Lab 7: Pulse shaping and Implementation of Digital Modulation Schemes in GNU Radio

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Aim of the experiment

- To introduce the basic concepts of pulse shaping and its importance for transmitting the signal using GNU Radio
- To plot eye diagram and determine the sampling region and noise margin using eye diagram
- Generating signals with different digital modulation format such as QPSK and 8-PSK and observe its constellation
- Understanding of different building blocks that are commonly used in pulse shaping and wireless digital communication system at transmitter end.
- Overall, this experiment should help you in understanding the bigger picture. Explicit details about implementation of the blocks will be learnt at a later stage in this course and in the theory course(s).

Lab Task 1: Pulse shaping of symbols generated to be transmitted

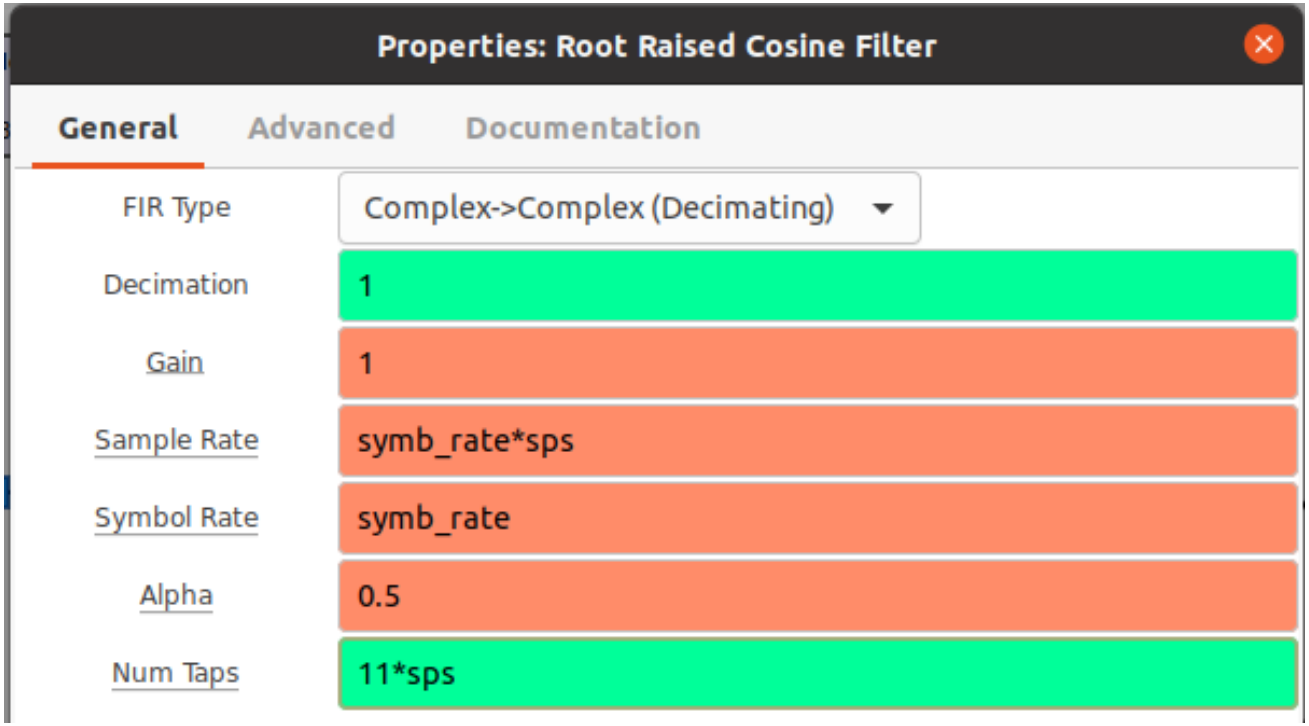
In this part, pulse shaping of the symbols generated is to be done

Instructions:

- symbols to be transmitted can be generated
  - randomly(using random source and chunks to symbols blocks in GNU)
  - using vector source block for determined pattern (as required)
- To perform pulse shaping for rectangular pulses generated using any of above ways, use **root raised cosine filter**
- For each block, after adding the block, check its output using Sink , before proceeding further (to get a feel for the signals that are present at various points in the system).

