SNS COLLEGE OF ENGINEERING

(Autonomous)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT- I

Discrete Fourier Transform

Filtering Methods based on DFT- Overlap Add Method

OVERLAP ADD METHOD:

STEP 1:

Let the length of the input sequence $x(n)$ be L_s and length of the impulse response $h(n)$ be M.

And $N = L_s + M - 1$.

STEP 2:

Input sequence $x(n)$ is divided into block of data of size $L_1 > M$

STEP 3:

Each block consist of L new data points followed by $(M-1)$ zeros

STEP 4:

Compute circular convolution of $x_i(n)$ with $h(n)$,

$$y_i(n) = x_i(n) \circledN h(n).$$

STEP 5:

Due to aliasing since each data block is terminated with $(M-1)$ zeros. The last $(M-1)$ points from each output block $y_i(n)$ must be overlapped and added to the 1st $(M-1)$ points of successive blocks.

PROBLEM:

Find the o/p $y(n)$ of a filter whose impulse response is $h(n) = \{1, 1, 1\}$ whereas $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$ using overlap add method.

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Sol:

STEP 1: $h(n) = \{1, 1, 1\}$

$M = 3$

$x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$

$L_S = 10$.

$N = L_S + M - 1$

$N = 10 + 3 - 1$

$N = 12$

STEP 2:

$L_1 > M$

$4 > 3$

$L_1 = 4$

STEP 3:

$x(n) = \{3, -1, 0, 1 / 3, 2, 0, 1 / 2, 1\}$

$x_1(n) = \{3, -1, 0, 1, 0, 0\}$ → (M-1) Zeros

$x_2(n) = \{3, 2, 0, 1, 0, 0\}$

$x_3(n) = \{2, 1, 0, 0, 0, 0\}$

$\because M = 3$

$M - 1 = 2$.

STEP 4:

$y_i(n) = x_i(n) ⓝ h(n)$.

$L = 6$, $m = 2$.

$x_1(n) = \{3, -1, 0, 1, 0, 0\}$

$h(n) = \{1, 1, 1, 0, 0, 0\}$

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$$\begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 3 \\ -1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 3 \\ 2 \\ 2 \\ 0 \\ 1 \\ 1 \end{bmatrix} = y_1(n)$$

$$x_2(n) = \{3, 2, 0, 1, 0, 0\}$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 3 \\ 2 \\ 0 \\ 1 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 3 \\ 5 \\ 5 \\ 3 \\ 1 \\ 1 \end{bmatrix} = y_2(n)$$

$$x_3(n) = \{2, 1, 0, 0, 0, 0\}$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 2 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \\ 3 \\ 1 \\ 0 \\ 0 \end{bmatrix} = y_3(n)$$

i.e., $y_1(n) = \{3, 2, 2, 0, 1, 1\}$

$y_2(n) = \{3, 5, 5, 3, 1, 1\}$

$y_3(n) = \{2, 3, 3, 1, 0, 0\}$

$y_1(n)$	3	2	2	0	1	1								
$y_2(n)$					3	5	5	3	1	1				
$y_3(n)$									2	3	3	1	0	0
	3	2	2	0	4	6	5	3	3	4	3	1		

RESULT:

$y(n) = \{3, 2, 2, 0, 4, 6, 5, 3, 3, 4, 3, 1\}$

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Thank You!