

**Definitions of Basic Terms  
Commonly Used in Digital Signal Processing  
Dr. Fred DePiero**

- 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),  $f_{\text{FOLD}} = S/2$ .
- 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).  $F_0 = f_0 / S$ .
- $t_s = 1/S$ , 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).
- $\Delta f = S/N$ , Frequency Spacing (Hertz), spacing along the analog frequency axis between adjacent samples  $X(k)$ , as computed via a DFT or FFT.
- $\Delta F = 1/N$ , 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  $\Delta F_r = 1/L$ , and  $\Delta F = 1/N$ .