

Assignment 5

Due March 4th 2019

1. Self-grade Homework 4.
2. Read all sections in note by Prof. Gastpar (link available on course website by lecture note on 02/22). Gastpar's note defines some variables with different symbols, so please use the following table to relate them.

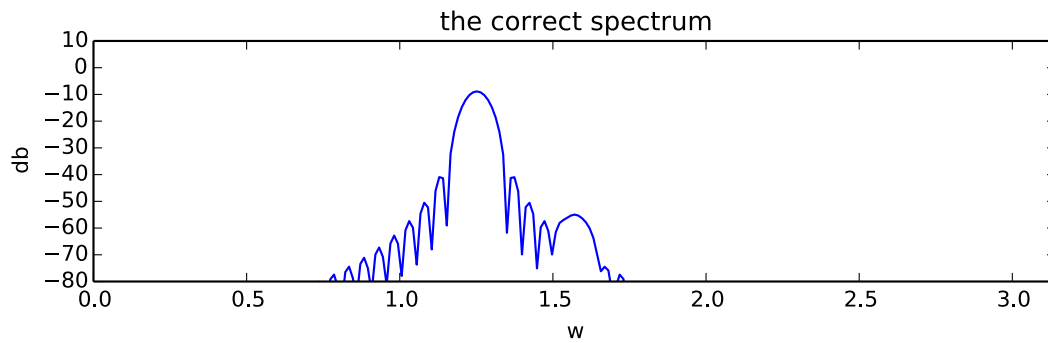
Variable Name	in Class Notes	in Gastpar Notes
signal	$f(t)$ or $x[n]$	$x(t)$
time shift	u	τ
window function	$w(t)$ or $w[n]$	$g(t)$
mother wavelets	$\Psi_{i,n}(t)$ or $\Psi_{s,u}[n]$	$\psi_{m,n}(t)$
father wavelets	$\Phi_{i,n}(t)$ or $\Phi_{s,u}[n]$	$\varphi_{m,n}(t)$
detail coeff.	$d_{s,u}$	$a_{m,n}$
approximation coeff.	$a_{s,u}$	c_n

3. Problem 2.49, Oppenheim and Schaffer, 3rd ed.
4. Determine whether each of the statements is true or false. Explain your reasoning.
 - (a) If $X(e^{j\omega}) = X(e^{j(\omega-\pi)})$, then the odd samples of $x[n]$ are zero.
 - (b) if $X(e^{j(\omega-\pi/2)}) = -X(e^{j(\omega+\pi/2)})$, then the even samples of $x[n]$ are zero.
5. *From Midterm I fall'13:* Practical Spectral Analysis

You are given 512 samples of a signal similar to the one shown in class, that contains two tones. One of the tones has an amplitude of -46db with respect to the other.

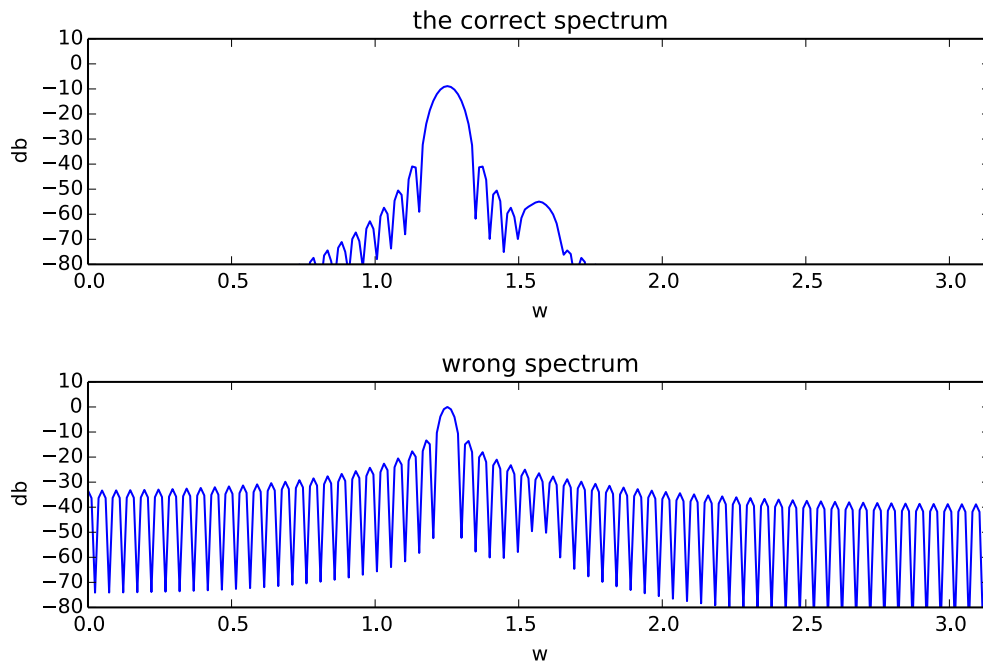
You write a python code that crops 128 samples from the signal, multiplies it with a Hann window, zero-pads to 512 samples, computes the DFT and displays the magnitude of the positive frequencies corresponding to $0 \leq \omega \leq \pi$.

