DIGITAL SIGNAL PROCESSING: COSC390

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Previous lectures covered:

- Complex numbers 1: Arithmetic and some calculus (continuous and discete) ... see Chapter 30 of text

This lecture will cover:

- Complex numbers 2: The Fourier series and Fourier transform (continuous and discrete)

Next lecture will cover:

- *Time-permitting*: The Laplace transform (continuous and discrete)

COMPLEX NUMBERS 2: THEORY AND EXAMPLES

Review: Let's work the following examples.

1. Let $z_1 = x_1 + jy_1$, and $z_2 = x_2 + jy_2$. Simplify $z = \frac{z_1^* z_2}{|z_1|^2 + |z_2|^2}$ into real and imaginary parts.
2. Express z in polar form and plot it for $x_1 = y_1 = 1.0$, and $x_2 = y_2 = -1.0$.
3. Express the function $v(t) = v_0 \cos(\omega t + \phi_0)$ as a phasor, and plot it.

The Fourier series representation of a function $f(x)$ is written:

$$S(x) = \frac{A_0}{2} + \sum_{i=1}^{\infty} \left(A_n \cos(nx) + B_n \sin(nx)\right) \tag{1}$$

with

$$A_n = \frac{1}{\pi} \int_0^{2\pi} f(x) \cos(nx) dx \tag{2}$$

$$B_n = \frac{1}{\pi} \int_0^{2\pi} f(x) \sin(nx) dx \tag{3}$$

Let's obtain the Fourier series coefficients A_n and B_n for a square-wave signal:

$$f(x) = 1, \quad 0 \leq x \leq \pi, \quad 0, \pi < x \leq 2\pi \tag{4}$$

(Observe on board). The result: $A_0 = 1.0$, all other $A_n = 0$, odd B_n values follow $2/(n\pi)$, even $B_n = 0$ as well.

Create octave code that plots this (see Moodle for example).

CONCLUSION