Hybrid Images

Due Date: 01:30pm on Friday, March 23rd, 2012

Figure 1: The creation process of a hybrid image (taken from [1]).

Credits: Assignment developed by Derek Hoiem at University of Illinois at Urbana-Champaign.

Overview

The goal of this assignment is to create hybrid images using the approach described in the SIGGRAPH 2006 paper by Oliva, Torralba, and Schyns [1]. Hybrid images are static images that change in interpretation as a function of the viewing distance. The basic idea is that high frequency tends to dominate perception when it is available, but, at a distance, only the low frequency (smooth) part of the signal can be seen. By blending the high frequency portion of one image with the low-frequency portion of another, you get a hybrid image that leads to different interpretations at different distances.

Problem 1.1

This part is intended to familiarize you with image filtering in frequency domain. You can find two sample images (of Derek Hoiem himself and his former cat Nutmeg) and some starter code that can be used to load two images and align them at http://www.cs.uiuc.edu/homes/dhoiem/courses/cp_fall2010/projects/hybrid/hybrid.zip. The alignment is important because it affects the perceptual grouping (read the paper for details). First, you’ll need to get a few pairs of images that you want to make into hybrid images. You can use the sample images for debugging, but you should use your own images in your results. Then, you will need to write code to low-pass filter one image, high-pass filter the second image, and add (or average) the two images (Figure1). For a low-pass filter, Oliva et al. suggest using a standard 2D Gaussian filter. For a high-pass filter, they suggest using the impulse filter minus the Gaussian filter (which can be computed by subtracting the Gaussian-filtered image from the original). The cutoff-frequency of each filter should be chosen with some experimentation.
For your favorite result, you should also illustrate the process through frequency analysis. Show the log magnitude of the Fourier transform of the two input images, the filtered images, and the hybrid image. In Matlab, you can compute and display the 2D Fourier transform with with:

\[
\text{imagesc}(\log(\text{abs}(	ext{fftshift}(	ext{fft2(gray_image))))))
\]

Try creating a variety of types of hybrid images (change of expression, morph between different objects, change over time, etc.).

**Problem 1.2**

This part is intended to familiarize you with image pyramid processing, but otherwise the goal is the same. Download and install the pyramid image processing toolbox by Eero P. Simoncelli [2]. First, you will generate Gaussian and Laplacian pyramids for the input two images. Then, you will want to generate a hybrid images by adding multiple levels of the Gaussian and Laplacian pyramids. In this case, the cutoff-frequency for the low-pass and high-pass filters can be set choosing the last N and the first M levels, respectively. To get the best results, you need to select the best thresholds for each pair of images. For this part of your problem set, you can use `buildGpyr`, `buildLpyr` and `pyrBand` functions supplied in [2].

For your favorite result, you should also show the Gaussian and the Laplacian pyramids of the input images. In addition, show the Laplacian pyramid of the hybrid image like the Figure 7 in [1].

As in the first part, try creating a variety of types of hybrid images (change of expression, morph between different objects, change over time, etc.).

**Grading**

The assignment will be graded out of 4:

- 0 (no submission), 1 (an attempt at a solution), 2 (a partially correct solution), 3 (a mostly correct solution), 4 (a correct solution), 5 (a particularly creative or insightful solution).

**What to Hand In**

You are required to submit all your code along with a short report in HTML. For that purpose, prepare a folder containing

- README.txt (text file containing details about your project)
- code/ (directory containing all your code)
- html/ (directory containing all your html report, including your images)
- html/index.html (html report)

Archive this folder as pset0.zip and email to my email address (aykut@cs.hacettepe.edu.tr).

Your HTML report should contain a brief overview of the problem, the details of your approach (not your code), and at least 4 of your favorite hybrid images for each part of the problem set. You should also comment on how the blurring level affects your perception of the hybrid images.

**References**
