Image Processing
Lecture 2.3 – Laplace blending

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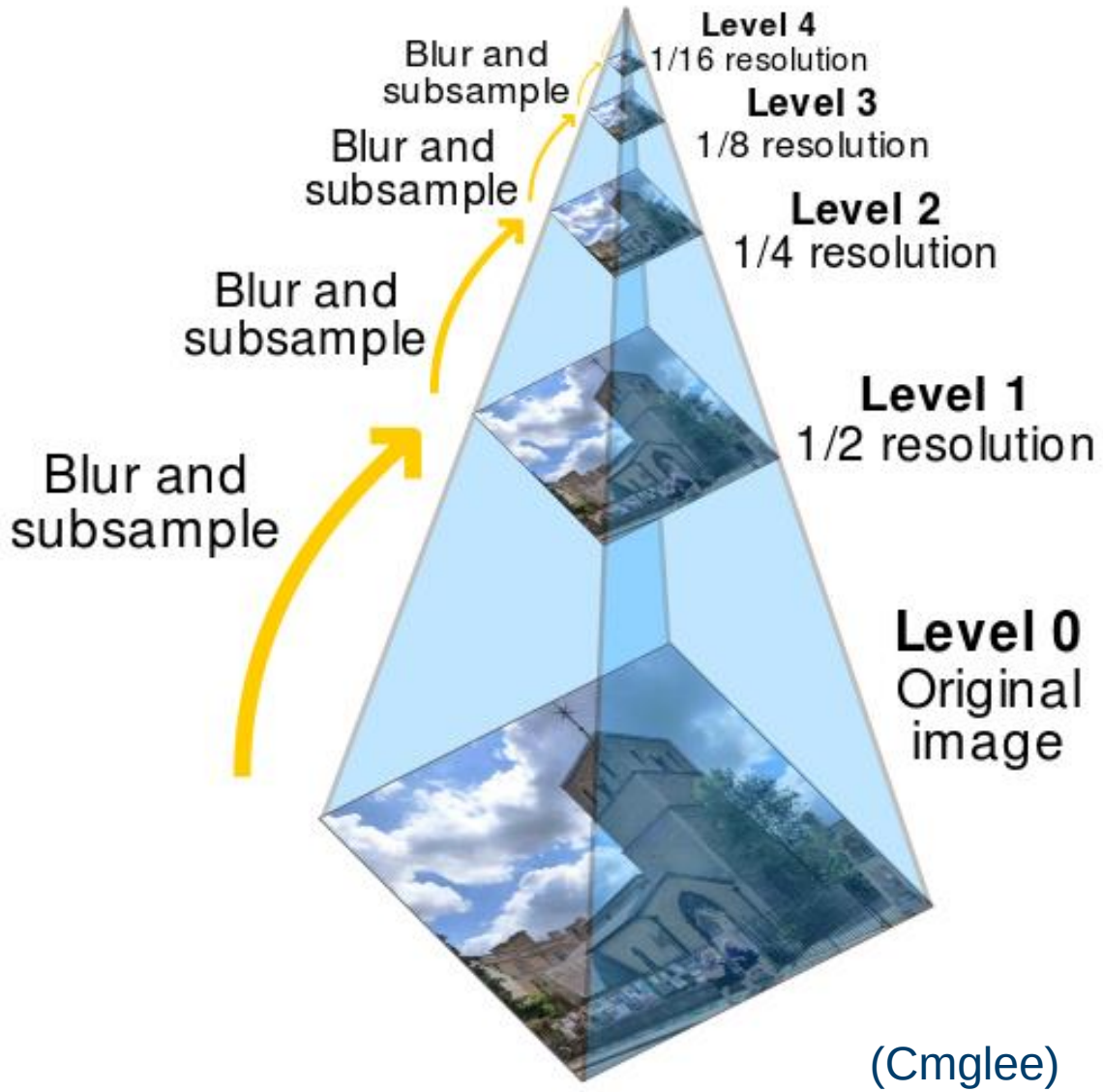
Pyramids

