Instructions

- Deadline: ***2020/4/23 11:59:59 p.m.***

- Hand in a complete report, as detailed as possible, including:
  - your introduction
  - implementation procedure
  - experimental results (of course you should also try your own images)
  - discussion (what difficulties you have met? how you resolve them?)
  - conclusion
  - work assignment plan between team members.

- Tasks:
  1. Hybrid image
  2. Image pyramid
  3. Colorizing the Russian Empire

Overview

A hybrid image is the sum of a low-pass filtered version of the one image and a high-pass filtered version of a second image. There is a free parameter, which can be tuned for each image pair, which controls how much high frequency to remove from the first image and how much low frequency to leave in the second image. This is called the “cutoff frequency”.

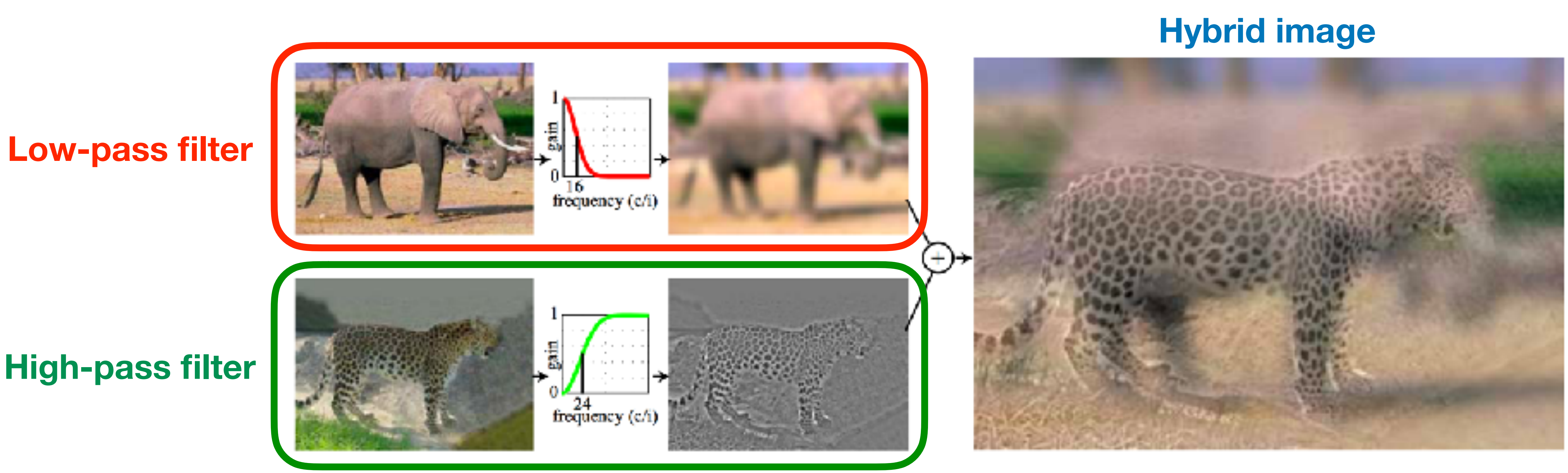
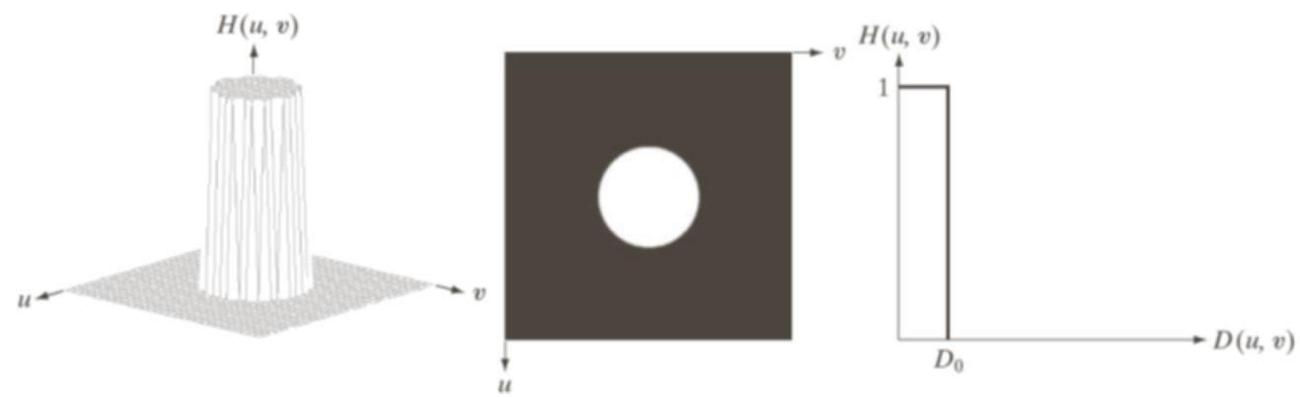


