Tiling Effect Performance Analysis

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Abstract

In this paper, we present a tile effect generation algorithm. The presented method cuts a given pictures with small-size tiles and an original image is composed of those tiles. The size of tiles is generated by random function. We use four parameters: size of horizontal and vertical block, size of skip blocks in horizontal and vertical direction. The presented method is tested on McM dataset. Simulation results provide performance comparison in terms of PSNR, CMSE and FSIM.

Keywords: *Tile effect, random function, skip block, performance assessment*

1. Introduction

Image processing is one of signal processing shapes where input is an image [1]. In general, image processing indicates digital signal processing, where optical image processing is possible. In image processing, a filter is a tool or process which adds specific effect or removes some unwanted feature [2-4]. Image filtering is one of attributes of signal filters, where image filters have two dimensional signal while signal filters is for one dimensional signal [5-7]. By applying image filters, one may suppress or express some aspect of the images. There are different types of image filters.

The tiling effect (TE) is an approach of traditional art, which can be applied to interior decoration in an old house. A TE is often viewed in poster art. For example, some effects divide original image with thousands of small pieces to form a related much larger image. Therefore, this effect may be seen as an illusion effect.

The TE approach is classified into three categories: block-based method, pixel-based method, and image-based method. Our proposed approach is one of block-based methods. In order to apply TE approach, we uses four parameters: horizontal block size, vertical block size, horizontal skip block size, and vertical skip block size. By changing the size of four parameters, we assess the objective and visual performance. We try our best to find the most appropriate size of the block in a given image.

In this paper we propose a filter which gives tiling effect on a given image [8]. Section 2 presents a proposed filter. The proposed filter has four parameters. Section 3 describes simulation results where objective and subjective performance are compared. By changing four parameters, different effects are presented. Conclusion remarks are provided in Section 4.

2. Proposed Method

2.1. Definition of the Proposed Method

The presented method is composed with following components. There are four parameters S_{HB}, S_{VB}, S_{HSB}, and S_{VSB}, which are defined as follows:

Legend:

RF

random function which generates values bigger than 0 and smaller than 1.

S_{HB}

horizontal block size

S_{VB}

vertical block size

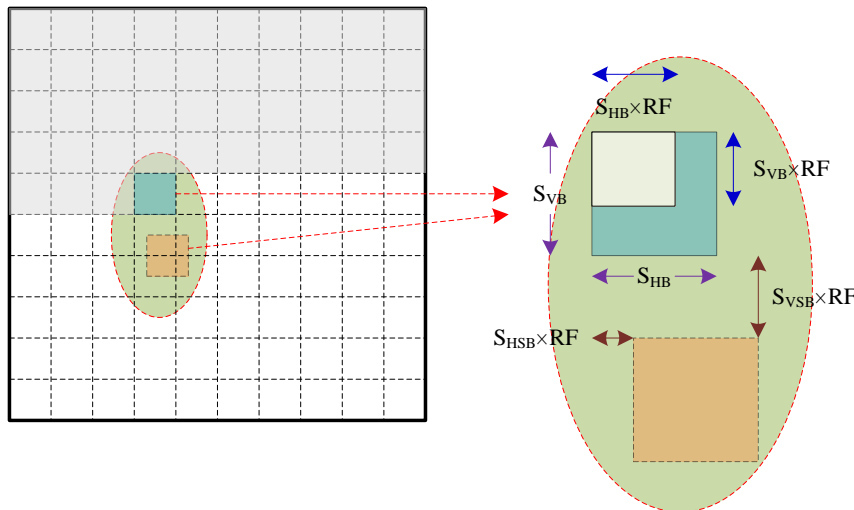S_{HSB}

horizontal skip block size

S_{VSB}

vertical skip block size

Figure 1. Concept of Four Parameters and their Corresponding Random Function

The pseudo code of the proposed method is explained as follows:

Pseudo code:

Step 1: Obtain input image.

Step 2: Determine S_{HB} and S_{VB} values.

Step 3: Determine S_{HSB} and S_{VSB} values.

Step 4: Divide given image with block size, S_{HB} by S_{VB}.

Step 5: Generate random numbers [0 1].

Step 6: Generate blocks with sizes [$S_{HB} \times RF$ $S_{VB} \times RF$].

Step 7: Skip block size generation [$S_{HSB} \times RF$ $S_{VSB} \times RF$].

