Comparison of Novel MSU Demosaicing Filters

23 April 2004

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Testing Methodology

We have tested the following demosaicing methods:

1. Linear
2. Color Correction
3. Kimmel
4. MSU slow debayer (by Alexey Lukin)
5. MSU fast debayer (by Maksim Mahinya)

Test images were converted to Bayer pattern. Resulting patterns were restored using different demosaicing methods. Restoration results were compared with original images, using PSNR measure.

PSNR charts are presented below. The higher is line on a chart, the better restoration is made by tested algorithm.
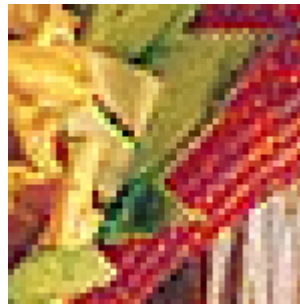
Following colors are used when results of restoration with two methods are compared with measure pictures:

- ■ - equal restoration or insignificant differences
- ■ - small advantage of first method
- ■ - big advantage of first method
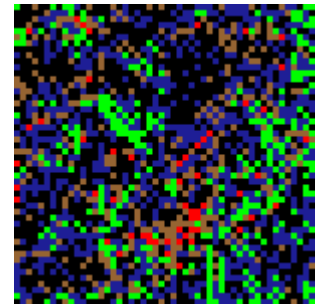- ■ - small advantage of second method
- ■ - big advantage of second method

Example:

Picture 1.   **Linear**

Picture 2.   **MSU slow**

Picture 3.   **MSU slow vs Linear**

Test Images

Picture 4.   img1 (1600x1200px)

Picture 5.   img2 (1600x1200px)

Picture 6.   img3 (1600x1200px)

Picture 7.   img4 (1600x1200px)

Picture 8.   img5 (1600x1200px)

Picture 9.   img6 (1600x1200px)

Picture 10.   img7 (1600x1200px)

Picture 11.   img8 (1600x1200px)

