Why sinusoids?

- We can combine sinusoids of various frequencies, magnitudes, and angle offsets to form ANY time signal (by constructive/destructive interference)

- “Fourier” = Frequency spectrum

- Energy or power transitions between signals and “environment” are more easily described through the frequency spectrum

- resonances

- absorption or generation of energy

- Most digital filters are designed to manipulate or manage spectra of signals

Graphical representation of spectra of sinusoids

- Based on Euler identity:

- Start with “radial frequency” graphical representation (rad/s)

- Then consider ”cyclic” frequency representation (Hz)

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Spectra mapped vs f (Hz)

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Sampling a time function

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- is an ordered list of “sampled” values of f(t) at uniform spacing ()

- List is indexed by integers [n]

- Any ordered list of values has a unique “characteristic” spectrum associated with it

Sampling rate:

analogous to cycles/sec (Hz)

- Radial version of sampling rate:

We start with sampled sinusoids -> then broaden to more arbitrary “ordered list” of sampled signals

Consider “spectrum” of sampled sinusoids:

- Analog signal

= “Analog” radial frequency (radians/sec)

= “Something else”

Sample g(t) at spacing of delta t

- “Normalized” frequency to make “standard spectrum” of ordered list

- Any normalized frequencies in formula produces same sequence

- This is called frequency ambiguity (aliasing)

Aliasing example

Sample at

= 80 samples/sec (80Hz)

Which alias do we use to recover the analog cosine from the ordered list?

- “Occam’s Razor”

- When multiple solutions occur, the simplest one is usually the best.

- “Principle Zone” description

- Lowest values of w hat that work. Look for -pi < w-hat < pi