Image refer to: http://cvcl.mit.edu/hybrid/OlivaTorralb_Hybrid_Siggraph06.pdf

Overview

Low pass filter

Ideal low pass filter



a b c

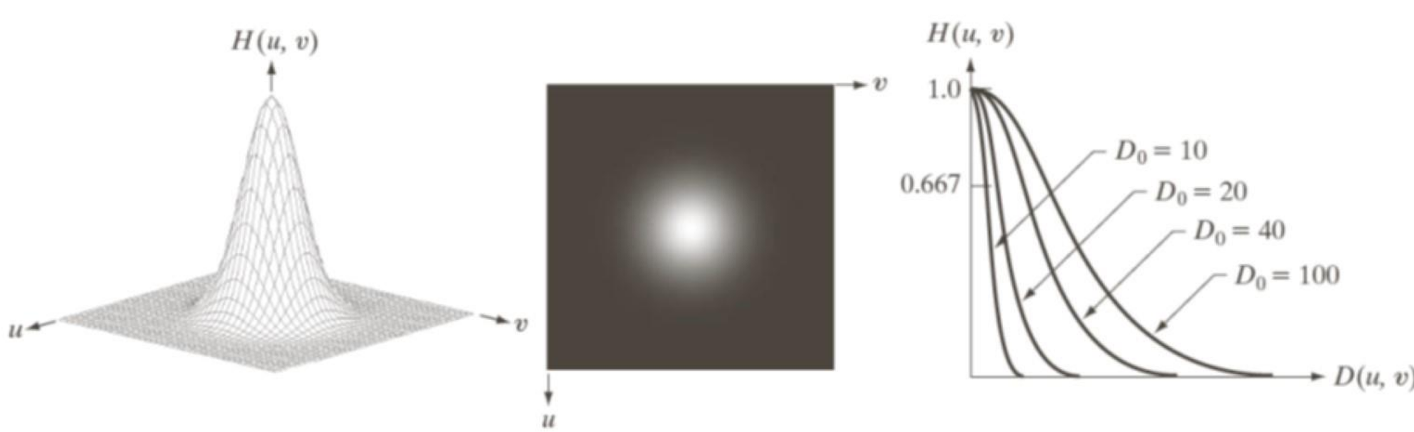
FIGURE 4.40 (a) Perspective plot of an ideal lowpass-filter transfer function. (b) Filter displayed as an image. (c) Filter radial cross section.

$$H(u,v)=\begin{cases}1 & \text{if } D(u,v) \leq D_0 \\ 0 & \text{if } D(u,v) > D_0\end{cases}$$