Lab Task 1 cont'd

Set **variables** for root raised cosine filter



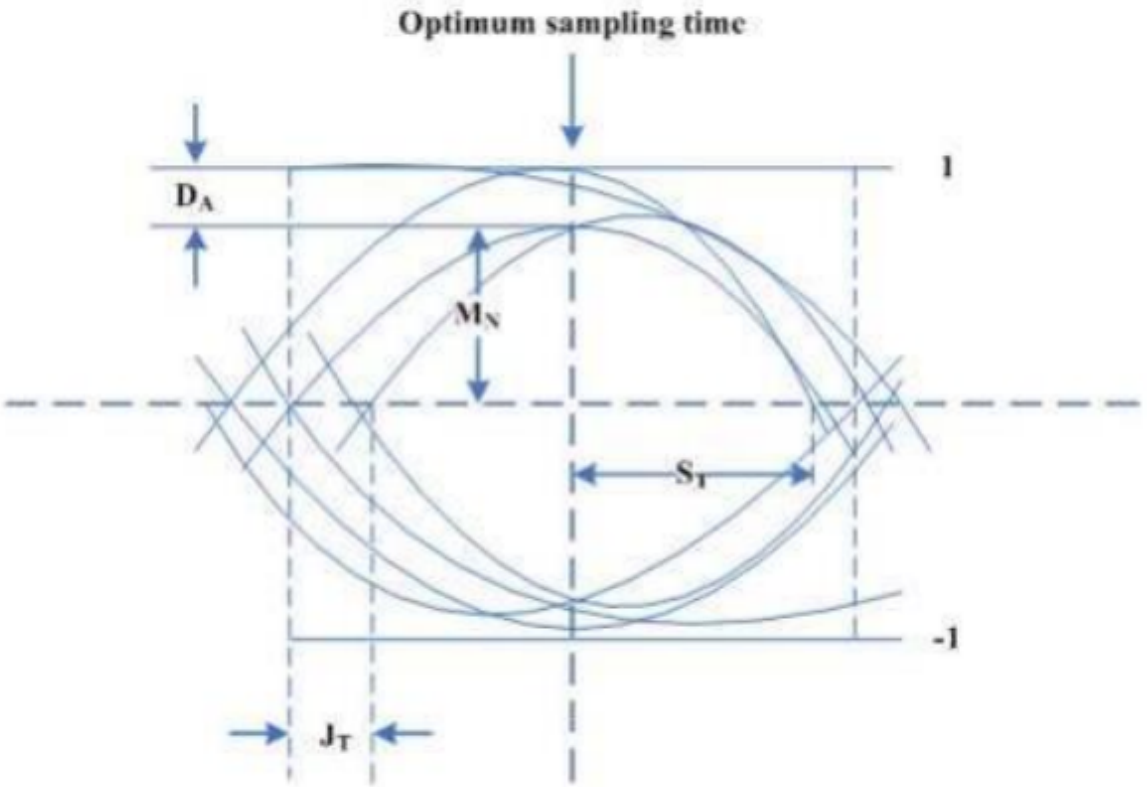
Note:

- Use interpolating FIR filter for clear visualization of individual pulses shaping before passing through root raised cosine filter
- Tap value for filters for zero padding is supposed to be 1

Lab Task 1 cont'd

- observe the Impulse response of root raised cosine
- Observe the output pulse shaped signal and demonstrate it to TA
- Change the parameters of raised cosine(by changing alpha value,sample rate) and observe variation in pulse shaping
- Think of other block which can replace Root Raised Cosine filter (can be used for pulse shaping)

