DSP Homework 07

Xu, Minhuan

October 13, 2022

Contents

Abstract

1 Pros and Cons of Shannon/Nyquist sampling method

1.1 Positive

Ideal and easy to understand

In Shannon/Nyquist sampling method, we only consider things that are ideal. Like $\delta(t)$, and the ideal LPF. It is mathematically simple and friendly to beginners.

Easy to calculate

Using Fourier series and Fourier transform, we can easily find the distribution of energy on the frequency domain since the δ function has nice special properties.

No Error

Through calculation, we know that if we make f_s and f_c have proper values, a perfectly the same frequency spectrum can be reconstructed. This is good because we don't need to worry about making mistake through communication.

Easy to Reconstruct

Assuming that we have a sampled signal, all we should do is to find the bandwidth, and to let the sampled signal pass a LPF. Then, a perfectly reconstructed signal is complete.

1.2 Negative

Non-existent signal

Though the sampling progress is theoretically easy to carry out, the δ function is not so easy to generate. Mathematically, it has infinite energy in *one* period. According to the law of conservation of energy, we can't make a signal like the $\delta(t)$, see (1).

$$E = \sum_{n=-\infty}^{\infty} T \to \infty \tag{1}$$

Waste of bandwidth

In practical usage, engineers cannot find a ideal LPF, especially which has infinite differential (has a sharp drop). All we can find is those which have smooth differential, and LPF like these will occupy more bandwidth of channels. Then, because

$$f_c < f_s - W$$

Therefore, the sampling frequency f_s need to be larger which is not good.

2 Conclusion