Step 8: Collect all generated blocks.

Step 9: Obtain tiling filter applied result images.

Figure 1 explains the concept of the proposed method. As we can see, tiling effect is reflected by four parameters S_{HB}, S_{VB}, S_{HSB}, and S_{VSB}, and their corresponding random function output.
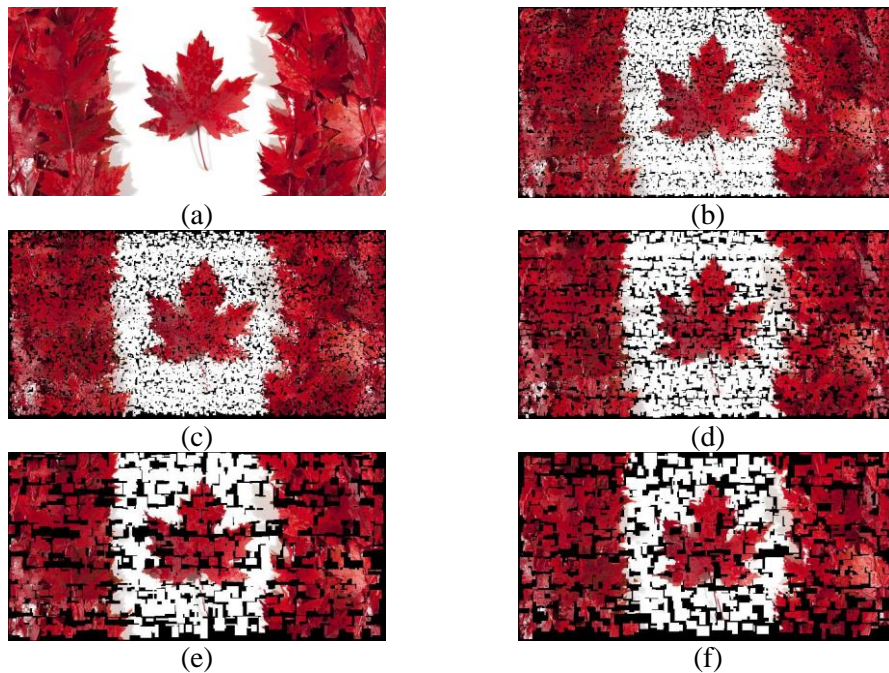

Figure 2. (a) Original 'Canadian Flag' Image. Tiled Images with (b) Parameter Set (5,5), (c) Parameter Set (5,10), (d) Parameter Set (10,5), (e) Parameter Set (20,5), and (f) Parameter Set (20,10).

2.2. Definition of the Proposed Method

Figure 2 shows some effects of original 'Canadian flag' image with different parameter sets. For instance, Figure 2(b) shows implemented image with the parameter set (5, 5). In the same manner, Figure 2(b-f) are obtained where parameter sets (5, 10), (10, 5), (20, 5), and (20, 10) were used. The flowchart of the proposed method is drawn in Figure 3.

