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4/21/15

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Exam 3 Rework

1.

 a. (a+jb)(c+jd) = ac + ajd + jbc – bd = (ac – bd) + j(ad + bc)

 k1 = c(a + b) k2 = a(d – c) k3 = b(c + d)

 ac – db = k1 – k3

 bc + ad = k1 + k3

 b. O(N2) is significant because it controls how fast the general execution time grows as the size of the input becomes lager. O(N2) impacts a DFT because it has a growth rate of O(N2). As the number of input samples increases the compute time in the DFT will be felt, as N grows the computational speed becomes faster. We know that Wn is periodic with a period of N, thus we can write the equation to be used by the FFT, reducing the calculation of the DFT. The N point is obtained by splitting the DIT in 2 sequences by two N/2 DFTs. The divide and conquer theory says that the N point DFT is consecutively broken down into smaller DFTs, thus reducing the number of computations (how expensive it is).

2.

 a. $w\left(n\right)=(\frac{1}{2}-\frac{1}{2}\*\frac{1}{2}\left(e^{\frac{j2πn}{m}}- e^{-\frac{j2πn}{m}}\right)w\_{r}\left(n\right)=\frac{1}{2} w\_{r}\left(n\right)-\frac{1}{4}w\_{r}\left(n\right)\*e^{\frac{j2πn}{m}}+\frac{1}{4}w\_{r}\left(n\right)\*e^{-\frac{j2πn}{m}}$

 $W\left(e^{jw}\right)=\frac{1}{2}w\_{r}\left(e^{jw}\right)-\frac{1}{4}w\_{r}\left(e^{j\left(w-\frac{2π}{m}\right)}\right)+\frac{1}{4}w\_{r}\left(e^{j\left(w+\frac{2π}{m}\right)}\right)$

 b. The 2nd and 3rd terms widen the main lobe of the window and the side lobes are lowed by the scaling factor.

 c. The width of the main lobe is the DTF samples between 2 zero crossings and the highest level of side lobe. The side lobe measures how many decibels down the highest side lobe is from the main lobe. We want the width of the main lobe to be narrow so that the input signal can be shifted to the right, and can be seen with sharp edges for improved windowing.

3

1. $Y\left(n\right)=x\left(n\right)\*h\left(n\right)+x\left(-n\right)\*h\left(n\right)=x\left(n\right)\*hs(n)$

 $x\left(-n\right)\*h\left(n\right)=\sum\_{m}^{\infty }=-\infty x\left(-m\right)h\left(n-m\right)=\sum\_{m}^{\infty }-\infty x\left(m\right)h\left(n+m\right)=x\left(n\right)\*h\left(-n\right)$

$$y\left(n\right)=x\left(n\right)\*h\left(n\right)+x\left(n\right)\*h\left(-n\right)=x\left(n\right)\left(h\left(n\right)+h\left(-n\right)\right)=>h\_{s}=h\left(n\right)+h(-n)$$

1. $h\_{s}\left(e^{jw}\right)=H\left(e^{jw}\right)+e^{-jw}=2Re(He^{jw})$
2. These properties will hold if h(n) is an IIR filter because we can add delays to the filter. The delays will cause the filter to be causal. The most important part of is, is that the program has already stored all the data and will not be affected by the causal filter, allowing us to look further into the array.