UNIVERSITÄT STUTTGART
Institut für Visualisierung und Interaktive Systeme (VIS)

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Scientific Visualization (Assignment 6)

Exercise 6. 1 [2 Points] Color interpolation on triangle grids

Regarding interpolation of colors, what problems would you expect when having two adjacent triangles instead of a square? Discuss the implication on triangle grids and the advantages of having a triangulation that satisfies the Delaunay properties.

Exercise 6. 2 [4 Points] Transfer Function

In this task, you have to apply a transfer function on a 2D scalar field (in this case a gray-value image). In computer graphics, a transfer function can be represented as a 1D texture that is used to sample colors from for a given scalar value. This task requires you to implement this method in C++ (*ltf.cpp*). The transfer function that is used is piecewise linear. First, you have to create a discrete array representing the transfer function with 128 entries from a set of color samples. Second, you have to apply the created transfer function on the given image (*lena.pgm*). Make sure that you interpolate correctly in both steps. Use the resulting application to convert the gray-value image *lena.pgm* to an RGB color image. Please, hand in the cpp file and the generated output.

Hint: You can open PGM and PPM files with Gimp.

Exercise 6. 3 [6 Points] Signal Processing

In the lecture, the Fourier Transform, as well as the basics of convolution, sampling theory, and filter design, was discussed. A signal's spectrum is given by

$$X(\nu) = \begin{cases} 1 - |\frac{\nu}{\nu_X}| & \text{if } |\nu| < \nu_X \\ 0 & \text{otherwise} \end{cases}$$

while the sampling is given as

$$S(\nu) = \sum_{n=-\infty}^{\infty} \delta(\nu - n\nu_S)$$

The input signal and the sampling are sketched in Figure 1 and Figure 2, respectively. Note that both signals are given in the *frequency* domain.

1. Give the condition for the sampling frequency ν_S that is needed to correctly reconstruct $X(\nu)$ with respect to ν_X. Submit the condition.
2. $S(\nu)$ is used for the sampling of $X(\nu)$. Construct the sampled signal (in the frequency domain) for a case where the condition in 1. is fulfilled and one where it fails. Submit sketches of examples for both cases.

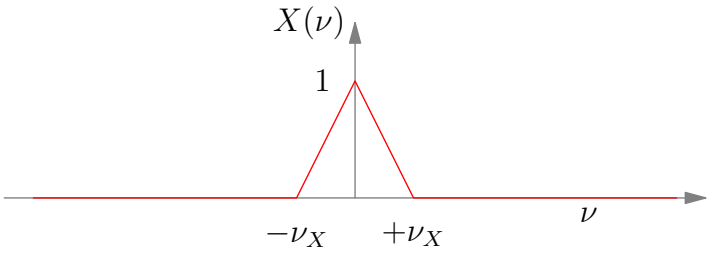

Figure 1: Input signal in frequency space

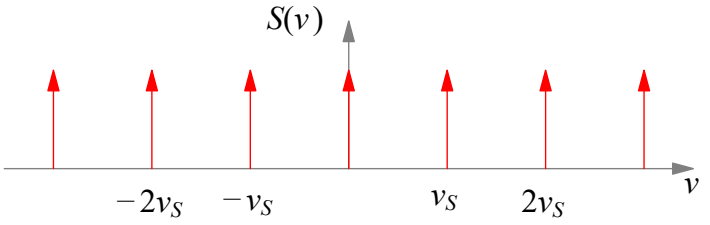

Figure 2: Sampling signal in frequency space

3. Specify a filter which needs to be applied to the sampled signal so the original signal can be reconstructed. Submit a sketch of the filter and how it is applied.

Sketches can be submitted in any human readable format. Code/tools may be used to generate the sketches, but are not considered valid formats.

Submission Deadline: 2019-05-24, 23:55

please hand in your submission through the ILIAS system.

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