When S_{HB} and S_{VB} (or, S_{HSB} and S_{VSB}) have different values, results images may be shown as Figure 4. Note that Figure 4(a) is result image with parameters S_{HB}=5, S_{VB}=20, S_{HSB}=10, and S_{VSB}=10, and Figure 4(b) is result image with parameters S_{HB}=20, S_{VB}=5, S_{HSB}=10, and S_{VSB}=10.
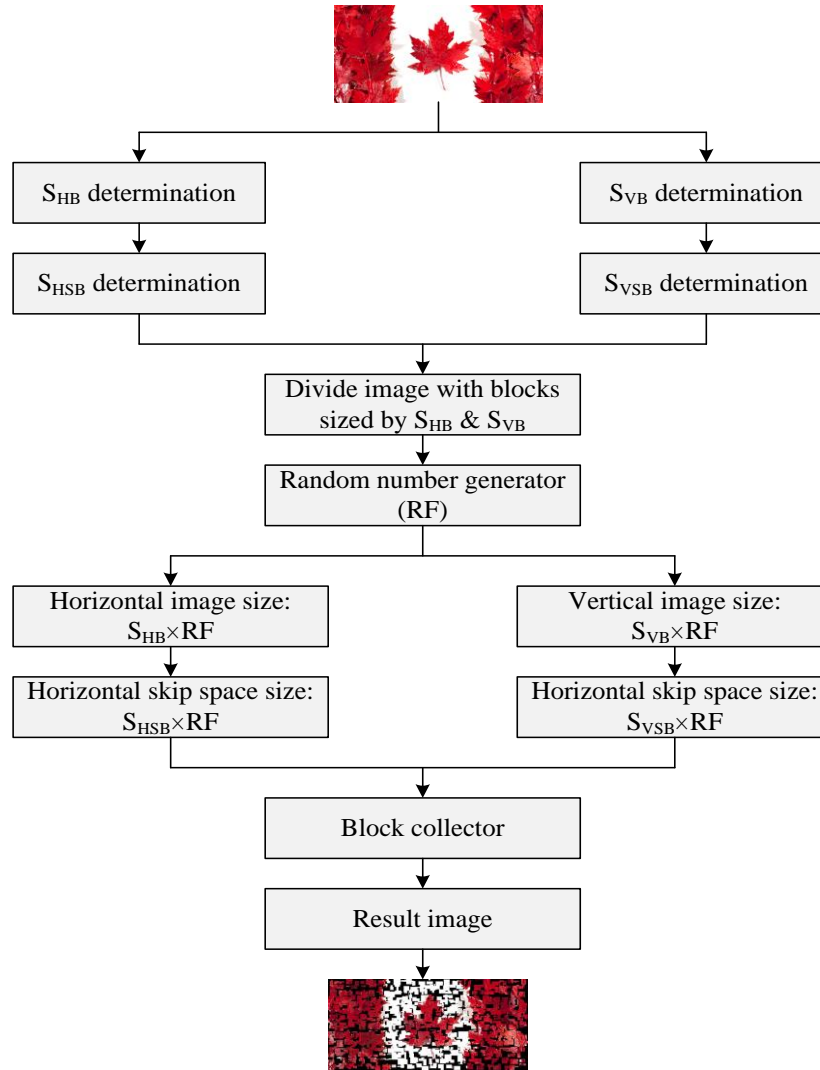
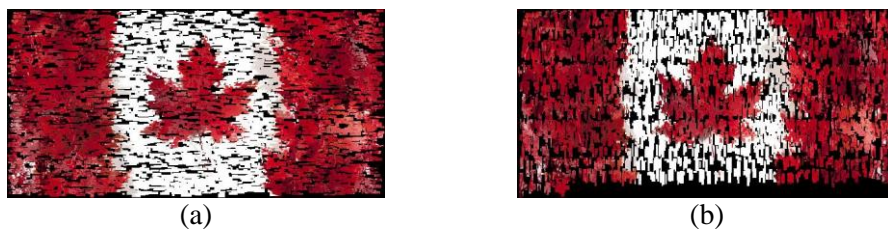**Figure 3. Flowchart of the Proposed Algorithm to Generate Tiling Effect**

| (a) | (b) |

Figure 4. Result Images with (a) S_{HB}=5, S_{VB}=20, S_{HSB}=10, and S_{VSB}=10, (b) S_{HB}=20, S_{VB}=5, S_{HSB}=10, and S_{VSB}=10

3. Experimental Results

Our simulation is based on an 18 McM images. The size of all images is 500×500. The test images are three channel color images. Figure 5 shows 18 McM images. Titling effect was given to original images with different parameters: S_{HB}, S_{VB}, S_{HSB}, and S_{VSB}.

3.1. Objective Performance Metrics

We used three objective metrics: peak signal-to-noise ratio (PSNR), CPSNR, MSE (mean squared error), and FSIM (Feature SIMilarity).

The first metric is PSNR, which is calculated as,

$$PSNR = 20 \log_{10} MAX - 10 \log_{10} MSE,$$

$$= 10 \log_{10} \frac{MAX^2}{MSE}, \tag{1}$$

where MAX is 255.

The second metric is MSE, which is calculated as,

$$MSE = \frac{1}{w \times h} \sum_{x=0}^{w-1} \sum_{y=0}^{h-1} \left[ori(x,y) - rec(x,y) \right]^2, \tag{2}$$

where $ori(x,y)$ and $rec(x,y)$ stand for original and restored pixels at the location of (x,y), and w and h are sizes of monochrome image.

