Lab 1: Sampling Theory, Quantization and PCM

In this lab, you will familiar with Sampling theorem, quantization and PCM generation.

Pre-lab Assignment: Given signal $x(t) = \text{sinc}(t)$,

1. Find out the Fourier transform of $x(t)$, $X(f)$, sketch them;
2. Find out the Nyquist sampling frequency of $x(t)$.
3. Given sampling rate f_s, write down the expression of the Fourier transform of $x_s(t) \to X_s(f)$ in terms of $X(f)$.
4. Let sampling frequency $f_s = 1$ Hz, sketch the sampled signal $x_s(t) = x(kT_s)$ and the Fourier transform of $x_s(t)$.
5. Let sampling frequency $f_s = 2Hz$, repeat 4.
6. Let sampling frequency $f_s = 0.5Hz$, repeat 4.
7. Let sampling frequency $f_s = 1.5Hz$, repeat 4.
8. Let sampling frequency $f_s = 2/3Hz$, repeat 4.

Lab Assignment 1: Sampling Theorem

1. Design matlab programs to illustrate items 3-8 in pre-lab assignment. You need to plot all the graphs. Using the Fourier transform of $x_s(t)$ as:
$$X_s(f) = \sum_k x(kT_s) \exp(-j\, 2\pi f\, kT_s)$$
2. Compare your results with your sketches in your pre-lab assignment and explain them.

Lab Assignment 2: Quantization of Voice

1. Read pcm.wav file into vector y (you can truncate the original data to the desired length);
2. Quantize the data vector y, using $N = 3$ bits (8 levels) uniform quantizer. Output PCM code number (0 to $2^N - 1$).
3. Generate binary (0 and 1) bit stream from PCM code number (this bit stream will be used in the later labs).
4. Recover the quantized sample values and replay the wave file, compare the original wave file to see if there is any distortion.
5. Repeat the above procedure, changing the number of quantization bits N. Summarize the recovered voice quality using different N.

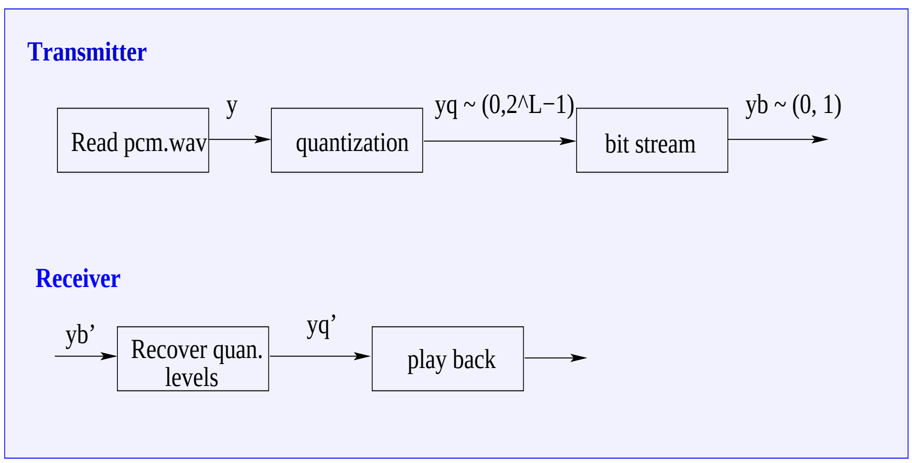

Figure 1: Procedure diagram.