

Aim: To understand windowing and analysis different window types.

Understanding:

The FFT of a periodic signal gives you a peak at some value in frequency domain which is almost exact. But for non-periodic signals this is not the case. When fft of some non-periodic function is carried out it gives a peak as well as some noise in frequency domain which is called leakage or errors. This leakage may even distort the original frequency spectrum or increase the frequency range. Hence to remove this extra noise to travel, we use technique called windowing.

Windowing:

A window basically a function is applied to a signal in time domain to make it periodic. The selection of window depends upon the application. It is shaped such that it is exactly 0 in the beginning than takes some special shape and again decays to 0 at the end. This window when applied to signal it forces the signal to become periodic. Hence the lobes in frequency domain which are comparatively far from the original frequency component are removed.

Types of Window and its effect:

Here we provide comparisons between windows and state points of difference between various window types:

1. Hamming and Hanning windows:

-> Both are similar shaped window types except that the main difference between them is their convergence at the edge. The Hanning window exactly goes to zero at the edges while the Hamming window touches just a little above or below zero. Hence Hamming window still has some discontinuity. Now in Frequency domain, the Hanning window provides a smooth cancellation of side lobes while Hamming window does a better job of cancelling the nearest side lobe but it increases the width of frequency spectrum and does not effectively reduce the later side lobes. The peak we obtain in both is essentially almost similar.

2. Blackman Window:

-> There exists extra cosine term in Blackman window function which reduces side lobes more than Hamming and Hanning window. Hence reduction of side lobes means less power is lost. Hence their being more terms in the function of Blackman window it provides more accurate results than Hamming and Hanning window.

3. Bartlett Window:

-> The Bartlett window is triangular shaped. The highest side lobe frequency does not fall significantly as in Hamming/Hanning or Blackman window. Hence the removal of side lobes with unnecessary frequency components is difficult to avoid.

4. Rectangle Window:

-> It is the simplest form of windowing. It simply replaces all N data points to zero making the signal ON and OFF suddenly. These sudden changes has undesirable responses in frequency domain hence there are changes made to the function and converted to better window like hamming or any other.