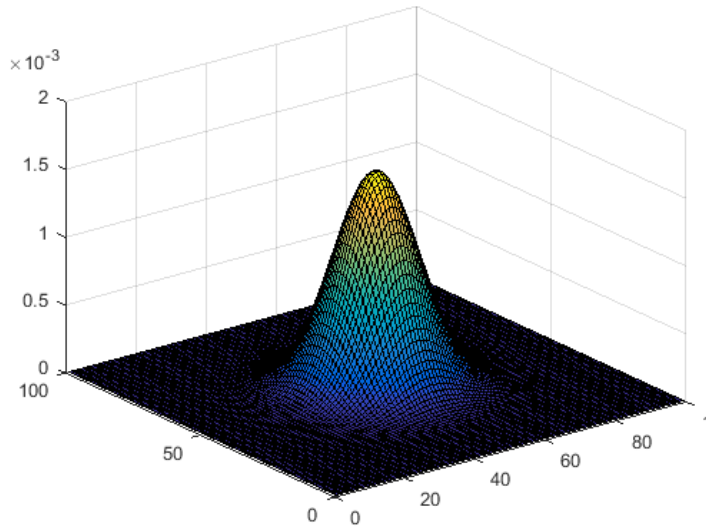
- Downsampling (decimation)
- Upsampling (interpolation)
- Pyramids
  - Gaussan Pyramids
  - **Laplacian Pyramids**
- Applications
  - Template matching (object detection)
  - Detecting stable points of interest
  - Image Registration
  - Compression
  - Image Blending
  - …



(Cmglee)

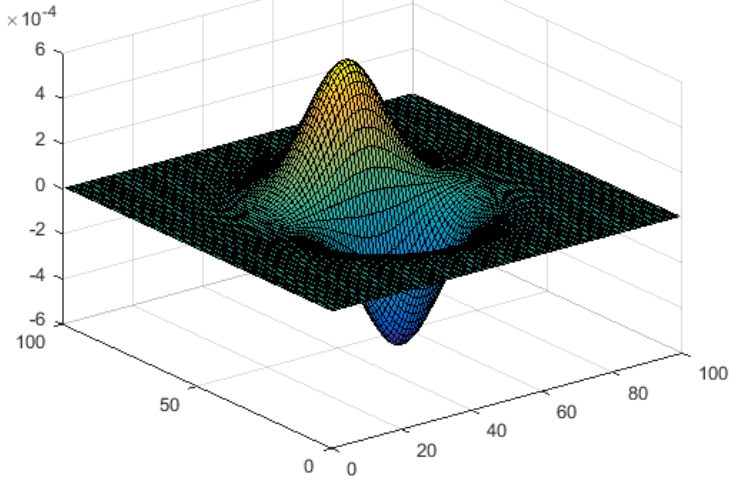
Edge detection filters

Gaussian (low-pass)



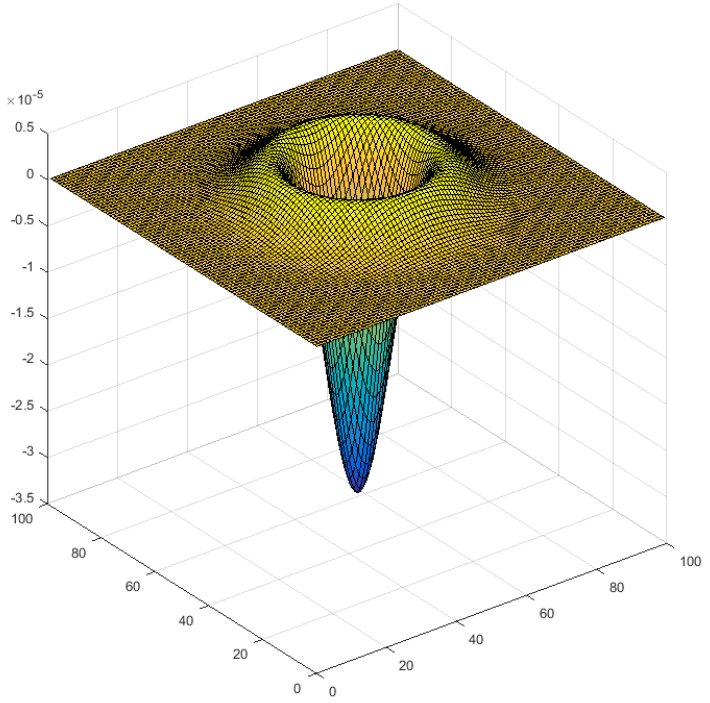
$$h_\sigma(u,v) = \frac{1}{2\pi\sigma^2} e^{-(\frac{u^2+v^2}{2\sigma^2})}$$

