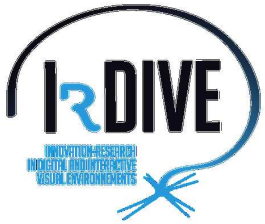


UMR CNRS 9189

Multispectral Demosaicing Using Intensity in Edge-Sensing and Iterative Difference-Based Methods

Sofiane Mihoubi

Laboratoire CRIStAL - Université Lille1

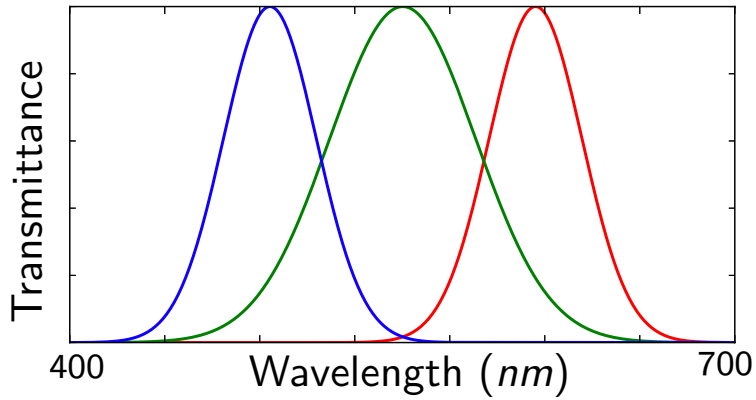
Authors:
Sofiane Mihoubi
Olivier Losson
Benjamin Mathon
Ludovic Macaire

Multispectral Image

Color image:

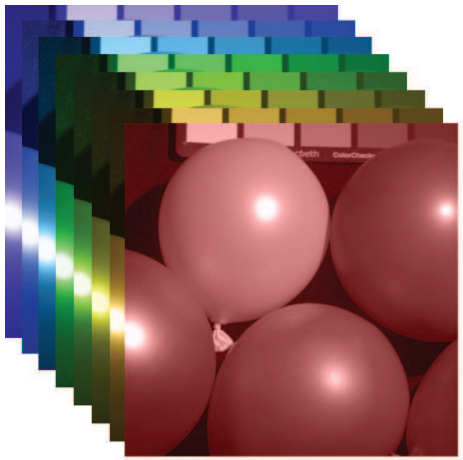
3 color channels (R, G, B).

visible spectrum

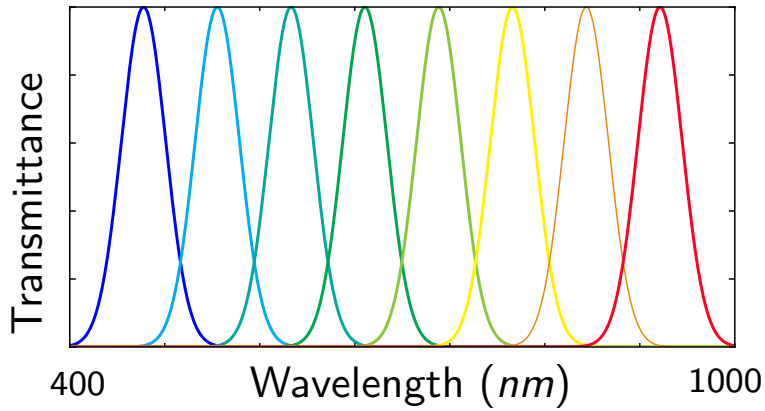


Multispectral image:

K spectral channels $I^1, .., I^K$.

