A Low Motion Blurring Algorithm on FPD systems

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Abstract

We propose a new interpolation algorithm that can effectively decrease motion blurring on moving image. The proposed algorithm can be easily applied to FPD systems, since its structure is very simple. The proposed algorithm has been simulated and verified for image definition and sharpness, quantitatively and qualitatively. The simulation result shows that the proposed method provides better performance than the conventional ones..

1. Introduction

Recently, the role of display systems that interact humans with various electronic systems is getting more important. FPD such as LCD(Liquid Crystal Display) and PDP(Plasma Display Panel) is the most suitable system to replace the existing CRT(Cathode Ray Tube) monitors, which are bulkier and dissipate more power than LCDs. The main advantages of LCD include lightweight, thinness, high-resolution and low-power operation. In addition, FPD systems employ digital driving methods, which have a better noise immunity. As the size of FPD panels increases and requires a higher resolution [1], FPD systems need a full screen display method. In order to display a full screen images, many interpolation algorithms have been proposed for digital image enlargement [2]

However, existing interpolators have a tendency to employ the same method on all pixels in the frame regardless of image features. If we apply the existing algorithm to FPD systems, the conventional algorithms can cause degradation of image quality such as image blurring for moving image, due to the response of liquid crystal cell. To overcome these problems, we propose an effective image interpolation algorithm for moving image

2. COVENTIONAL METHODS

Conventional interpolation methods are divided into the linear interpolation method and non-linear interpolation method that is based on median filters. There are some typical linear interpolation methods such as ZOI(Zero Order Interpolation) [3], and FOI(First Order Interpolation) [3]. The non-linear interpolation methods are the Median method [4], and PMED(pseudomedian) method [5].

2.1 ZOI

The ZOI method repeats the pixels of the previous line to create new pixels [3]. Fig. 1 shows the principle of ZOI method. It is suitable for still images and it has been used in still parts in an image.