Derivative of Gaussian



$$\frac{\partial}{\partial v} h_\sigma(u,v)$$

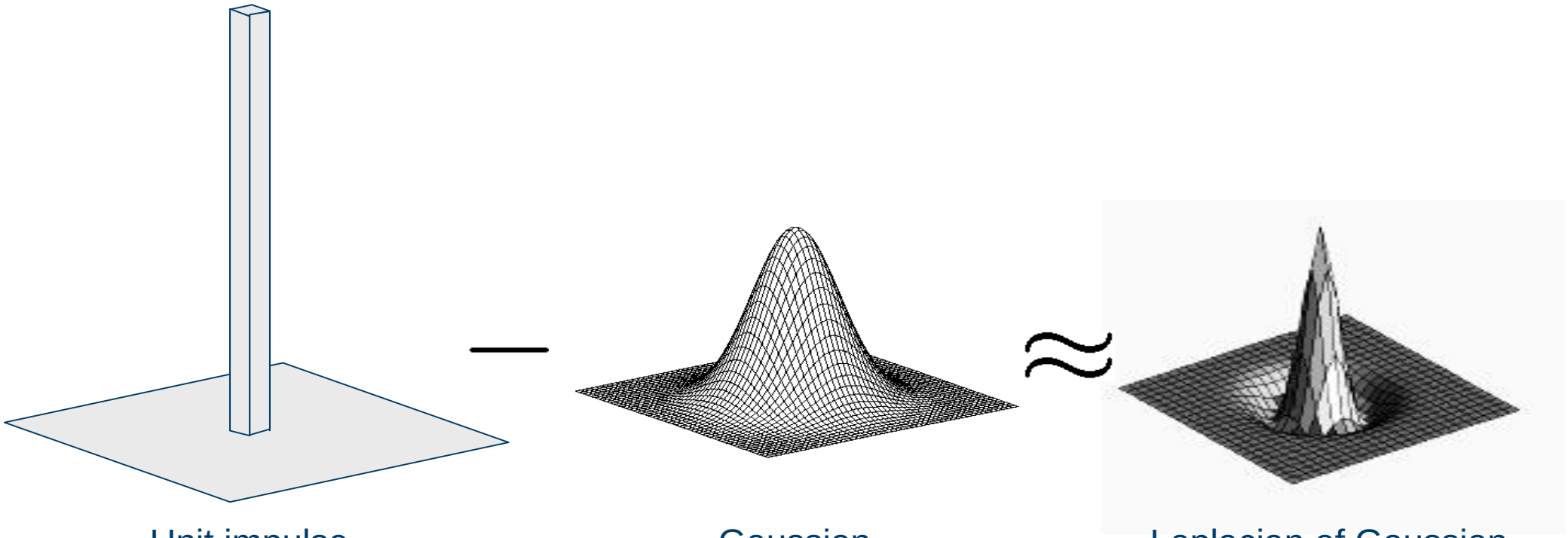
Laplacian of Gaussian (band-pass)



$$\nabla^2 h_\sigma(u,v)$$

Laplacian operator: $\nabla^2 f = \frac{\partial^2 f}{\partial^2 x} + \frac{\partial^2 f}{\partial^2 y}$ (high-pass)