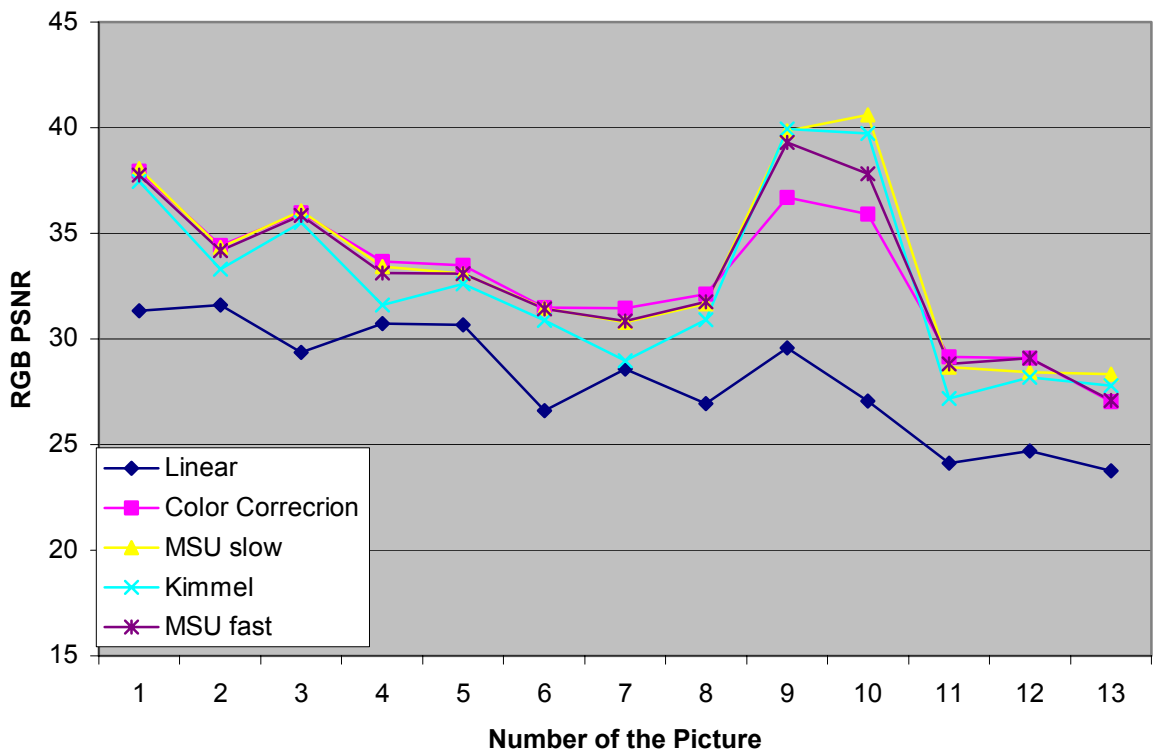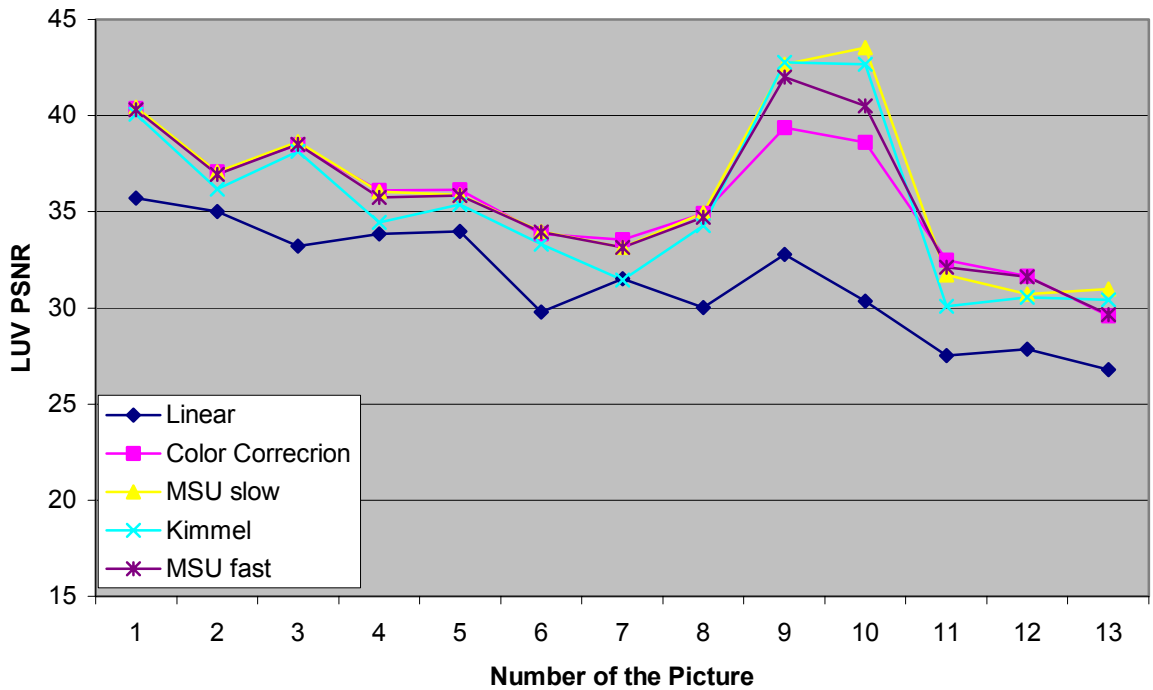**Picture 12.   img9 (640x480px)**

Picture 13.   img10 (512x512px)

Picture 14.   img11 (512x512px)

Picture 15.   img12 (512x512px)

**Picture 16.   img13 (320x408px)**

Demosaicing PSNR measurements charts

On several images MSU slow has significant advantage over other algorithms. On these pictures MSU fast method is much better than Color Correction.

