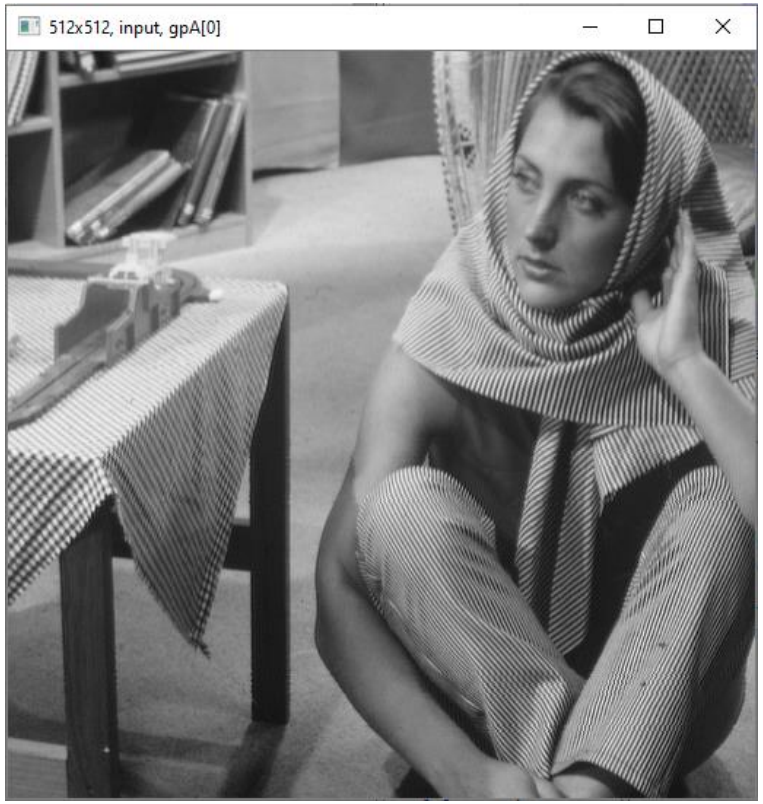
Local Laplacian filtering

1. Build Gaussian pyramid of the input image: gpA
2. Build Laplacian pyramid of the input image: lpA
3. Set the parameters: sigma (σ), alpha (α), and beta (β).
4. If (image(x,y) – gpA[0][x,y]) < *abs*(α – σ), use detail remapping function.
5. If (image(x,y) – gpA[0][x,y]) >= *abs*(α – σ), use edge remapping function.
6. The remapping function calculates enhanced image over small region[x-2 : x+2, y-2 : y+2].
7. Find Gaussian pyramid of remapped image (5 x 5).
8. Find Laplacian pyramid (lp_subimage) of remapped image.
9. Replace lpA[5](x,y) with lp_subimage(x,y).
10. Reconstruct image from Laplacian pyramid.

Local Laplacian filtering

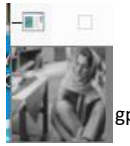
1. Gaussian pyramid (gpA)



