Motion Fuzzy Image Denoising Algorithm Based on Wavelet Threshold Compression

Min Li, Chuan Gu

School of Software Engineering, Anyang Normal University, Anyang 455000, Henan, China

Defa Hu*

School of Computer and Information Engineering, Hunan University of Commerce, Changsha 410205, Hunan, China
*Corresponding author Email: hdf666@163.com

Abstract
Under the condition of strong interference, the fuzzy motion picture usually contains a lot of noise. It is difficult to carry out the detailed analysis. So it is necessary to carry out the image noise reduction filtering. The traditional method uses wavelet analysis to reduce the noise of the image details. A new image denoising algorithm based on wavelet threshold compression is proposed. A fuzzy wavelet image motion analysis model has been constructed, and the image denoising-filtering processing has been realized by using wavelet threshold compression method of motion fuzzy image corner detection and forming with corner layer wavelet threshold compression library. Simulation results show that using this algorithm can effectively achieve the image denoising and improve the image quality and the peak of signal-to-noise ratio.
Key words: IMAGE DENOISING, WAVELET ANALYSIS, THRESHOLD, FUZZY

1. Introduction

Digital image processing technology nowadays has been widely used in medical imaging, space exploration, investigation experiments and the news media production. The fuzzy motion picture, captured under the condition of strong interference, usually contains a lot of noise. It is difficult to carry out the detailed analysis, so it is necessary to carry out the image noise reduction filtering. Therefore, the research on image denoising algorithm is of great importance in image target detection, tracking and target identification, which has become a focus research topic in the field of computer vision. And it has important application value especially in the field of intelligent video surveillance, iamge access and retrieval based on content, etc[1].

Some effects have been achieved in fuzzy image denoising for traditional image denoising processing algorithms like the wavelet analysis algorithm, the time-frequency denoising filtering algorithm and the particle swarm filtering image denoising algorithm. Fang Zhiwen et al. have proposed an image denoising algorithm based on information feature subspace uniform traversal. The detail texture features of the fuzzy motion image are established through mutual orthogonal linear approximation model, which adopts the space uniform traversal to realize the denoising of the fuzzy images. However, there are problems of this algorithm like higher computational complexity, inaccurate extraction of detail bright spot features.

Lin Suzhen et al. have proposed an image denoising algorithm based on image line mode filtering, which uses corner detection to filter image and extract the useful component for image denoising. However, the imaging quality and identification probability of this algorithm has not improved effectively, and the improvement of the peak of signal-to-noise ratio is not very good. Generally speaking, the effect of traditional denoising method which uses the algorithm based on the image detail filtering of wavelet analysis is not very good for image corner deviation part under motion scene [5]. In view of problems of traditional methods, this paper proposes a motion fuzzy image denoising algorithm based on wavelet threshold compression. A fuzzy wavelet image motion analysis model has been constructed, and the image denoising-filtering processing has been realized by using wavelet threshold compression method of motion fuzzy image corner detection and forming with corner layer wavelet threshold compression library. Simulation results show that using this algorithm can effectively achieve the image denoising and improve the image quality and the peak of signal-to-noise ratio.

2. Model construction and preprocessing of image wavelet analysis

2.1. Model construction and problem description of motion fuzzy image

First, motion fuzzy image bright spot model is constructed based on texture partition segmentation of mathematical morphology. The reference image is taken as the multi-resolution image whose scale is taken as 1 and the highest scale is taken as M. Detail texture feature structure of fuzzy motion image is illustrated in figure 1.

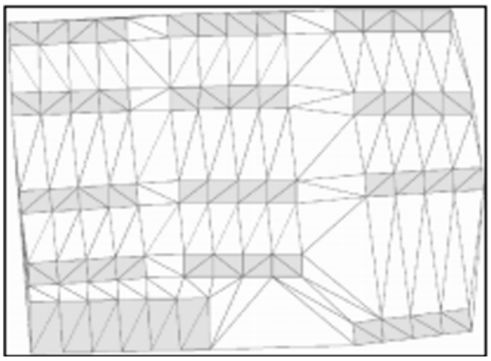

Figure 1. Detail texture feature structure of fuzzy motion image

The original pixel features of motion fuzzy image are extracted and pre-processed, and the gray degree pixel features of fuzzy motion image, representing by , can be obtained by the following formula based on the structure analysis of triangular mesh texture partition of fuzzy motion image illustrated in figure 1:

$$c = \sum_{j}^{m} P(z(k)/m_j(k), z^{k-1}) P(m_j(k)/z^{k-1}) = \sum_{j}^{m} \Lambda_j(k)\overline{c}_j \quad (1)$$