Although Kimmel sometimes gives better PSNR value, on most pictures it works worse than CC and MSU fast methods. However PSNR advantage of Kimmel method does not always mean advantage in visual comparison.
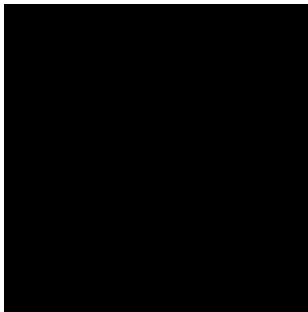
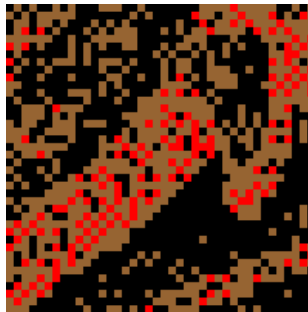## Different Method Examples (pictures and measures)

Picture 17.   Original
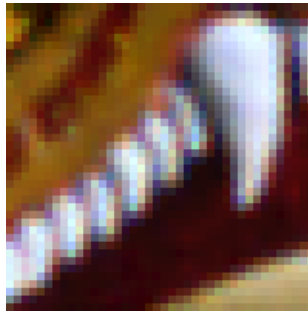
Picture 18.   Linear

Picture 19.   Kimmel

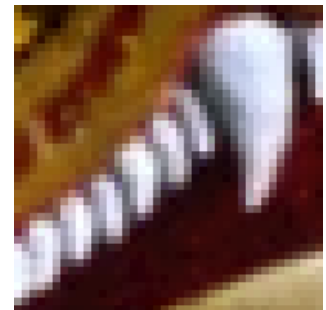**Picture 20.   Original m.**

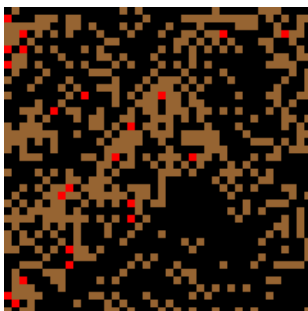**Picture 21.   Linear m.**
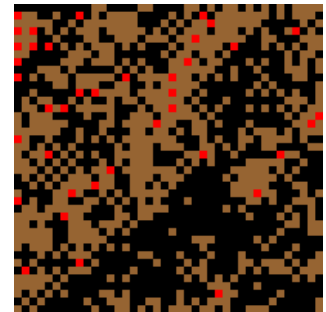
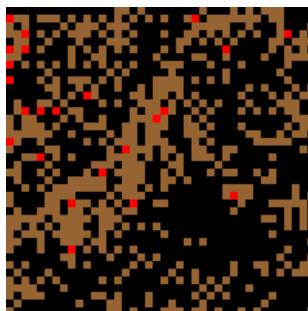**Picture 22.   Kimmel m.**
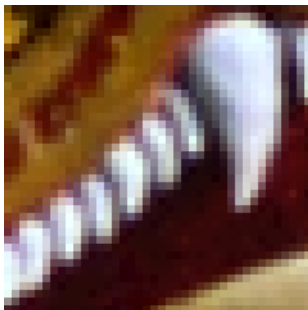
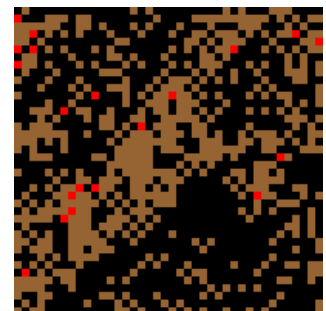**Picture 23.   CC**

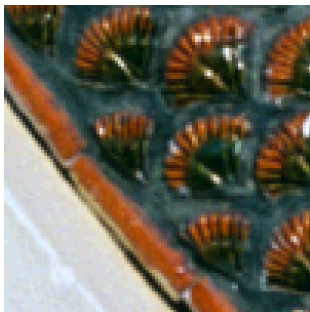**Picture 24.   MSU Slow**

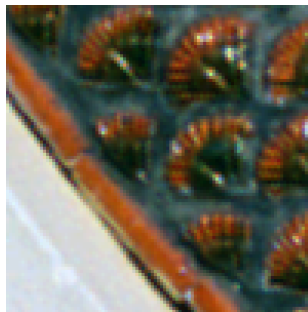**Picture 25.   MSU fast**
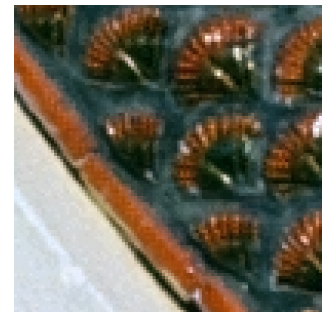

Picture 26.   CC m.

