Communication System Assignment 4

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- Exercise 1
- Exercise 3 (Mandatory)

Exercise 1 OFDM transmitted signal

1.1 All tones turned off

Focusing on the DFT modulator based on 2N real samples transmitted on 4-QAM constellation, the spectrum of the tones is shown as in figure 1.1. Turning off the right and left 10 tones, to simulate the OFDM transmitted waveform.

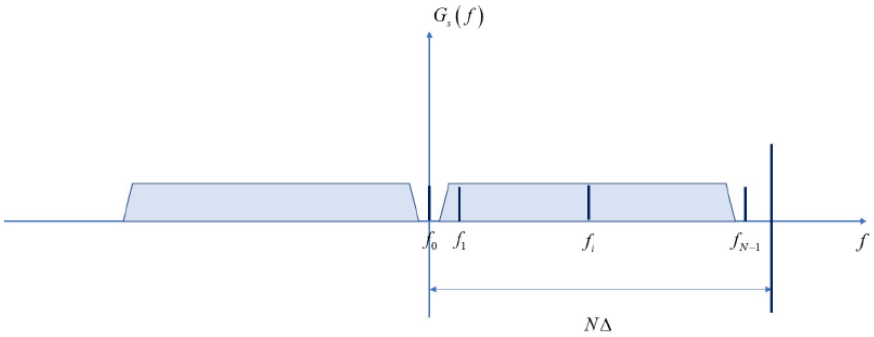

Figure 1.1: Spectrum of the tones

The simulated transmission system is with N=128, Δ=1 in one sample period with T_s=1. Firstly turn off all the tones, which is setting all the tones as 0, excepting the eleventh tone X(10) as 1-j, an original sinusoidal signal with 10 periods with the amplitude equals to about 1.414 can be got.

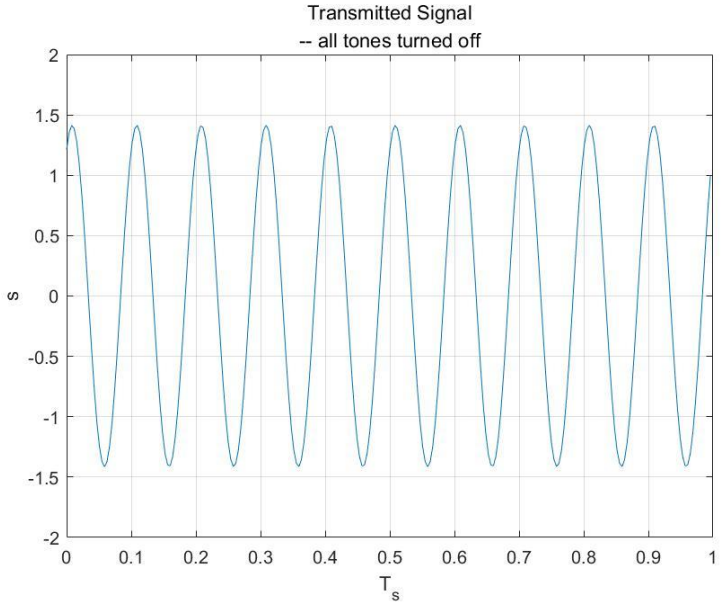

Figure 1.2: Transmitted signals when all tones turned off

1.2 All tones turned on

When turning on all the tones, the transmitted signal is as shown in figure 1.3. It can be observed that when the tones are turned on, the signals have much higher

amplitudes and are distributed around 0.

