Hybrid Images

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What are hybrid images?

As the name suggests, hybrid images are composed of two images, one which is low-pass frequency filtered and the other, which is high-pass frequency filtered, superimposed on each other. Up close, since the resolution will be high, the high spatial frequency image will be more visually perceptible to the observer. As the image is moved far away from the observer, he is more likely to see the low spatial frequency image. Hybrid images are highly used by artists to generate compelling displays where images appear to change as the viewing distance is changed.

Problem-

The idea of generating hybrid images was originally given by Schyns and Oliva [1994; 1997; 1999], and their work is extended in the paper given by Aude Oliva, [2006]. Our task is to implement this paper to build hybrid images with stable percepts at each viewing distance.

Methodology-

The first image(I1) is low pass filtered with the help of Gaussian filter(G1). The second image is high pass filtered with 1-G2, (where G2 is a Gaussian filter and max gain set to 1). The cutoff frequency is obtained where gain becomes equal to 0.5, the resulting hybrid image is given by $H = I1 \cdot G1 + I2 \cdot (1 - G2)$, in frequency domain. The distance at which the transition from one image to another occurs, depends on the frequency cutoff values of these filters. To produce a good hybrid image with unambiguous percepts, the low pass and high pass filters must not have larger overlaps.

Studies show that the human visual percept unfolds from global structure of the image first and then quickly to the local variations of the image. According to

Gestalt rules of perception, human observers tend to interpret the image in the most simplest and symmetrical views. Since the low spatial frequencies(blobs) lack precise boundaries and object structures than the high frequency ones, they tend to dominate over them even when the viewing distance is small. This influence of low spatial frequency image can be reduced by properly aligning it to the high spatial frequency image.

Experimental Analysis-

To reduce overlap between filters, low variance Gaussian or high order Butterworth filters could be used for best results. To address the low frequency blobs, we will experiment by giving proper alignment in certain directions.

After aligning the images, we will construct two image pyramids, Gaussian (for viewing the downsampled images) and its corresponding Laplacian pyramid. The effectiveness of our hybrid images will be tested by viewing the cross-correlations matrix obtained between the different levels of a Laplacian pyramid.

Dataset to be used-

We will test our work on a good number of two similar and different real images, and also some randomly generated feature images and see their hybrid output image.

Important references-

1. *Hybrid images* Aude Oliva, Antonio Torralba, Philippe. G. Schyns Publication: ACM Transactions on GraphicsJuly 2006
2. Oliva, A., and Schyns, P. 1997. Coarse blobs or fine edges? evidence that information diagnosticity changes the perception of complex visual stimuli. Cognitive psychology 34, 1, 72--107.
3. http://olivalab.mit.edu/publications/Talk_Hybrid_Siggraph06.pdf