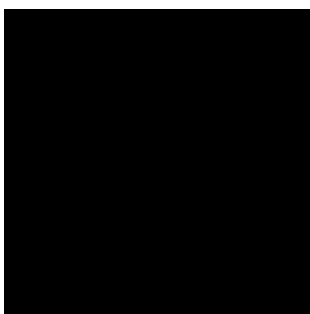
Picture 27.   MSU Slow m.

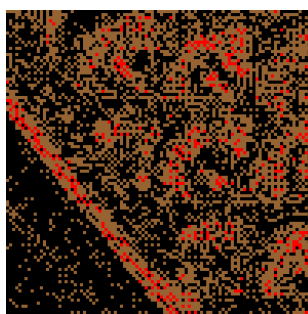**Picture 28.   MSU fast m.**

Picture 29.   Original

Picture 30.   Linear
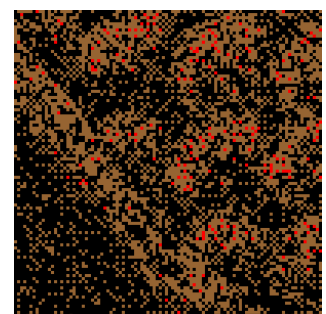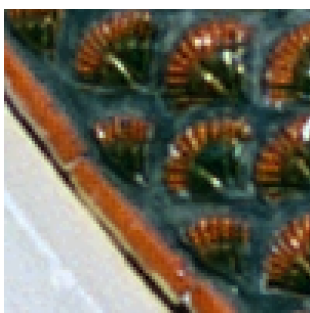

