ΜΗΧΑΝΙΚΗ ΟΡΑΣΗ

Assignment 1: Filtering Hybrid Images

Lab Team 23:
Apostolopoulos Athanasios -Iakovos
Perakis Georgios
Tzortzi Maria-Eleni

In this assignment we filtered images in order to create hybrid images comprising of the low frequencies of one image and high frequencies of another. The procedure followed is quite simple and is described below.

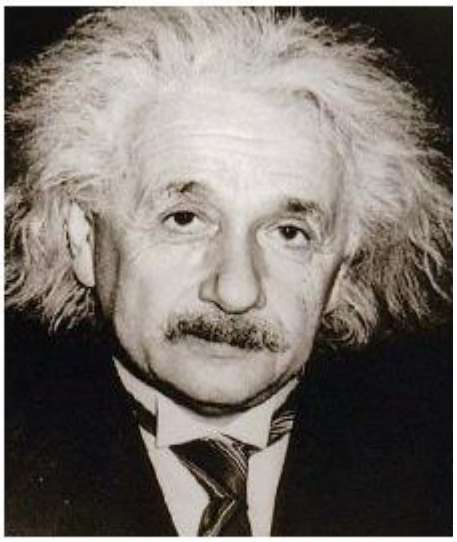
First we created a function (my_conv) that computes the convolution of a two-dimensional image with any kernel with odd dimensions (M*N).We then used this function to create the function my_imfilter which can be used to filter both grayscale and coloured images. In my_imfilter function we determine the type of the image (grayscale-RGB) and process each type in a different way. For grayscale images the function simply computes the convolution. For coloured images the function separates the image into its three key components (red-green-blue) convolves each dimension and combines them to get the filtered final image.

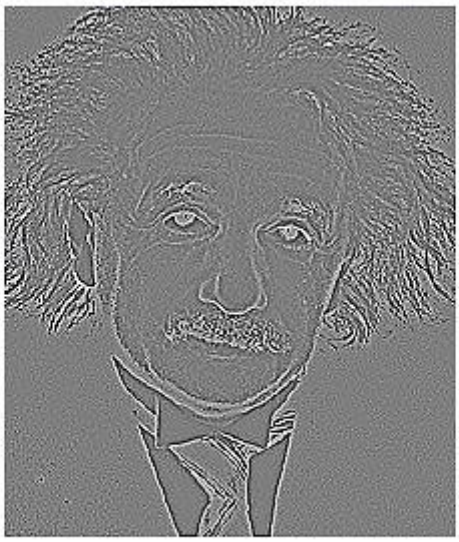
The main idea was using my_imfilter to filter the images to get the low frequencies or the high frequencies, depending on the image, and then combine the results in one hybrid image. Each pair of images had its own tailored processing so the two procedures will be explained separately.

Pair 1 Einstein-Monroe (Einroe)

To create the first hybrid image :

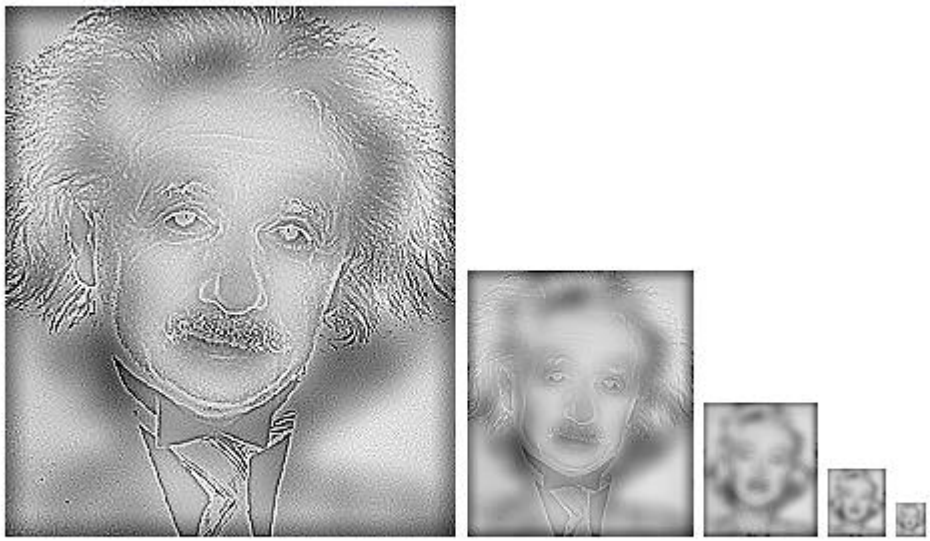
We filtered the original Einstein image using a Laplacian filter, which filtered out the low frequencies of the image (texture) , leaving the high frequencies (or edges). To illustrate the image we added 0.5 as the image is zero mean and has negative values.