You run the code and the results do not look right. You debug and fix it several times, each time it produces a different result. Finally you go to Frank who helps you fix the problem and come up with the following plot:



Consider that things could have gone wrong in the implementation. Which combination of problems in: cropping, Hann windowing, zero-padding and DFT could explain the resulting spectrum in the following figures. Explain briefly the evidence leading to the choice. (Hint: Look at the side lobe, resolution, main lobe etc.)

a) What happened here?

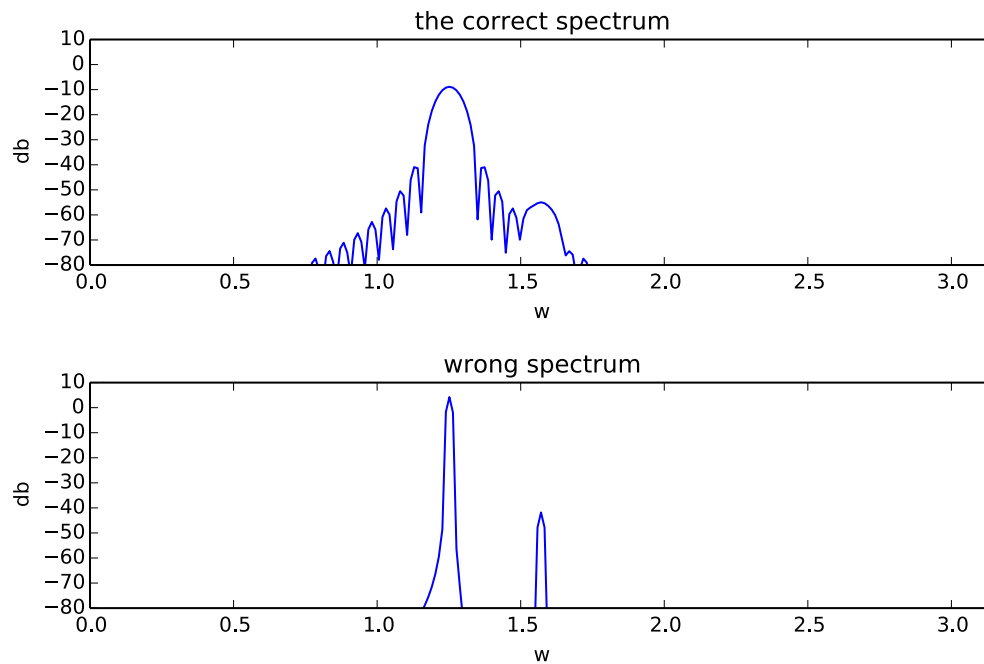


I got this figure because I forgot to:

☐ Crop the signal ☐ Hann windowed ☐ zero-pad ☐ DFT

Evidence:

b) What happened here?



I got this figure because I forgot to:

☐ Crop the signal

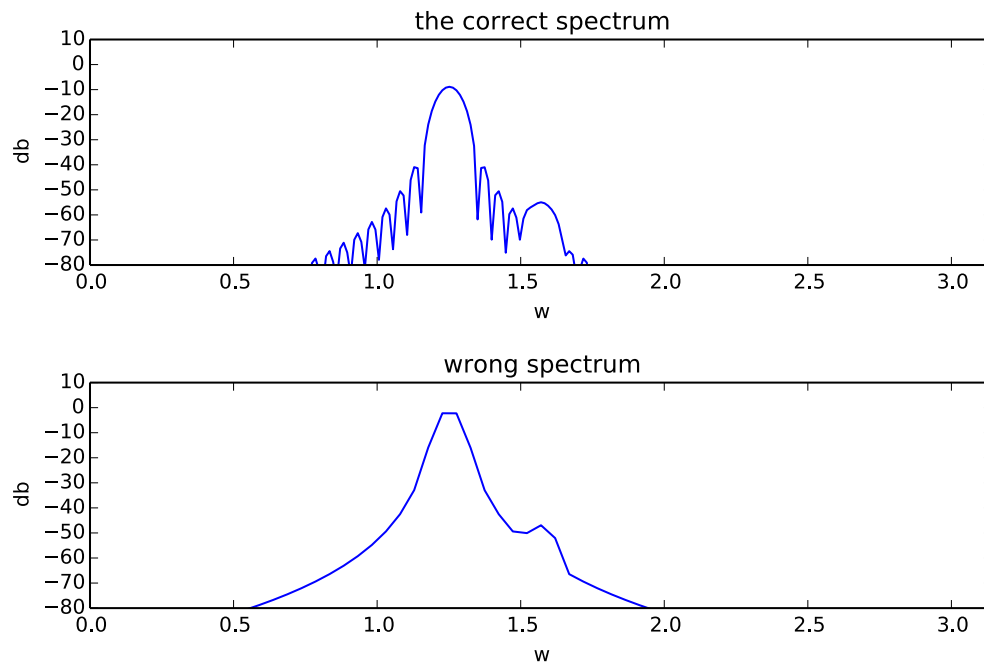
☐ Hann windowed

☐ zero-pad

☐ DFT

Evidence:

c) What happened here?



