106-1 Advanced VLSI HW2

Multirate Processing of Digital Signals

TA Information
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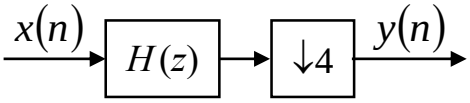
Homework requirement:

1. (35%) If we have a system below, where $H(z) = \sum_{i=0}^{7} h_i z^{-i}$.



   (a) (5%) Plot the RTL design of "direct implementation" based on Direct-form I structure.

   (b) (15%) Plot its equivalent RTL design based on "polyphase structure."

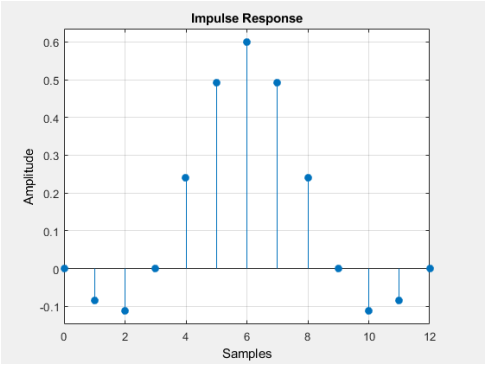
   (c) (15%) Compare these two RTL designs in terms of

      1. Total complexity (no. of adders/multipliers/registers, etc.).
      2. Running clock rate of each adder/multiplier. Suppose that input clock rate of x(n) is 1G sample/sec.
      3. Your general comments on these two designs. E.g., comment on the redundant operation of "direct implementation." Why polyphaser design is better? What do you save and gain?

   (Refer to the slide Lec2.30 – page 30 of Lecture 2 note)

2. (10%) Design a Raised-Cosine Filter based on Matlab program specified in https://www.mathworks.com/help/signal/ref/rcosdesign.html?requestedDomain=www.mathworks.com

   (a) (5%) Create a normal raised-cosine filter with rolloff 0.25. Specify that this filter span 4 symbols with 3 samples per symbol, as shown on the right figure



   (b) (5%) Plot the frequency response of this raised-cosine filter. What is the value of its **excess bandwidth, α?** See definition of Excess Bandwidth on p.12 and p.13 of Lec6-2 slide.

3. (55%) Refer to the slide Lec4.20 and Lec4.21.
   (a) (10%) Validate the RTL design of short-length FIR filter with M = 3 on Lec4.21. Is it correct? Or the design on Lec4.21 needs modification? If so, please check the slide on Lec4.21 and re-design it.
   (b) (25%) Verify the RTL design of short-length FIR filter with M = 3 on Lec4.21, by using a filter design with coefficients of the above Raised-cosine filter. That is, run a Matlab program to verify the RTL design on Lec.4.21, by comparing its filtering results with a normal *M=1* (direct implementation) FIR filter. Show **the first 30 filtering results** of your Matlab program of both *M=3* and *M=1* filters.
   (c) (20%) Derive the "transpose architecture" of the correct Lec4.21. Then, re-run the Matlab. Show **the first 30 filtering results** of your Matlab program of both *M=3 (transposed form)* and *M=1* (*direct implementation)* filters.

Deadline: 2017/11/12 23:59:59

1. The file name of the report should be **r06943xxx_hw2_report.pdf**
2. The simulation code should be upload
3. An easy readme.txt file should be provided to describe how to use your code
4. Put the report, codes and readme in the same folder, which is named **r06943xxx _hw2**
5. Compress the folder to **r06943xxx_hw2.rar/ r06943xxx_hw2.zip**
6. Submit the .rar/.zip to Ceiba before deadline