Definitions of Basic Terms
Commonly Used in Digital Signal Processing
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- **S**, Sample Rate, The number of samples per second acquired during the sampling process.
- The Sampling Theorem states that a signal with bandwidth B can be recovered from its samples if \( S > 2B \).
- **\( f_{\text{FOLD}} \)**, Folding Frequency (Hertz), \( f_{\text{FOLD}} = \frac{S}{2} \).
- **A/D**, Analog-to-Digital converter. Changes an analog signal \( x_a(t) \) to a digital signal \( x[n] \) (a sequence of numbers). Conversions are performed at the rate \( S \). Real A/Ds generate integers for \( x[n] \). Because integers are quantized in intensity such signals are referred to as ‘digital’ signals. Often the intensity quantization is ignored (to simplify analyses) in which case \( x[n] \) is a ‘discrete signal’ (discrete in time, not in amplitude).
- **D/A**, Digital-to-Analog converter, Performs the inverse operation of an A/D.
- **\( f \)**, Analog Frequency (Hertz)
- **\( F \)**, Digital Frequency (cycles/sample). \( F_0 = \frac{f_0}{S} \).
- **\( t_s = \frac{1}{S} \)**, Sample Spacing (sec), the spacing in time between adjacent samples of \( x[n] \)
- **\( N \)**, Number of samples associated with DFT or FFT transforms. (There are other uses of ‘\( N \)’ also).
- **\( \Delta f = \frac{S}{N} \)**, Frequency Spacing (Hertz), spacing along the analog frequency axis between adjacent samples \( X(k) \), as computed via a DFT or FFT.
- **\( \Delta F = \frac{1}{N} \)**, Frequency Spacing (cycles/sample), spacing along the digital frequency axis between adjacent samples \( X(k) \), as computed via a DFT or FFT.
- **Spectral Spacing**, Same as frequency spacing.
- **Spectral Leakage**, A phenomena that causes blurring in the spectrum of a signal. Spectral leakage always occurs for finite-length versions of signals, compared to their infinite-length versions. However, spectral leakage may not be observed in the samples \( X(k) \) of a DFT. Spectral leakage will not be observed for a sinusoid at frequency \( f_0 \), if \( f_0 N / S \) is an integer.
- **Zero Padding**, the process of adding zeros at the end of a signal to increase the overall length. For example, if \( L \) samples of a signal are acquired and \( M \) zeros added, then the total length is \( N = L + M \). This provides a better (smaller) \( \Delta F \).
- **\( \Delta F_r \)**, Spectral resolution, the minimum separation in frequency between two sinusoids that permits the two individual sinusoids to be distinguished (or ‘resolved’) in a spectrum. For a zero-padded signal \( \Delta F_r = \frac{1}{L} \), and \( \Delta F = \frac{1}{N} \).