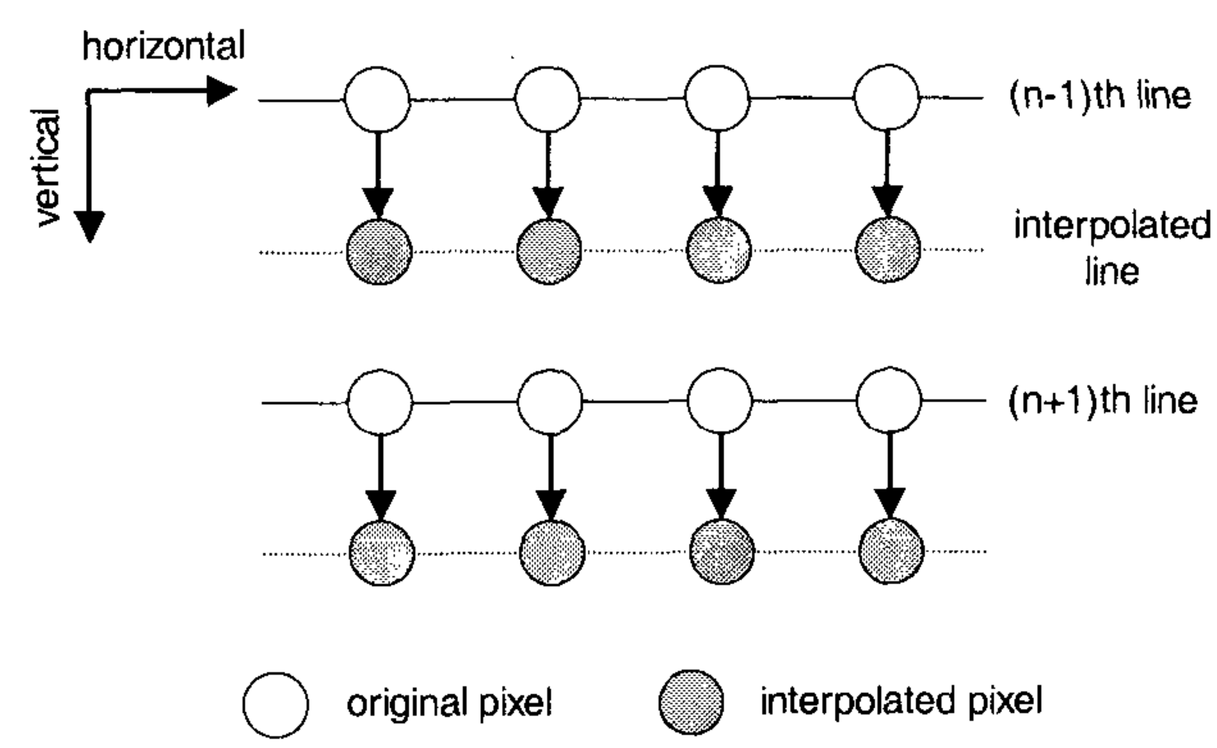


Figure 1. The principle of ZOI method

2.2 FOI

The FOI method averages neighboring two pixels in the *(n-1)th* line and *(n)th* line of the interpolated line [3]. Fig. 2 shows the principle of FOI method. Although we can't have a high-quality image, we use the FOI method because of its simple structure with low cost.

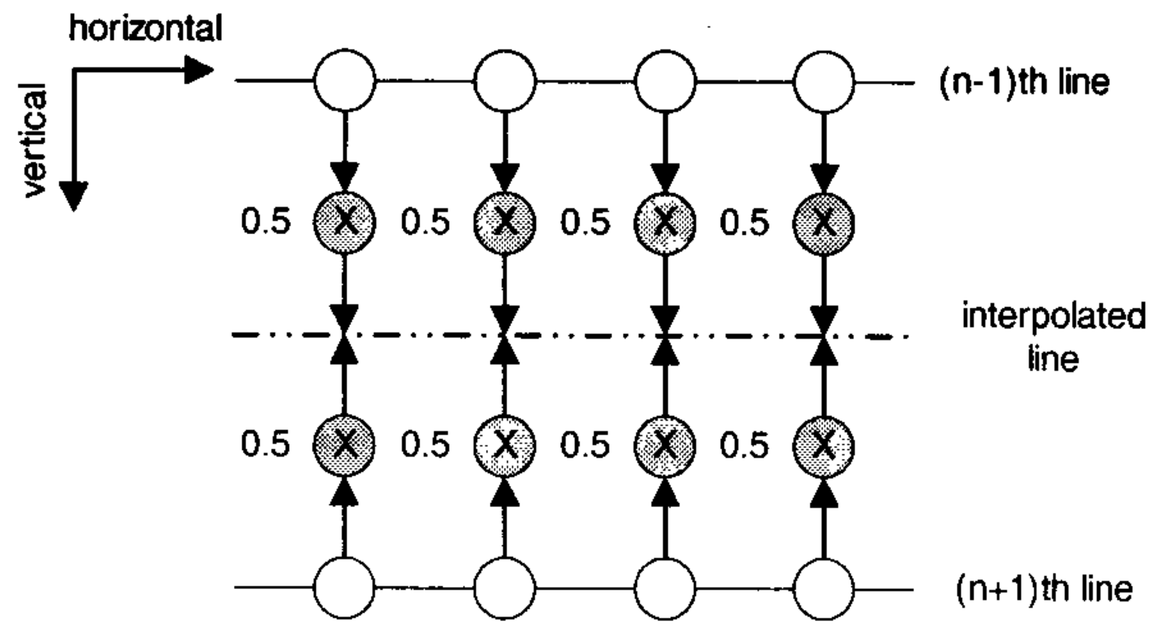


Figure 2. The principle of FOI method

2.3 Median method

The median method is one of the most general non-linear methods being used for signal processing. Its principle is not complex but it requires many computations [4]. The output of the method is the median in the windows. This method is particularly effective when the noise pattern consists of strong and spikelike components [6].

Interpolated pixel g is given by equation (1). Fig. 3 shows the pixels using median method.