Figure 5. Test Images: McM Dataset

Finally, FSIM is Feature SIMilarity metric, which is calculated as,

$$FSIM = \frac{\sum_{x \in \Omega} S_L(x) \cdot PC_m(x)}{\sum_{x \in \Omega} PC_m(x)}, \tag{3}$$

where Ω stands for the whole image, PC is phase congruency, $S_L(x)$ is,

$$S_L(x) = \left[S_{PC}(x) \right] \left[S_G(x) \right] \tag{4}$$

3.2. Objective Performance Comparison

We have six different scenarios with different parameters. We assumed parameters S_{HB} and S_{VB} are identical, and parameters S_{HSB} and S_{VSB} are the same.

Size parameter sets were considered, they are:

Scenario 1: $S_{HB}=5$, $S_{VB}=5$, $S_{HSB}=5$, $S_{VSB}=5$,
Scenario 2: $S_{HB}=5$, $S_{VB}=5$, $S_{HSB}=10$, $S_{VSB}=10$,

Scenario 3: S_{HB}=5, S_{VB}=5, S_{HSB}=15, S_{VSB}=15,
Scenario 4: S_{HB}=5, S_{VB}=5, S_{HSB}=20, S_{VSB}=20,
Scenario 5: S_{HB}=10, S_{VB}=10, S_{HSB}=5, S_{VSB}=5,
Scenario 6: S_{HB}=20, S_{VB}=20, S_{HSB}=5, S_{VSB}=5.
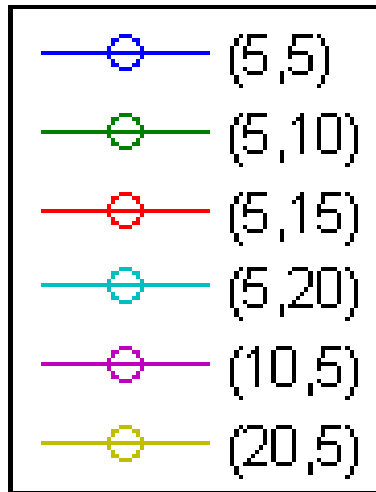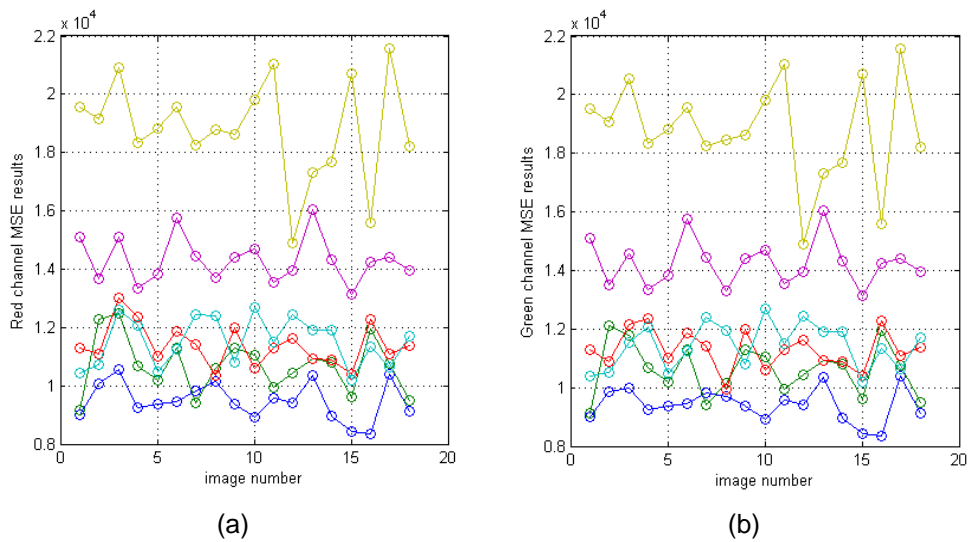
Figure 6 shows the legend of MSE and PSNR comparisons.
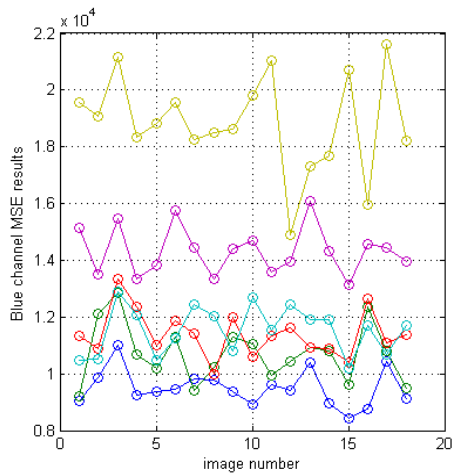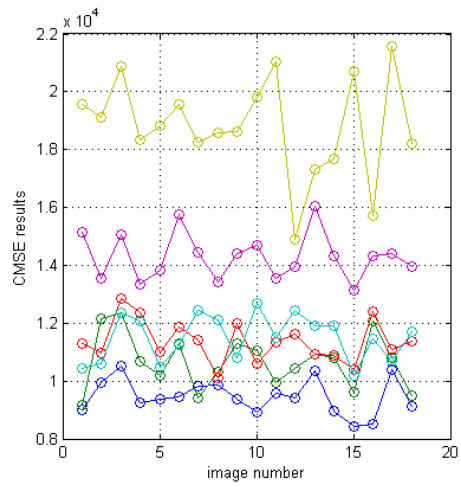