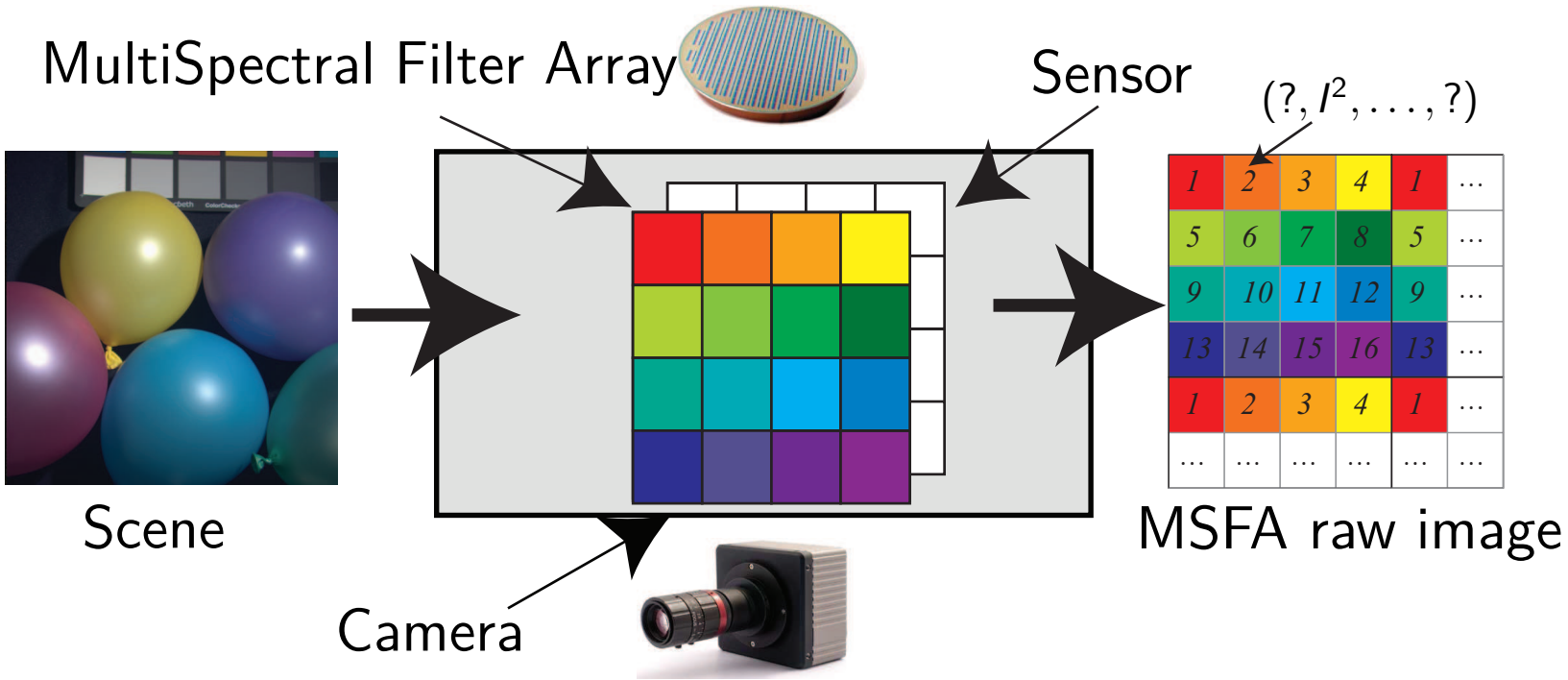


visible + nir spectrum



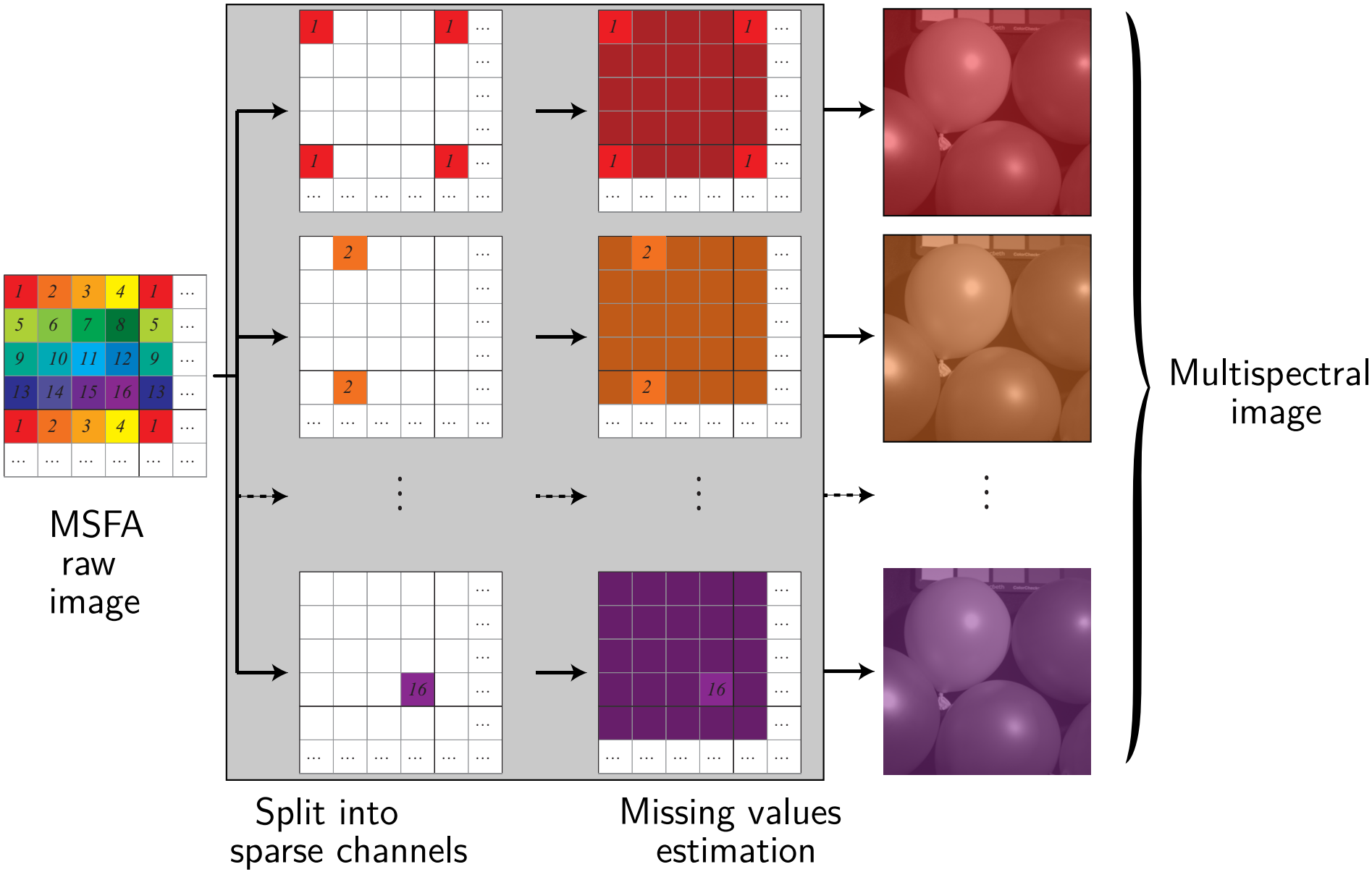
Single sensor camera

- A single-sensor multispectral camera provides an *MSFA* raw image.
- An *MSFA* raw image is composed of a periodically repeated basic pattern.
- To mimic snapshot mosaic camera[1], we focus on 16-channel *MSFA* raw image with 4×4 periodic pattern.