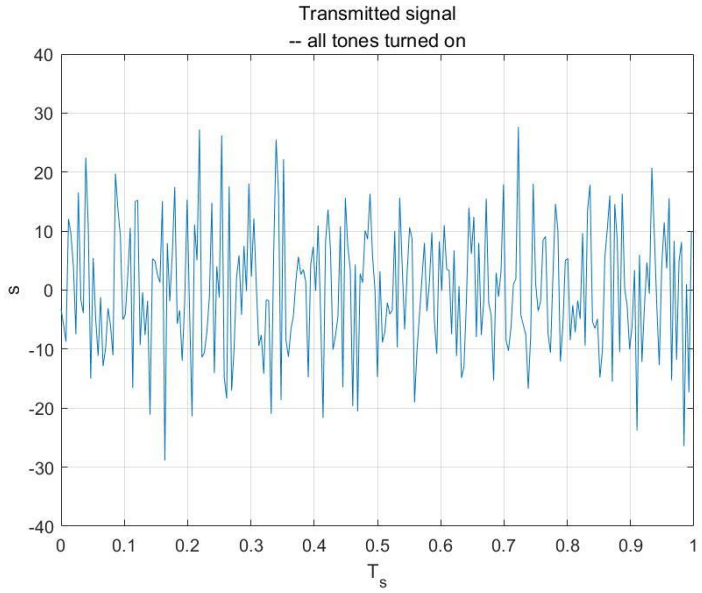

Figure 1.3: Transmitted signals when all tones turned on

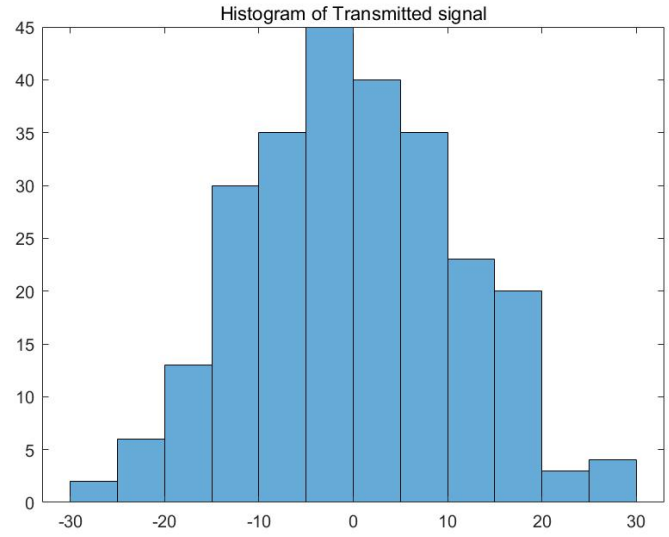

Figure 1.4: Histogram of transmitted signal

As shown in figure 1.4, the transmission signal has a Gaussian pdf and also with a nearly zero mean.

Exercise 3 Hartogs-Hughes algorithm

When applying OFDM modulation, bit allocations is one of the critical steps, which is to distribute a certain amount of power into each transmitted tone. A better distribution means that the all the useful tones must be allocated with enough power effectively, which this goal can be achieved by Hartogs-Hughes algorithm.

The attenuation along the frequency is shown as the first picture of figure 2.1. In the second figure in figure 2.1 stands for the bits of the tones to be transmitted applying Hartogs-Hughes algorithm, that there are 95 tones have been successfully transmitted with 240 bits. When the total power has averagely allocated only to the active tones proved by the Hartogs-Hughes algorithm, the number of active tones has become 74, which is lower than the using of Hartogs-Hughes algorithm and but with less bits.

However, when the total power applies uniformly on all the tones as shown in the last figure in figure 2.1, the number of active tones has been further decreases, so as the transmitted bits.