Figure 6. Legend of Objective Performance Comparison

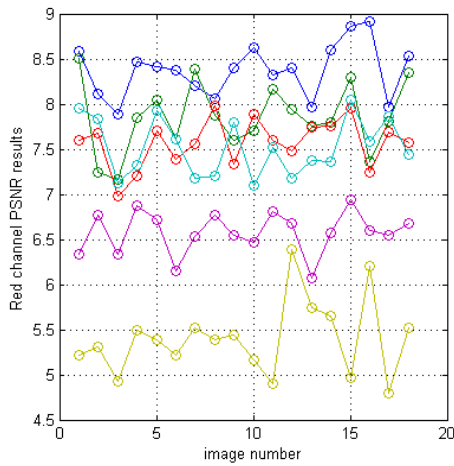(a)   (b)
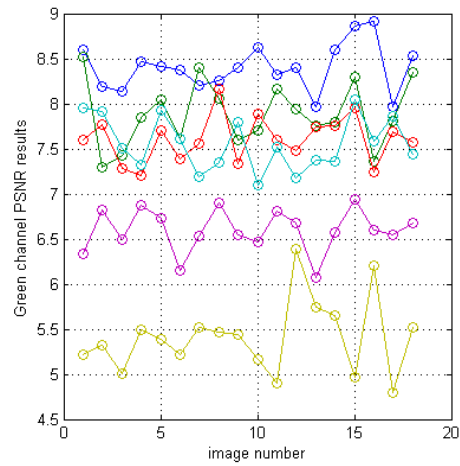
(c)   (d)

Figure 7. Performance Comparison using MSE Metric: (a) Red Channel, (b) Blue Channel, (c) Green Channel, and (d) Color MSE

Figures 7 and 8 compare MSE and PSNR results. Table 1 compares FSIM results for six scenarios.
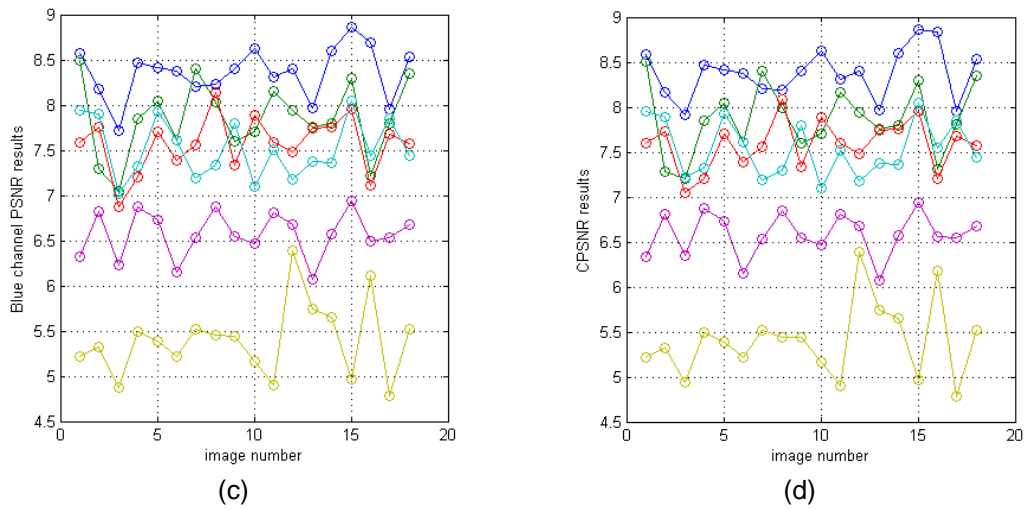