gpA[0]: 512 x 512, same as input image

gpA[1]: 256 x 256

gpA[2]: 128 x 128



gpA[3]: 64 x 64

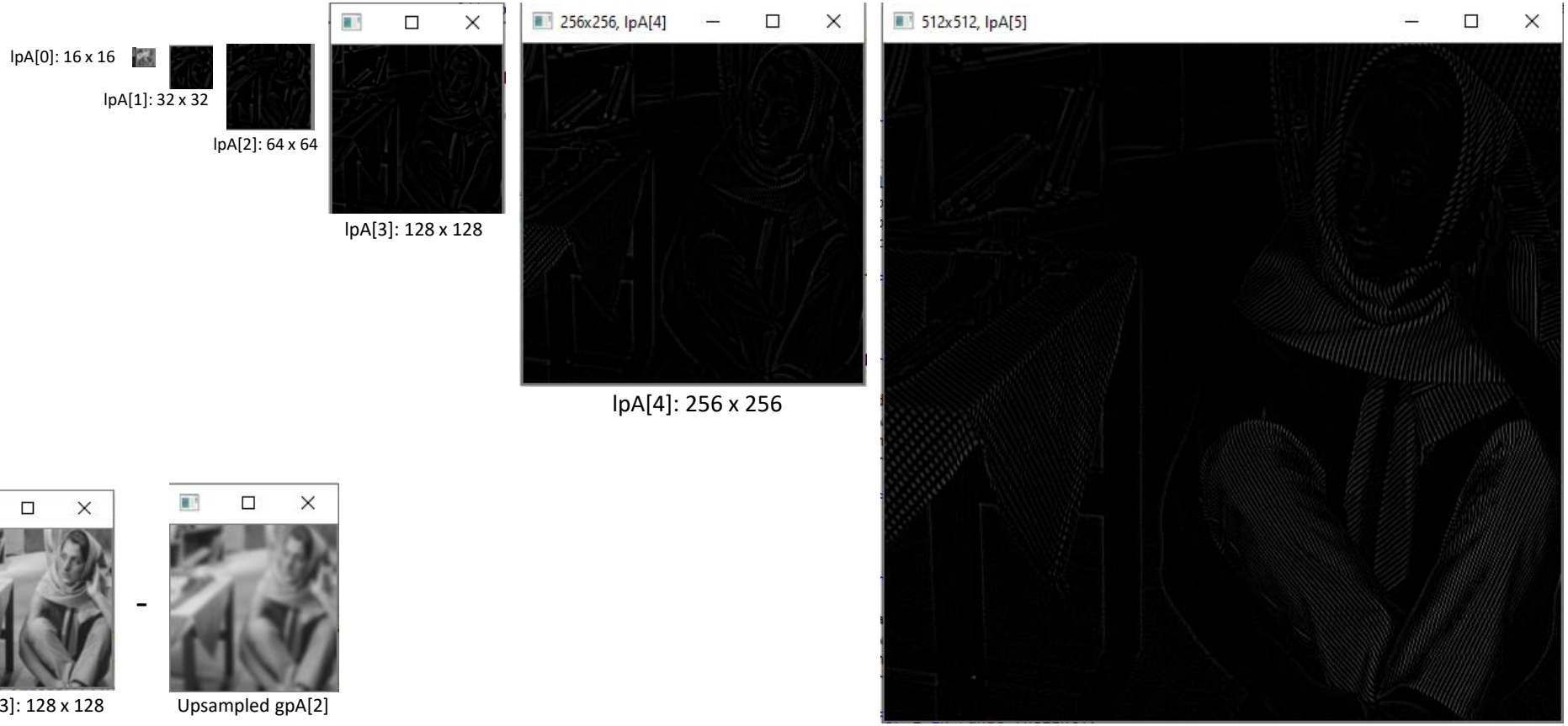
gpA[4]: 32 x 32

gpA[5]: 16 x 16

Gaussian pyramid is formed by removing consecutive rows and columns in lower-level image. For interpolation, 5x5 Gaussian convolution is used. (Downsampling)

Local Laplacian filtering

2. Laplacian pyramid (lpA)



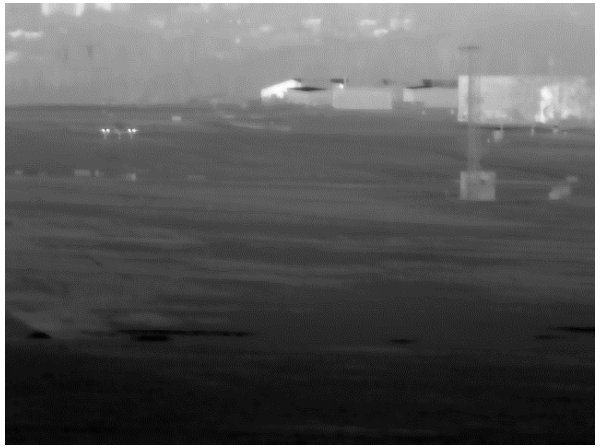
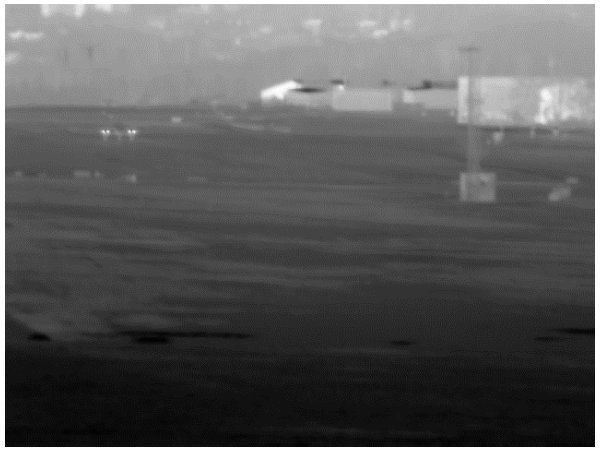
lpA[3] = -

gpA[3]: 128 x 128 Upsampled gpA[2]

Laplacian pyramid is the difference between the levels in Gaussian pyramid.
lpA = gpA[i] – upsampled (gpA[i-1])

