E9 222 Signal Processing in Practice

Assignment - Image Sharpening (Due Feb 18, 2026)

High boost filtering is a popular technique used for image sharpening that uses a combination of a high pass filter and a gain factor. For a given image $f(m,n)$, the sharpened image $g(m,n)$ is obtained as

$$g(m,n) = f(m,n) + k\left[f(m,n) * h(m,n)\right],$$

where $h(m,n)$ is a high pass filter, such as the Laplacian filter.

Sharpen the given images using high boost filtering (the images have been often demonstrated as examples using the photo-unblur feature of recent Pixel phones). Be sure to incorporate saturation of pixel values below 0 or above 255. Use the following high pass filter,

$$h = \begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix},$$

where the middle coefficient of the filter corresponds to $(0,0)$. Design a spatially varying gain $k(m,n)$ such that for weak edges (or small magnitude of the Laplacian filter output), k is larger and for stronger edges (or large magnitude of the Laplacian filter output), k is smaller. In particular, design a curve for k as a function of $|f(m,n) * h(m,n)|$ with the above property. Show visually whether the choice of a curve gives a better result than a constant $k(m,n)$ for all the location.