ENSC380
Lecture 22

Objectives:

- Brief analysis of Ideal Discrete Time Filters

DT Filters

- Most of real world signals are CT by nature. However, with the advancements in the digital world, DT signals and systems are employed widely today.
- The advantages of working with DT signals and systems over CT are:
  - DT signals can be stored indefinitely on magnetic media without degradation.
  - DT systems can be built with much smaller components than CT systems, and are not sensitive to environmental changes, e.g. temperature.
  - DT filters can have programmable parts which makes changing their parameters simple.
- A DT LTI system in time domain is defined by its “impulse response”, and in frequency domain by its “frequency response”.

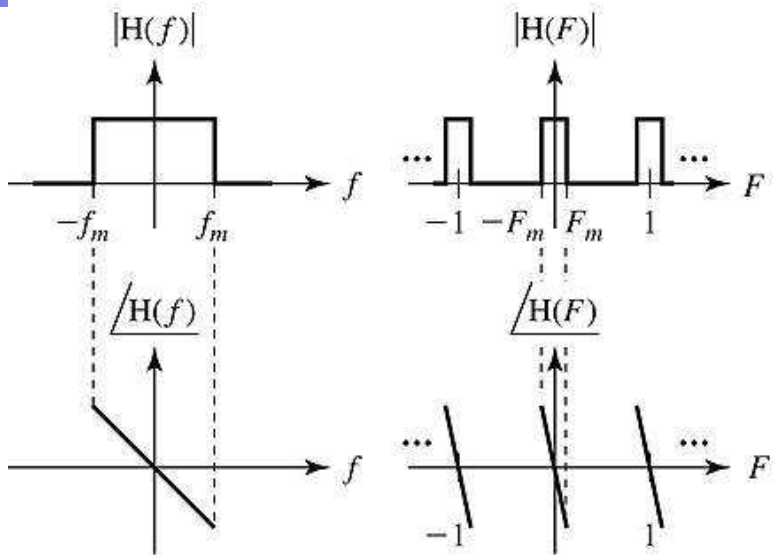
Ideal Discrete Time Filters

- The definitions for ideal discrete time filters are almost exactly the same as for continuous time filters. DT filters can also be divided into “low pass”, “band pass”, “high pass”,“band stop”, and “all pass (distortion less)”.
- We should remember that the impulse response of a DT filter, i.e., the DTFT of $h[n]$, is always periodic with period .
- Just like its CT version, an ideal distortion less (all pass) DT filter has an impulse response and frequency response of the form:

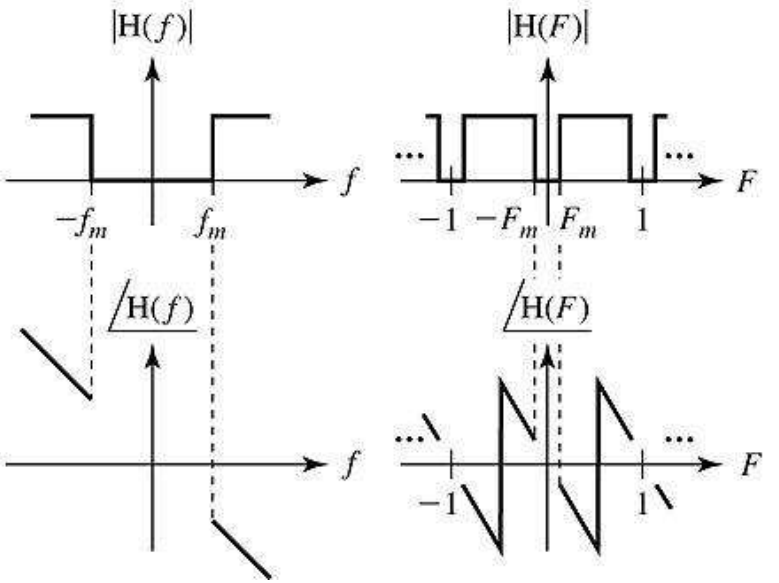
- Other types of ideal DT filters, have the same frequency response as the ideal all pass filter during their pass band, and zero else where.

