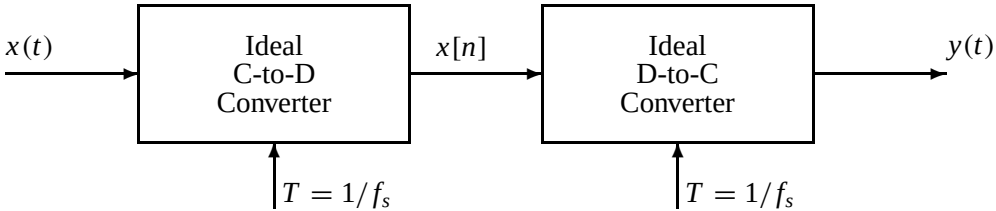
PROBLEM:

Consider the following system.



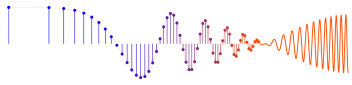
Suppose that the output of the D-to-C converter is

$$y(t) = 5\cos(500\pi t + \pi/4)$$

and that the sampling rate is $f_s = 1/T = 2000$ samples/second. Determine two *different* continuous-time signals $x(t) = x_1(t)$ and $x(t) = x_2(t)$ that could have been inputs to the above system. Give equations for both inputs.

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

SOLUTION



$F_s = 1/T_s = 2000$ samples/sec

FREQ = 250Hz

If $y(t) = 5\cos(500\pi t + \pi/4)$, then $x[n]$ must be

$$x[n] = 5\cos\left(2\pi\left(\tfrac{1}{8}\right)n + \pi/4\right)$$

$\frac{250}{2000} = \frac{1}{8}$

- One possible signal comes from unaliased sampling

$$x_1(t) = 5\cos(500\pi t + \pi/4)$$

- A second signal comes from folded aliasing

$$f = 2000 - 250 = 1750 \text{ Hz}$$

but the phase must be negated.

$$x_2(t) = 5\cos(2\pi(1750)t - \pi/4)$$

NEGATIVE PHASE

- Other possible inputs are obtained by adding $2\pi(2000)$ to the freq:

$$x_3(t) = 5\cos(2\pi(250+2000)t + \pi/4)$$
$$= 5\cos(4500\pi t + \pi/4)$$