We filtered the original Marilyn image with a gaussian filter to cut the high frequencies of the image. We applied the filter once and then applied its transpose, as we wanted to cut out both horizontal and vertical edges. This way the computations are a lot quicker than doing it all in once.The result was a low frequency (blurred) image.

We added the two images into one and then used the given function visualize_hybrid_image to simulate the change of perception of the image as the viewer moves away from the screen.



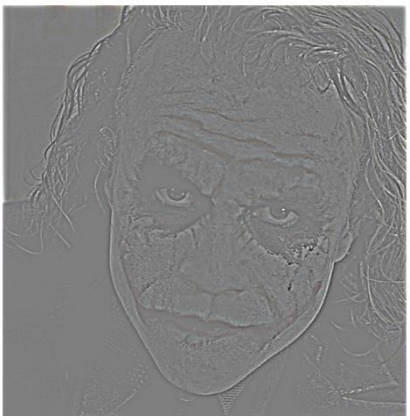
The results indicate that when the viewer is close to the image the edges or high frequencies tend to be the ones that are the most prominent (Einstein) . As the viewer moves away from the image the low frequencies are the ones that are prominent (Marilyn)

Pair 2 Joker-Heath Ledger (Jeath)

In order to produce the second hybrid image, we used the same procedure with some small variations (haha probability humor).

We applied the low pass filter using the same procedure as above.

In order to isolate the high frequencies of the joker we used a different approach. We first used a low pass gaussian filter on the image as described above. Then, we subtracted the low pass coefficients (texture) from the original image leaving only the high frequencies (edges). We had to experiment a little bit with the variation of the low pass filter in order to subtract the wanted amount of texture from the original image and get the desired intensity of the edges.



We created the hybrid image and visualised it in the same way.

The results were the same as the previous hybrid image, as we can see the joker up close and heath when moving away.

Pairs 3 and 4: Nora the cat looking at the lens/looking away

In this section we decided to experiment a bit, by taking photos of the team members cat and making hybrids of her looking at the lens and then looking away. The matlab codes are included in our file but are basically the same code described above with different photos. For each pair of photos we used two different approaches (the one used for pair1 and one used for pair2).The results shown below are the input images and hybrid images. More detailed images can be seen by running the code.

Nora pair 1 approach

Nora pair 2 approach

Nora pair 1 approach

Nora pair 2 approach

Conclusion

Making hybrid images is a quite simple procedure which can be used to add textures to images . simulate changes over time, movement or fuse two or more images for fun. At a different viewing distance, a different spectrum of frequencies is more prominent.

In this assignment, only two cut-off frequencies were used, to fuse two images. From our results we can extrapolate that more images can be fused. If each image has its own band of frequency, the viewer could see three or more different results as he moves away. In the instance of a house being constructed, different phases of the construction could be photographed and then fused. This way the viewer could see a smoother transition between the images from the house under construction to the finished house image. It is important to note that the images have to have a similar orientation for the fusing be effective. So, whereas fusing the changes of something stationary (such as the house) is easy and can be done with satisfying results, fusing the image of a moving object is more challenging. In the example of the cat above we can see that the two pictures had a quite similar orientation and thus the hybrid image was satisfactory.

There are many more interesting applications for this method as mentioned in the relevant paper and for a such simple algorithm we think that the results are quite impessive.