University of Massachusetts Lowell
Department of Electrical and Computer Engineering
16.520 Computer Aided Engineering Analysis

1. Consider the function

$$u(x) = cos(3x) \quad \text{for } 0 \le x < 2\pi$$

Using the N-point DFT $U(k)$ of the sampled function $u(x_i)$ where $x_i = i\ 2\pi/N$ for $i = (0, N-1)$

a. Evaluate for $N = 16$ du/dx at each point x_i.

b. Evaluate $u(x_i + \Delta x/2)$ where $\Delta x = 2\pi/N$.

2. Consider two spatially sampled signals $u(x_i)$ and $v(x_i)$ used to compute the he anti-aliased version of the product $w(x_i) = v(x_i)u(x_i)$. where $i = (0, N-1)$ and $N = 16$. Therefore the highest freq index of the spectrum is $N/2$.

a. If $u = cos(3x)$ and $v = cos(4x)$ then $w = (cos(7x) + cos(x))/2$. the highest frequency index is 7. In other words $W(k)$ contains no frequency components greater than $N/2 = 8$.

b. Consider the case $u = cos(7x)$ and $v = cos(7x)$ then $w = (cos(14x) + 1)/2$ has the highest frequency index is 14. Using the Fourier transforms $U(k)$ and $V(k)$ Find the anti-aliased product $w(n)$ which is equal to 1/2.