EE332 Digital Communication Assignment

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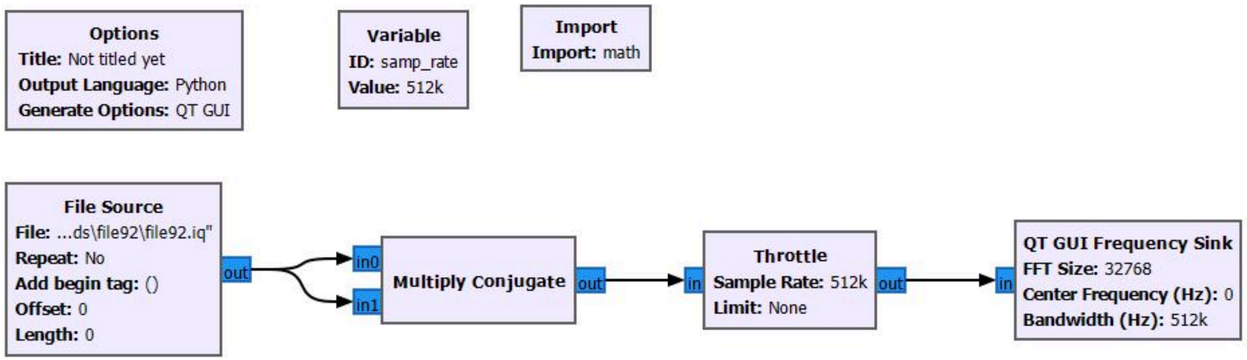
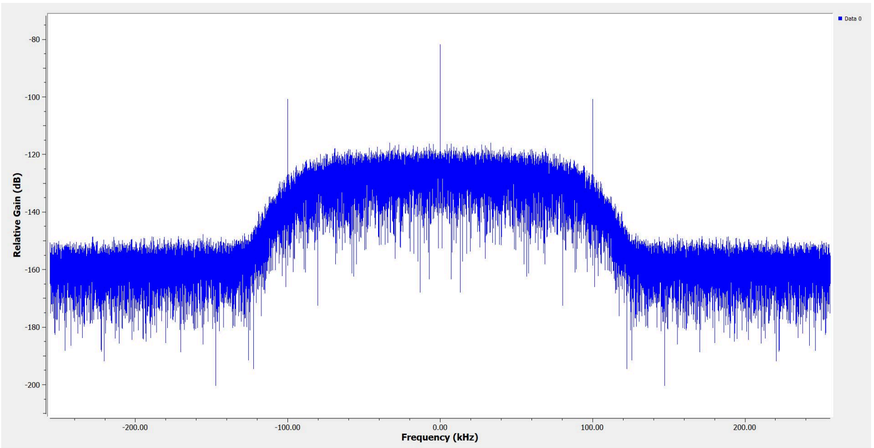
IQ file: 92

Objective: To determine the symbol rate, samples per symbol, frequency offset and the modulation scheme of the given baseband IQ samples and sampling rate = 512 kHz.

1. Symbol rate and Samples for symbol.



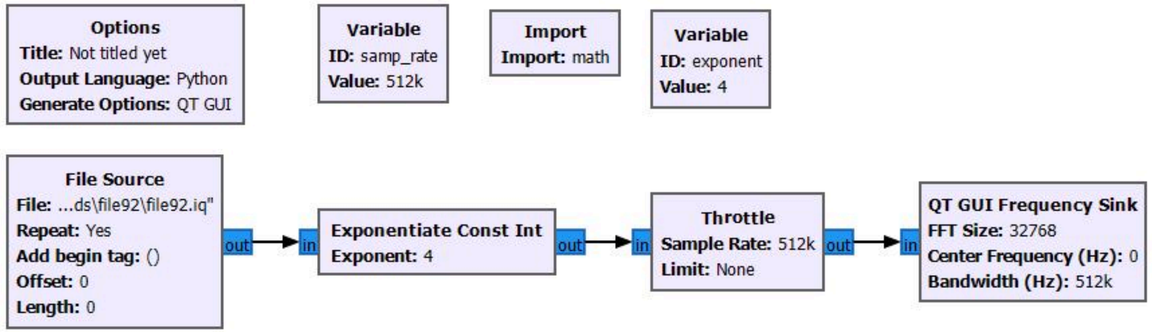


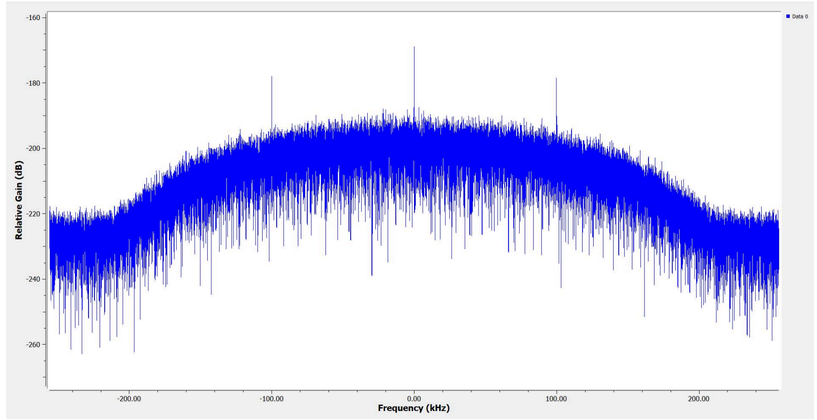
Multiply the received signal r(nTs) with its conjugate, the frequency spectrum (FFT) of this product gives the peaks at -1/T , 0 and +1/T. (where T is the symbol rate). Therefore, symbol rate equals 1/T.

