python* 3.

This procedure should be done for both the DFE and MLSE algorithms. Both algorithms should be tested with the BPSK and 4QAM modulation schemes. All the tests should also be done with static and dynamic impulse responses.

For a more in-depth look and instructions, refer to the pre-practical lecture slides, and the evaluation script.

Instructions

An evaluation script is provided with pre-defined functions. The evaluation script should be completed to perform the aforementioned tasks. The script should then be uploaded to AMS before the deadline, the 4th of October.

- The last submission will be taken as your final submission.
- Ensure all the Python functions are callable, even if it does not return the correct answer. If the file can not be imported, then it can not be marked.
- Do not copy! The copier and the copyee will receive zero and disciplinary action will follow for both parties.
- For any questions, please make an appointment with Prof. Myburgh or Mr. Fourie.