$$g = MED(a,b,c,d,e,f,h) \\ h = (b+e)/2 \tag{1}$$

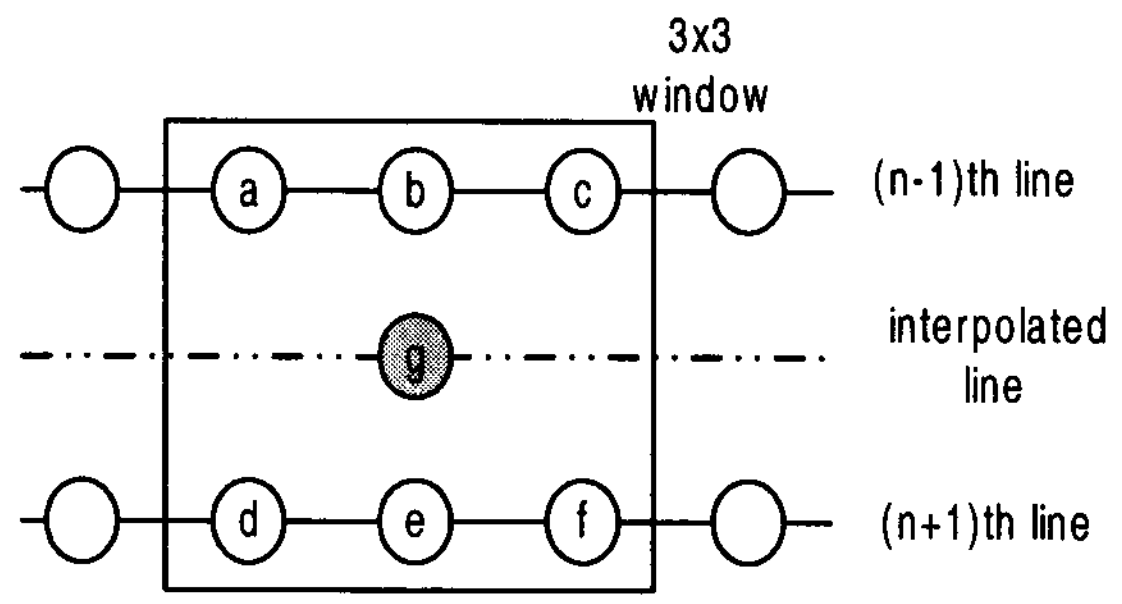


Figure 3. The pixels using median method

2.3 PMED

PMED is proposed for an effective computation of median method [5]. The definition of PMED is represented in equation (2) and (3) when each N is 1 and 2.

$$\begin{aligned} & PMED\{a,b,c\} \\ & = 0.5\times \max[\min\{a,b\},\min\{b,c\}] \\ & + 0.5\times \min[\max[a,b\},\max\{b,c\}] \end{aligned} \tag{2}$$

$$\begin{aligned} & PMED\{a,b,c,d,e\} \\ & = 0.5\times \max[\min\{a,b,c\},\min\{b,c,d\},\min\{c,d,e\}] \\ & + 0.5\times \min[\max\{a,b,c\},\max\{b,c,d\},\max\{c,d,e\}] \end{aligned} \tag{3}$$

Since the pseudomedian method uses the N+1 sub-windows difference from a median method, it adds stronger weight to the middle value. It also has better edge and impulse response characteristics than median method. Typically, the pseudomedian method is named according to the shape of the sub-windows.

3. The Proposed χ-shaped PMED algorithm

Conventional pseudomedian algorithm uses the maximum 3 pixels in a sub-window. In the proposed scheme, we use the maximum 4 pixels in a sub-window. The expansion of sub-window size may give better performance of the generation of interpolated pixel. We make a sub-window considering the relationships of vertical, horizontal and diagonal direction. The shape of sub-window is like χ. Thus we call the proposed algorithm as χ-shaped PMED algorithm. Equation (4) gives the interpolated pixel g.

$$\begin{aligned} & g = PMED\{a,b,c,d,e,f\} \\ & =0.5\times \max[\min\{a,b,e,f\},\min\{b,c,d,e\},\min\{b,e\}] \\ & +0.5\times \min[\max\{a,b,e,f\},\max\{b,c,d,e\},\max\{b,e\}] \end{aligned} \tag{4}$$

Fig. 5 shows the pixels using the χ-shaped PMED.