Laplacian filter

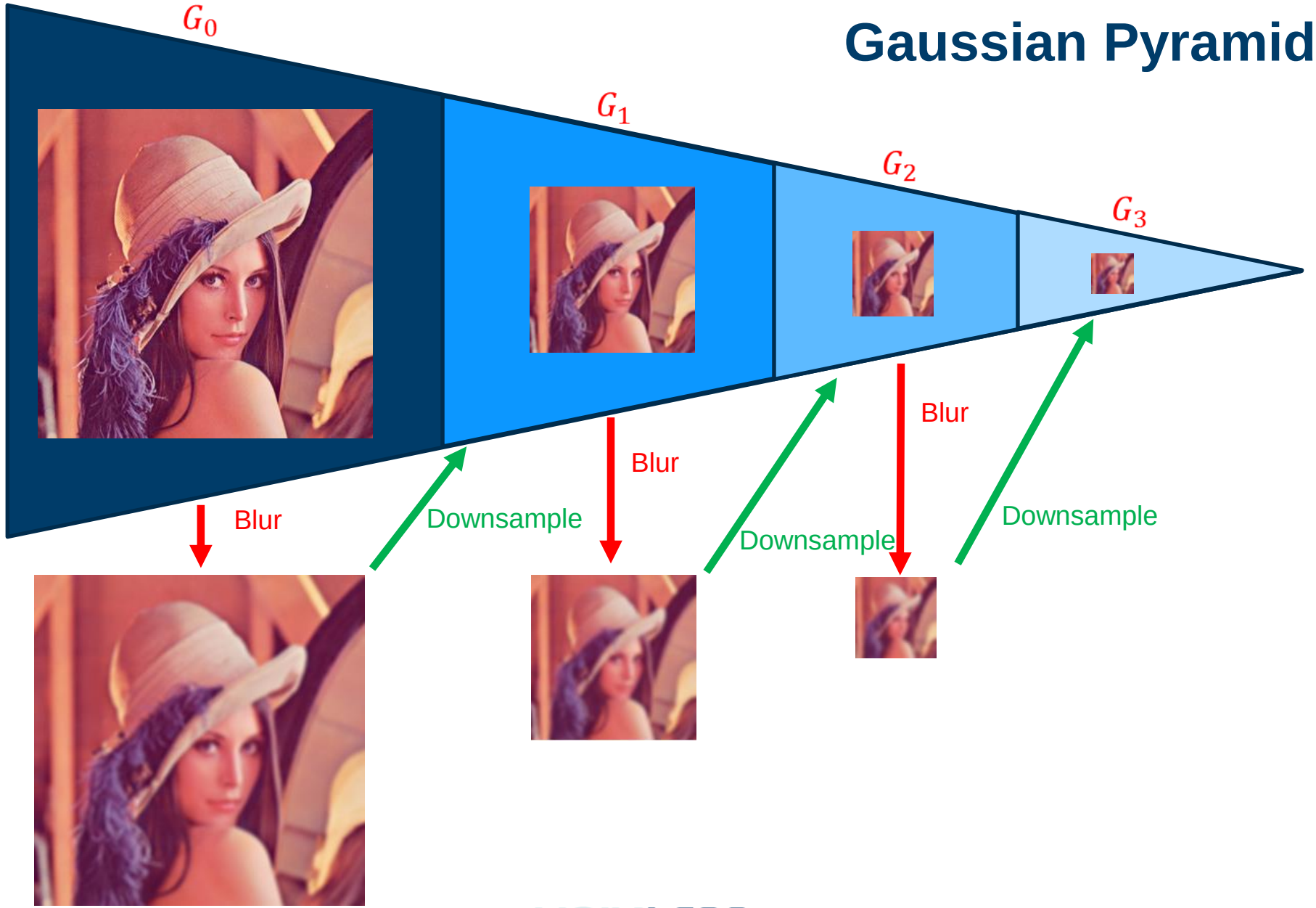


Unit impulse — Gaussian ≈ Laplacian of Gaussian

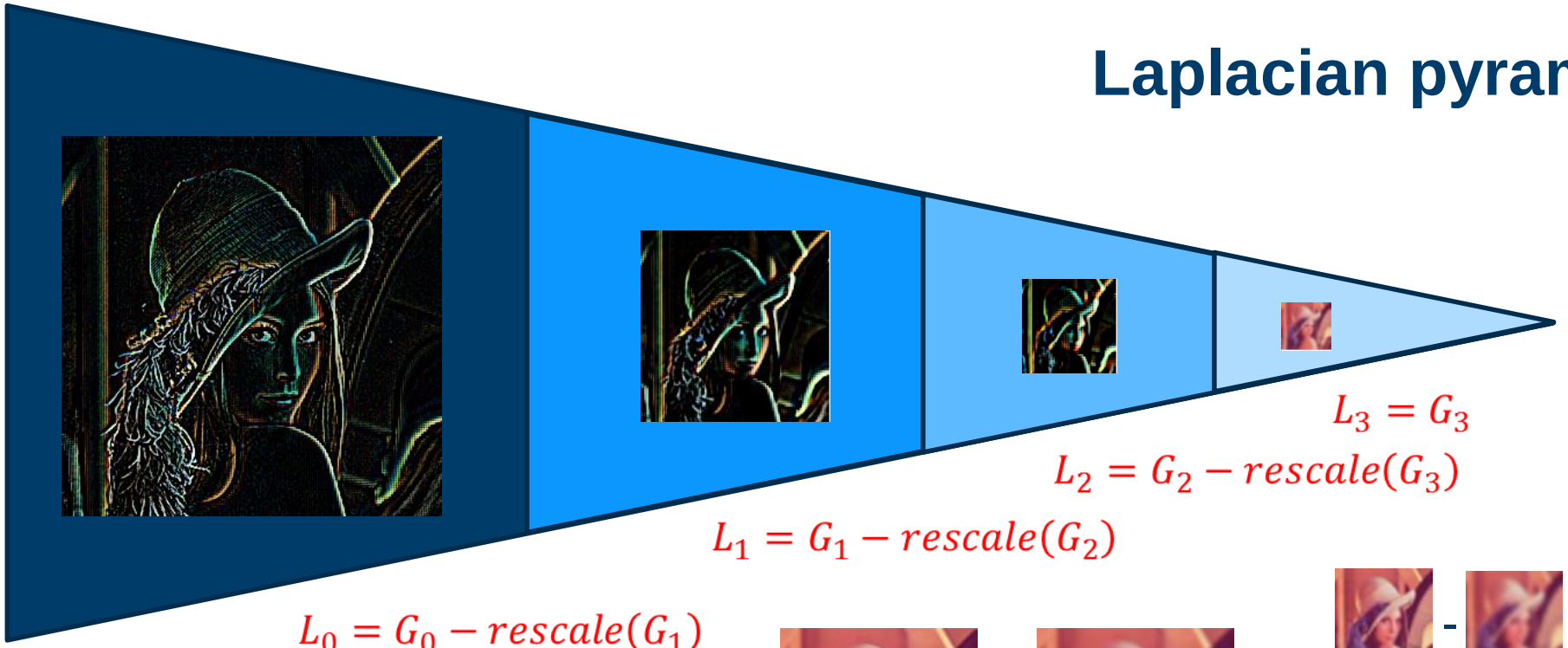
(Source: Lazebnik)