(a)   (b)

(c)   (d)

Figure 8. Performance Comparison using PSNR Metric: (a) Red Channel, (b) Blue Channel, (c) Green Channel, and (d) Color PSNR

Table 1. Shows FSIM Performance Comparison

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Average FSIM	0.2128	0.2011	0.1959	0.2008	0.2753	0.4291

3.3. Visual Performance Comparison

In this subsection, visual performance comparison is provided in Figures 9-11. Figure 9 shows original #1 and #2 McM images.
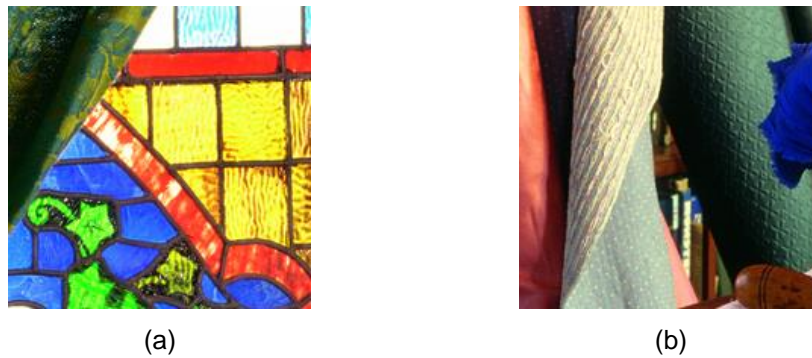

(a)   (b)

Figure 9. Original McM Images: (a) #1 Image, (b) #2 Image

With different parameter sets, different titling effects were obtained.
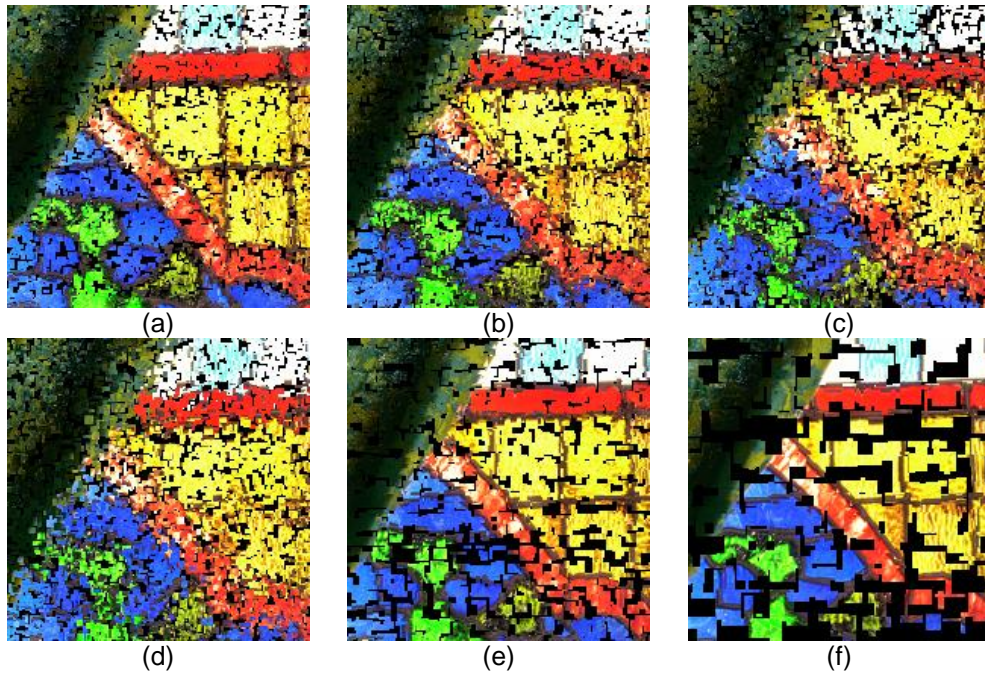
Figure 10. Results on #1 McM Image with Different Parameter Sets: (a) Scenario 1, (b) Scenario 2, (c) Scenario 3, (d) Scenario 4, (e) Scenario 5, and (f) Scenario 6
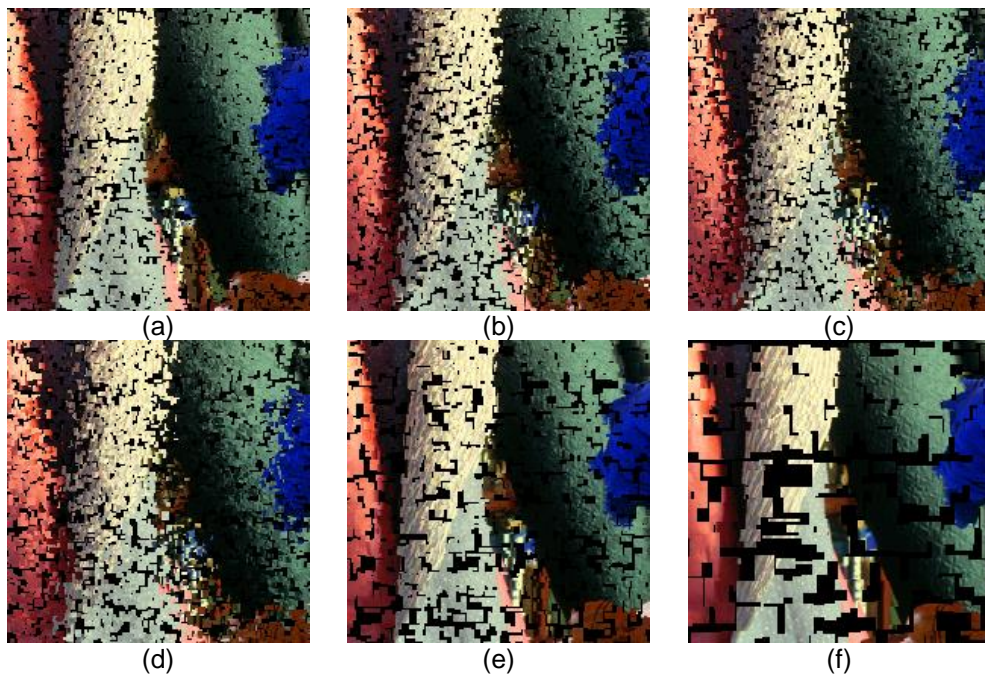

