ISS – Numerical exercises IV.

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Example 1 – transfer of a harmonic signal through an LTI system

Given a cosine: $x(t) = 45\cos(160\pi t + 0.4\pi)$. Transfer the signal through an amplifier with amplification 10 at frequency 80 Hz and delay of phase 0.5π . What is the output signal considering that the amplifier is perfectly linear?

Example 2 – sampling

A cosine (1 kHz) given by : $x(t) = 10\cos 2000\pi t$. is sampled on sampling frequency $F_s = 8000$ Hz.

- Plot the spectrum of the origianl cosine.
- Plot the spectrum of the sampled cosine.
- Signal is reconstructed by ideal low-pass filter with transfer $\frac{1}{8000}$ from -4 kHz to 4 kHz, 0 elsewhere. What does the resulting spectrum look like?
- What are the outputs if considered a cosine with angular frequency $\omega_1 = 14000\pi$ rad/s ?
- Determine normalized frequencies for both cosine functions.

Example 3 – circular convolution

Discrete signals with length $N = 4$ are defined for $n = 0, 1, 2, 3$:
$x = [\ 0\ \ 2\ \ 2\ \ 0]$
$y = [-1\ \ 1\ \ 0\ \ 0]$
Compute their circular convolution.

Example 4 – DTFT

Compute Frourie transform with discrete time of the signal $x[n]$.

Example 5 – DFS

Compute DFT coefficients of the periodized signal $x[n]$ with period $N = 4$.

Example 6 – DFT

Compute DFT of the signal $x[n]$.

Example 7 – DFT once more

Compute DFT of a signal of length $N = 8$: $x[n] = 5\cos(\frac{2\pi}{8}n + \frac{\pi}{2})$ for $n = 0 \ldots 7$, 0 elsewhere.