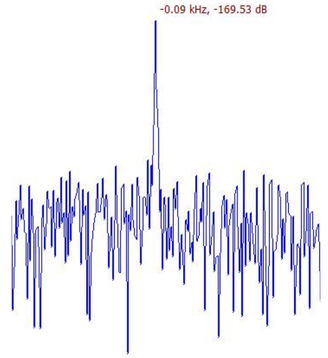
In the frequency spectrum, we observe the peak at -100 kHz, 0 kHz and 100 kHz. Hence the symbol rate = 100 kHz

Samples per symbol = Sampling rate/ Symbol rate = 512 kHz / 100 Hkz = 5.12

2. Frequency Offset





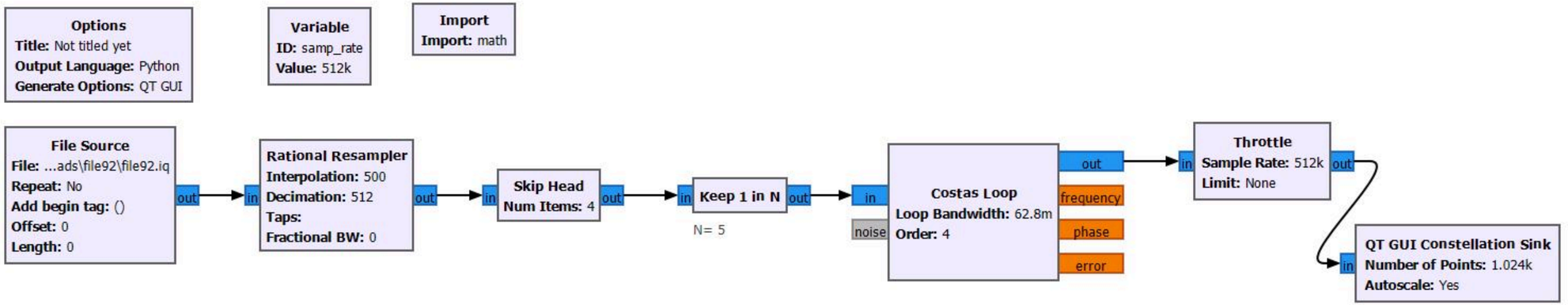


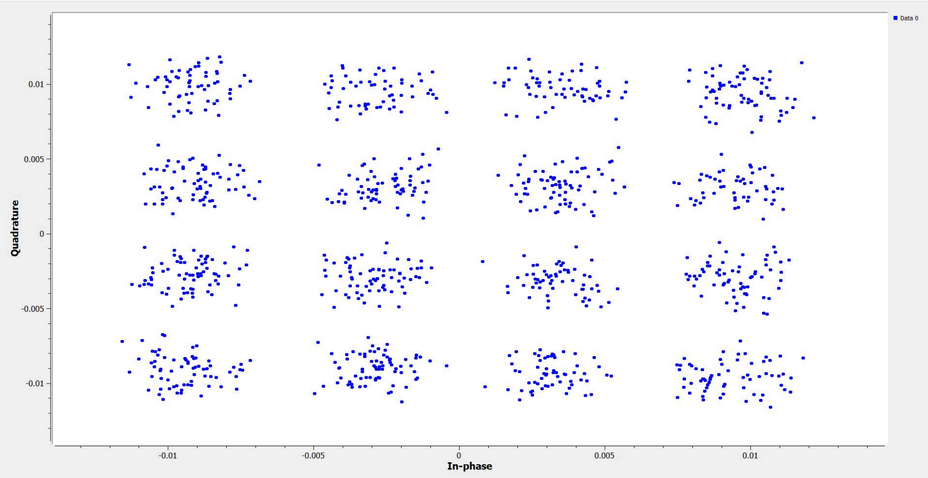
Zoomed in central peak

Raise the received signal r(nTs) by a exponent q , Take the FFT and vary q till we get distinguished peaks at qΔf +1/T

We observe that on taking q=4, we get the three distinguished peaks. Also, the central peak (earlier at 0 kHz) has now shifted to -0.09 kHz.
Therefore, Frequency offset = Δf = 0.09 * 10^3 /q = 90/4 = 22.5

3. Modulation scheme





From the constellation , we conclude that the modulation scheme is 16 QAM

Summary

Sampling Frequency: 512 kHz
Symbol rate: 100 kHz
Samples per symbol: 5.12
Frequency offset: 22.5
Modulation scheme: 16 QAM