Lecture 5 Sampling & Aliasing Part 2

The University of Texas at Austin

EE 313 Linear Systems and Signals

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$f_s > 2 f_{max} \longrightarrow f_{max} < \frac{1}{2} f_s$

sampling frequency

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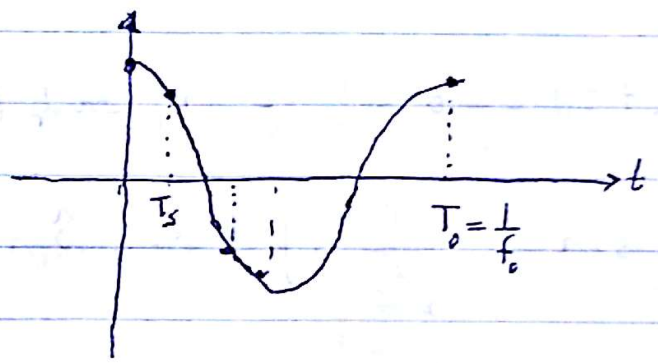
How many samples should we take?



$x(t) = \cos(2\pi f_0 t)$

$x[n] = x(t)\Big|_{t = nT_s} = \cos(2\pi f_0 (n T_s))$

I can write $T_s = \frac{1}{f_s}$

$\longrightarrow x[n] = \cos(\underbrace{2\pi \frac{f_0}{f_s}} n)$

$\hat{\omega} = 2\pi \frac{f_0}{f_s}$

Sample at 1 sample per cosine periods

$f_s = f_0 \longrightarrow \hat{\omega} = 2\pi \frac{f_s}{f_0} = 2\pi \longrightarrow x[n] = \cos(2\pi n) = 1$

$\leftarrow$ constant value

Sample at 2 samples per cosine period,

$f_s = 2f_0 \longrightarrow \hat{\omega} = 2\pi \frac{f_0}{f_s} = 2\pi \frac{f_0}{2f_0} = \pi$

$\longrightarrow x[n] = \cos(\pi n) = (-1)^n \longrightarrow$ it works for cosine
But what about sine?

$y(t) = \sin(2\pi f_0 t) \longrightarrow y[n] = \sin(2\pi f_0 (\frac{n}{f_s}))$

$\longrightarrow y[n] = \sin(\underbrace{2\pi \frac{f_0}{f_s}}_{\hat{\omega} = 2\pi \frac{f_0}{f_s}} n) = \sin(\hat{\omega} n)$

sample 2 samples per period for sin

$\longrightarrow y[n] = \sin(\pi n) = 0 \longrightarrow$ By selecting $f_s = 2f_0$ it doesn't work

$\boxed{\text{Slide 5-9}}$

$f_{max} < \frac{1}{2} f_s \longrightarrow \frac{f_0}{\frac{1}{2} f_s}$ $\frac{\hat{\omega}}{\pi}$ $\longrightarrow$ fundamental range

$-\frac{1}{2} f_s$ $-\pi$