SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A+' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF BIOMEDICAL ENGINEERING

19BMB302 - BIOMEDICAL SIGNAL PROCESSING

III YEAR/ V SEMESTER

Unit 1 : TRANSFORMS

- Sampling theorem
- ECG signal conversion system
- Discrete Fourier Transform (DFT)
- Fast Fourier Transform (FFT)
- Decimation in time
- Decimation in frequency
- Multi rate Signal Processing
- Wavelet Transform.

Multi rate Signal Processing

Single-rate v.s. Multi-rate Processing

- **Single-rate processing**: the digital samples before and after processing correspond to the same sampling frequency with respect to (w.r.t.) the analog counterpart.
  e.g.: LTI filtering can be characterized by the freq. response.
- **The need of multi-rate**:
  - fractional sampling rate conversion in all-digital domain:
    e.g. $44.1k$Hz CD rate $\Longleftrightarrow$ $48k$Hz studio rate
- **The advantages of multi-rate signal processing**:
  - Reduce storage and computational cost
    - e.g.: polyphase implementation
  - Perform the processing in all-digital domain without using analog as an intermediate step that can:
    - bring inaccuracies – not perfectly reproducible
    - increase system design / implementation complexity

Sampling rate conversion

Decimation

- Decrease the sampling rate

Interpolation

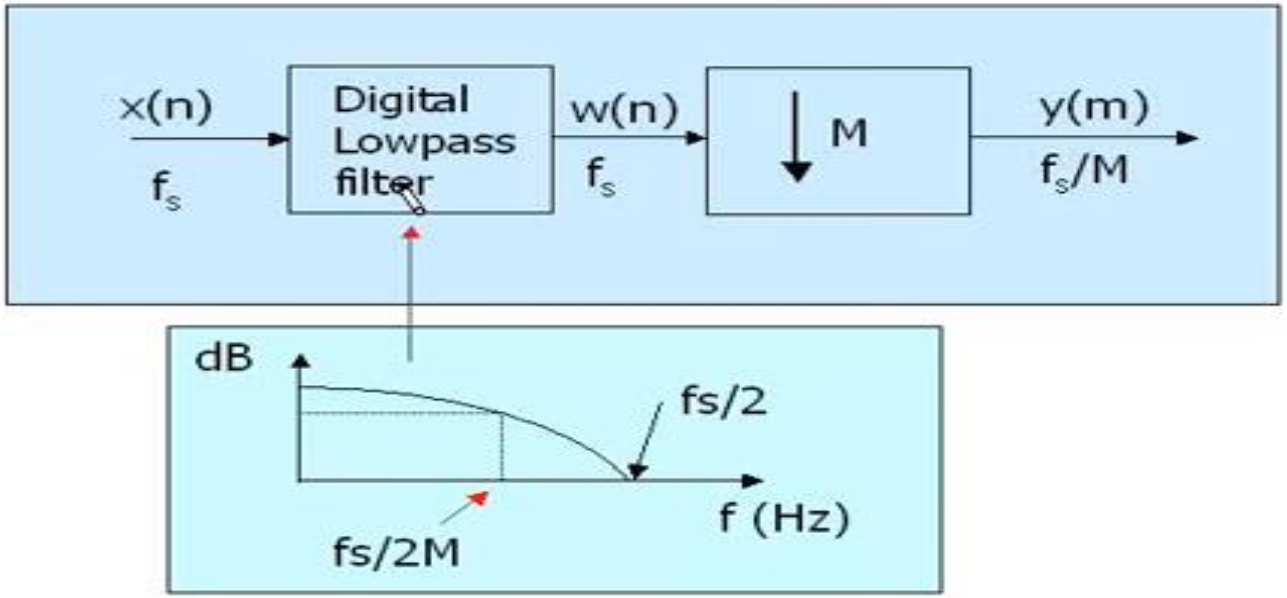
- Increase the sampling rate

- Multirate systems used for audio and video processing, communications systems, and transform analysis to name but a few.
- In most applications multirate systems are used to improve the performance, or for increased computational efficiency.
- The two basic operations in a Multirate system are decreasing (decimation) and increasing (interpolation) the sampling-rate of a signal.
- Multirate systems are sometimes used for sampling-rate conversion, which involves both decimation and interpolation.