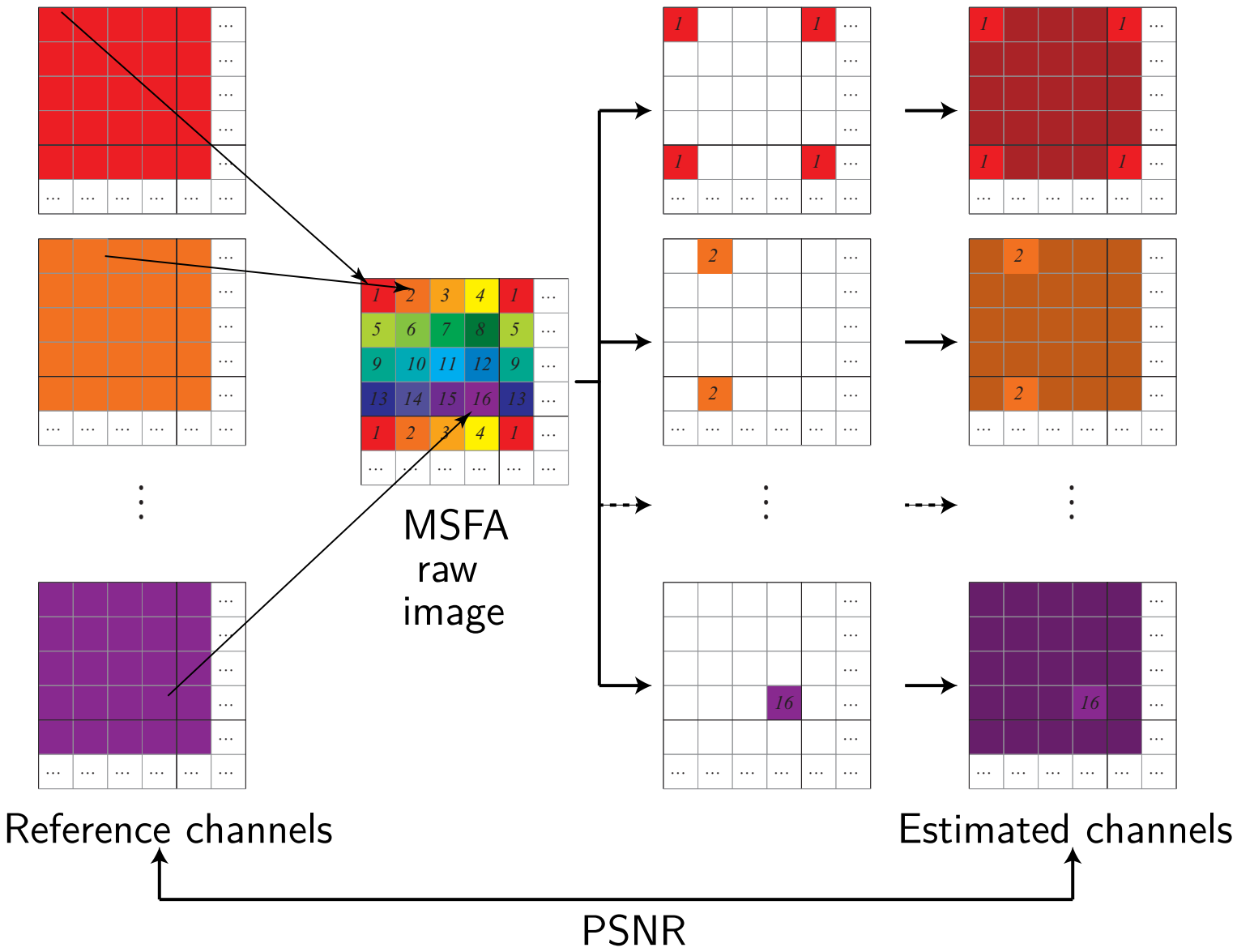


[1] B.Geelen *et al.*. A compact snapshot multispectral imager with a monolithically integrated per-pixel filter mosaic. San Francisco, California, USA, Feb 2014.