Local Laplacian filtering

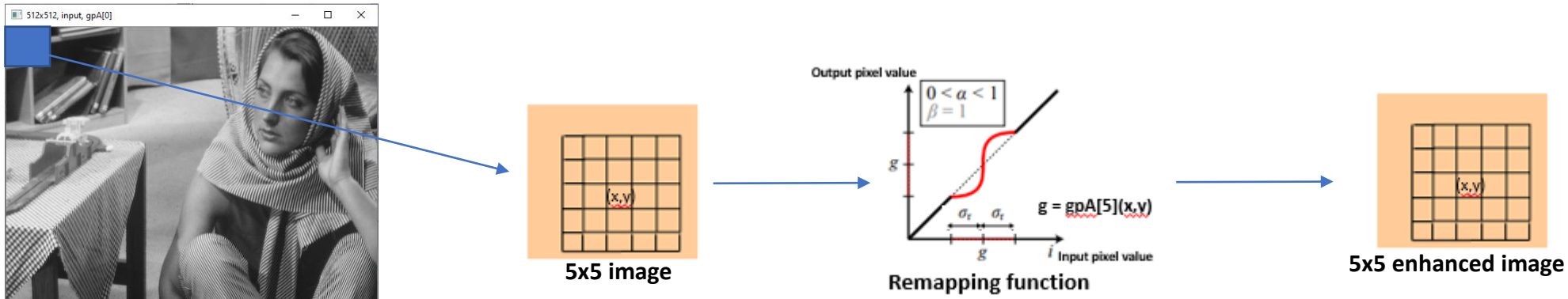
3. Parameters (σ, α, and β)

	α = 0.25 , β = 1	α = 0.5 , β = 1	α = 4 , β = 1
σ = 0.1			
σ = 0.4			

β is used for tone mapping.

Local Laplacian filtering

4. Remapping function – remapping function calculates detail enhanced image over 5 x 5 region (x-2:x+2, y-2:y+2)



512x512 input image

5x5 image

Remapping function

5x5 enhanced image

If (image(x,y) – gpA[5](x,y)) is less than *abs*(g- σ), use detail remapping function (r_d):

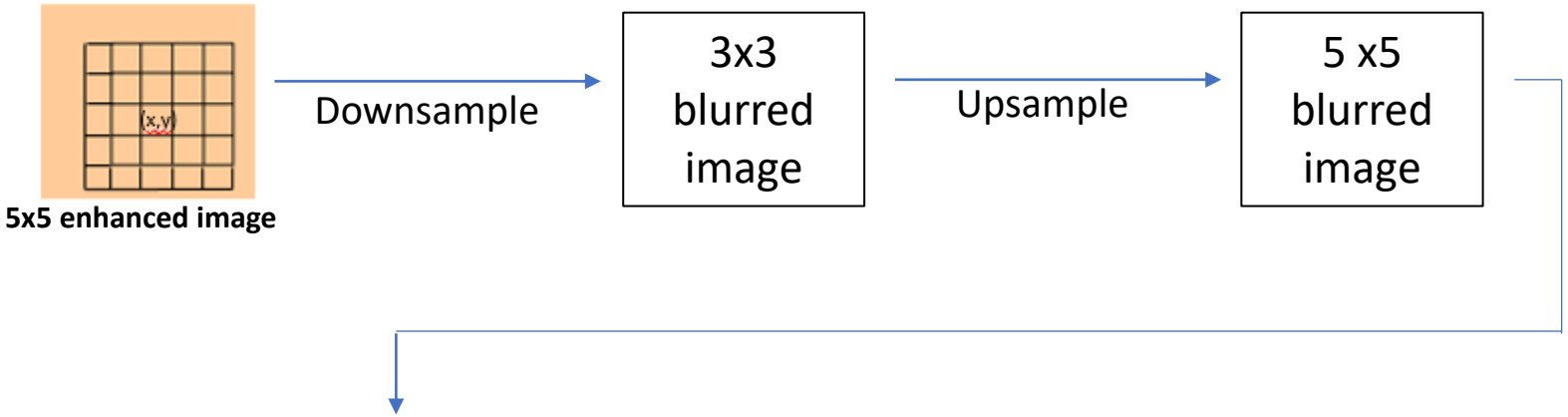
$$r_d(i,g,\sigma) = g + \text{sign}(i-g)\,\sigma\, f_d(|i-g|/\sigma) \qquad (1)$$

If (image(x,y) – gpA[5](x,y)) is greater than *abs*(g- σ), use edge remapping function (r_e):

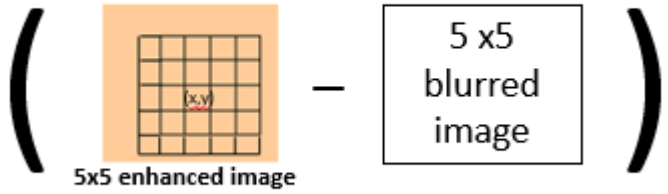
$$r_e(i,g,\sigma) = g + \text{sign}(i-g)\big(f_e(|i-g|-\sigma)+\sigma\big) \qquad (2)$$