D_0: cutoff frequency

$D(u,v) = (u^2 + v^2)^{1/2}$

Gaussian low pass filter



$$H(u,v) = e^{-D^2(u,v)/2D_0^2}$$

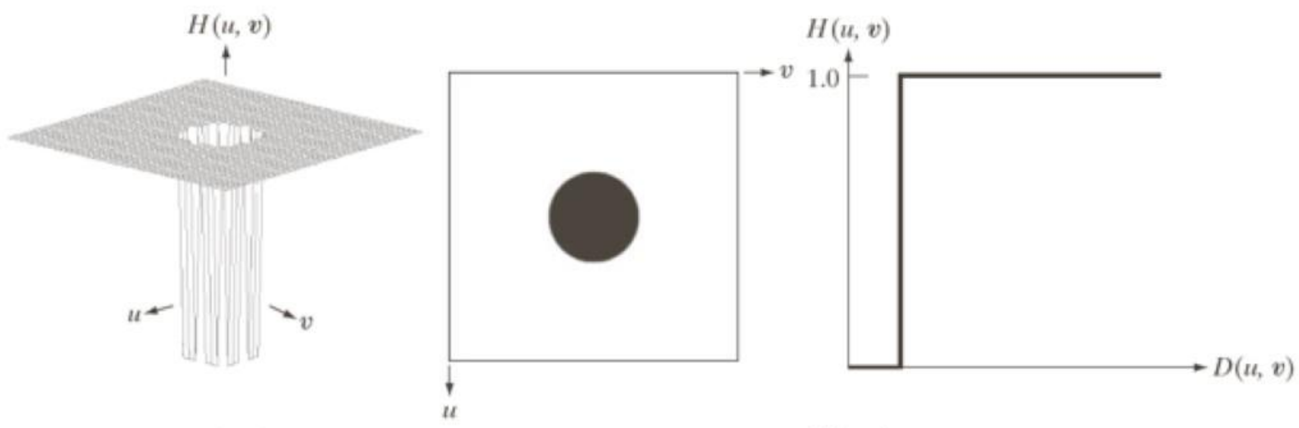
a b c

FIGURE 4.47 (a) Perspective plot of a GLPF transfer function. (b) Filter displayed as an image. (c) Filter radial cross sections for various values of D_0.

Image refer to: Digital Image Processing, 3rd Ed., Rafael C. Gonzalez and Richard E. Woods

High pass filter

Ideal high pass filter

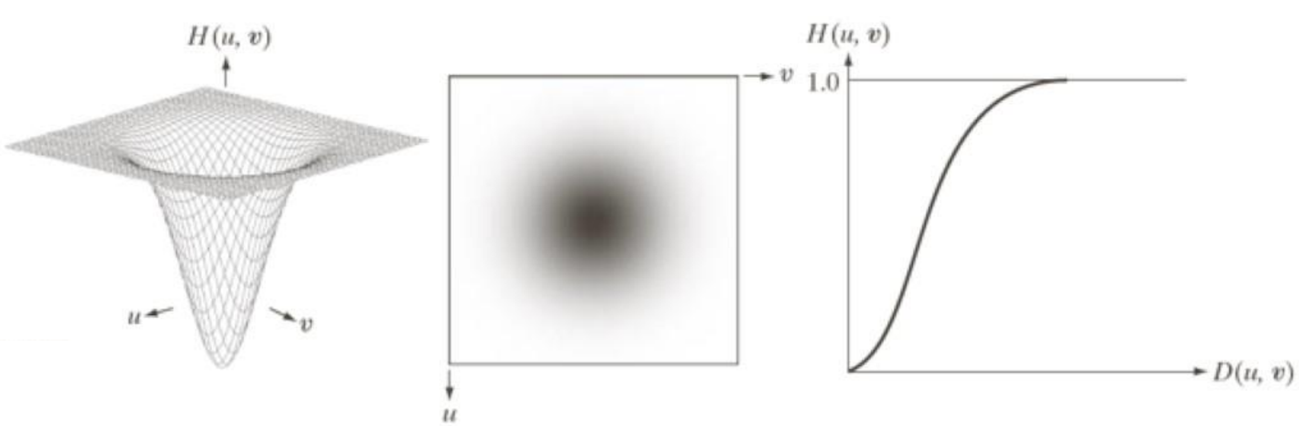


$$H(u,v)=\begin{cases}0 & \text{if } D(u,v) \le D_0 \\ 1 & \text{if } D(u,v) > D_0\end{cases}$$