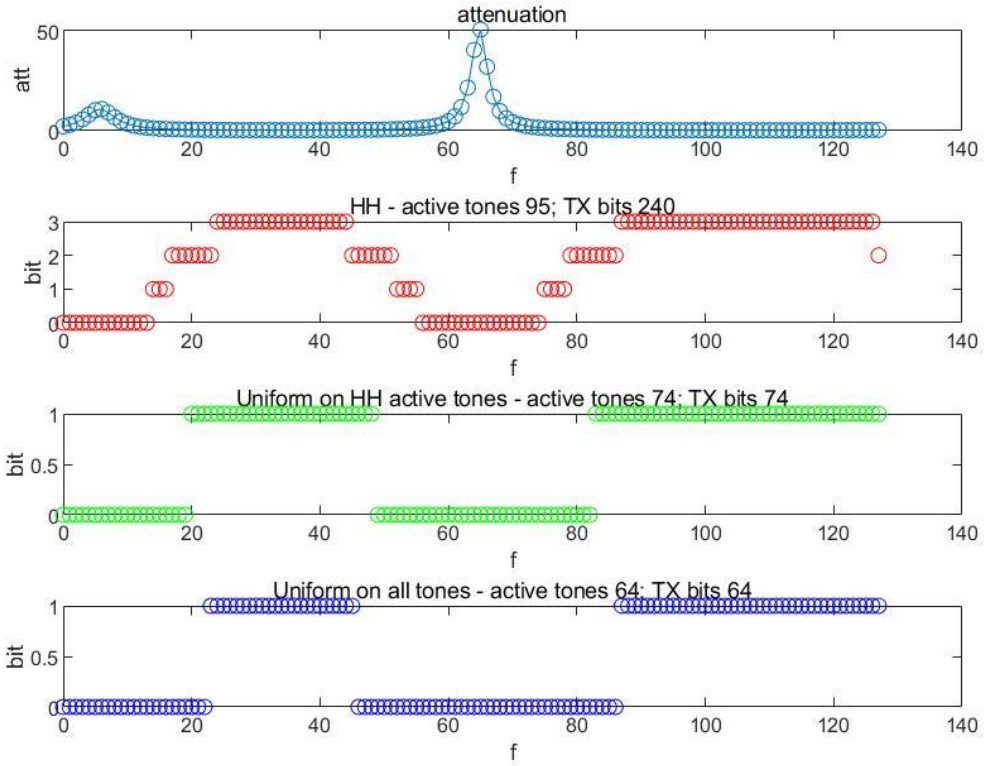

Figure 2.1: Hartogs-Hughes algorithm simulations (v.1)

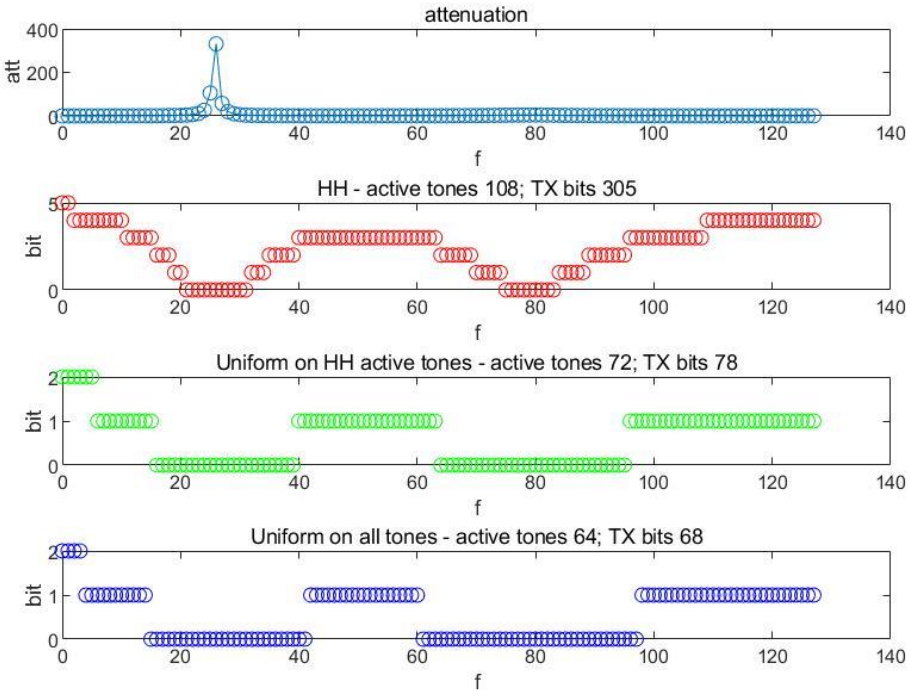

Figure 2.2: Figure 2.1: Hartogs-Hughes algorithm simulations (v.2)

The same method has been applied once again as shown in figure 2.2 with different phases, where the same conclusions can be drawn.