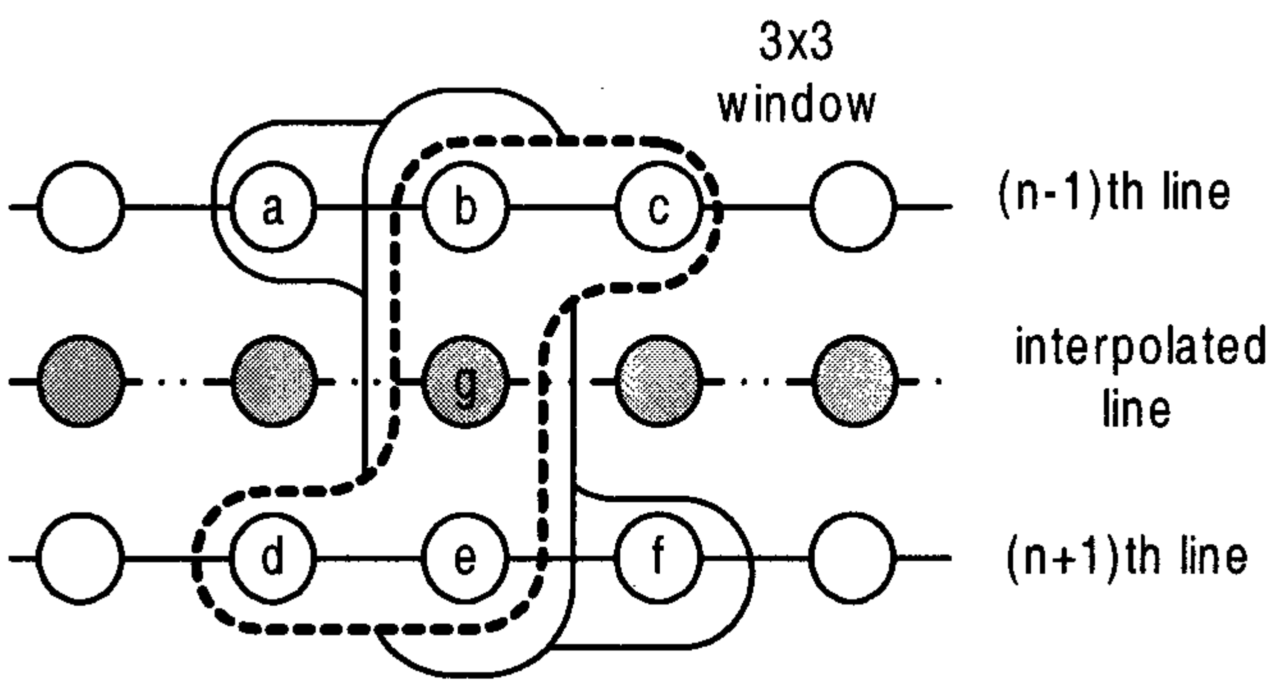


Figure 5. The pixels using the χ-shaped PMED

4. Simulation Result

The proposed algorithm is based on PMED (Pseudomedian) algorithm. For the verification of the proposed algorithm, we have performed the computer simulation. Moreover, we have verified the performance of the proposed algorithm by means of comparing the existing algorithms with the proposed algorithm and analyzing the former into the latter. The verification has been executed with the quantitatively by PSNR(Peak Signal to Noise Ratio) and the qualitatively by the edge characteristics. In addition the interpolation has been performed with 1024 x 960, which is two times of the original image.

We choose two types of three images, such as two moving images and one semi-moving image, for simulation. Two moving images are "*Flower Garden*(30 frames)" and "*Football*(25 frames)". One semi-moving is "*Salesman*(30 frames)". In the sample image "*Flower Garden*", its objects do not move but the camera does. In the simulation results, we give the edge characteristics and PSNR for the verification of performance.

Fig. 6 and 7 show the edge characteristics of original images and the images processed by the conventional algorithm, respectively.

(a) (b) (c)

Figure 6. The edge characteristics of original images (a) "Flower Garden" (b) "Football" (c) "Salesman"

(a) (b) (c)

Figure 7. The edge characteristics of the images processed by adaptive PMED method (a) "Flower Garden" (b) "Football" (c) "Salesman"