Picture 31.   Kimmel

Picture 32.   Original m.
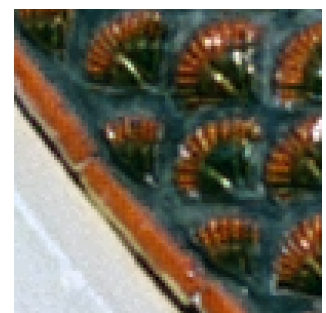

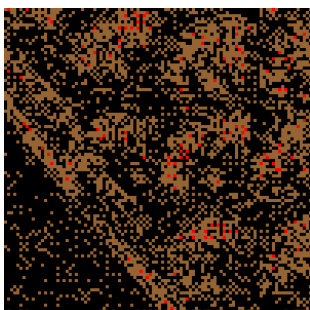**Picture 33.   Linear m.**

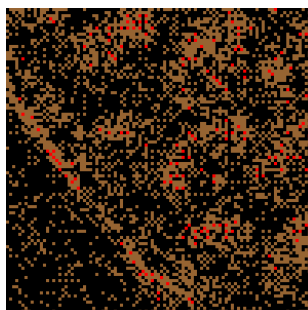**Picture 34.   Kimmel m.**

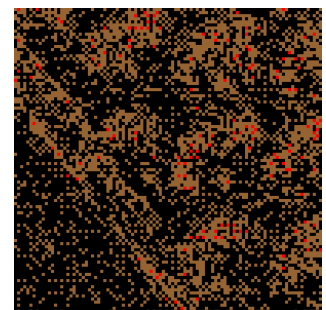**Picture 35.   CC**

Picture 36.   MSU Slow
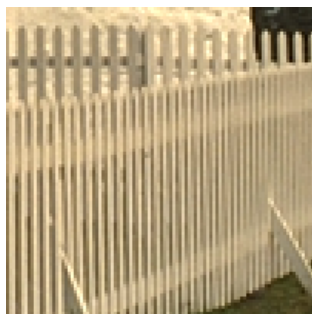

Picture 37.   MSU fast
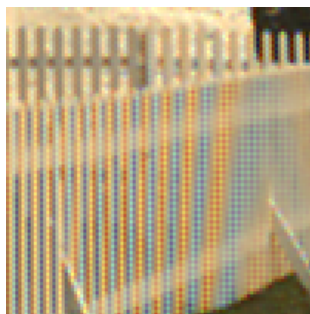

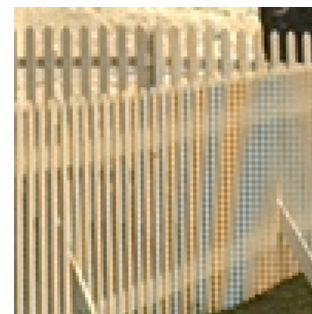**Picture 38.   CC m.**

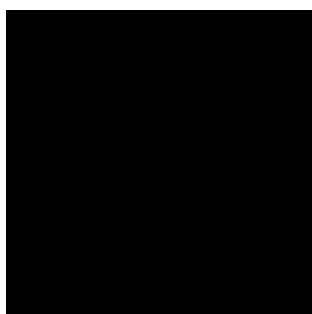**Picture 39.   MSU Slow m.**

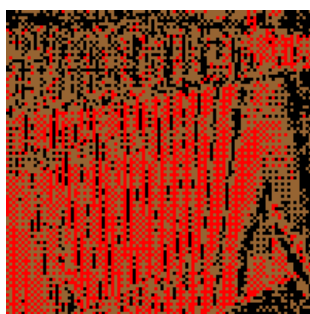**Picture 40.   MSU fast m.**

Picture 41.   Original
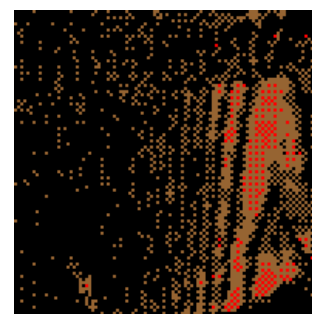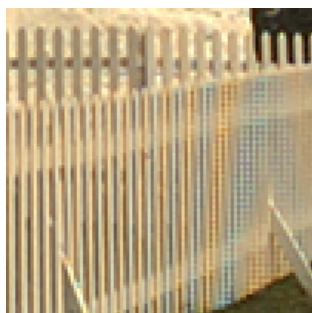

Picture 42.   Linear

Picture 43.   Kimmel

Picture 44.   Original m.
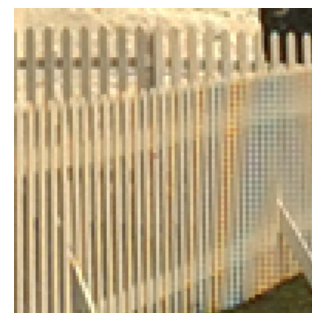

Picture 45.   Linear m.

Picture 46.   Kimmel m.

Picture 47.   CC
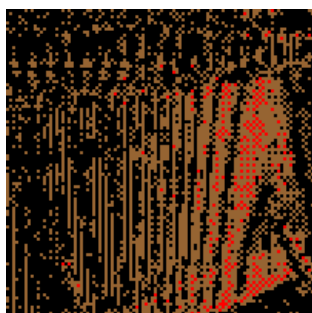

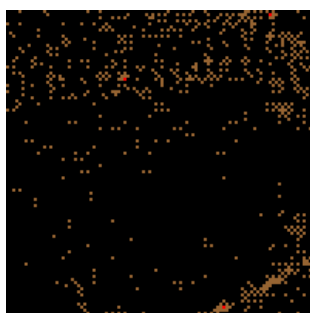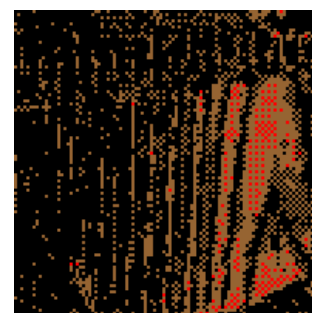**Picture 48.   MSU Slow**

Picture 49.   MSU fast

Picture 50.   CC m.

Picture 51.   MSU Slow m.

Picture 52.   MSU fast m.

