

CS-330 Assignment 3

Resampling

Deadline: 2/11/2023 23:59 via turnin


26 October 2023

General Information

The goal of this assignment is to become familiar with some up-sampling issues to better understand the challenges of sampling theorem.

Exercise 1


In this exercise you will investigate the accuracy of the three different up-sampling/interpolation schemes. Consider the case of doubling the sample rate, thus for each input sample two are output.

1. Build the logic of the three schemes in a single flowgraph called *lab3_1.grc*: 
 - (a) For each input sample a second sample is produced with zero amplitude (zero padding).
 - (b) For each input sample a second sample is produced with the exact same amplitude (duplication/repetition).
 - (c) For each input sample a second sample is produced with the average amplitude of the current and next input samples.
2. Use the proper combinations of the available GNU Radio blocks and implement the three aforementioned schemes.
3. Test the three schemes by using the following parameters:
 - (a) Input sample rate 48000 Hz.
 - (b) Output sample rate 96000 Hz.
 - (c) A test cosine signal from 0 up to 24 kHz. Use a QT Range slider to adjust the frequency in real time.
4. Report and discuss your findings. How is the frequency domain affected? Which system is the best?
5. Recall, the decimation process of the previous assignment. In that case, after the decimation aliasing artifacts appeared. In the interpolation schemes above, do you observe any kind of artifacts? If yes, explain why they appear and try to compensate them.

NOTE: You can evaluate all the schemes by using a spectrum analyzer block with three input ports
6. After evaluating the three schemes, do you consider of a better scheme to up-sample? If yes, report the reasoning, build the scheme, test it against the others, and report your findings.

Exercise 2

In this exercise you will implement a resampler, by combining properly decimation and interpolation implemented in the previous assignment and at Exercise 1. Note that your final result should compensate as much as possible any aliasing or other artifacts. The SNR between the signal tone and any other artifact should be at least 20 dB. For the interpolation process you can choose one of the three proposed schemes of Exercise 1.

- Create a flowgraph with the name *lab3_2.grc*
- Assume a source sampling rate of $s_{rcs} = 48$ kHz and a test cosine signal from 0 up to 24 kHz. Use a QT Range slider to adjust the frequency in real time.
- Resample properly the signal to 62.4 kHz, by combining properly decimation and interpolation. Use a frequency sink operating at 62.4 kHz to visually inspect the result. 

About Submission

The submission of the Assignments will be done through the **turnin** process. If needed, more info will be sent to the list prior to the deadline. You can turnin this assignment until **2/11 23:59**. Use the command below:

turnin assignment3@hy330 <dir>

You should provide a report as a **single pdf file**, containing your comments, screenshots or anything that you believe will be helpful for your grading. Also include any .grc files that you have created or changed.

About Oral Examination

All the students who have submitted their exercises are requested to attend the oral exam session, in order to present their solutions. A short quiz will also take place during that time. You will need to choose a timeslot for the oral exam using Doodle. More details will be sent to you via email.

Attention

- Each student will only be examined during the timeslot choosed.
- During this session both the Assignments 1, 2 and 3 will be examined.
- Both the timely submission and the oral exam session will contribute to the grading of the assignment.