Base the Nyquist law, discussing the A/D new system developing.

Nyquist law Application of Image Scaling

Abstract: The article mainly introduces the Nyquist theorem and A/D new system. Next, it introduces the application of Nyquist theorem in computer image processing, and introduces several computer image scaling methods.

Keywords: Nyquist law, image scaling, Interpolation method

Introduction:

With the rapid development and popularization of digital technology, especially information technology, in the fields of modern control, communication, and detection, in order to improve the performance of the system, digital computer technology has been widely used for signal processing. Since the actual objects of the system are often some analog quantities (such as temperature, pressure, displacement, images, etc.), to enable the computer or digital instrument to recognize and process these signals, these analog signals must first be converted into digital signals; The amount of digital output after analysis and processing often needs to be converted into a corresponding analog signal before it can be accepted by the implementing agency. Thus, there is a need for an analog-to-digital and digital-to-analog converter that can act as a bridge between analog and digital signals. However, I want to introduce is about digital-to- digital conversion instead of digital-to-analog conversion, it is about Nyquist law Application of Image Scaling.

1. Nyquist law and Image scaling principle

In a computer, all data is expressed in binary numbers. In other words, signals that the computer can resolve are all digital signals. And computer image processing is a common practice for professionals to convert signals, and the image scaling I will introduce is part of it. From the perspective of the Nyquist sampling theorem, image scaling can be interpreted as a form of image resampling or image reconstruction.

How to perform image scaling relates to sampling and quantification of image information, because image amplification can be regarded as oversampling, and image reduction can be regarded as undersampling. The key difference between these two operations and sampling and quantizing an original image is that it is suitable for amplification and contraction. in a digital image.

Three steps of A/D conversion are sampling, quantization and coding.

2. Image scaling method

As already mentioned, the resampling is involved in the image scaling. Our most common method is interpolation. So here we introduce two interpolation methods. Nearest-neighbor interpolation and Bilinear interpolation.

Interpolation algorithm in numerical analysis can be used that gx

Where h is the interpolation basis function and Ck is the kth original function value. Different interpolation functions differ only in the basis function n and the number of selected interpolation points n. Introduce nearest neighbor interpolation, bilinear interpolation here

2.1 Nearest-neighbor interpolation

Nearest interpolation is the simplest gray value interpolation, and it is the simplest and fastest implementation of image scaling technology, also known as zero-order interpolation, which is to make the gray value of the transformed pixel equal to the nearest input pixel to it. grayscale value.

Nearest neighbor interpolation basis function:

The principle of image scaling is to have a reference image and use this image as a basis to build a new zoom image. Depending on the scaling, the constructed image will be smaller, larger or equal in size. Take a magnified image as an example. When magnifying an image, we are actually introducing blank space in the original basic image.

You can use the nearest neighbor interpolation method to get new pixel positions and grayscale values. The nearest neighbor algorithm is based on linear interpolation.

In this case, the nearest pixel is the previous pixel. Care must be taken not to access non-existent pixel values. Using height as a division of the percentage also uses a similar interpolation along the Y axis. The following are the basic implementation methods: (sourceX and sourceY represent the original pixel position, round is a rounding function, targetX and targetY are the target positions, and Width and Height represent width and height)

sourceX = int( round ( targetX / targetWidth \* sourceWidth ) )

sourceY = int( round ( targetY / targetHeight \* sourceHeight ) )

2.2

Except for interpolation, bilinear image scaling is approximately the same as nearest neighbor image scaling. Instead of copying neighboring pixels (which usually results in a zig-zag image), interpolation techniques based on surrounding pixels are used to produce smoother scaling.

Bilinear Interpolation Basis Functions

For a destination pixel, set the coordinates of the float coordinates obtained by the inverse transformation to (i+u,j+v) (where i and j are floated

The integral part of the point coordinates, u, v is the fractional part of the floating point coordinate, which is the floating point number in the range of [0,1), then the pixel value g(i+u,j+v) can be from the original image. The coordinates are determined by the values of the surrounding four pixels corresponding to (i, j), (i+1, j), (i, j+1), and (i+1, j+1). The conversion formula is as follows:

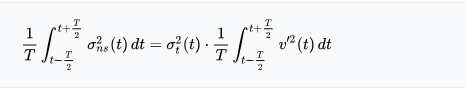
Where f(i, j) represents the pixel value at the source image (i, j) and g(i, j) represents the pixel value at the output image (i, j). The image obtained by this method is more smooth.

2.3 Peak-Signal to Noise Ratio,PSNR and Mean Square Error,MSE. To measure the quality of the image to be evaluated from a statistical point of view. Set the image to be evaluated to F, the reference image to R, and their size to M N. Then use PSNR and MSE to characterize the image quality as. Both PSNR and MSE measure image quality by calculating the global size of the pixel error between the image being evaluated and the reference image. The larger the PSNR value, the less distortion between the image to be evaluated and the reference image, and the better the image quality. The smaller the MSE value, the better the image quality.

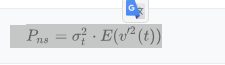
3. Quantization error

We can regard the original image acquisition as sampling, the image interpolation as quantization, and the interpolated data as encoding. Most analog-to-digital converters have a linear response type. Quantization errors and non-linearity errors (assuming this analog-to-digital converter is nominally linear) are inherent errors in any analog-to-digital conversion. It is due to the bad oscillations of the clock and often occurs during the digitization of the time domain signal.

In general



If the original signal has eigentraversal characteristics, then the left side of the above equation can be understood as the noise power.



4. conclusion

In the field of digital signal processing, the sampling theorem is a fundamental bridge between continuous-time signals (often called "analog signals") and discrete-time signals (often called "digital signals"). For computer image processing, we can use the original image as the source of the information, and then process the data. Other types of data can also use this method for signal conversion, so as to obtain more valuable information.Therefore, I believe that the development of the information discipline in the future is mainly based on the collection and processing of information. If we can convert information into more valuable data, we will develop more rapidly.