Picture 53.   Original
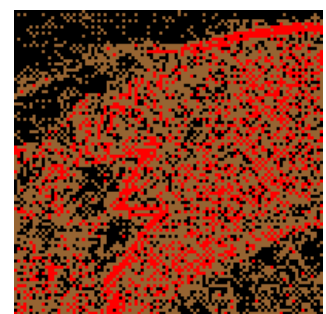

Picture 54.   Linear

Picture 55.   Kimmel
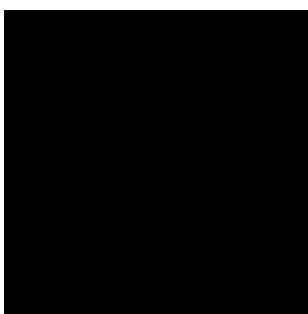
Picture 56.   Original m.
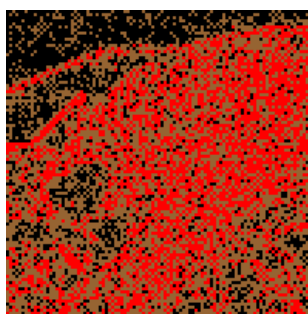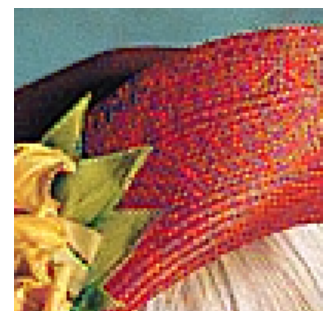

Picture 57.   Linear m.

Picture 58.   Kimmel m.

Picture 59.   CC
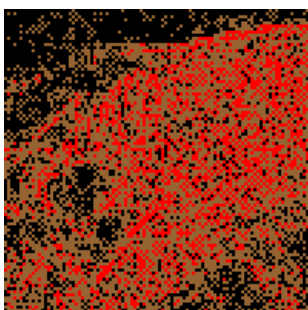

Picture 60.   MSU Slow

Picture 61.   MSU fast

Picture 62.   CC m.
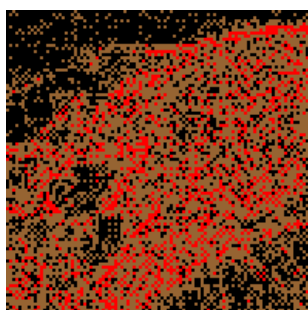
Picture 63.   MSU Slow m.
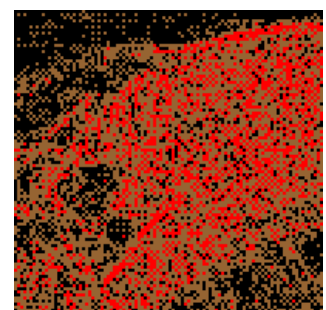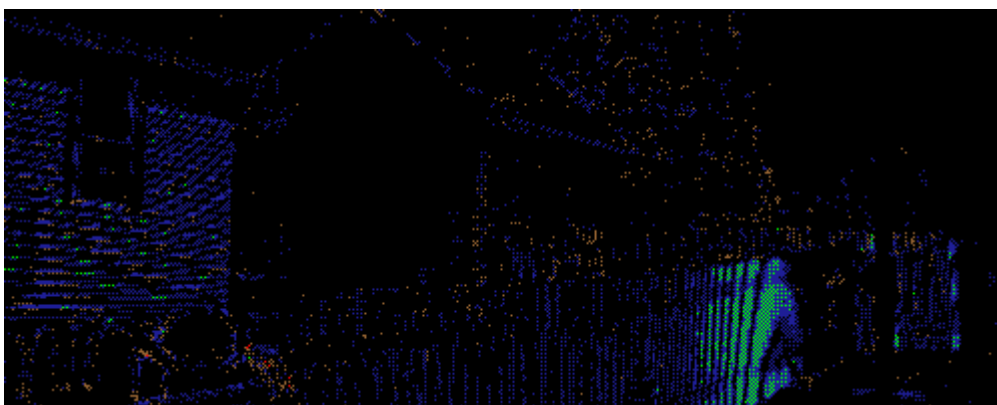

Picture 64.   MSU fast m.