Ideal Filters (Freq. Response)

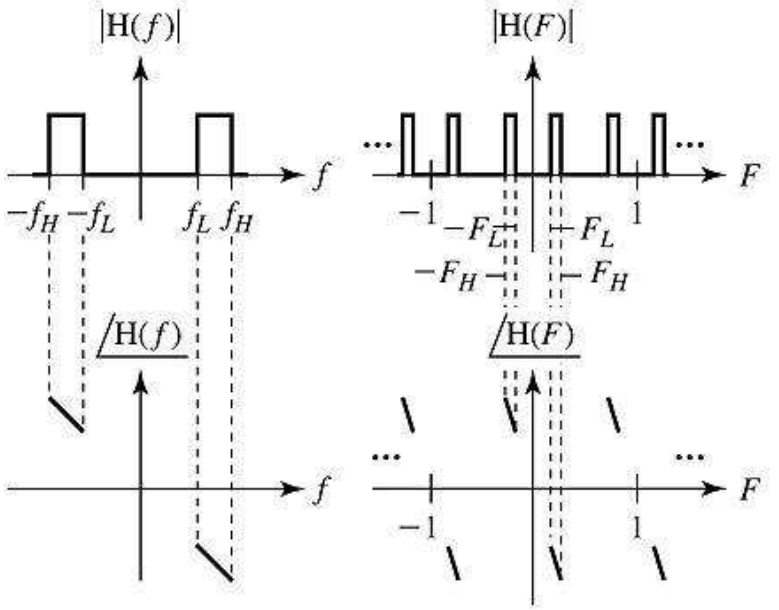
Ideal lowpass filter



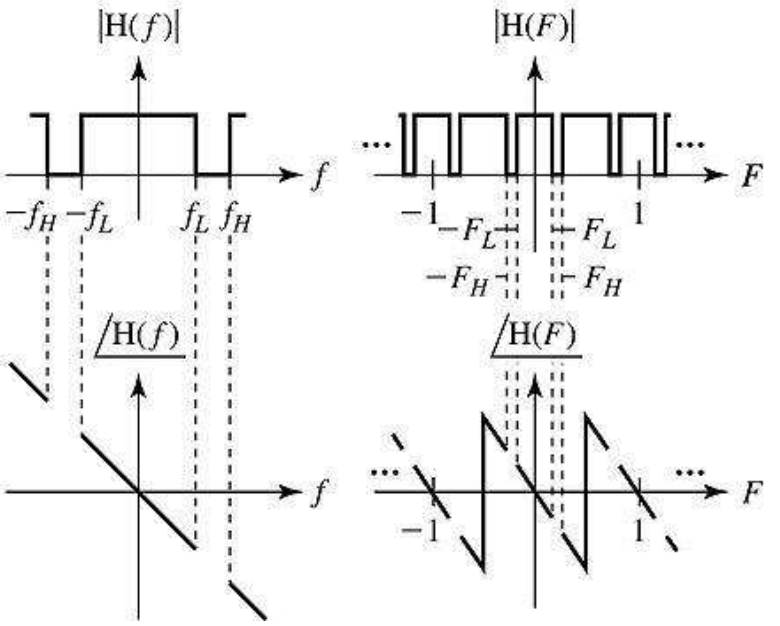
Ideal highpass filter



Ideal bandpass filter

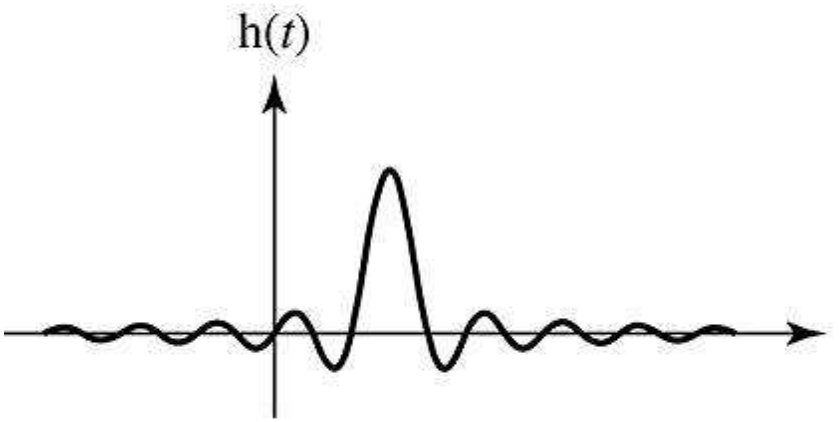


Ideal bandstop filter

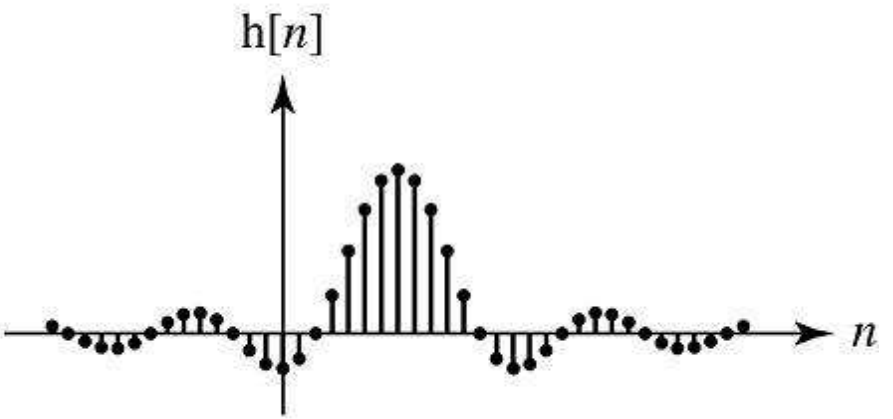


Ideal Filters (Impulse Response)