D_0: cutoff frequency

$D(u,v) = (u^2 + v^2)^{1/2}$

Gaussian high pass filter



$$H(u,v) = 1 - e^{-D^2(u,v)/2D_0^2}$$

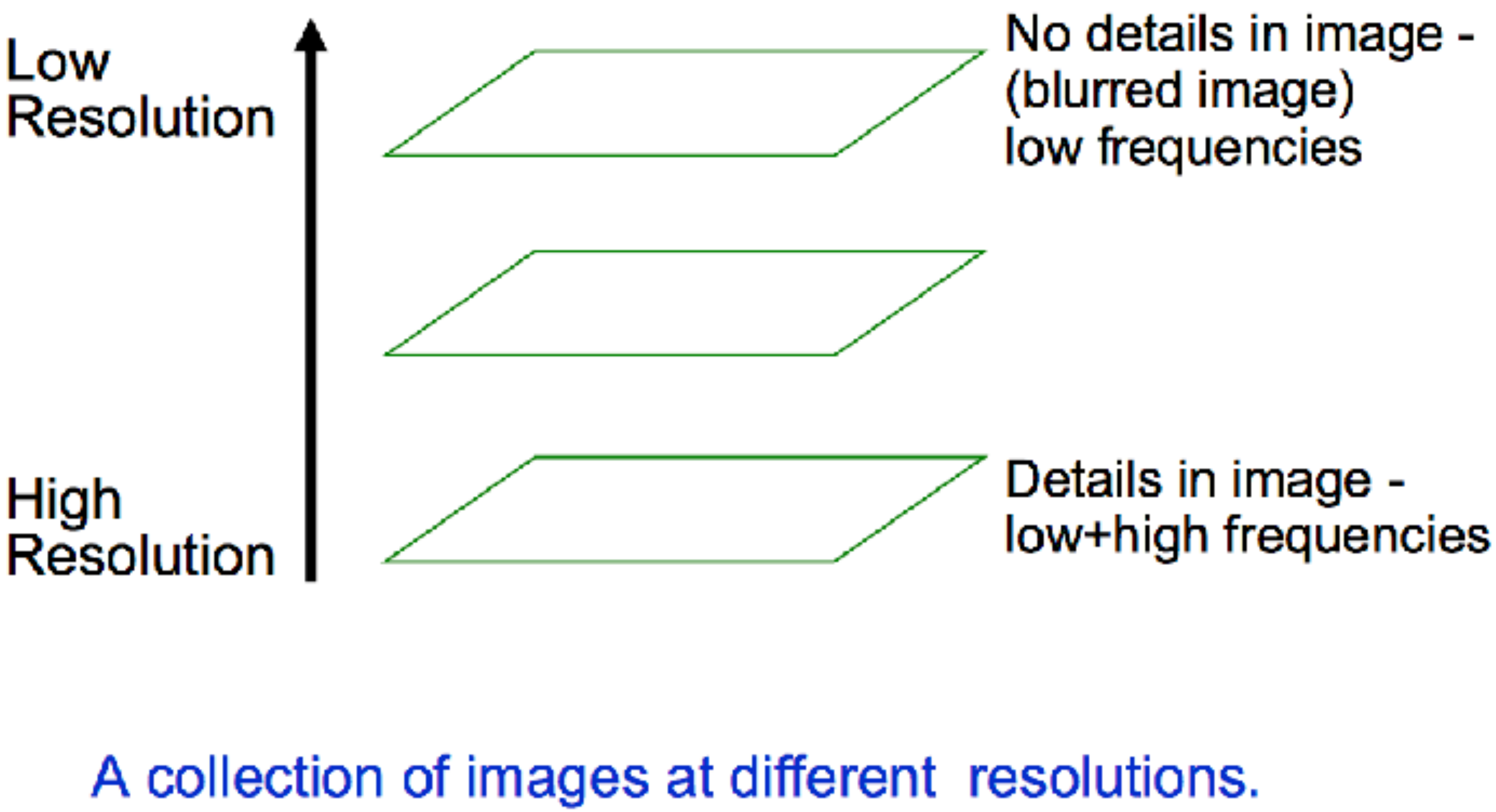
Image refer to: Digital Image Processing, 3rd Ed., Rafael C. Gonzalez and Richard E. Woods

Procedure

1. Multiply the input image by $(-1)^{x+y}$ to center the transform.
2. Compute Fourier transformation of input image, i.e. $F(u,v)$.
3. Multiply $F(u,v)$ by a filter function $H(u,v)$.
4. Compute the inverse Fourier transformation of the result in (3).
5. Obtain the real part of the result in (4).
6. Multiply the result in (5) by $(-1)^{x+y}$.

Overview

An image Pyramid is a collection of representations of an image.

