SIO 207A: Fundamentals of Digital Signal Processing
Class 12

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Decimation

- We aim to reduce the sampling rate by a factor of 8
- To avoid aliasing after decimation, we must pass the original signal through a low pass filter

see also Sections 6.4 – 6.5 in Oppenheim & Schafer, 1999: Decimation, Interpolation, Multirate Signal Processing

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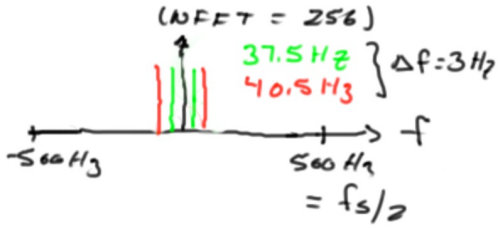
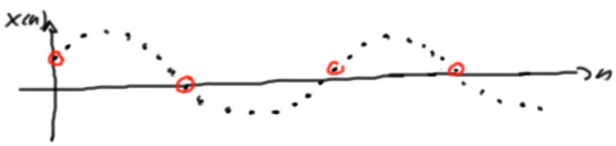
Homework 5

- Resolve 2 closely space signal with a fixed length FFT



Decimation will lower the sampling rate



$f_s = 1\text{kHz} \longrightarrow \text{FFT bin width: } f_s/256 \approx 4\text{Hz}$

- Save one sample out of every 8 results in a decimation of factor 8
- This results in $f_s' = 125\text{Hz}$ and FFT bin width: $f_s'/256 \approx 0.5\text{Hz}$

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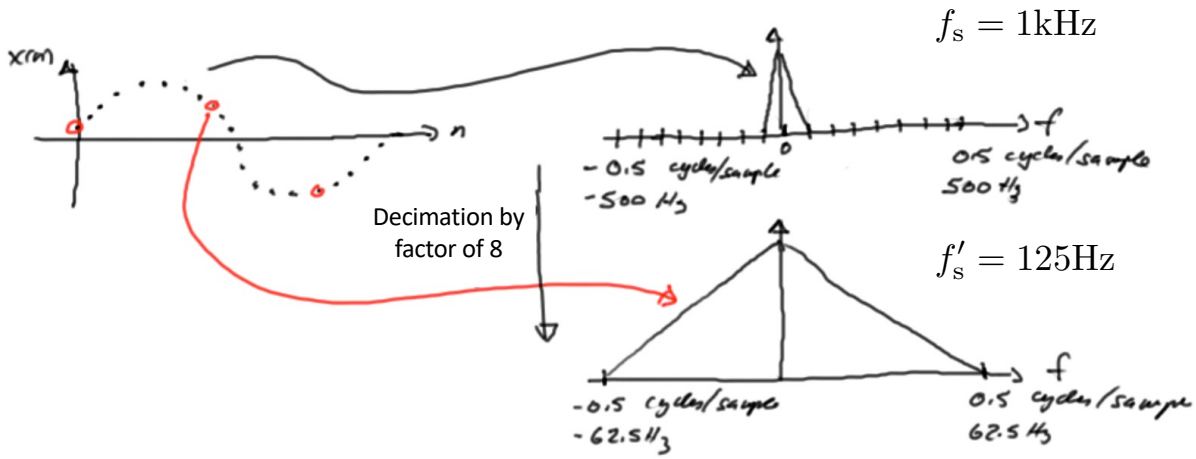
Decimation – Mapping of Frequencies



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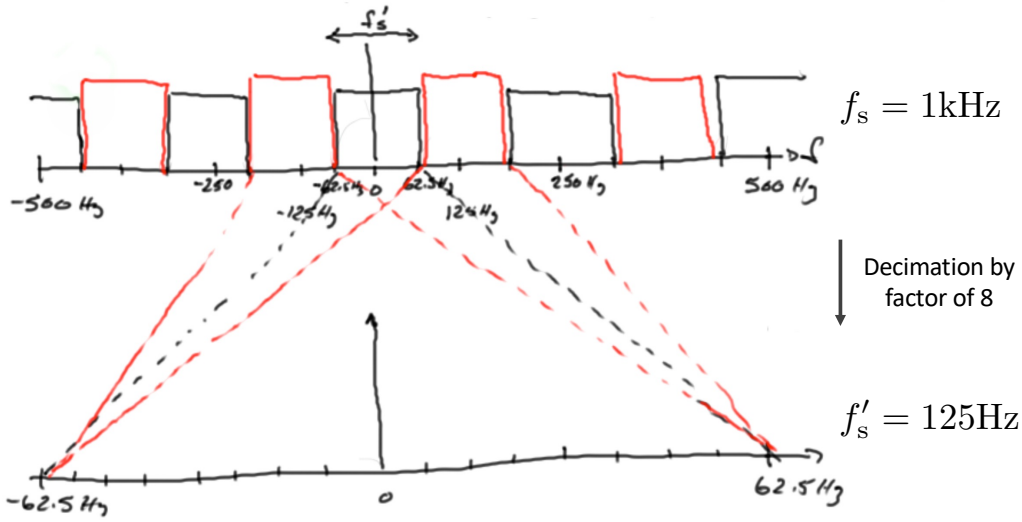
Mapping of Frequencies after Decimation and Aliasing Issue



For example a signal at 260Hz in $x[n]$ will alias to 10Hz in $x'[n]$

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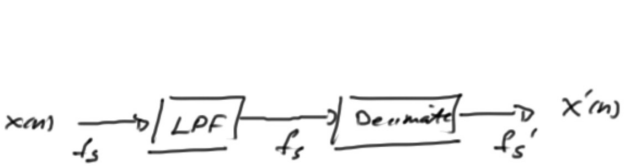
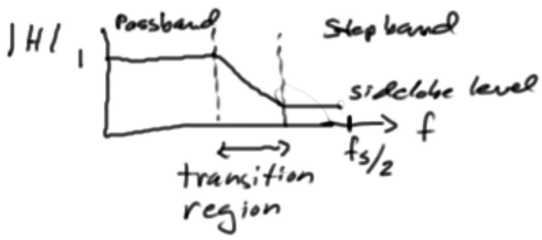
LP Filter to Avoid Aliasing

- To avoid aliasing after decimation, we must pass the original signal through a low pass filter
- This is essentially the same concept as an antialiasing filter prior to A/D conversion, i.e., we aim to remove all signal components that would alias into the signal band of interest





- The function of LPF is to attenuate high frequency content in $x[n]$ so aliasing is not a problem

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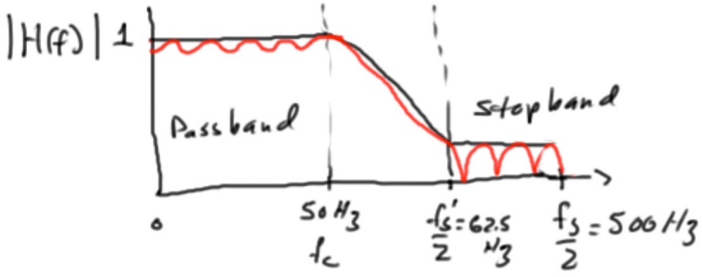
LP Filter Design in Matlab

- Design filter using ``*firpm*'' function in Matlab
  - pay particular attention to how frequencies are defined
  - note that there are distortions or ripples in both passband and stopband regions

Filter Specifications:



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