**Image feature processing by Fourier transformation**

**To make the picture more clear and vivid**

**Related concept**

Fourier transformation can transform pictures from the domain of space into the domain of frequency. In the domain of frequency, high frequency indicates that the original signal changes in a sharp speed while low frequency means the original signal changes in a low speed.

**The grey scale of the picture and gradient**

Space where we live in is 3-dimension, whereas that of the pictures is 2-dimension, in order to disclose the positions of objects of 3-dimension in 2-dimension space, the variable gradient must be involved. The size of gradient shows difference of gray scale between 2 adjacent points in the picture. Since our project’s target at processing images of two-dimensional, we need to generalize the one-dimensional Fourier transform, which means one transformation should be applied on one dimension, and the consequence of first transformation will act as an initial formular for the second transformation on another dimension.

**Noise and filter**

The noise in the picture is unnecessary and disturbing information that impair the quality of pictures. In order to cope with the noise, we use filter to sift out the noise after processing Fourier transformation. Filter helps us to obtain or eliminate a signal with a particular frequency.

**Transform the gradient into frequency**

In our case, high frequency indicates the rapid changes in the grey scale of the picture. Study shows that the noise in the pictures usually have higher frequency, therefore, proper filter should be used to process pictures that have been already transformed into frequency, we can make pictures become more smooth and clearer.

**Details on mathematics**

**Deduction of Fourier transform**

Euler’s formular and trigonometric series after normalization are involved to express the time function by complex number form, which is going to be extended to non-periodic function----expression of Fourier transform.

**Obtain discrete signals**

The expression we obtain is continuous variables targeted, while signals of pictures are discrete. So, it is inevitable that we need to modify the formular to meet the discrete signals. In this procedure, fast Fourier Transform is considered to be used because this algorithm halves the flop of the tradition one (further certify will be given via MATLAB).

**Properties discovery**

A pattern of noise on the spectrogram

Related property of rotational consistency.

**The outcome of Fourier transformation and filter applied to pictures**

By applying the Fourier transformation to pictures, we are able to eliminate the noise so that pictures will be made clearer.

**How we evaluate our outcome**

We manually add noise to a picture and then use the program that we implemented based on Fourier transformation to process the picture and compared it to the original picture to check whether the Fourier transformation that we apply successfully enhances the picture to be vivid.

In terms of the noise that we add to the picture, we have several kinds of noise, like gaussian noise, salt & pepper noise and Poisson noise. For each kind of noise, we initially add them to the pictures, afterward we apply Fourier transformation to them and then filter out the noise to see if there’s any difference when our program process different kinds of noise.

Group3: 1930026143 薛劭杰

1930026115 唐仲一

1930026127 吴楚瑜

1930026060 柯煜华