Lab Assignment - 7
The Hilbert Transform

March 30, 2016

PROBLEM 1:

Consider the message signal $x(t)$ with the Fourier transform as shown in Fig. 1.

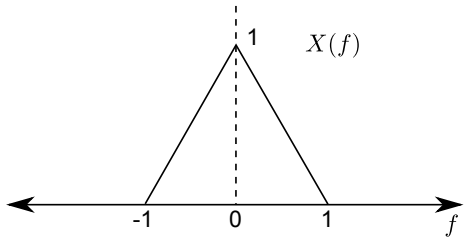

Figure 1:

Your task is to use the Hilbert transform approach to generate the spectrum $|Y(f)|$ as shown in Fig. 2.

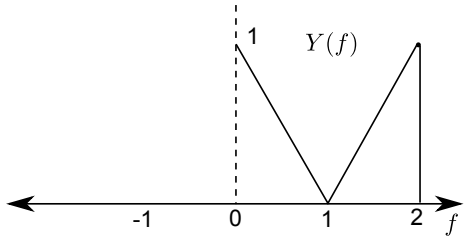

Figure 2:

1. Generate a signal $x(t)$ for $-5 \leq t \leq 5$ with the Fourier transform as shown in Fig.1. Plot the Fourier transform of $x(t)$ and confirm that it has the same shape as that of Fig.1.

2. Compute the output of the Hilbert transformer $m_h(t)$ when the signal $x(t)$ is passed through it. The output $m_h(t)$ can be calculated by first taking the Fourier transform of $x(t)$, multiplying it with the frequency response of the Hilbert transform, and then taking the inverse Fourier transform. Plot the spectrum of the complex signal $z(t) = x(t) + jm_h(t)$. (Hint: The length of the output vector containing the Hilbert transform will depend on the length of the FFT. After the inverse Fourier transform, just take the first K samples of $m_h(t)$, where K is the length of the vector containing samples of $x(t)$).

3. Use only complex multiplication, complex addition and complex conjugate operations on $z(t)$ and/or $x(t)$ to generate $y(t)$ with the spectrum as shown in Fig.2. Plot its Fourier transform to confirm that your answer matches the one shown in the figure.

Deliverable

You are required to bring a hand-written report of the assignment to the lab. You don't need to print plots and only need to write the code corresponding to different plots. The first page of your report should answer the short questions in different parts of the assignment.

All the spectra in this assignment should display both positive and negative frequencies and not just positive ones. There should be no `for` loops in the entire solution.