Demosaicing



Experimental procedure



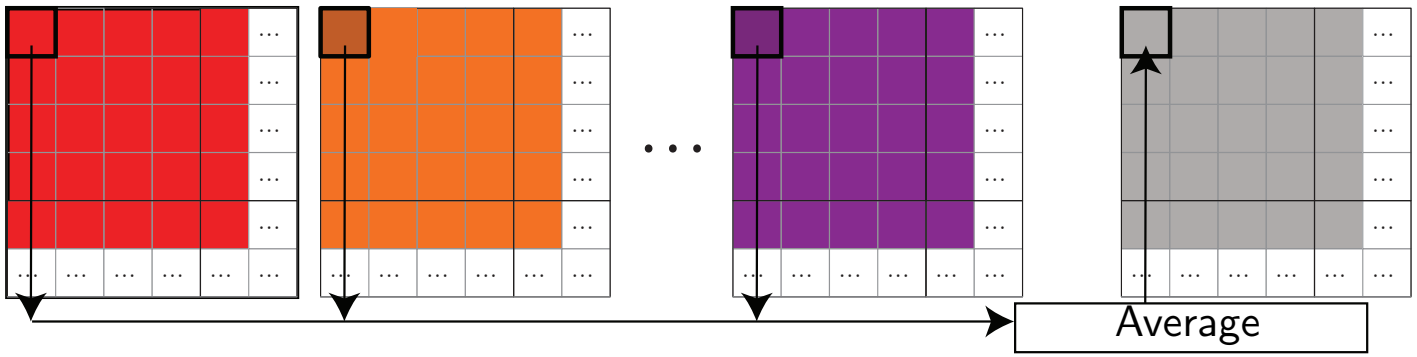
Outline

1. Intensity estimation
2. Using intensity for demosaicing
3. New Proposal: Nearby channel intensity
4. Experimental results
5. Conclusion

Intensity Definition

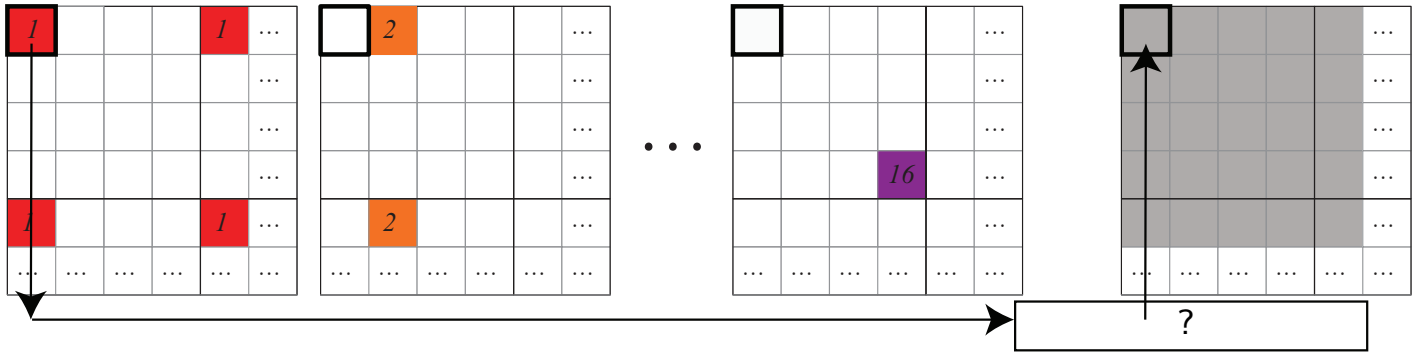
Definition:

Average of all channels of a multispectral image at each pixel.



Issue:

In MSFA raw image, there is only one available channel at each pixel.