Laplacian of Gaussian

Gaussian Pyramid



Laplacian pyramid



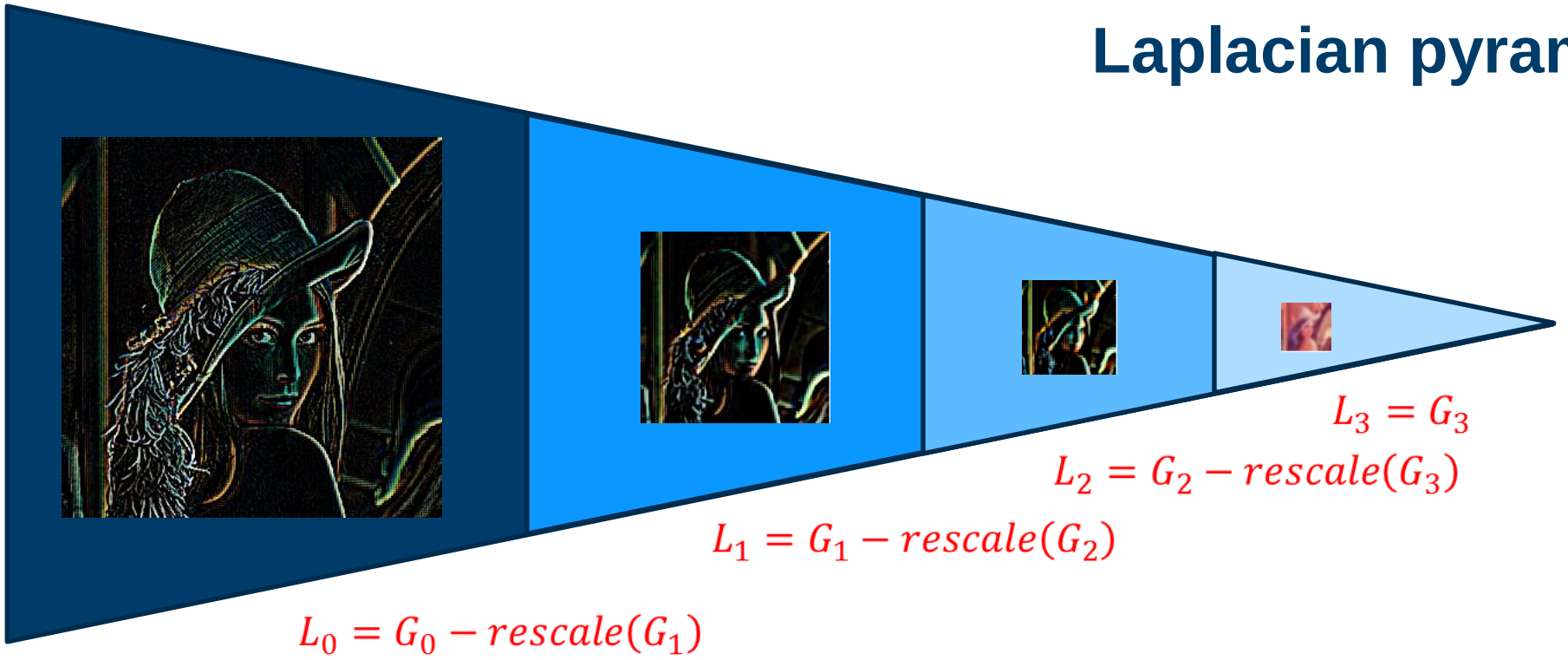
$L_3 = G_3$

$L_2 = G_2 - rescale(G_3)$

$L_1 = G_1 - rescale(G_2)$

$L_0 = G_0 - rescale(G_1)$

Laplacian pyramid



Collapsing the Laplacian pyramid:

$$rescale(rescale(rescale(L_3) + L_2) + L_1) + L_0 =$$

Image blending

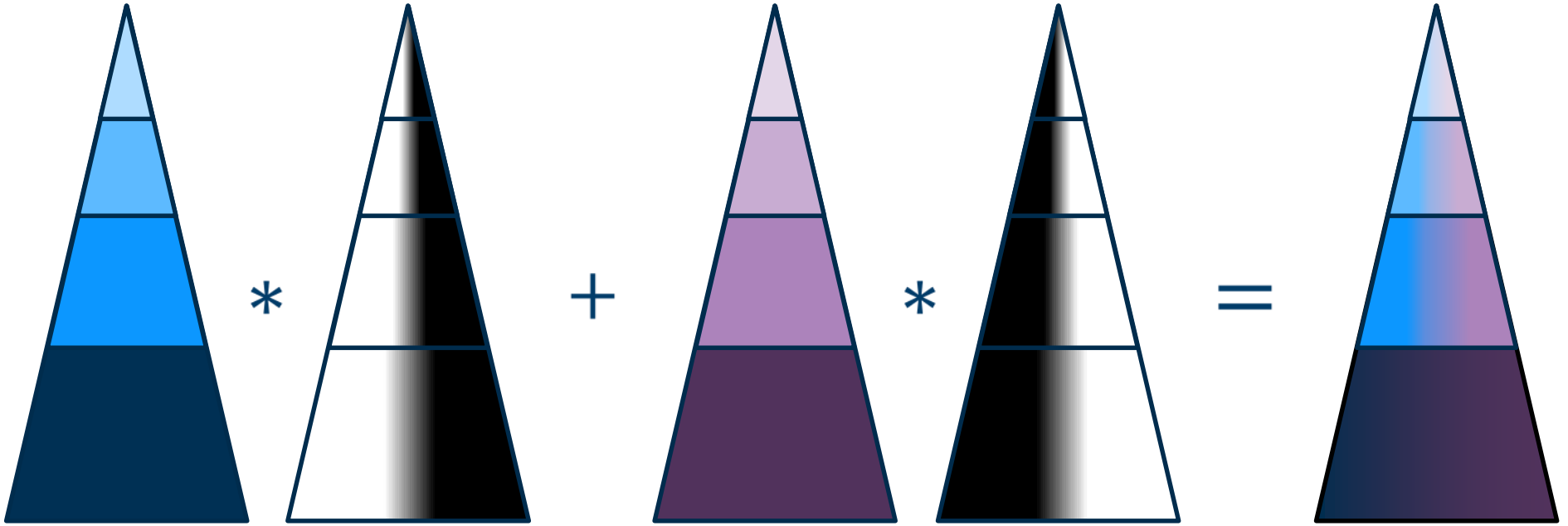
Blending based on Laplacian pyramids

Steps:

1. Choose img1 and img2 and crop/resize to the same size
2. Chose a region mask of the same size
3. Create Laplacian pyramid for img1 and img2
    1. Create Gaussian pyramid for img1 and img2
    2. Create Laplacian pyramids from Gaussian pyramids
4. Create Gaussian pyramid for the region mask
5. Blend the two Laplacian pyramids using the mask's Gaussian pyramid to weight the two images at each level of the pyramid
6. Collapse the resulting Laplacian pyramid to reveal the blended image.

Image blending with Laplacian pyramids

Weighted sum for each level of the pyramid



L_1
Laplacian
of img 1

G
Gaussian
of mask

L_2
Laplacian
of img 2

1-G
Flipped
mask

L
Laplacian
blend

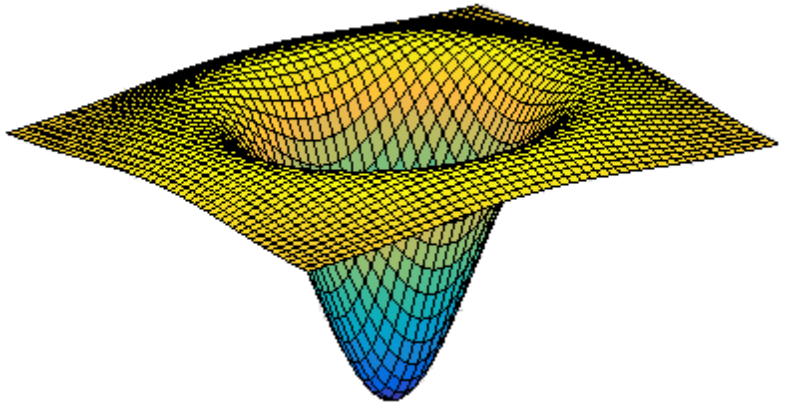
Image blending - example

Image blending - example

Mask

Result

Summary



Laplacian Pyramids:

- Laplacian filter
- Laplacian pyramid
- Image blending

More information: Szeliski 3.5