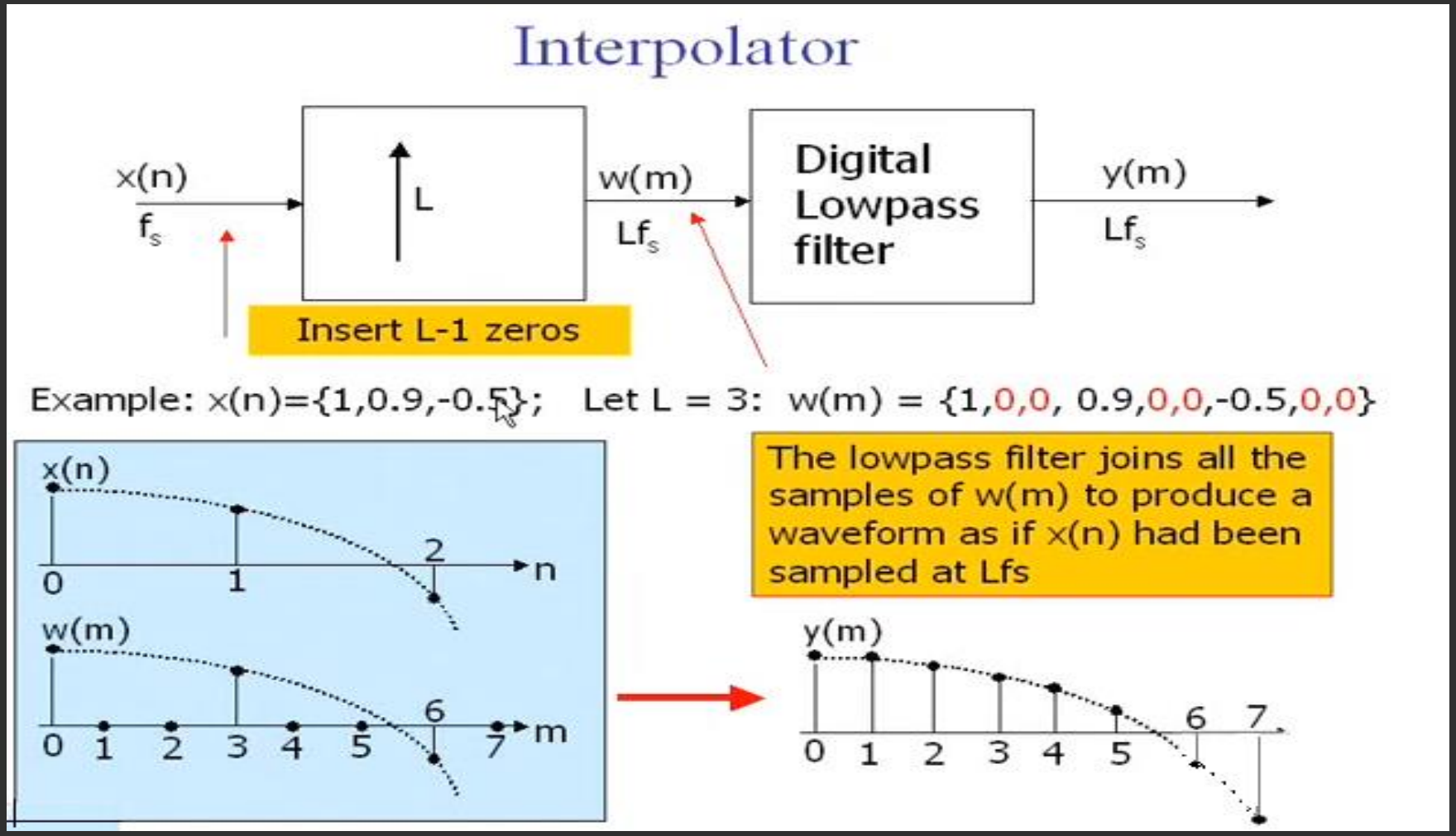
Decimator

The diagram below shows a block representations of a times M decimator.

The signal x(n) is first passed through a lowpass filter that attenuates the band from {fs/2}/M to fs/2 to prevent aliasing.



Interpolator



Thank You!