In working conditions of dynamic monitoring and complex interference background, the LPNTI integral operation of fuzzy motion image's two-dimensional or three-dimensional pixel features is carried out. Then details of fuzzy motion image are identified and the second-order plus dead-time LPNTI integration process is obtained. The identification model of fuzzy motion image is as follows:

$$G_P(s) = \frac{e^{-2.5s}}{s(2s+1)} \quad (2)$$

In the usual interference environment, the image acquisition is interfered by the environment. The collected images mostly are interfered by high-power pulse. The high-power interference image denoising filtering can be classified into two groups: the linear filtering and nonlinear filtering. Generally speaking, the nonlinear filtering denoising has more advantages. The construction of virtual imaging index model is based on the feature point model structure of fuzzy motion image which is based on the nonlinear image point sequence processing. Through the above analysis, the construction of the fuzzy motion image model is fulfilled and the problems are described, which offers the model foundation for the further analysis.

2.2. Preprocessing of the image wavelet analysis

Based on the above model, this paper adopts wavelet threshold compression method for image denoising and feature sequence smoothing. The wavelet threshold compression of each layer is isolated to form the original layer wavelet threshold compression library which can be expressed by the following equation:

$$v_i = \frac{\sum_{k=1}^{n} (1-(1-u_{ik}{}^{a})^{1/a})^m (x_k + b\overline{x_k})}{(1+b)\sum_{k=1}^{n}(1-(1-u_{ik}{}^{a})^{1/a})^m} \quad (3)$$

For a pair of gray level fuzzy motion image $g(x, y)$, M-1 times of iteration are carried out. Iterative recursion formula is as follows:

$$. d_{i+1} = 2F(x_{i+1} + \frac{1}{2}, y_i + 2) . \quad (4)$$

According to the above formula, the wavelet feature of two time points image with noise is extracted. A small subdomain is extracted from the image. The horizontal and vertical movement is executed to the image of the subdomain. The displacement is denoted by Δx and Δy respectively. Then the horizontal and vertical displacement of the subdomain image is acquired. Following the above method, wavelet threshold compression accumulated vector of the motion image's bright spot model is put into the system to form the original wavelet threshold compression library. The first order Taylor expansion is carried out to the above formula. And the fuzzy image bright spot model's texture feature can be obtained by using vector intersection method:

$$M = \frac{\sum_{i=1}^{n} \min(P_1(i), P_2(i))}{\sum_{j=1}^{n} \max(P_1(j), P_2(j)} \quad (5)$$

In the above formula, P_1 and P_2 represent two projection vector of the same length and the length is n. The value range of M is [0-1]. Then the partial derivatives of image $g(x, y)$ in horizontal and vertical direction are $g(x, y)$ and $k(x, y)$ respectively. The wavelet analysis model construction of fuzzy motion image denoising is obtained, which is illustrated in figure 2.

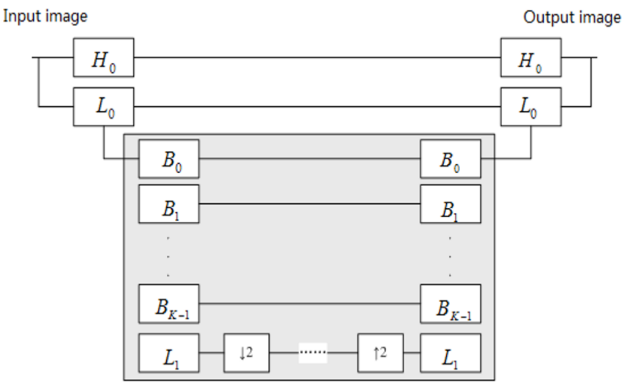

Figure 2. Wavelet analysis model construction of fuzzy motion image denoising

Figure 2 shows that the adoption of weak spot image detection algorithm based on wavelet threshold compression, morphological filtering noise algorithm and binary classification of three-dimensional features in high dimensional space can improve the identification and resolving of the image.