Lab Task 2 : Interpretation of Eye plot



where
D_A is a measure of distortion caused by intersymbol interference (ISI)
J_T is a measure of the timing jitter
M_N is a measure of noise margin
S_T is a measure of sensitivity-to-timing error

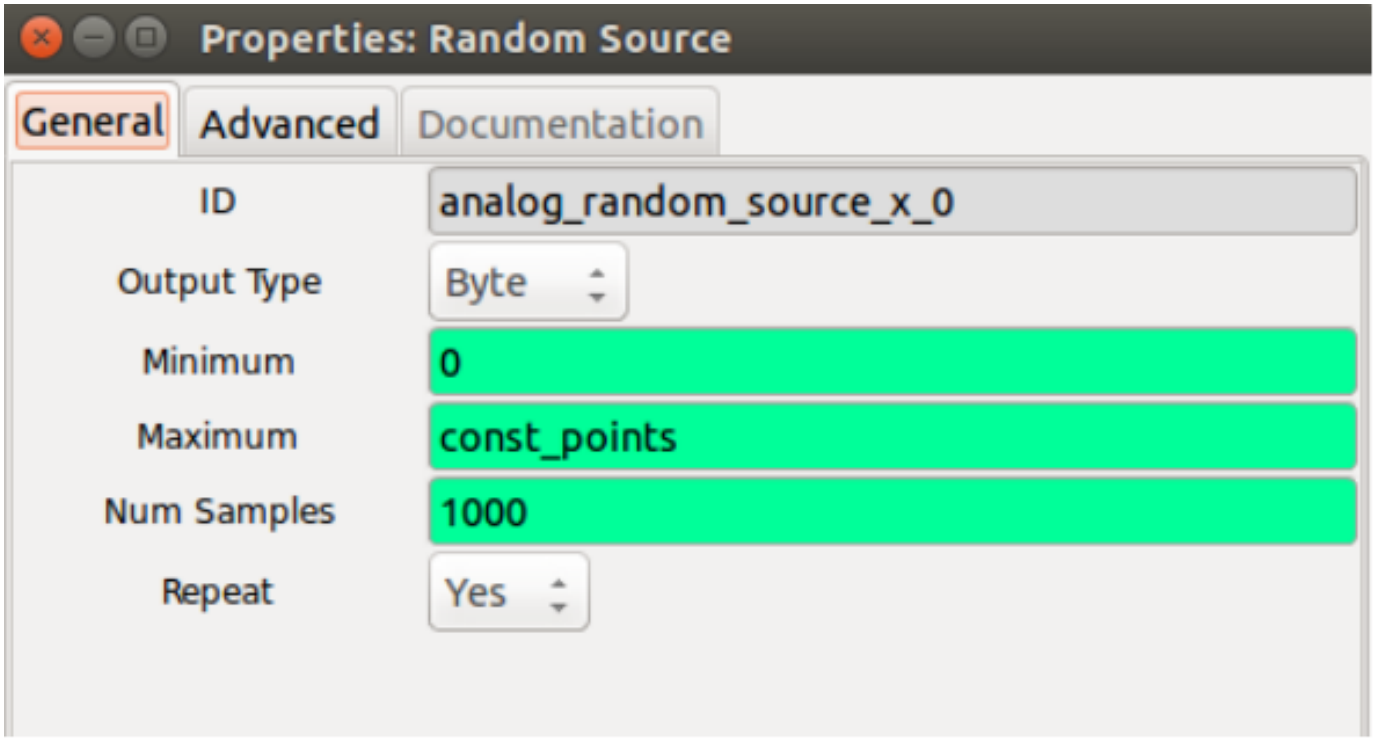
Lab Task 2 cont'd

Observe following parameters from Eye diagram plotted

- Margin of Noise
- Total Jitter range
- Eye width
- sampling region range

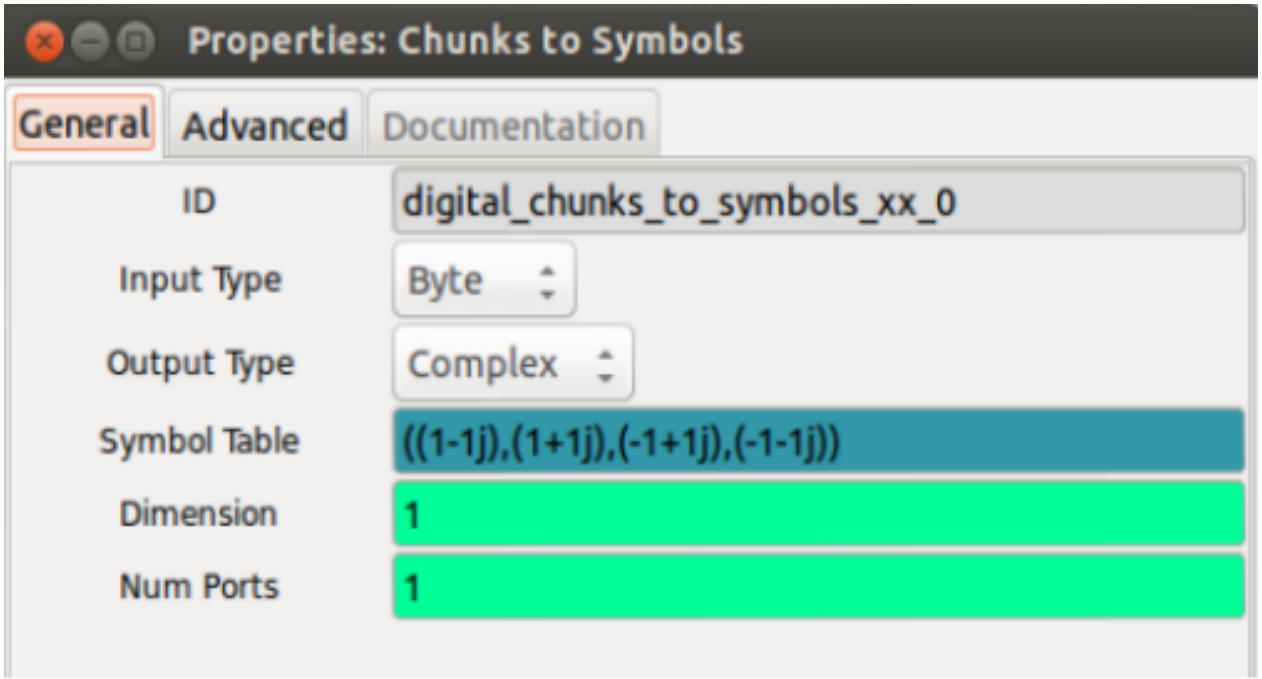
Lab Task 3 : Local generation of signal with QPSK modulation (Building the Transmitter)

Use following blocks (in the correct sequence to build the transmitter section:
Random Source: for generating symbols randomly (integers of values 0 to const points-1)



Lab Task 3 cont'd : Building the Transmitter

Chunks to symbols: Maps the symbol values to the contellation points in the complex plane (here QPSK)



Note : Observe the output in x-y plot in scope sink for the QPSK constellation. Also observe the samples in time domain try to make sense out of it.

Lab Task 3 cont'd : Building the Transmitter

Pulse shaping blocks : Use the RRC(Root raised cosine) filter (with appropriate alpha value,sample rate) used in above task (Lab Task 1)

- Observe the time domain waveforms of the output and the same output in the x-y graph in the scope
- Observe the constellation of signal and demonstrate it to TA

The obtained signal is basically your baseband QPSK modulated signal!

Lab Task 3 cont'd : Upconversion to a carrier frequency

- Upconvert the baseband signal to passband, by multiplying it with a 100 kHz carrier signal.
- Before upconversion use of Rational Resampler to upconvert it by a factor of 5.
- Observe the obtained signal (which represents a practical QPSK modulated signal that one can actually transmit from the antenna).