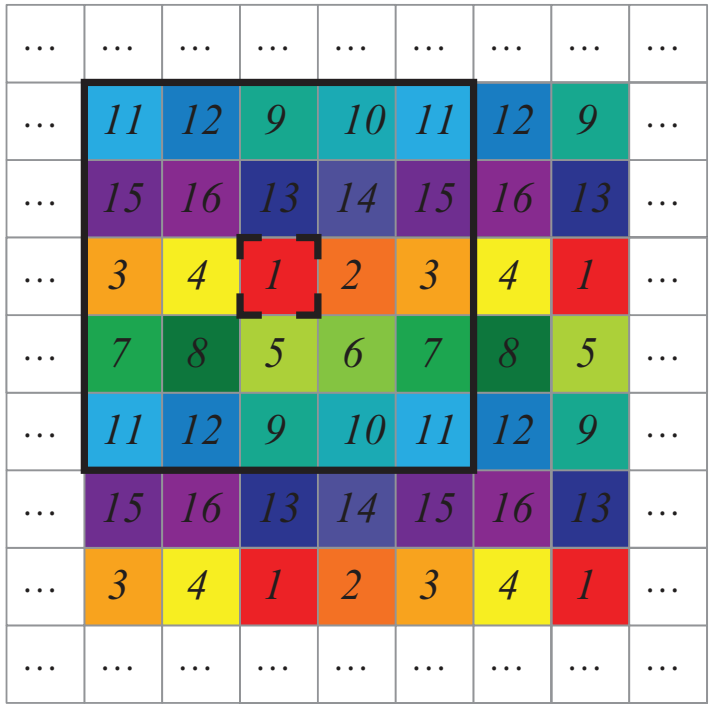
Estimated intensity from MSFA[2]

Proposal:

Average of all channels in a neighbourhood of each pixel using isoweight filter:

$$\frac{1}{64} \cdot \begin{bmatrix} 1 & 2 & 2 & 2 & 1 \\ 2 & 4 & 4 & 4 & 2 \\ 2 & 4 & 4 & 4 & 2 \\ 2 & 4 & 4 & 4 & 2 \\ 1 & 2 & 2 & 2 & 1 \end{bmatrix} \quad (1)$$

The coefficients are inversely proportional to the number of occurrences in the neighbourhood.



[2] S. Mihoubi *et al.* Multispectral demosaicing using intensity-based spectral correlation. Image Processing Theory, Tools and Applications (IPTA 15), Orléans, France, Nov. 2015.