Method Comparison

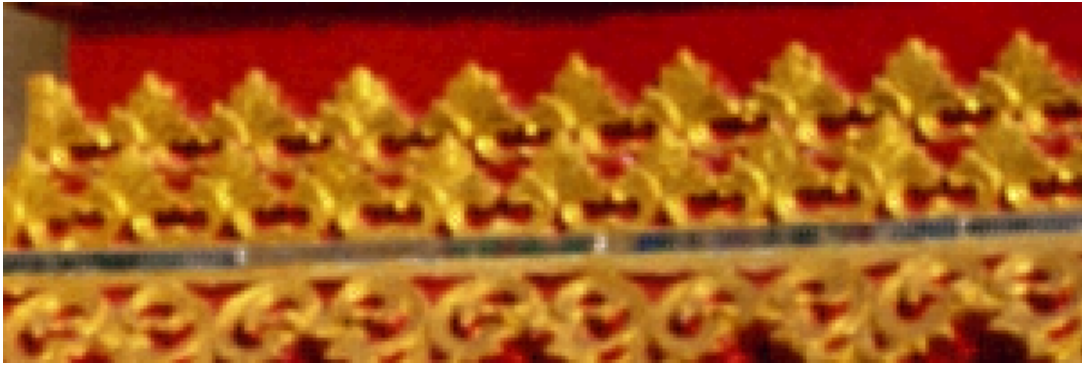
Picture 65.   MSU slow

Picture 66.   Kimmel

Picture 67.   MSU slow vs Kimmel

Conclusion

As clearly seen on test pictures, MSU slow method shows much better result on hard lighthouse part. In fact, this method creates smallest number of artifacts in this area among all tested.

Picture 68.   MSU fast
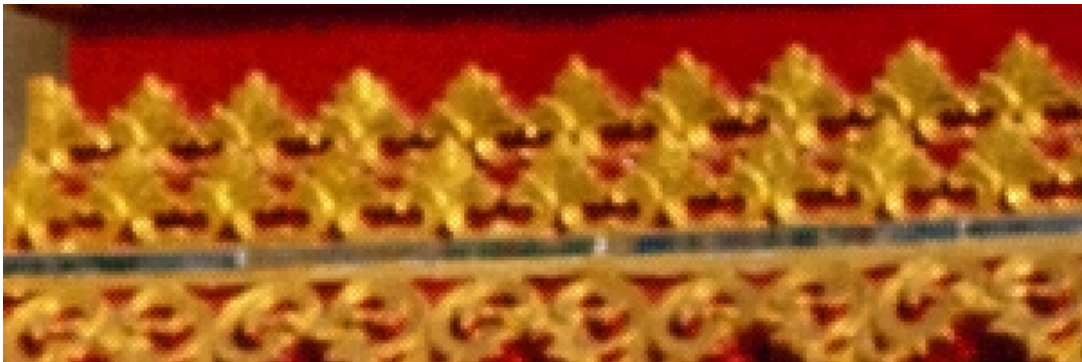
Picture 69.   Kimmel
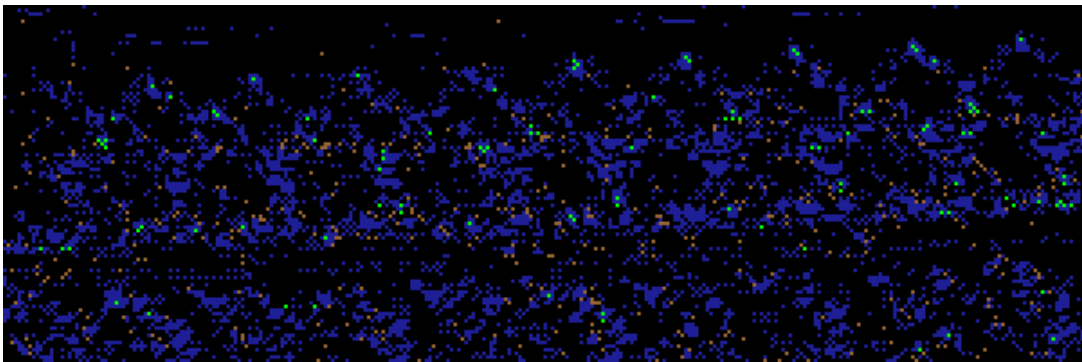
Picture 70.   MSU fast vs Kimmel

Conclusion

While working only 10% slower than Kimmel method, MSU fast creates much less artifact on test image. These Kimmel method artifacts are common for colorful images.

Conclusion

MSU slow shows special advantage on structured areas and thin lines, but is highly computationally expensive. Processing takes long period of time - about 60 seconds on resolution 1600x1200, comparing to less than 10 seconds of other algorithms. Color Correction gives good results on colorful images.

Kimmel is better than CC on images where RGB color components change simultaneously.

MSU fast is not worse than Color Correction, while employing Kimmel advantages.