International Journal of New Developments in Engineering and Society
ISSN 2522-3488 Vol. 3, Issue 2: 192-197, DOI: 10.25236/IJNDES.19226

Adaptive Median Filtering Algorithm under Multi-windows in Digital Image Processing Based on Automatic Recognition

Weiliang Li[1,*], Yuwei Lan[2], Yiming Zhou[3]

1.College of Internet of Things Engineering, HoHai University, Changzhou Jiangsu, 213022, China
2.College of Internet of Things Engineering, HoHai University, Changzhou Jiangsu, 213022, China
3.Hohai University, Changzhou Jiangsu, 213022, China
[*]Corresponding Author

ABSTRACT. *The traditional median filtering method will lose some of the image details while removing the impulse noise, and the running speed can not meet the real-time requirements well. As an important medium and means of transmitting information, image information is particularly important in human-accepted information. As a nonlinear filtering method, median filtering can eliminate random noise and pulse interference, and can retain the edge information of the image to a large extent. Combining with the block median filtering method under the multi-window structure of automatic recognition, it can preprocess the image well under the complex situation. Digital image processing is mainly realized by computer, which can process image information to meet people's visual psychology or application needs. As a typical non-linear filtering method, median filtering is widely used in digital image processing.*

KEYWORDS: *Median filtering; Image information; Automatic recognition; Multi-window*

1. Introduction

With the development of digital image processing technology, image processing has been applied more widely. In image acquisition, due to the influence of sensors or memory, the image contains noise [1]. Image enhancement includes a series of technical means to improve the visual effect of the image, or to transform the image into a more suitable form for human or machine analysis [2]. As an important medium and means of transmitting information, image information is particularly important in the information accepted by human beings. Under certain conditions, median filtering can overcome the image blurring caused by linear filtering, and it is

the best way to eliminate image impulse noise [3]. The linear filtering method generally has a low-pass characteristic, and the edge information of the image corresponds to a high-frequency signal. Therefore, the linear filtering method tends to cause the edges of the image to be blurred, and a good restoration effect cannot be obtained. Image-enhanced content refers to the emphasis or sharpening of certain features of the image, such as edges, contours, contrast, etc. [4]. The way images are used has become a common way of perceiving things and understanding things, entering family and personal life, and being closely related to the individual's spiritual life.

As a nonlinear filtering method, median filtering can eliminate random noise and pulse interference, and can retain the edge information of the image to a large extent. Enhancement will not increase the relevant information in the image data, but it will increase the dynamic range of the selected features, making these features easier to detect or identify [5]. There are different filtering methods for different noises. Median filtering has a good effect on filtering out impulse noise, but it also loses some of the details of the image. In the aspects of psychophysics, neurophysiology, cognitive neurology, etc., with a variety of new scientific research tools, a variety of research methods have been combined to have a deeper understanding of the entire human visual process [6]. The traditional median filtering algorithm ranks the pixels in each window to get the median, whose complexity is proportional to the square of the number of sorted objects [7]. When median filtering is applied to images, the computation is too large to meet the requirements of real-time processing. Digital image processing is mainly realized by computer, which processes image information to meet people's visual psychology or application needs [8]. As a typical non-linear filtering method, median filtering is widely used in digital image processing.

2. Basic Principles and Traditional Algorithms of Median Filtering

Image filtering and restoration is an important content in the field of image preprocessing. Image filtering is the most basic and important research content in computer vision. It is the key technology for successful boundary extraction, image analysis, image understanding and image description. The most common shape of sliding window in median filtering is square, which is called standard median filtering. Among the median filtering algorithms and their various improved algorithms, some of them use fixed size filtering windows. However, some algorithms adopt the adaptive filtering window which increases step by step from small to large. The filtering of noise signals is one of the basic tasks of image processing, mainly including linear filtering and nonlinear filtering. The image filtering technique is simply to design a suitable filtering algorithm for the image signal contaminated by noise, so that the image signal after filtering output can best approximate the original image signal. An image may be subject to various noise sources, including electrical sensor noise, photo grain noise, and channel errors. And filtering the noise with a linear or non-linear filtering method for noise-interfering images.

