

Module 3 : Sampling and Reconstruction

Lecture 25 : Aliasing (Under Sampling)

Objectives:

Scope of this lecture:

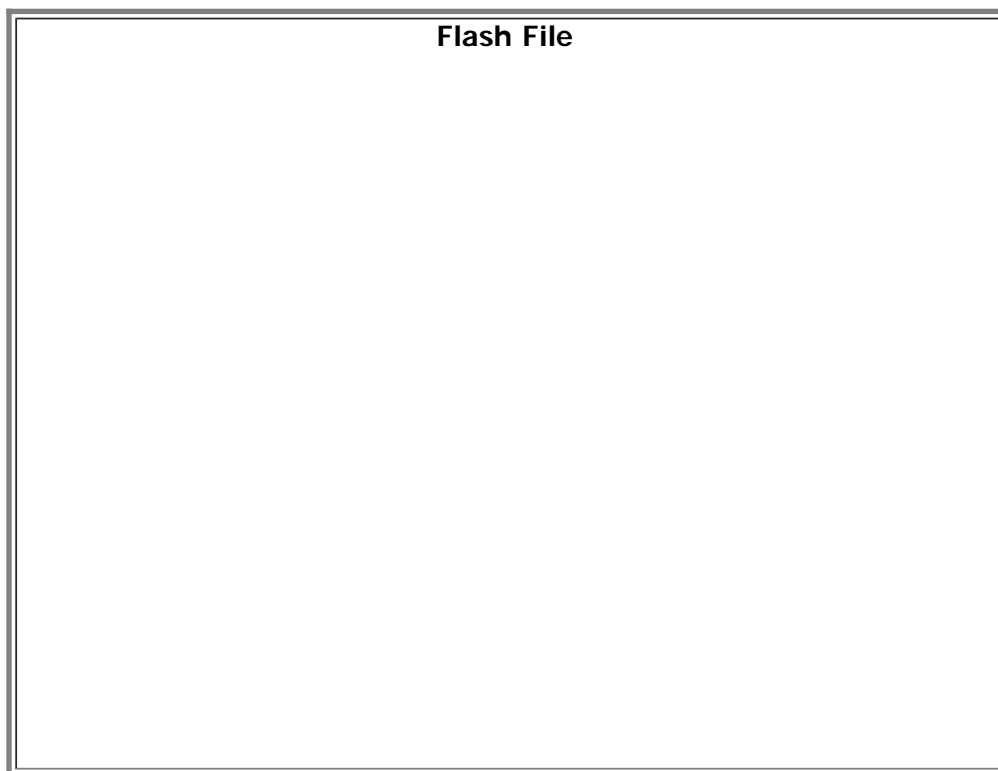
In the previous lecture we studied that a train of pulses which obey the Dirichelet's Conditions are generally used for sampling a signal. We learnt the conditions necessary for the reconstruction of the original signal. In this lecture we will study the concept of **Aliasing** the problems associated with improper sampling frequency selections.

- To study what happens when sampling rate is less than or equal to twice the bandwidth of the original signal which is also called as the *Aliasing effect* of under sampling .
- To understand *stroboscopic* effect .
- Advantages of aliasing

ALIASING EFFECT OF UNDERSAMPLING

We have seen how by sampling a Band-limited signal at a rate greater than twice the bandwidth of the signal, it is possible to reconstruct the original signal. But what happens if the sampling rate is less than (or equal to) twice the bandwidth of the band-limited signal?

The different translated versions of the original spectrum overlap in the spectrum of the sampled signal. This effect is called aliasing. If we attempt to reconstruct the original signal using a low-pass filter, we might get a signal completely different from the original signal. Lets take an example.



Example:-

Let us now also look at very special **example**, consider a disc rotating with a single radial line marked on the disc. The flashing strobe acts as a sampling system, since it illuminates the disc for extremely brief time intervals at a periodic rate. When the strobe frequency is much higher than the rotational speed of the disc, the speed of rotation of the disc is perceived correctly. When the strobe frequency becomes equal to the rotational frequency, the line appears to be at same position. When the strobe frequency becomes less than twice the rotational frequency, the rotation appears to be at a lower frequency than is actually the case. Furthermore due to phase reversal, the disc will appear rotating in the reverse direction .This phenomenon is known as **stroboscopic effect**.

Advantages of aliasing :

1. Can be made to use f_s , i.e. carrier frequency for transmission & use Band Filter.
2. We can use frequency of any multiple of f_s
3. Also in this case modulation by C_x do not need pulses with average value zero.

Conclusion:

In this lecture you have learnt:

- Original signal cannot be reconstructed from undersampled signal because higher frequencies are reflected into lower frequencies in the Fourier transform of the undersampled signal .
- Stroboscopic effect helps in understanding undersampling.
- Aliasing is not always undesirable . It has some advantages also.

Congratulations, you have finished Lecture 25.