

Assignment 2

Decimation

Given $x[n]$ and $h[n]$, where $x[n]$ is the input sequence and $h[n]$ are half band filter coefficients. Calculate $y[n]$

1. With convolution(filter) and downsampling
2. With modified equations to exploit half-band filter properties

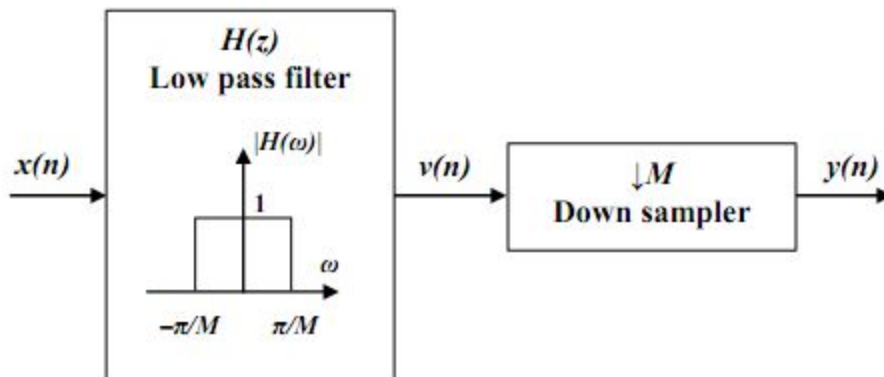
where:

$x[n] = [0 \quad 1.0098 \quad 0.1732 \quad 1.5000 \quad 0.6928 \quad 0.4902 \quad 0.0000 \quad -0.4902 \quad -0.6928 \quad -1.5000$
 $-0.1732 \quad -1.0098 \quad -0.0000 \quad 1.0098 \quad 0.1732 \quad 1.5000 \quad 0.6928 \quad 0.4902 \quad 0.0000 \quad -0.4902$
 $-0.6928 \quad -1.5000 \quad -0.1732 \quad -1.0098 \quad -0.0000 \quad 1.0098 \quad 0.1732 \quad 1.5000 \quad 0.6928 \quad 0.4902$
 $-0.0000 \quad -0.4902 \quad -0.6928 \quad -1.5000 \quad -0.1732 \quad -1.0098 \quad] \text{ (36 samples)}$

3 different lengths(7, 23, 39) of half band filters:

- a. $h[n] = [-0.0085 \quad 0.0000 \quad 0.2451 \quad 0.5000 \quad 0.2451 \quad 0.0000 \quad -0.0085]$
- b. $h[n] = [-0.0023 \quad 0.0000 \quad 0.0054 \quad -0.0000 \quad -0.0159 \quad 0.0000 \quad 0.0385 \quad -0.0000$
 $-0.0893 \quad 0.0000 \quad 0.3124 \quad 0.5000 \quad 0.3124 \quad 0.0000 \quad -0.0893 \quad -0.0000 \quad 0.0385$
 $0.0000 \quad -0.0159 \quad -0.0000 \quad 0.0054 \quad 0.0000 \quad -0.0023]$
- c. $h[n] = [-0.0013 \quad 0.0000 \quad 0.0020 \quad -0.0000 \quad -0.0038 \quad 0.0000 \quad 0.0071 \quad -0.0000$
 $-0.0124 \quad 0.0000 \quad 0.0204 \quad -0.0000 \quad -0.0330 \quad 0.0000 \quad 0.0542 \quad -0.0000 \quad -0.1002$
 $0.0000 \quad 0.3163 \quad 0.5000 \quad 0.3163 \quad 0.0000 \quad -0.1002 \quad -0.0000 \quad 0.0542 \quad 0.0000$
 $-0.0330 \quad -0.0000 \quad 0.0204 \quad 0.0000 \quad -0.0124 \quad -0.0000 \quad 0.0071 \quad 0.0000 \quad -0.0038$
 $-0.0000 \quad 0.0020 \quad 0.0000 \quad -0.0013]$

Block diagram:



Instructions :

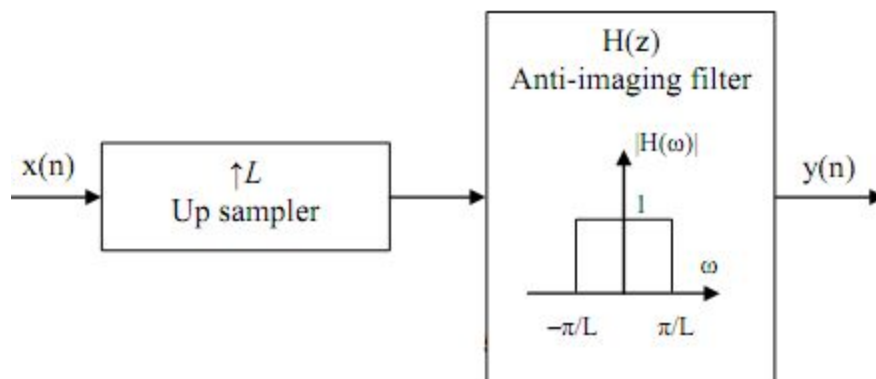
- Write a **C code** with generalised function for calculating $y[n]$ which should work with variable length of half-band filter
- Compare the differences between both methods(1 & 2) and write your inferences?

Interpolation

Given $x[n]$ and $h[n]$, where $x[n]$ is the input sequence and $h[n]$ are half band filter coefficients.

Calculate $y[n]$

1. With upsampling and convolution(filter)
2. With modified equations to exploit half-band filter properties



where:

$x[n]$ is the decimation output, $h[n]$ is the same as above.

Instructions :

- Write a C code with generalised function for calculating $y[n]$ which should work with a **variable length of the half-band filter** and a **variable length of the input**
- Check that, whether your interpolated output is same as $v[n]$ (output of LPF in decimator) or differ with some scaling factor. Write your observation in text file and upload the pdf.

How to upload:

- Upload main function, common_functions.c, common_functions.h files
- Upload pdf document with your inferences

Submit your code files with your id, Example: EE17BTECH11026_**A2**.c,
EE17BTECH11026_**A2**.pdf

Note :

decimation //(convolution + downsampling)

decimation //(convolution with Modified Equations for HBF + downsampling)

Interpolation //(upsampling + convolution)

Interpolation //(upsampling + convolution with Modified Equations for HBF)