Since the maximum, median and minimum values of each window are calculated each time, the filtering speed is slower than a single cross-window median filtering. Denoising with a small filter window keeps the details and edges of the image better, but the noise filtering is not complete. Although the noise filtering effect is better with a large filtering window, it is easy to cause image details to be blurred and distorted. The edge information of the image corresponds to the high frequency signal, so the linear filtering method tends to cause the edge of the image to be blurred, and a good restoration effect cannot be obtained. Since sorting is a very time consuming operation, for each pixel, if the filter window is used from a small and large adaptive filtering method, the calculation time is significantly increased [9]. There is a great similarity between image noise and detail information. This similarity makes filtering noise and protecting details become a pair of inherent contradictions. In order to improve the speed of adaptive median filtering, the information of adjacent windows is proposed. A fast adaptive median filtering algorithm is constructed by degenerating and advancing two intersecting vectors.

For the signal, due to band limitation, the energy of the signal is mainly distributed in the low frequency region. Therefore, for noisy signals, the proportion of noise energy in low frequency region is small, while the proportion of noise energy in high frequency region is large. Therefore, the focus of denoising should be in the high frequency region. Fig. 1 is the structure of the digital image analysis system.

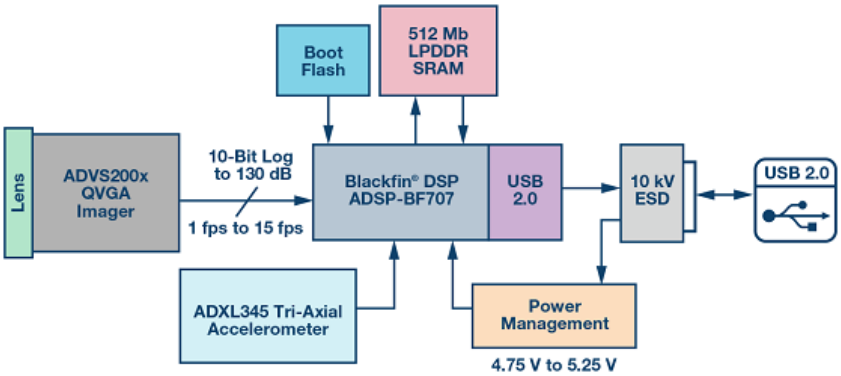

Figure 1 Digital image processing analysis system structure

Multiple digital image windows can be combined in series or in parallel. The method adopted is a control method in which a proportional link and a plurality of digital image links are connected in parallel, and each digital image link tracks and controls a signal of one frequency. The system also considers the effects of inverter nonlinearity. The inverter parameters are shown in Table 1.

Table 1 Driver power inverter parameters

Parameter	Numerical value
Modulation carrier period (μs)	150
Modulated carrier frequency (kHz)	15
Delay time (μs)	6
Freewheeling diode voltage drop (V)	3

Images are often contaminated by noise, and noise can occur during image acquisition. Or during the transmission of the image, even during the reproduction of the image. In the implementation of adaptive threshold median filtering, the full parallel comparison sorting algorithm is based on parallel comparison of any two numbers in the sequence. In order to speed up the adaptive median filtering, the relationship between the front and back windows is fully utilized to reduce the data elements involved in the sorting. The high-frequency component is often the portion of the gray value of the edge of the region in the image that changes sharply. This filtering removes these components, resulting in a smoother image. In image processing, removing noise from images is the most important task. For a given set of data, a comparison between two numbers is made first, and a comparison result is obtained for each two numbers. The size of the filter window depends on the noise density of the image, which depends on the prior knowledge of the image. In image processing, median filtering is more effective than smoothing noise in suppressing discrete impulse noise and protecting edge contour information.

3. Adaptive Median Filtering Algorithm

Median filter is a kind of non-linear spatial filter, which replaces the median of gray level in the neighborhood of the pixel. Median filtering is to select a certain form of window to make it move at all points of the image, and replace the gray value of the pixel in the center of the window with the median value of the gray value of the pixel in the window. The method of describing noise can borrow the description of stochastic process, that is, the method of probability and statistics. When the window moves in the first row of the whole image, the vector is initially established, and a new column of pixels is added for every right column, which is sorted by the traditional sorting method. The median filtering is a sorting operation within the sliding window, so most of the results of the previous sorting are retained each time the window is swiped. Entering this sorting operation reduces the amount of sorting calculations and saves system time. The noise embedded in the image reflects different characteristics. The noise can be associated or unrelated, it can also be coherent or independent of the signal. The order in which the windows move is the scan line order, moving from top to bottom, and each row moves from column to column from left to right.

