Laboratory 4: Hybrid Images

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Abstract

Making hybrid images is a process where it needs to be taken care of the shape and color of the previous images. Taking the high frequencies of one image to another may differ between images. In this case, mixing one image need a Gaussian filtering with a sigma bigger than the other way.

1. Introduction

Hybrid images are figures that when the observer is close it can distinguish a special figure and when it is far from the image it can only seen another picture. This special feature is achieved only by grouping the low frequencies of the image that is wanted to be seen in the background and the high ones of the image that is desired to be seen in the near distance.

2. Material and Methods

The images were taken by the author with his Canon Camera, trying to focus the faces of the author's cats. The images were taken 30 centimeters away from the face of the animal, avoiding the maximum editing time and deformation of the resulting picture.

2.1. Photos description

The face needs to be describe with attention because this is were the low/high frequency is. The black with touches of orange with white cat is Chanel, author's three years old cat. The image shows that she has the right eyes semi-closed. The nose is pink mixed with white. Her right ear is completely brown and his left one is a mixture between brown and black. She has orange-brown eyes and a face-like describing hate. Under his mouth it can be seen a jingle bell. Chanel does not have long hair compared to Baylis.

Baylis, the 1 year old cat, is not a common cat. Likewise Chanel, she has his belly covered in with hair and, unlike to Chanel, she is orange on the other part of her body. The special physical characteristic of Bayliis is the eyes of hers. She has a condition called heterochromia. her right eye is brown colored and her left eye is blue. She has long hair and her nose has a orange spot. Her jingle bell cannot be seen.

The main difference between them is the long hair and the eyes. Chanel, as said before, has one eyes semi-closed and Baylis has both open at the "same level". Off course, Baylis has heterochromia and Chanel don't. In the other hand, Chanel has short hair and Baylis has a long one.

2.2. Editing

This section is very short. Because the faces of Chanel and Baylis are very similar, overlapping the shapes isn't difficult. The crop was made taking similar proportions of the window and taking the least difference in the window scale. Once both images were cropped, the Chanel picture was rescaled to the Baylis cropped photo so the mixing and processing does not create or delete new/old information.

2.3. Methods

The first process was to filter the images. To get the low frequencies, a Gaussian filter was used. To get Chanel in the low frequencies, a filter with sigma equals to 17 was used. To get Baylis in the low frequencies, a Gaussian Filter with sigma equals to 8 was used. The formula (1) shows the process made to get the hybrid image.

$$H_{(D,C)}(X_1, X_2, \sigma) = C * F(X_1, \sigma) + D * (X_2 - F(X_2, \sigma)) \tag{1}$$

Where $X_2 - F(X_2, \sigma)$ are the high frequencies of X_2 and $F(X_1, \sigma)$ are the low frequencies of X_1. Moreover, $F(X, \sigma$ is the Gaussian filtering of X with $\sigma = \sigma_0$. Also, D and C are constant to augment or decrease the contrast of the low and high frequencies.

In the Baylis as the low frequency, a factor of $C = 1$ and $D = 3$. When Chanel was the low one, a factor of $C = 1$ and $D = 3$ were used as well.

3. Results

The hybridizing result of the images are shown in the figures [2] and [3].

4. Discussion

The big result of this images is the changing in the color and shape of the eyes, in any direction - understand by direction that Baylis is the low frequencies and Chanel the high ones and viceversa -. This phenomena is produced because the high frequencies hide the eyes from the other cat at close range. At a distance, the low frequencies 'win' versus the high ones.

5. Conclusion

- When filtering an image, the method and parameters need to be selected carefully. Not all the images will generate the same responses to a filter, then choosing the properly the technique is prejudicial to get the maximum performance.
- Selecting two random shapes will not give any satisfactory hybrid picture. This shapes need to be similar and the detail of one of the selected images need to hide details of the other one.
- A previous picture processing before the hybridization might be a good idea to enhance the details of the high frequency image. Also, a good definition image might help the process.

6. Code and Images

```
%I choose the region of interest of the image
%2
f2_2 = f2(689:2104,2463:3848,:);
%I rotate the image because it ins't in the
%position
f2_2p = imrotate(f2_2,90);
f2_2 = f2_2p;
% I crop the region of interest of the image
%1
f1_2 = f1((634:1696),(1389:2470)-20,:);
% Resize the image 2 so it can fit
n=size(f1_2);
f2_2 = imresize(f2_2, [n(1) n(2)]);
% Choose a sigma for the filtering
sigma = 17;
%I filter the images and make the low and
%high frecuencie images
frecB = 1*imgaussfilt(f2_2,sigma);
frecA = uint8(3*(double(f1_2)-...
double(imgaussfilt(f1_2,sigma))));
%I generate the hybrid image
hybridIm = frecB+frecA;
```

Figure 1. Original photo of Chanel

Figure 2. Original photo of Baylis

Figure 3. Resulting image between Chanel photo as the low frequency image and Baylis photo as the high frequency one

Figure 4. Resulting image between Chanel photo as the low frequency image and Baylis photo as the high frequency one

Figure 5. Pyramid where Baylis is the low frequencies and Chanel the high ones.

Figure 6. Pyramid where Chanel is the low frequencies and Baylis the high ones.