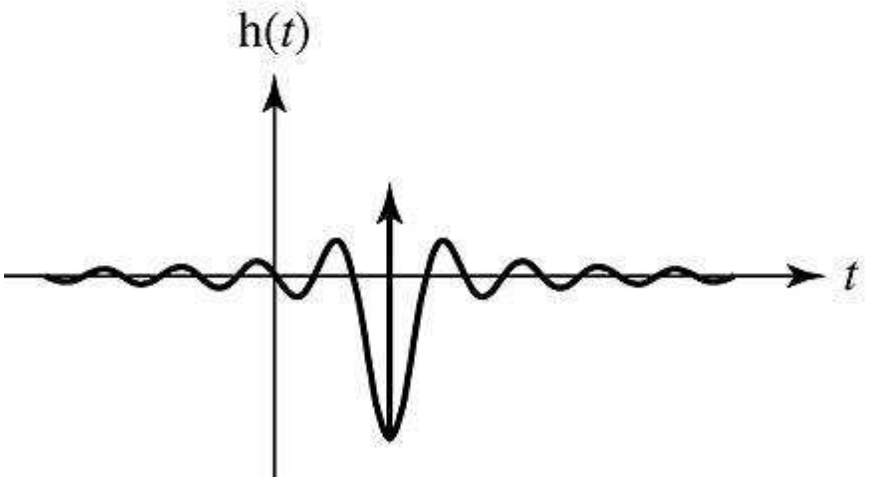
Ideal CT lowpass



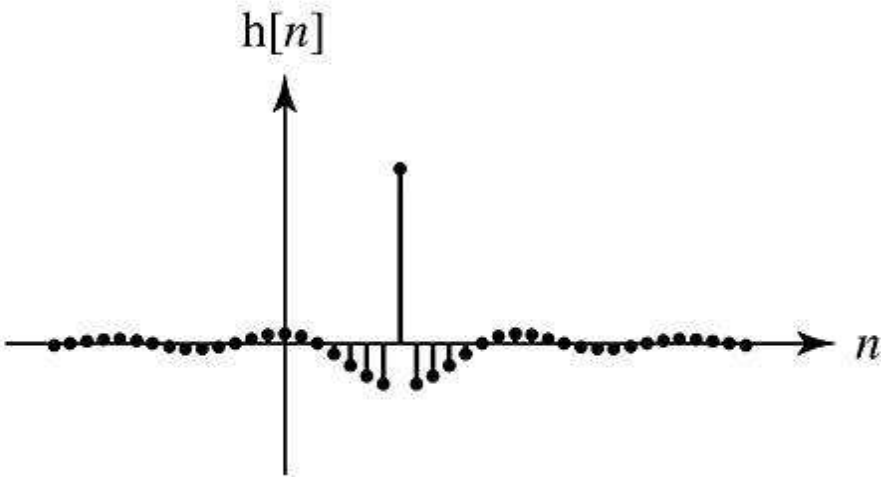
Ideal DT lowpass



Ideal CT highpass

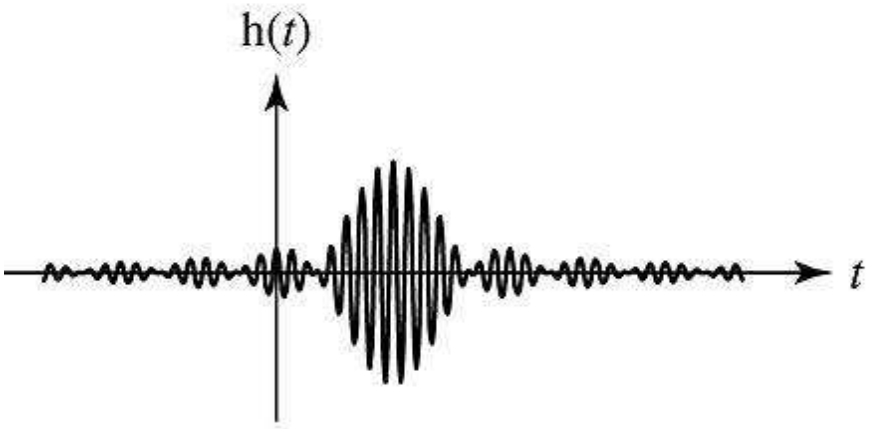


Ideal DT highpass

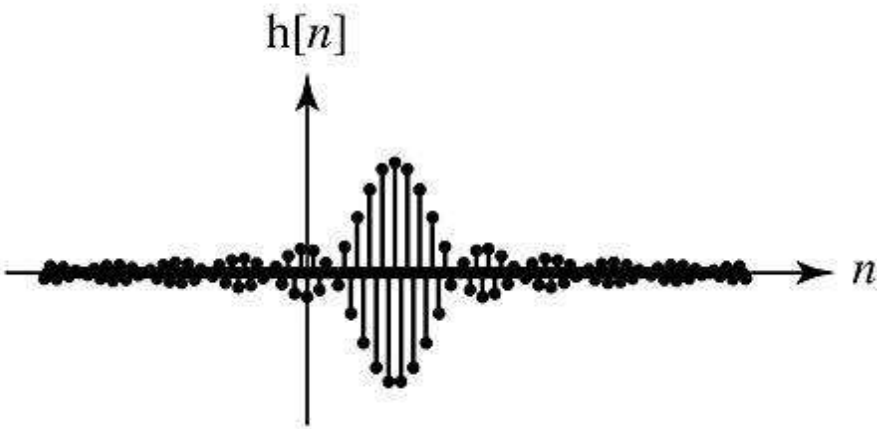


Ideal Filters (Impulse Response)

