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TÉCNICAS DE AQUISIÇÃO E PROCESSAMENTO DE SINAIS -

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Convolution – Cross-correlation

The aim here is to simulate a hypothetical sonar signal to evaluate the displacement of a target, applying the cross-correlation to consecutive signals.

1- The signal should be simulated as a sinusoidal with 8 cycles, and then exponential and hamming windows are to be sequentially applied.

2- Create a second signal using the same procedure but shifted in time. One way of doing that is to apply a convolution between the signal with an impulse shifted in time. A suggestion is to have both signals with the same number of points, what can be achieved, for example, using the Zero Padder.vi function.

3- Add Gaussian noise to both signals so that 20 dB signal to noise ratio is obtained.

4- Estimate the time delay between both signals using the cross-correlation function. Peak detector can be used to find the point of maximum correlation and, consequently, the time delay.

5- Apply the same procedure 100 times using, for example, a while loop. Also repeat that algorithm for 3 different time delays (for example, 1/3, 2, and 4 wavelengths). For each case, evaluate the means and standard deviation values.

   a. Let´s say the signal was sequentially obtained from the same target, estimate its displacement. How does the sampling frequency affect the described procedure?
   b. Assuming we used a low sampling frequency, how could we improve the analysis?