Adaptability is proposed because different regions in the image, due to uneven illumination intensity, produce image effects that are not conducive to target

recognition. Median filtering is one of the most widely used filtering methods. However, the denoising effect and processing speed of median filtering depend on the size of the filtering window and the number of pixels participating in the median calculation. When there is a noise agglomeration in the image, or the number of noise points in the filtering window is large, it is necessary to use the compression extremum method in the filtering window. In order to eliminate the influence of this factor in the fast filtering, a block adaptive fast median filtering method that adaptively adjusts the filtering window size is used in different positions of the search window [10]. In median filtering, for an image, a square neighborhood centering on each pixel in the image is first determined. Then, all the pixels in the neighborhood are sorted according to the order of gray value from small to large. When the number of noise pixels is greater than or equal to half of the number of pixels in the neighborhood, its performance is poor. Moreover, larger filtering window may destroy image structure and spatial neighborhood information.

The adaptive median filtering algorithm can better preserve image details and deal with impulse noise with higher probability of noise by judging whether the center of the window is noise or not and adjusting the size of the filter window according to certain conditions. Because of its high dependence on windows and data points, its processing effect and efficiency are limited when dealing with impulse noise with large spatial density. Mean filter algorithm smoothes the image noise, but at the same time, it will blur the details of the image itself. The mean operation reduces the image noise variance and causes image detail blurring. Mean filtering is a typical linear filtering algorithm, which refers to giving a template to a target pixel on an image, the template including adjacent pixels around it. In the hardware implementation, the comparison between the two pairs of all numbers is performed at the same time, so only one clock time is needed to get the comparison result. For large templates, the relationship between the increase in the number of pixels used to calculate the median and the effect of noise removal is non-linear. The median filter is just one of the sorting statistical filters.

4. Conclusion

Noise processing is an important part of digital image processing technology. Its research focus is on filtering noise and maximizing detail protection. The neighborhood processor features are utilized when designing the implementation. Combined with the adaptive median filtering algorithm, the whole process of adaptive median filtering is realized. The images acquired by the imaging system are often not directly applicable due to various conditions and random interference. The original image must be subjected to image preprocessing such as gamma correction, noise filtering, etc. at an early stage of the application. The effect of adaptive median filter is better than that of standard median filter. It not only filters out impulse noise, but also preserves image details. Fuzzy theory has great advantages in dealing with some uncertain problems. Especially, the fuzzy filtering technology developed on the basis of the fuzzy theory has obvious effect in dealing with different noises, especially mixed noises. Combining with the block median filtering method under

the multi-window structure of automatic recognition, it can preprocess the image well under the complex situation. Improve the accuracy and validity of post-processing image, such as image segmentation and image analysis.

References

[1] Chen C, Ni J, Huang J (2013). Blind Detection of Median Filtering in Digital Images: A Difference Domain Based Approach. IEEE Transactions on Image Processing, vol.22, no.12, p.4699-4710.
[2] El-Dahshan E S A, Mohsen H M, Revett K, et al (2014). Computer-aided diagnosis of human brain tumor through MRI: A survey and a new algorithm. Expert Systems with Applications, vol.41, no.11, p.5526-5545.
[3] Nair M S, Mol P M A (2014). An Efficient Adaptive Weighted Switching Median Filter for Removing High Density Impulse Noise. Journal of The Institution of Engineers (India): Series B, vol.95, no.3, p.255-278.
[4] Lien C Y, Huang C C, Chen P Y, et al (2013). An Efficient Denoising Architecture for Removal of Impulse Noise in Images. IEEE Transactions on Computers, vol.62, no.4, p.631-643.
[5] Zhang Y, Li S, Wang S, et al (2014). Revealing the Traces of Median Filtering Using High-Order Local Ternary Patterns. IEEE Signal Processing Letters, vol.21, no.3, p.275-279.
[6] Matsuoka J, Koga T, Suetake N, et al (2016). Switching non-local vector median filter. Optical Review, vol.23, no.2, p.195-207.
[7] Gao W, Mogi T, Rong J, et al (2015). Motion behaviors of the unburned particles ahead of flame front in hexadecanol dust explosion. Powder Technology, vol.271, p.125-133.
[8] Chaudhury S P, Ravishankar T, Ray A K, et al (1998). Towards an Integrated Design of Ranked Order and Median Filter for 2-D Images. IETE Journal of Research, vol.44, no.6, p.267-274.
[9] Yang Q, Ahuja N, Tan K H (2015). Constant Time Median and Bilateral Filtering. International Journal of Computer Vision, vol.112, no.3, p.307-318.
[10] Angulo J (2013). Morphological bilateral filtering. Siam Journal on Imaging Sciences, vol.6, no.3, p.1790-1822.