Hybrid image Synthesis

Mcmillon Walton Student
2017chb1047@iitrpr.ac.in

The Indian Institute
of Technology,Punjab
Ropar, India

Abstract

A **Hybrid image** is an optical illusion made by combining the **spatial frequency components** of 2 images. **High spatial frequencies** of one image and the **low spatial frequencies** of the other are the key components in the synthesis. This report presents on how a hybrid image is made.

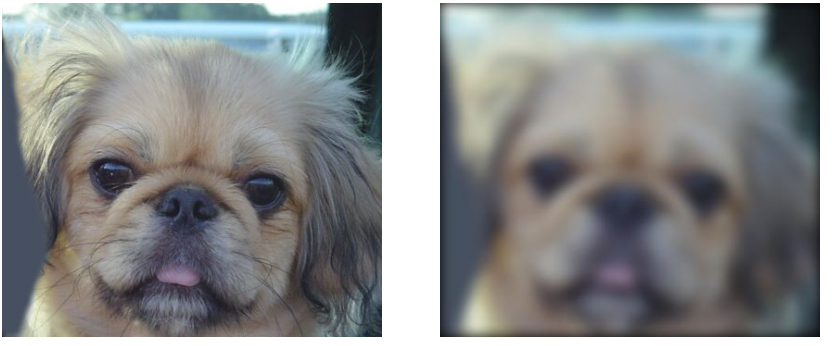
1 Introduction

The hybrid image is an image that is perceived in one of two different ways depending on the distance it is viewed from [2].It exploits on how humans process visual data through our eyes(visual input), which creates the optical illusion .The technique for synthesizing hybrid images was developed by Aude Olivia of MIT and Philippe G. Schyns of University of Glasgow. The method was originally proposed by Schyns and Oliva in 1994. [1] The Hybrid image combines the **high spatial frequencies** of one picture and **low spatial frequencies** of the other to get an hybrid image.

2 Methodology and Algorithm

The synthesis of the hybrid image involves mainly 3 steps:

Low pass filter on one image
Apply Gaussian filter or any averaging filter such as a box filter on one of the images(You will get a different output based on which of the 2 images you choose).This filter will blur the image thereby removing the high frequencies present in the image.As a result the image will have low spatial frequencies .Gaussian filter is used here of dimension 29×29 and of standard deviation 7.

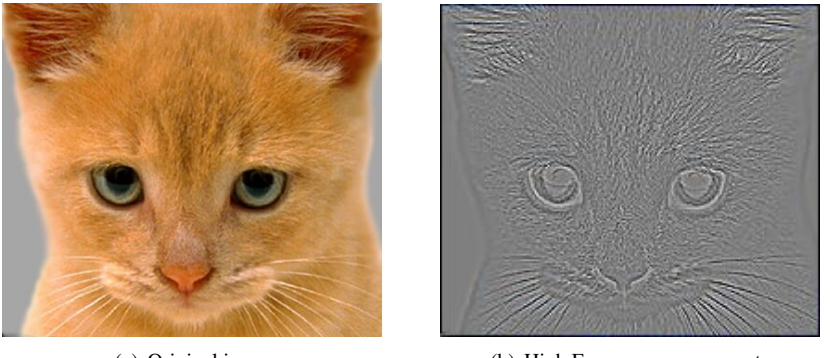


(a) Original image (b) Low frequency components

Figure 1: Low pass filtering

High pass filter on the other image

An edge detection filter such as sobel, Laplacian filter can be used as a high pass filter, as features like edges are the high frequency components of an image.(Care should be taken that the value of the pixels are centered around zero) But alternatively as done here, the easiest way to obtain the high frequencies(and pixel intensities centered around zero) is by subtracting the image from its blurred image(low spatial frequencies) so that only high frequencies remain.



(a) Original image (b) High Frequency components

Figure 2: High Pass filtering

Combining the 2 components

Once the 2 images with their counter frequency components removed. Simply combine the 2 pictures to get the hybrid image.

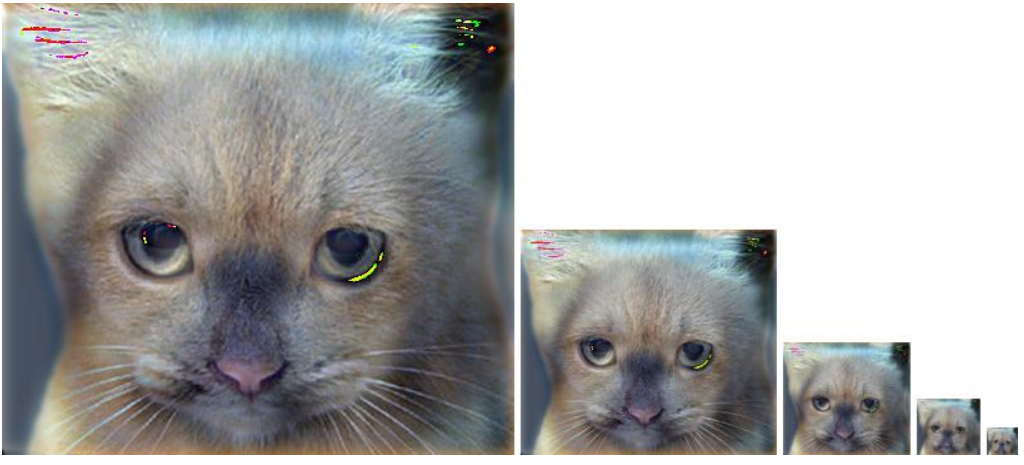


Figure 3: Hybrid image at varying scales

3 Results and Observations

The hybrid image is interpreted in one of two ways depending the distance it is viewed from. After Filtering one of the images through an averaging filter. The image is blurred and looses some information like edges, corners etc. This acts as a **low pass filter** allowing for only low frequencies to persist in the image. If this image were to be subtracted from the original image, only the counter frequencies *i.e* **the high frequencies** will exist, plus the **pixel values will be centered around zero**.

After the combination of 2 such images. It is seen that the high frequency component of the image is the one interpreted at **close distances**. But as the viewing distance increases, the lower spatial frequencies becomes more and more visible to the human eye.

4 Conclusion and Takeaway

- Gaussian filter was used here as a low pass filter. Filter description in methodology.
- An untouched image if subtracted by its low frequency/blurred image, only the high frequency components persist along with their pixel intensities centered around zero.
- High frequency components of any visual input are more prominent from close ranges. whereas Low frequencies are more prominent from afar.

References

[1] Philippe G. Schyns Aude Olivia, Antonio Torralba. Hybrid images. *ACM Transactions on Graphics*, pages 527–532, 2006.

[2] Wikipedia. Hybrid image. *https://en.wikipedia.org/wiki/Hybrid¡mage*.