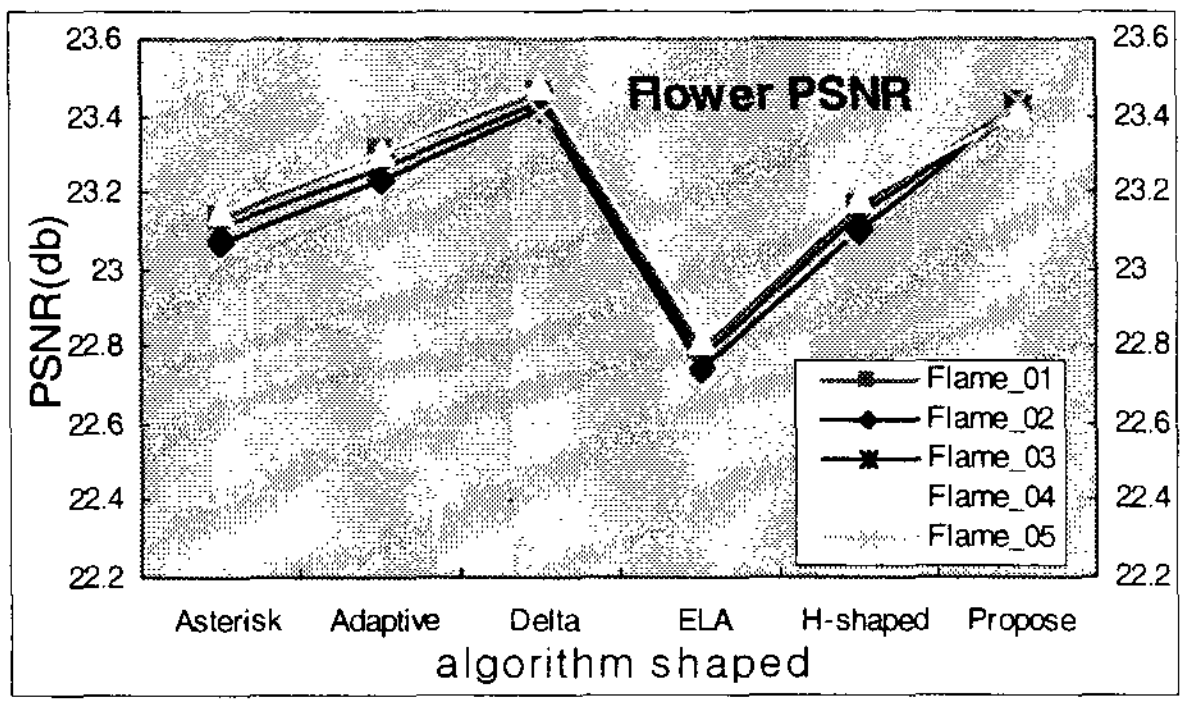
Fig. 8 shows the results by the proposed algorithm.

(a) (b) (c)

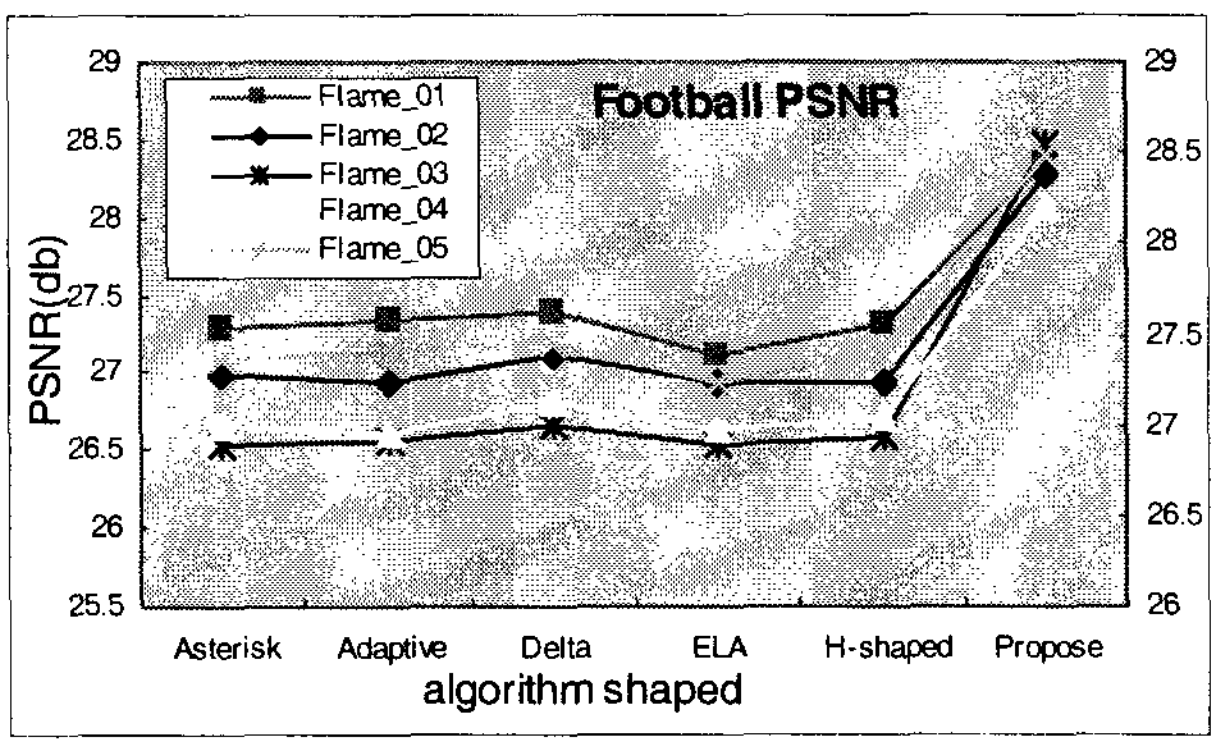
Figure 8. The edge characteristics of the images processed by the proposed algorithm (a) "Flower Garden" (b) "Football" (c) "Salesman"

In the results of edge characteristics, the images processed by the proposed algorithm have higher definition and lower image blurring than the conventional ones. Fig. 9 shows the PSNR results.

