Chp 5: Discrete Time Fourier Transform. DTFT

Note Title 3/31/2010

DTFT

Subject: Aperiodic $x[n]$

Formulas:

Synthesis $x[n] =$

Analysis $X(e^{jw}) =$

* Comparison: We use $X(e^{jw})$ for DTFT. $X(jw)$ for CTFT.

*

Generalized DTFT.

Subject:

Ex: Suppose $x[n] = e^{j\frac{\pi}{3}n}$

Find $X(e^{jw})$

Ans: Direct Computation is for aperiodic $x[n]$. In this case, $x[n]$ has period 6. We need to use inspection

Nonetheless, we are not done yet.
Since $X(e^{j\omega})$ is periodic, we must have many other impulses to make it periodic or $X(e^{j\omega}) = \sum_{k=-\infty}^{\infty} 2\pi\,\delta(\omega - \frac{\pi}{2} - 2\pi k)$

Example: $x[n] = \cos\left(\frac{3}{2}\pi n\right)$

$$= \frac{1}{2}e^{j\frac{3\pi}{2}n} + \frac{1}{2}e^{-j\frac{3\pi}{2}n}$$

Find $X(e^{j\omega})$.

Ans: By inspection

Step 1:

Step 2: Make it periodic

Final Answer:

Ex $x[n] = \sin\left(\frac{5}{4}\pi n\right)$.
Find & plot $X(e^{j\omega})$

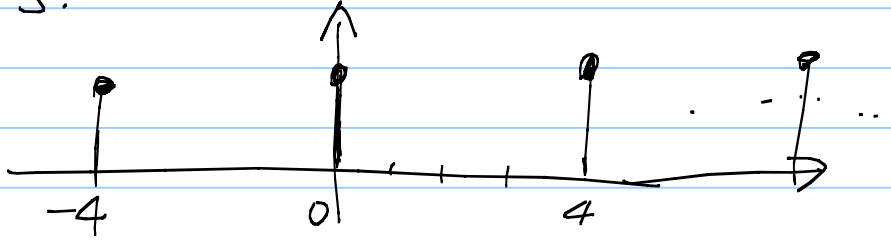
Ans: By inspection.

Step 1

Step 2: Make it periodic

* For general periodic signals, we rely on DTFS.

Ex: $x[n] = \sum_{k=-\infty}^{\infty} \delta(n-4k)$



(Example 5.6)
Find $X(e^{j\omega})$

Ans: Now we are facing a DT periodic signal that cannot be solved directly by inspection.

Step 0:

Step 1: By inspection,

Step 2: Make it periodic