Digital Signal Processing

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Properties of DFT

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Properties of DFT

Numericals

I $x(n) \longrightarrow X(k)$

$[1\ 1\ 1\ 1\ 0\ 0\ 0\ 0]$

$x_1(n) = [1\ 0\ 0\ 0\ 0\ 1\ 1\ 1] \Rightarrow x(n-\underset{n_0}{5})_8 \rightarrow X(k)\,e^{-j5\pi k/4} = X_1(k)$

$x_2(n) = [0\ 0\ 1\ 1\ 1\ 1\ 0\ 0] \Rightarrow x(n-\underset{n_0}{2})_8 \rightarrow X(k)\,e^{-j\pi k/2} = X_2(k)$

$\downarrow$

$e^{-j2\pi k 2/8}$

Properties of DFT
Numericals

II $x(n) \xrightarrow{D} X(k) = [0, 1+j, 1, 1-j] \Rightarrow 4$

a) $x_1(n) = x(n)e^{j\pi n/2} \longrightarrow DFT\left[x(n)\, e^{j2\pi n/2\cdot 2}\right] = X[k-1]_4$

$[1-j, 0, 1+j, 1]$

b) $x_2(n) = \cos\frac{\pi n}{2} \cdot x(n)$

$DFT\left[\frac{1}{2}e^{j\pi n/2}x(n) + \frac{1}{2}e^{-j\pi n/2}x(n)\right]$

$\frac{1}{2}X[k-1]_4 + \frac{1}{2}X[k+1]_4$

$= \frac{1}{2}\left[(1-j, 0, 1+j, 1) + (1+j, 1, 1-j, 0)\right] = (1, 0.5, 1, 0.5)$

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c) $x_3(n) = x(n-1)_4 \longrightarrow X[k]\, e^{j2\pi k 1/4}$

$X_3[k] = [0 \cdot e^{0},\ (1+j)\, e^{-j\pi/2},\ 1\, e^{-j\pi},\ (1-j)\, e^{-j6\pi/4}]$

$= [0, 1-j, -1, 1+j]$

d) $x_4(n) = x(-n)_4$

$DFT[x(-n)_4] = X[N-k] = X[-k]_4 = [0, 1-j, 1, 1+j]$

e) $x_5(n) = (0, 0, 1, 0) \circledast_4 x(n)$

$DFT[\delta(n-2) \circledast_4 x(n)] = DFT[x(n-2)_4] = e^{-j2\pi k 2/4} X[k]$

$(-1)^k X[k]$

$= (0, -1-j, 1, -1+j)$

THANK YOU

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