3. Implementation of the image denoising algorithm

Based on the above model construction and feature preprocessing extraction, the denoising effect of traditional methods which adopt the wavelet analysis image detail filtering algorithm to remove noise is not very good for image corner shift section in motion. This paper proposes a fuzzy motion image denoising algorithm based on wavelet threshold compression. Suppose that the pixel number of fuzzy motion corners accounts for no more than 0.1% of the whole image pixel number. Image corner usually has the feature like rotation invariance, good robustness for light. Therefore, the algorithm proposed in this paper is feasible. Algorithm implementation of the specific process is described as follows. The difference of grey value of subdomain image adopting wavelet threshold compression algorithm before and after translation squares is as follows:

$$\begin{cases} V_i^d(t+1) = W \cdot V_i^d(t) + C_1 \cdot R_1 \cdot (P_{best}^d(t) - P_i^d(t)) \\ P_i^d(t+1) = P_i^d(t) + V_i^d(t+1) \end{cases} \quad (6)$$

$V_i^d(t)$, $V_i^d(t+1)$, $P_i^d(t)$ and $P_i^d(t+1)$ represent weak bright spots feature matching weight of wavelet threshold compression respectively. The multi-layer feature is intensified through the feature extraction method of autocorrelation accumulation. The following equation is obtained by nominalizing the bright spot factors:

$$w^*(k) = w(k) / \|w(k)\| \quad (7)$$

$\|w(k)\|$ represents the separation mode factor; $w^*(k)$ represents the data variable in spatial location i; $T_{service}$ represents the smooth consumption of wavelet threshold compression; ρ_{SRm} represents the density function of wavelet threshold compression; λ_{SRm} represents the eigenvalue of wavelet threshold compression; $\sum_{i=1}^{M} \lambda_i p_{im}$ represents the feature weight sum of wavelet threshold compression. The above analysis shows that, under strong interference, when the bright spot trace ($trace < m(x, y)$) of fuzzy image is matrix $M(x, y)$, the monitoring point is thought to be in the inner part of the area which the grey scale changes little or never changes; When the value of response function is greater than a certain threshold, the corresponding point is the corner to be detected. The optimum estimation value $s(k | k)$ of the corresponding moment is obtained by adopting the fuzzy motion image corner detection based on wavelet threshold compression method. The minimum channel intensity value of fuzzy motion image denoising filter tends to image background brightness A, which forms the layer wavelet threshold compression library with corners. It can be described by the expression

$$\min_{c \in \{r,g,b\}} (\min_{y \in \Omega(x)} (\frac{I^c(y)}{A})) \to 1 .$$

Thus the image denoising filtering process is implemented.

4. Simulation experiment and results analysis

The simulation experiment is carried out to testify the performance of the algorithm in this paper for image denoising. The hardware environment for simulation experiment is PC with Windows 7 as operating system. Image feature sampling time $T = 0.04$. The robustness indicator equals 1.7 with $trace \quad m(x, y)$. According to this method, the wavelet threshold parameters are obtained: Kp=0.17827, ti=0.0207, Td =0.5148. Based on the above simulation environment, the image denoising simulation is carried out. The denoised images of the algorithm in this paper and the traditional algorithm are illustrated in figure 3. The algorithm in this paper can effectively realize the denoising filtering process for motion fuzzy image and can make the detail feature of image much clearer.

(a) algorithm in this paper (b) traditional algorithm

Figure 3. Simulation results of motion blur image denoising

In order to analyze the denoising performance quantitatively, the image fringe corner feature is extracted to form signal sequence for denoising performance analyzing. The results are illustrated in figure 4. The purity of corner features is increased obviously by algorithm in this paper. Through calculating, the peak of signal-to-noise ratio of the image is increased 23.5 dB by adopting this algorithm. The performance of this algorithm is good.

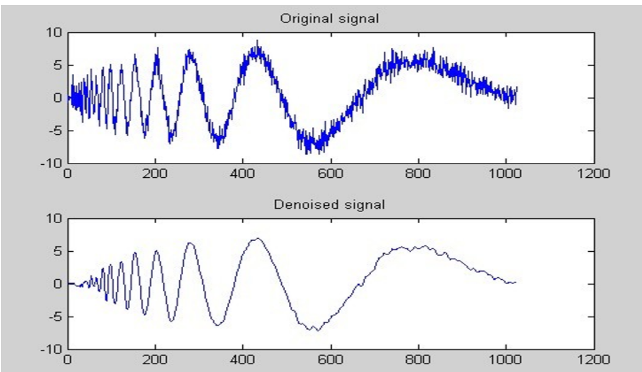

Figure 4. Performance test

5. Conclusions

The research on image denoising algorithm is of great importance in image target detection, tracking and target identification. This paper proposes a motion fuzzy image denoising algorithm based on wavelet threshold compression. The image denoising-filtering processing has been realized by using wavelet threshold compression method of motion fuzzy image corner detection and forming with corner layer wavelet threshold compression base. Simulation results show that using this algorithm can effectively achieve the image denoising and improve the image quality and the peak of signal-to-noise ratio.

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