ALaRI: Digital Signal Processing

Exercise Session 5: OFDM transmission

Deepaknath Tandur, Paschalis Tsiaflakis, and Toon van Waterschoot[1]

May 2013

Goal: to create an m-file for simulating and evaluating the OFDM transmission over a non-ideal (i.e., noisy and frequency-selective) transmission channel.

Requirements: Matlab in Windows or Linux, 4 m-files (ofdm_experiment.m, ofdm_mod.m, ofdm_demod.m, ber.m).

Outcome: 1 m-file (ofdm_experiment_channel.m).

Exercise 5-1: OFDM – transmission over a non-ideal channel

Create a Matlab file "ofdm_experiment_channel.m" that will serve to evaluate your OFDM transmitter and receiver design for non-ideal (i.e., frequency-selective and noisy) channels. You can start from the ofdm_experiment.m file created in Exercise 4-1, and reuse the ofdm_mod.m, ofdm_demod.m, and ber.m functions implemented earlier.

1. **Additive noise**
   (a) Add GWN to the receiver input signal, with a user-defined SNR.
   (b) Compare the BER obtained for different QAM constellations at a given SNR.
   (c) Run the same experiment for different SNRs.
2. **Frequency-selective (multipath) channel**
   (a) Set SNR $= \infty$ dB and insert a channel with transfer function $H(z) = h_0 + h_1 z^{-1} + \cdots + h_L z^{-L}$ between the transmitter and receiver, with a user-defined channel order L. The channel coefficients can just be random numbers, or you can choose them yourself (but make sure that the channel properties are physically relevant).
   (b) Make sure that the cyclic prefix length is longer than the length of the impulse response. Check the BER.
3. **Frequency-selective (multipath) channel with additive noise**
   (a) Add in GWN again and check the BER for different channel transfer functions $H(z)$ and different SNRs.
   (b) Use the channel impulse response measured in Exercise 2-2 (or 2-3), add GWN, and check the BER.

[1]For questions and remarks: toon.vanwaterschoot@esat.kuleuven.be