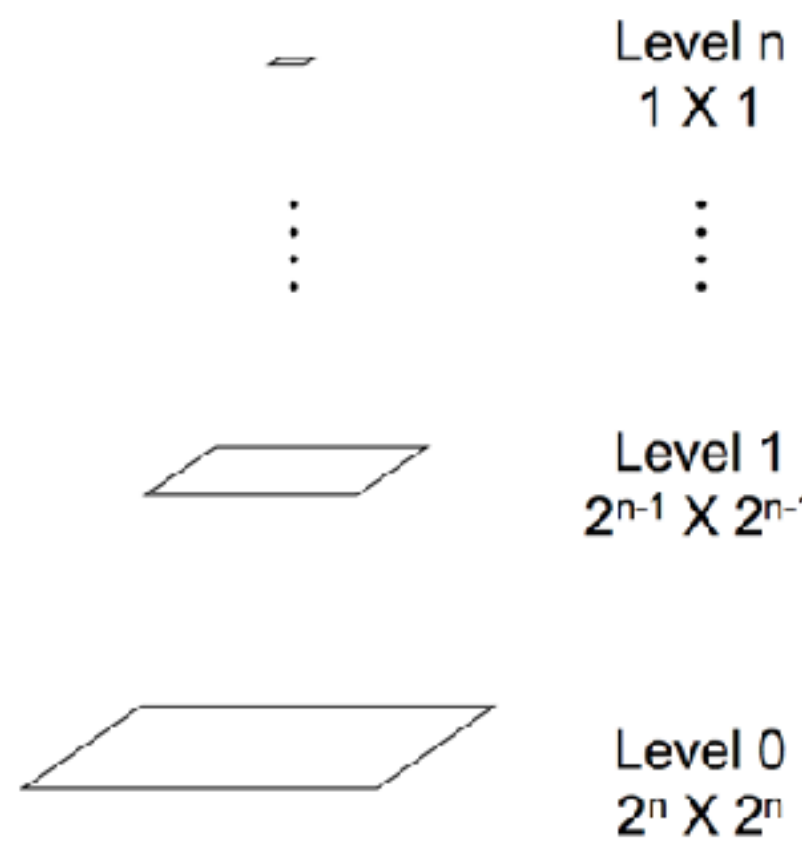


Refer to: http://cs.haifa.ac.il/hagit/courses/ip/Lectures/Ip11_MultiscaleRepx4.pdf