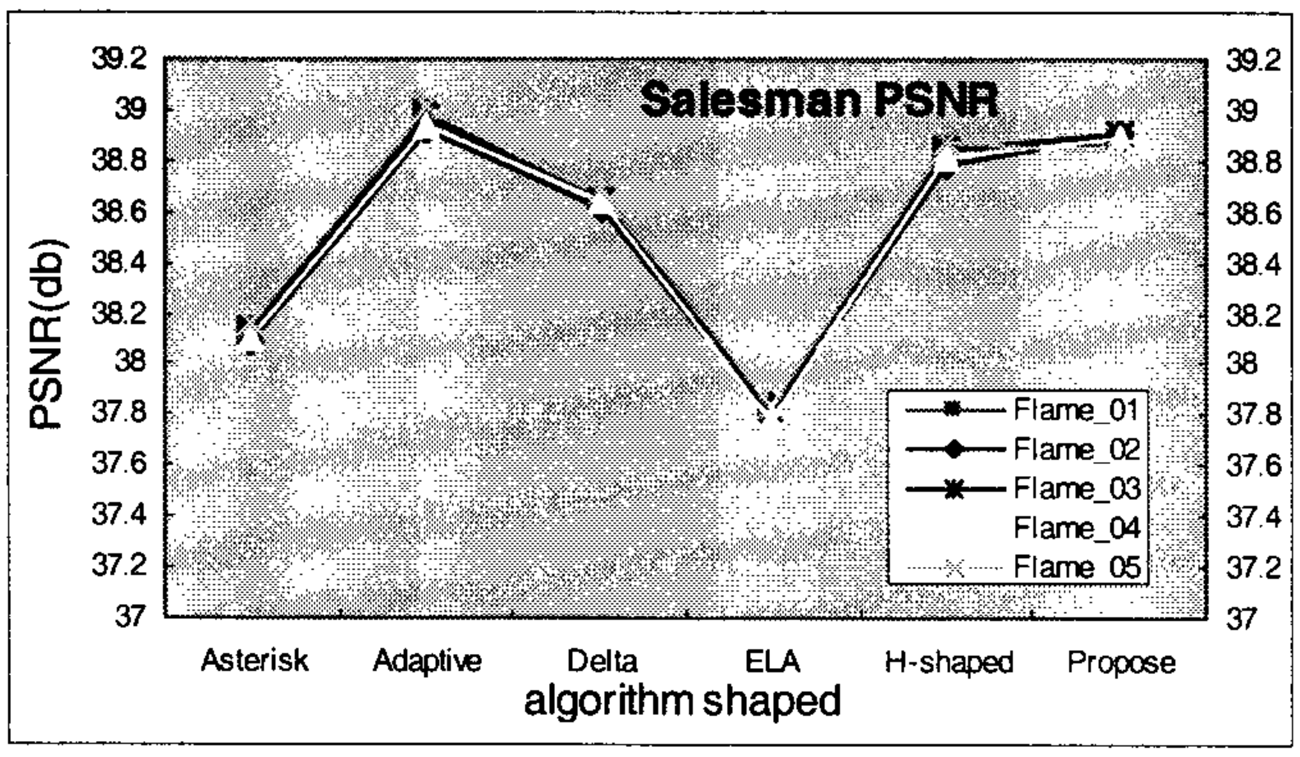
In the results of PSNR, we can see that the results of the proposed algorithm have larger values than the conventional ones. Therefore, the proposed algorithm has a better performance comparing to the conventional ones.



(a)



(b)



(c)

Figure 9. The results of PSNR (a) "Flower Garden" (b) "Salesman" (c) "Football"

5. Conclusions

A new interpolation algorithm is effectively decrease motion blurring on moving image and with a simple structure. Moreover, it is suitable for the real-time processing because of its simple computational process. So, it is easily applied to the FPD systems, such as LCD and PDP, to perform an effective scaling and increase the image quality because it is based on LCD controller. Therefore, we have concluded that the proposed interpolation algorithm can be effectively applied to digital display systems such as LCD monitors with enhancement of image quality.

6. REFERENCES

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