

**CEG4311**  
**Computer Assignment (lab) #2**  
**Filtering, Subsampling, Interpolation**  
**Preliminary version for Oct. 17 lab period**

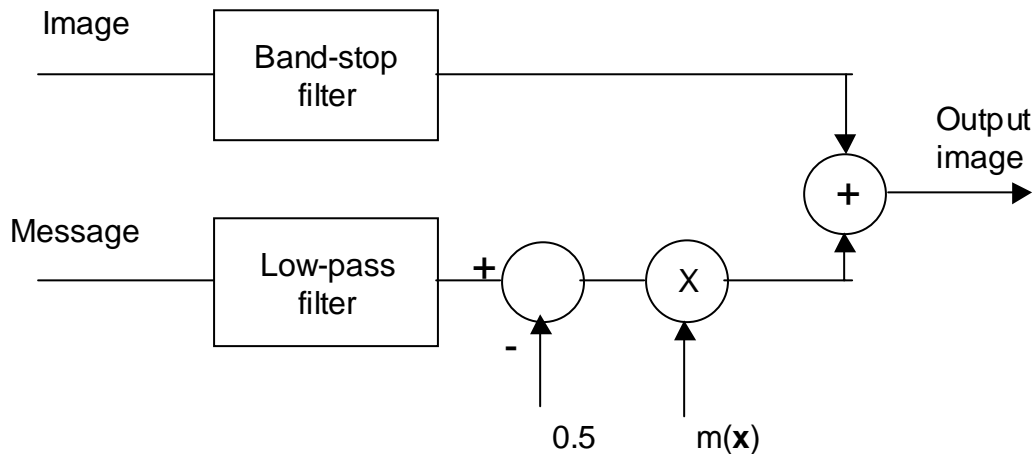
**Due date:** Your report is due on November 4 in the virtual campus site. Results will be demonstrated during the lab periods on October 17, October 24 and October 31 in SITE 2060.

**Objectives:**

1. Decode a hidden image using filtering and demodulation.
2. Subsample and interpolate images (to come).

**Procedure:**

1. An image with another image hidden within it (message) has been created using the following system:



The modulation function is  $m[n_1 X, n_2 X] = 0.0625 \cos(2\pi(u_1 n_1 X + v_1 n_2 X))$  for a given modulation frequency  $(u_1, v_1)$ . Both  $u_1 X$  and  $v_1 X$  are a multiple of 0.05. The image and the hidden image (message) are both sampled on a square lattice with spacing  $X$ , and are of size 512 by 512. The low-pass filter is non-separable with diamond-shaped pass-band and is designed using the window method. The band-stop filter has a stop-band centered at the frequency  $(u_1, v_1)$  and has a slightly larger bandwidth than the low pass filter. The output image is `portrait_code_2007.tif`.

**Your task:** Recover the hidden image from the output image. It may give a hint as to who the portrait is of, if you don't recognize him. You first need to determine the modulation frequency using the power density spectrum estimation program `WelchPSD_comp.m`

Oct. 17, 2007

In my encoder, I have used the two-dimensional low-pass filter  $h_{LP}$ ; the MATLAB code to generate it is given on the course page. Note that modulating a two-dimensional low-pass filter unit-sample response with similar modulation functions (but different amplitudes) yields suitable band-pass filter unit-sample responses.

Can you see the effect of the hidden image in the original coded image? Can you remove that effect?

In your report, you should give a complete block diagram of your decoder, explain the theory for each block, and give the MATLAB statements that implement that block. You may show any frequency responses or power spectra that you find relevant. Display the decoded hidden image in your report.

2. To come later...