Gaussian image pyramid

High resolution → Low resolution

512 256 128 64 32 16 8



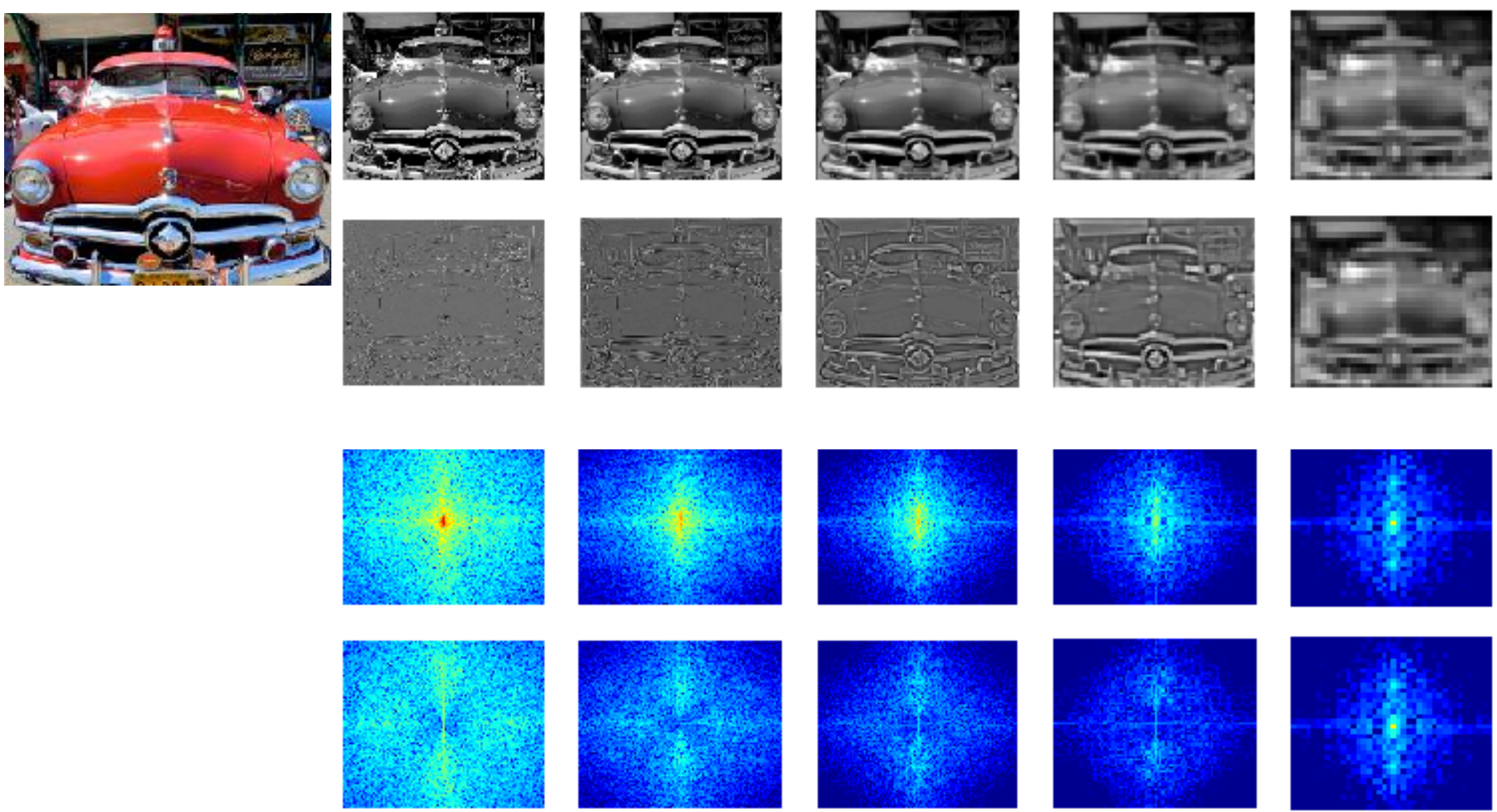
Procedure

Set the finest scale layer to the image

For each layer, going from next to finest to coarsest

> Obtain this layer by smoothing the next finest layer with a Gaussian, and then subsampling it.

End



Overview

Goal: automatically produce a color image from the digitized Prokudin-Gorskii glass plate images with as few visual artifacts as possible.

The glass plate images record three exposures of every scene onto a glass plate using a red, a green, and a blue filter. In order to do this, extract the three color channels from the glass plate, then place and align one above the other so that the combination forms a single RGB color image.

Assume that a simple x,y translation model is sufficient for proper alignment. However, the full-size glass plate images are very large, the alignment procedure will need to be fast and efficient.

Refer data:
http://www.cs.cmu.edu/afs/cs.cmu.edu/academic/class/15463-s10/www/proj1/www/abarnat/images/standard/

Procedure

Divide the original image into three images with same size.

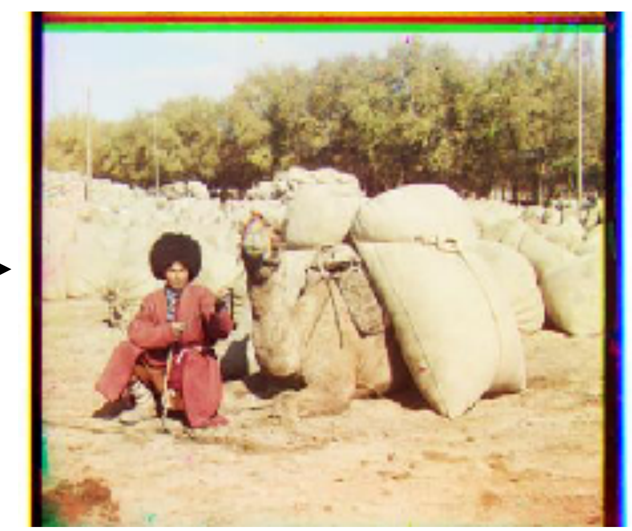
Blue

Green

Red

Input: glass plate images

Auto align the G and R channels to the B channel.



Output: one color image