Computer Graphics: Assignment 03

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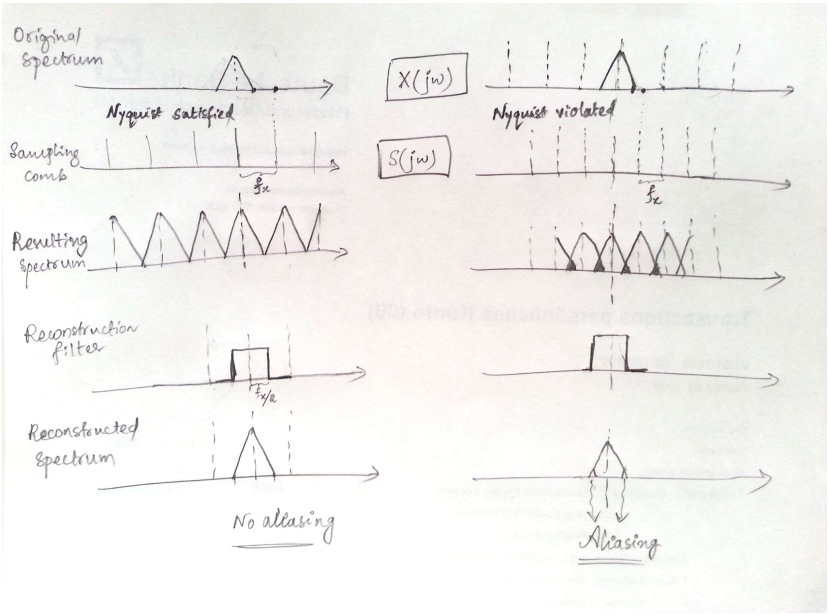
November 13, 2016

1. BRDF

- The three parameters which can be input into a BRDF are,
  - Incoming light direction
  - Outgoing view direction
  - Surface position
- The value of a BRDF for a certain parameter set tells us how much light is reflected when light makes contact with a certain material.
- Either of the below two approaches could be used to obtain BRDFs.
  - Use a device called gonioreflectometer to measure BRDF directly
  - Theoretical models such as Basis illumination approach for instance.

2. Aliasing

- Equation for the sampling frequency w_s that is needed to reconstruct X(jw) with respect to w_n is, $w_s = 2 * w_n$
- Sampled signal with aliasing and without aliasing:

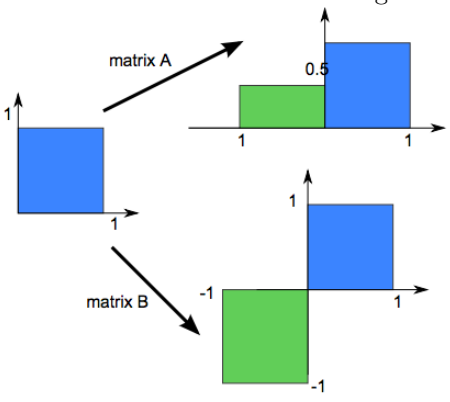


- Box filter can be used to reconstruct the original signal as sketched in the above diagram.

$$f(x) = \begin{cases} 1, & \text{if x} \geq -1 \text{ and x} \leq 1 \\ 0, & \text{otherwise.} \end{cases}$$

3. Transformations

Matrix A scales by 0.5 in y direction and mirrors about the y axis and matrix B mirrors about the zero crossing as depicted in the below diagram.



- Rotating an object without translating it equals a translation around the coordinate center.
- Rotating after translating the center of the rectangle to zero results in a rotation around the rectangle center. (And a translation of (-3,2) if it is not translated back afterwards).
- Rotating after tranlation of V_1 to the coordinate center will result in the rectangle rotated around V_1 and shifted by (-2,2).
- Yes it is possible if you work with homogeneous coordinates. Transform vertices to homogeneous coordinates ($(2,2) \to (2,2,1)$ etc.) and multiply with matrix

$$P = \begin{pmatrix} 1 & 0 & 2 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2} & 0 \\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & -2 \\ 0 & 1 & -2 \\ 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} \frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2} & 2 \\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} & 2-2\sqrt{2} \\ 0 & 0 & 1 \end{pmatrix}.$$