

METHODS OF IMPROVING IMAGE QUALITY IN X-RAY IMAGES

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X-ray technique and technology direction 2 - graduate students

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Abstract: X-ray images are images that show the state of the internal structure, bones, and tissues of the human body. Several methods are widely used to improve the quality of images. Iterative reconstruction algorithms, histogram equalization algorithms and image segmentation are used to improve image quality.

Key words: X-ray beam, algorithm, iterative reconstruction, histogram calculation, image segmentation, analytical approach, clustering, pixel, contrast.

X-ray images are X-ray images of internal structures that are widely used in medicine, industry, and other fields. X-ray imaging is an essential tool for precision and efficiency in medicine and technology. In the world, great attention is paid to the improvement, development and introduction of methods and algorithms for digital processing of biomedical images, separation and recognition of objects in images. In recent years, advances in this field and improvements in image processing algorithms have made it possible to develop computer-based analytical approaches to image identification. One of the ways to improve image quality is the iterative reconstruction method. Iterative reconstruction is a reconstruction method based on repeated image updating, unlike the classical FBP algorithm, in which the previously calculated image is compared with real measurements at each iteration step and the error is reduced.

Algorithm steps:

1. The initial guess is taken as a simple FBP or null image
2. The projection is a simulated projection
3. Comparison Measured and calculated projections are compared
4. The update will make corrections to the image
5. The repetition is processed up to the specified criterion

Histogram equalization algorithm:

- The histogram of the input image is determined.
- Calculates the distribution of each pixel value (cumulative distribution function, CDF).
- New pixel values are redistributed based on CDF, contrast is improved.

Histogram equalization is an effective technique used to increase image contrast. With this method, differences in dark or very bright areas of the image appear more clearly.

Algorithm steps:

1. Calculation of histogram

- The frequency of each pixel value in the image is determined. For example, for an 8-bit image from 0 to 255, each value is calculated as how many pixels correspond to it.

2. Calculate the cumulative distribution function (CDF).

- A consecutive sum of the histogram is obtained. This gives the cumulative probabilities of the pixel values.

- $CDF(x) = S$ (probability of pixels in neighboring subvalues).

3. Calculation of updated pixel values

- For each old pixel value, the new value is calculated as follows:

$$\text{new_value} = \text{round}((CDF(\text{old_value}) - CDF_{\text{min}}) / (1 - CDF_{\text{min}}) * (L-1))$$

where L is the maximum pixel value (256).

- This value makes the pixel distribution more accurate and even.

4. Result

- The contrast of the resulting new image is increased, dark and light areas are more clearly visible in the image. Histogram equalization is a powerful technique for enhancing surface contrast and is used in many image processing applications.

Image segmentation is the process of dividing an image into specific parts or objects. In this step, pixels or groups of pixels are separated into different classes (for example, background and object). Segmentation is a key task in image analysis, classification and object detection. The purpose of segmentation is to extract important objects or regions from the image, reduce data and facilitate analysis, prepare objects for detection, calculation and tracking. Segmentation methods include thresholding, clustering, region growing, edge detection, and model-based approaches. Image segmentation is the foundation of the image analysis process and is necessary for the identification and classification of objects and background. It is performed using different algorithms and each method has its own advantages and limitations.

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