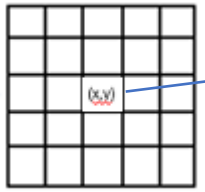
Local Laplacian filtering

5. Build pyramids on remapped image (5x5).



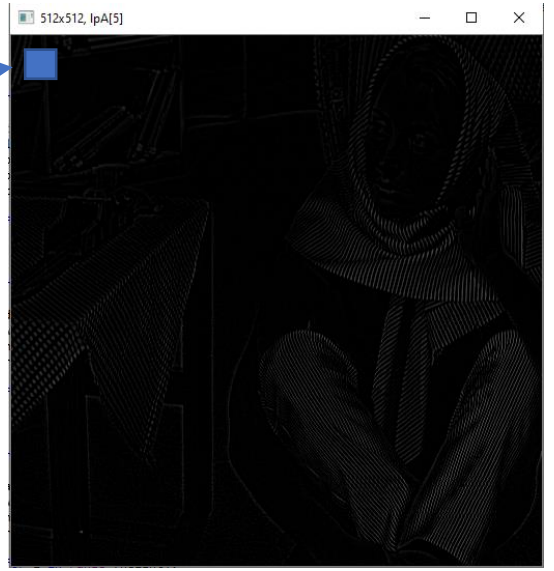
Subtract blurred image from enhanced image





5x5 Laplacian filtered image

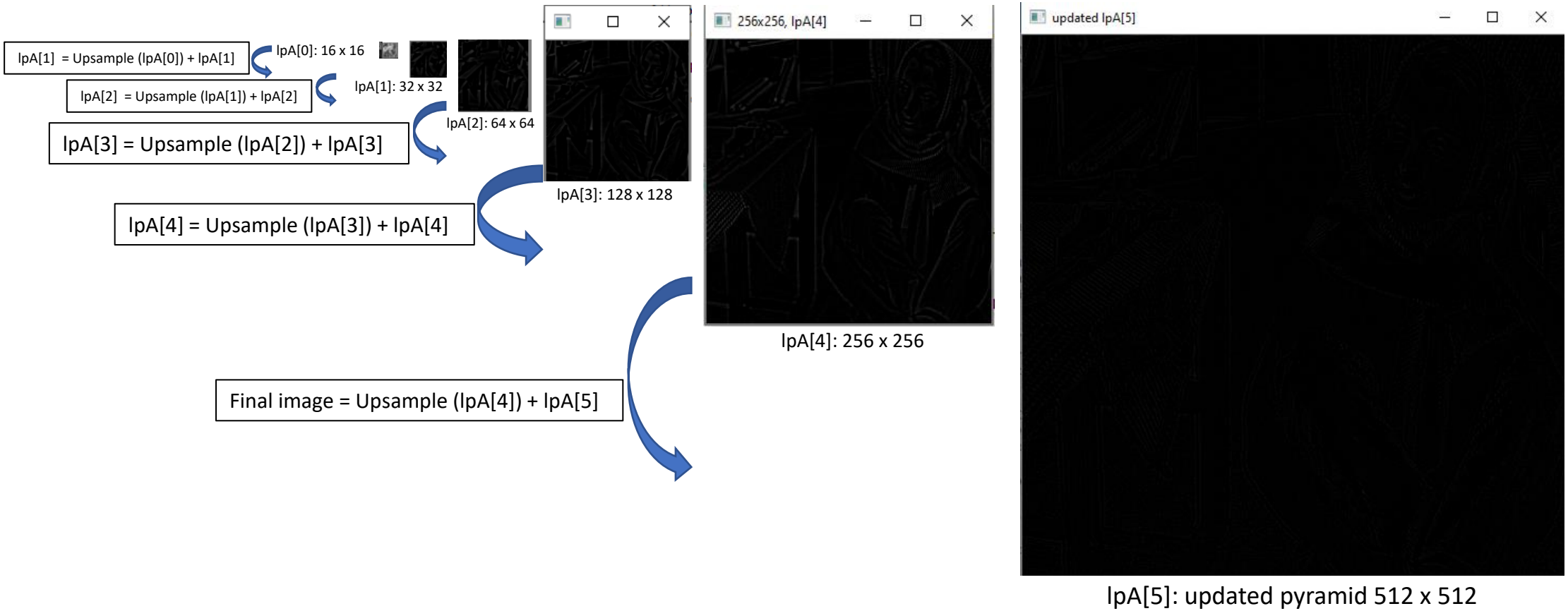
Replace lpA[5] (x,y) with the center of the 5x5 Laplacian filtered image



Local Laplacian filtering

6. Reconstruct image from Laplacian pyramid.

- Repeat step 4 and step 5 over the entire image (512x 512 times).
- Reconstruct image from Laplacian pyramid



Local Laplacian filtering

6. Test images

Input

Result, α = 0.25 , β = 1, σ = 0.4

Local Laplacian filtering

6. Test images

Input

Result, α = 0.25 , β = 1, σ = 0.4