Figure 11. Results on #2 McM Image with Different Parameter Sets: (a) Scenario 1, (b) Scenario 2, (c) Scenario 3, (d) Scenario 4, (e) Scenario 5, and (f) Scenario 6

4. Conclusions

This paper presents a tile effect generating technique. The provided method cuts a provided image into different sized tiles. Four parameters were used to determine the size of horizontal and vertical block, size of skip blocks in horizontal and vertical direction. The provided approach is tested on McM dataset in terms of PSNR, CMSE and FSIM metrics. In addition, visual performance is comparison in detail.

Acknowledgements

References

[1] N. Ahmed and A. A. Khan, "An efficient image buffering and tiling algorithm for multiple channel image acquisition for space missions," in Proc. ICASE 2013, **(2013)**, pp. 1-5.
[2] S. D. Thepade and S. Erandole, "Effect of tiling in image compression using wavelet transform & hybrid wavelet transform for cosine & kekre transforms," in Proc. ICE-CCN 2013, **(2013)**, pp. 753-758.
[3] A. M. Kuruvilla, "Tiled Image Container for Web Compatible Compound Image Compression," in Proc. IEEE SITIS 2012, **(2012)**, pp. 182-187.
[4] M. J. Powell, J. R. Hughes, N. C. Bird, C. Glasse, and T. R. King, "Seamless tiling of amorphous silicon photodiode-TFT arrays for very large area X-ray image sensors," IEEE Trans. Medical Imaging, vol. 17, no. 6, **(1998)**, pp. 1080-1083.
[5] K. Hua, I. Pollak and M. Comer, "Optimal Image Tilings with Application to Video Compression," in Proc. ICIP2006, **(2006)**, pp. 2497-2500.
[6] C. Jin, Q. Deng and J. Liu, "Computer Virus Propagation Model Based on Variable Propagation Rate," IJAST, vol. 1, **(2008)** December, pp. 29-34.
[7] C. Hsieh, Y. Wu, and K. Hung, "Hybrid Watermarking Scheme for Halftone Images," IJAST, vol. 1, **(2008)** December, pp. 9-20.
[8] S. Lee, J. Yang, and G. Jeon., "Performance Analysis on Tiling Effect," in Proc. EEC2014, **(2012)** December.

Author

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