# Signal Processing - LAB 7 Report

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In this lab, we write a function to quantize continuous-valued signals, and compute the SQNR. We also study the effect of quantization on the quality of the signal.

## 6.1 - Quantization

a) Quantization involves discretization and encoding of samples of a signal. We write a function to quantize a given continuous signal

The function, *quadratic_quant(x,B,a)* takes the following inputs:

- x → input signal
- a → positive real number and [-a,a) forms the range for quantization
- B → number of bits used to decide quantization levels

It returns a vector y which is the quantized version of x.

b) We use the function to quanitize the function $x(t) = sin(2 * \pi * f_0 * t)$ where $f_0 =$ 10Hz

We sample this signal at Fs = 5kHz to get a discrete signal and then quantize this signal to get $x_q[n]$.

c) We plot the various graphs and also calculate and plot it's quantization error.

d) We then use the *histogram( )* function to plot the errors (and repeat the same for B =3.

e) We then plot a graph with the maximum absolute quantization error against the various values of B.

We notice that the error decreases with an increase in B because the precision of the quantized signal increases with an increase in B, and the quantized signal becomes closer to the original signal.

f) We find the Signal Quantization Noise Ratio (SQNR) which is the ratio of the power of the signal to the power of noise and is found using the formula:

$$SQNR = \frac{\sum_n |x[n]|^2}{\sum_n \left|e_q[n]\right|^2}$$

Then we plot SQNR vs B on a graph. We find that SQNR increases with an increase in B because the error decreases and since SQNR is inversely proportional to error, it increases.

g) In a non-uniform quantizer, we notice that the range of the different intervals increases as we move away from the x-axis (x=0). Hence, the accuracy also decreases as we move away from the x-axis.

A uniform quantizer would have equal ranges in all intervals and thus we can say that this will be more accurate than a non-uniform quantizer because we can more accurately map the original signal values to values in the interval, thus decreasing the error.

## 6.2 - Quantization of Audio Signals

a) We load the audio signal in MATLAB and quantize it using the function.

On quantization, we notice that the quality of the signal worsens. The quantized signal sounds more noisy and less clear than the original audio file.

b) We notice that as the value of B increases, the audio file becomes less noisy and more closer to the original audio signal.

c) Quantization doesn’t affect the frequency of the quantized signal (because we notice that we use Fs for both the original and quantized signal).

Thus, B doesn’t play a role in this.