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//
//PROTOTYPE FUNCTIONS
//      These prototype functions should be at the
//      beginning of the Operations.cpp program
//

BOOL Fourier2D (CImage *f, float Spectrum[], double Real[], double Imag[], int size, int dir);
int GetPaddingSize (CImage *f);
void LinearTransform (CImage *f, float Array[]);
```

GetPaddingSize

Because we are using the Fast Fourier transform to perform the Discrete Fourier Transform, the dimensions of the image f must be a power of two, i.e., the number of rows must equal the number of columns, and the number of columns must be a power of two (4, 8, 16, 32, ...). The function GetPaddingSize returns the smallest integer number that is a power of two that encompasses the image size.

Fourier2D:

If dir=0, then Fourier2D performs the forward Discrete Fourier Transform with the FFT algorithm. In this case:

Inputs

CImage f (called as pDoc->volimg)
size (obtained from GetPaddingSize)
dir (0 if forward, 1 if inverse)

Outputs

Spectrum (float array)
Real (double array)
Imag (double array)

Algorithm

If f is the image, then Fourier2D calculates the 2D Fourier Transform of f . Specifically,

$$F(u, v) = \mathfrak{F}\{f(x, y)\}$$

$$\text{Real} = \text{Re}\{F(u, v)\}$$

$$\text{Imag} = \text{Im}\{F(u, v)\}$$

$$\text{Spectrum} = \sqrt{\text{Re}\{F(u, v)\}^2 + \text{Im}\{F(u, v)\}^2}$$

If dir=1, then Fourier2D performs the inverse Discrete Fourier Transform with the FFT algorithm. In this case:

Inputs

Real (double array)
Imag (double array)
size (obtained from GetPaddingSize)
dir (0 if forward, 1 if inverse)

Outputs

Spectrum (float array)

Algorithm

If Real and Imag contain the real and imaginary portions of the Fourier Transform, then Fourier2D calculates the inverse 2D Fourier Transform to produce f . The values of the image f are stored in the array Spectrum. Specifically,

$$F(u, v) = \Im\{f(x, y)\}$$

$$\text{Real} = \text{Re}\{F(u, v)\}$$

$$\text{Imag} = \text{Im}\{F(u, v)\}$$

$$\text{Spectrum} = F^{-1}(u, v)$$

LinearTransform

The output of the inverse transform computed with Fourier2D is an array of real numbers contained in the array Spectrum. These numbers can be large, they can be small, they can be negative, they can be positive, and they can even be zero. To view the array, one must scale these numbers from 0 to 255. The function LinearTransform does this scaling. Once scaled, then the numbers in the input array can be viewed as usual (pDoc->UpdateAllViews(NULL)).

Input

float Array

Output

CImage pDoc->volimg