Script

Applications of the Fourier Transform

1. Analyzing the algorithm

In the file FFT.java are the methods and algorithms used in this experiment, carefully observe the functioning of each method.

1.1. Direct FFT from an image:

Identify which method calculates the direct FFT of an image. What is the use of this method? Fill out the report.doc.

1.2. Direct FFT from a vector:

Identify which method calculates the direct FFT of a vector. What is the use of this method? Fill out the report.doc.

1.3. Inverse FFT of an image:

Identify which method calculates the inverse FFT of an image. What is the use of this method? Fill out the report.doc.

1.4. Direct FFT from a vector:

Identify which method calculates the inverse FFT of a vector. What is the use of this method? Fill out the report.doc.

1.5. Polar-> rectangular conversion

Identify which method calculates the polar-> rectangular conversion.

What is the use of this method? Fill out the report.doc.

1.6. Rectangular-> polar conversion

Identify which method calculates the polar rectangle-> conversion.
What is the use of this method? Fill out the report.doc.

2. Applications of Fourier

We disposed of 2 sets of images (256*256 pixels) to test the Fourier transform:

- Natural images (N): lena.tif, cat.tif, fourier.tif, rotation1.tif, rotation2.tif,
- Images from test (T): grid.tif, zero.tif, gaussian.tif, fourierhouse.tif, rect1.tif, rect2.tif, rect3.tif, rect4.tif.

2.1 observation of the Fourier transform

Apply the Fouier transform to the various images (N) and (T) using FFTDirect. Observe the results.

2.2 Reverse

Apply the Fourier transform an image of N and the inverse Fourier transform using FFTDirect and FFTInverse.

Compute as much of the absolute difference between the original and the reconstructed image using ImageJ commands.

Compare the original and the reconstructed image and fill out the report.doc

2.3 Importance of the phase

Apply the inverse Fourier transform using the FFTInverse taking as input the FFT modulus of one image and the FFT phase of another. Repeat the operation with two images. Fill out the report.doc

2.4 understand the process of reconstruction

The FourierProgressiveReconstruction plugin computes FFT first; then progressively reconstructs the image of a subset of Fourier coefficients, adding one at a time. To get a better understanding of the rebuild process, enable "Show Animation and Basis Functions" in the dialog box and display the image succession with:
ImageJ's "surface plotter → Analyze → Surface plot →(disable) smooth checkbox." Repeat the operation for an image of (N) and an image of (T).
Reconstruct the image with:

- the low-frequency coefficient (choose 1 as the number of coefficients);
- the 36 low-frequency coefficients;

- the 5000 Coefficients from low-frequencies (disable the animation, requires a lot of memory).

Observe and complete the report.doc

2.5 Progressive reconstruction

Choose an image. and start a progressive reconstruction using FourierProgressiveReconstruction.

5 methods are proposed to choose the order of the coefficients:

- low frequencies
- average frequencies
- smaller coefficients
- larger coefficients
- rhamdomic

What results of the reconstruction method that is visually closest to the original (for example:
with 5000 coefficients)? Why? Complete
the report.doc