I got this figure because I forgot to:

☐ Crop the signal

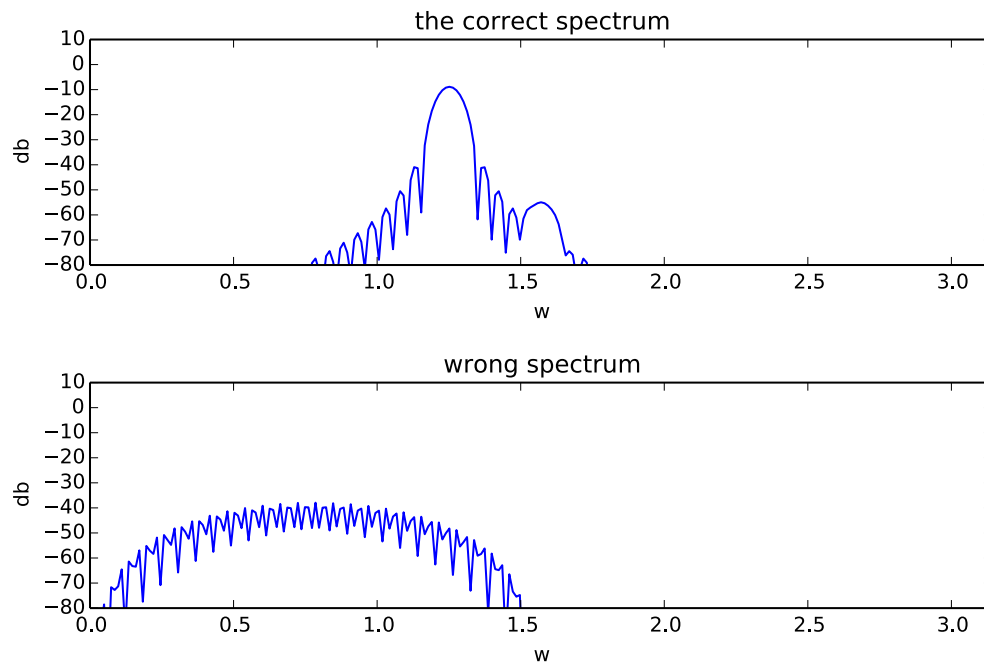
☐ Hann windowed

☐ zero-pad

☐ DFT

Evidence:

d) What happened here?



I got this figure because I forgot to:

☐ Crop the signal

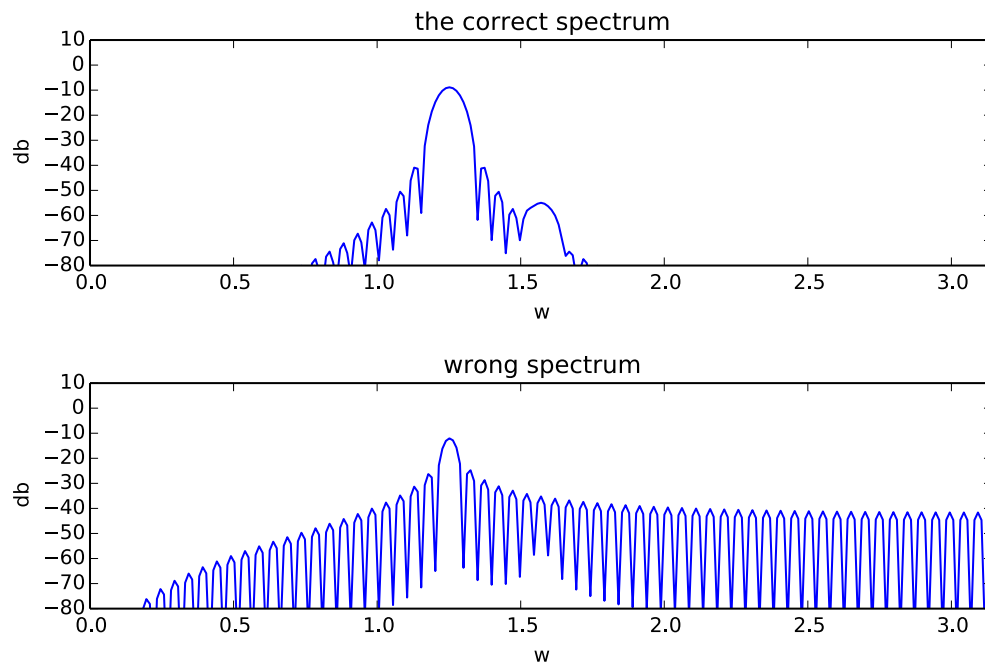
☐ Hann windowed

☐ zero-pad

☐ DFT

Evidence:

- e) *** In this part, all of the operations have been performed, but the order may have been swapped. *** What happened here?



I got this figure because I ordered the operations in the following way (fill in the order of execution):

-- Crop the signal	-- Hann windowed	-- zero-pad	-- DFT
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Evidence:

6. Redo all midterm questions.