3. Experiment

3.1 FIR: Design

• 1 Mark This question is for you to compare the performances of filters designed using different windowing functions. Using the FDA Tool, design four windowing-based filters of order 50, with cutoff frequency at 4KHz. Use the following windows for your filters: Rectangular, Hamming, Hann (Hanning) and Blackman. Create a table with three items: a) frequency of the first sidelobe, b) magnitude of the first sidelobe in dB and c) attenuation at 5KHz in dB.

• 1 Mark You have a bandlimited signal which is being corrupted with white noise and a strong noise component at 5KHz. You want to preserve the signal the best you can up to 5KHz. Based on your measurements and observations from the previous question, select one of the filters which will better solve this problem.

3.2 FIR: Simulation

• 2 Marks With the model described on the outline running (order 20), change the input frequency and draw the filter frequency response from the output values. In order to do that, you can set the running time to inf, as it is shown in the outline. Use 500Hz, 1kHz, 4kHz, 5kHz, 8kHz, 9KHz, 10.2kHz, and 11KHz. Explain the variations in magnitude observed.
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• 2 Marks For this question, you will concentrate on the main lobe of the filters you design, and will analyze three filters of different orders. Plot your results for the three filters on the grid below, indicating which graph corresponds to which filter. Use orders 20, 40 and 80 for the Hann window, cutting off at 4KHz. Repeat the procedure used on the previous question, using 1KHz, 2KHz, 4KHz, 4.5KHz, 4.8KHz, and 5KHz.

• 1 Mark Now look at the impulse response plot for the three filters above, of orders 20, 40 and 80. When you implement an FIR filter, you are implementing a convolution between the (sampled) input and these impulse responses. With that in mind, record the time it would take for a sample to travel through all the taps of the FIR filter. Based on this and the plots above, cite one advantage and one disadvantage associated with the order?

4. FIR: Implementation

• 2 Marks With the filter running on the DSP, change the input frequency and draw the frequency response magnitude. Use 500Hz, 1kHz, 4kHz, 5kHz, 7kHz, and 10kHz. Compare these results with the ones obtained in the simulation for the appropriate filter order.
• 1 Mark Identify where the first sidelobe is by varying the frequency of your input signal (this is going to be a very small variation). Show it to the TA.