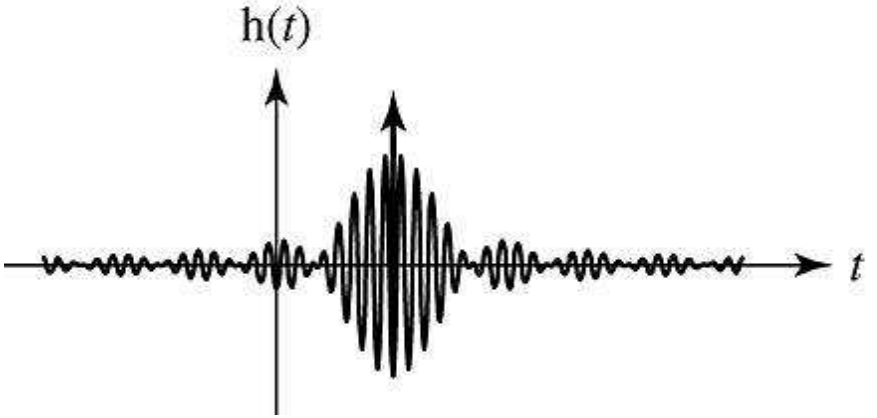
Ideal CT bandpass



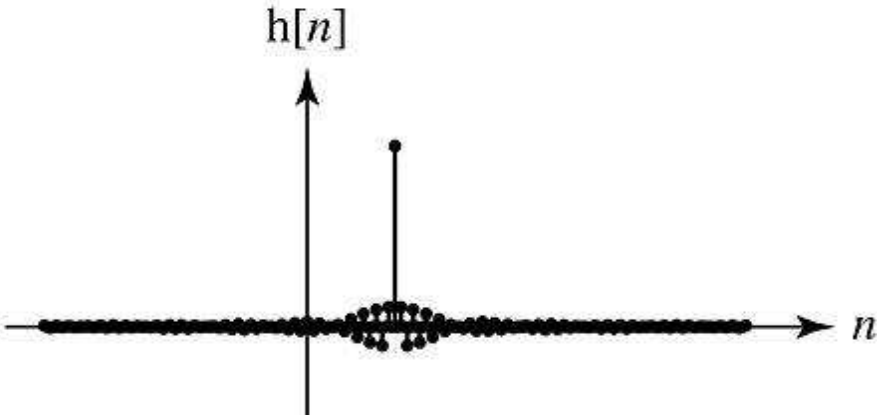
Ideal DT bandpass



Ideal CT bandstop



Ideal DT bandstop



Example

Let's find the impulse response of the ideal DT high pass filter, with cutoff frequency F_m.