Outline

1 Intensity estimation

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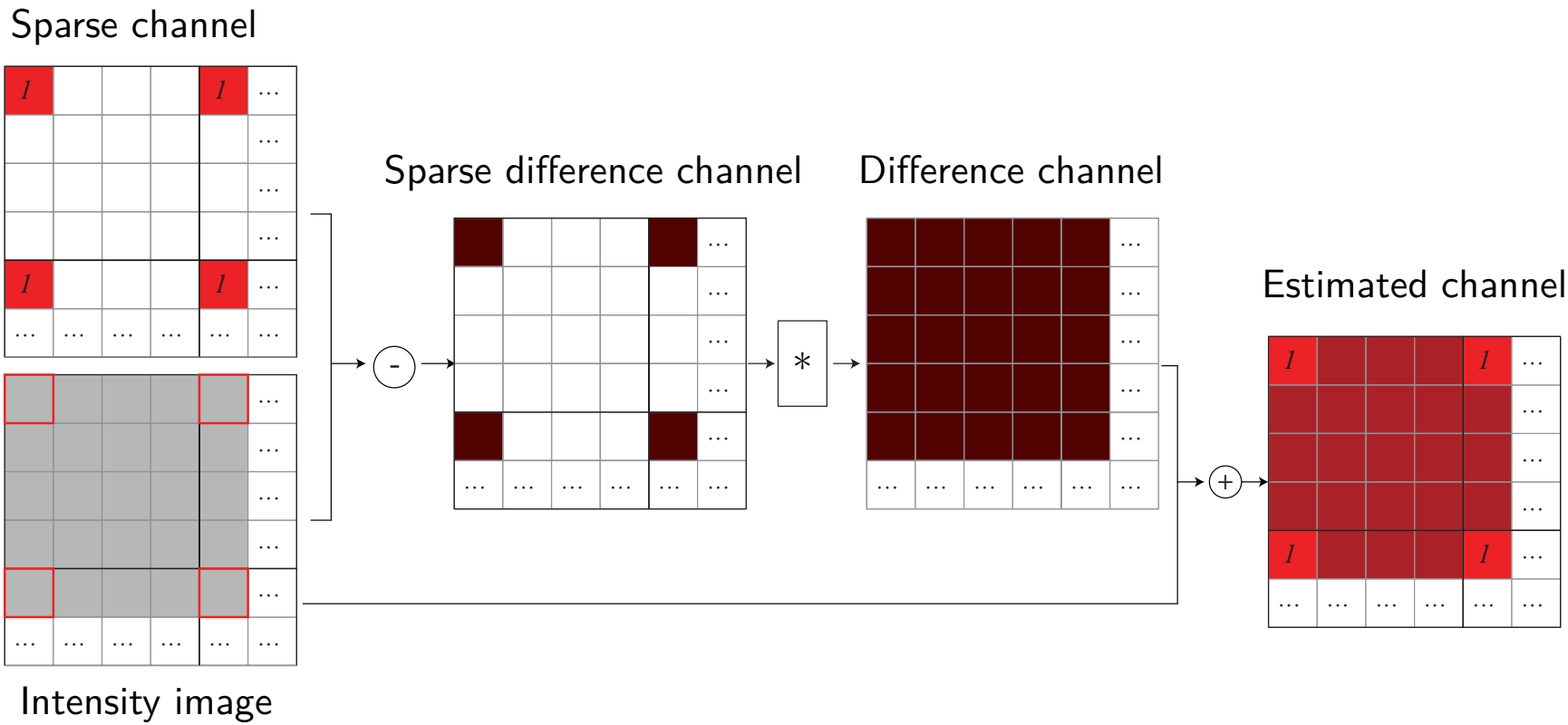
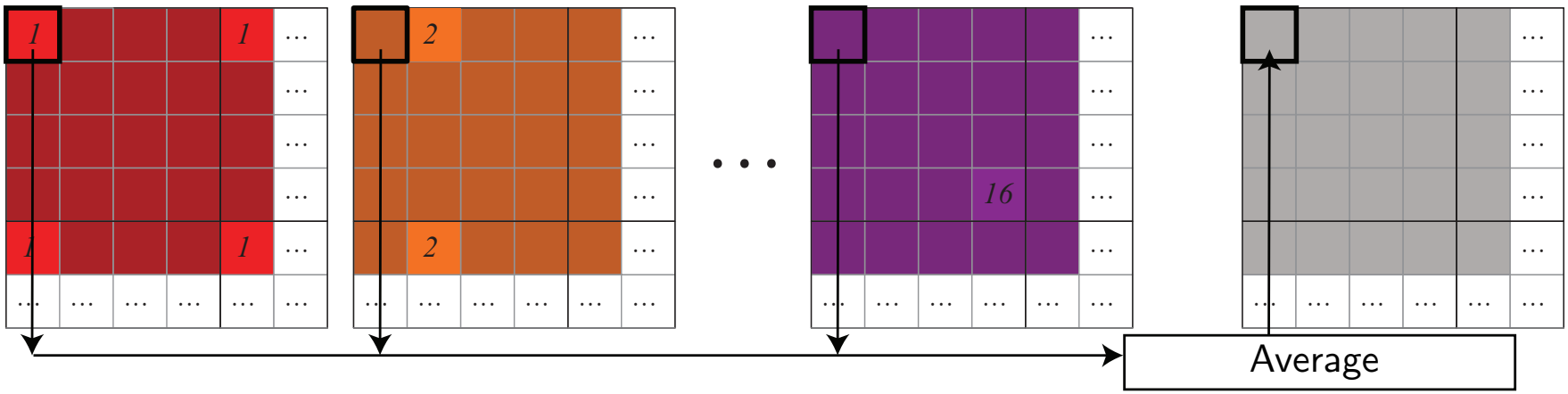
Intensity Difference[2] (step 1)



[2]S. Mihoubi *et al.* Multispectral demosaicing using intensity-based spectral correlation. Image Processing Theory, Tools and Applications (IPTA 15), Orléans, France, Nov. 2015.

Iterative Intensity Difference[2] (step>1)

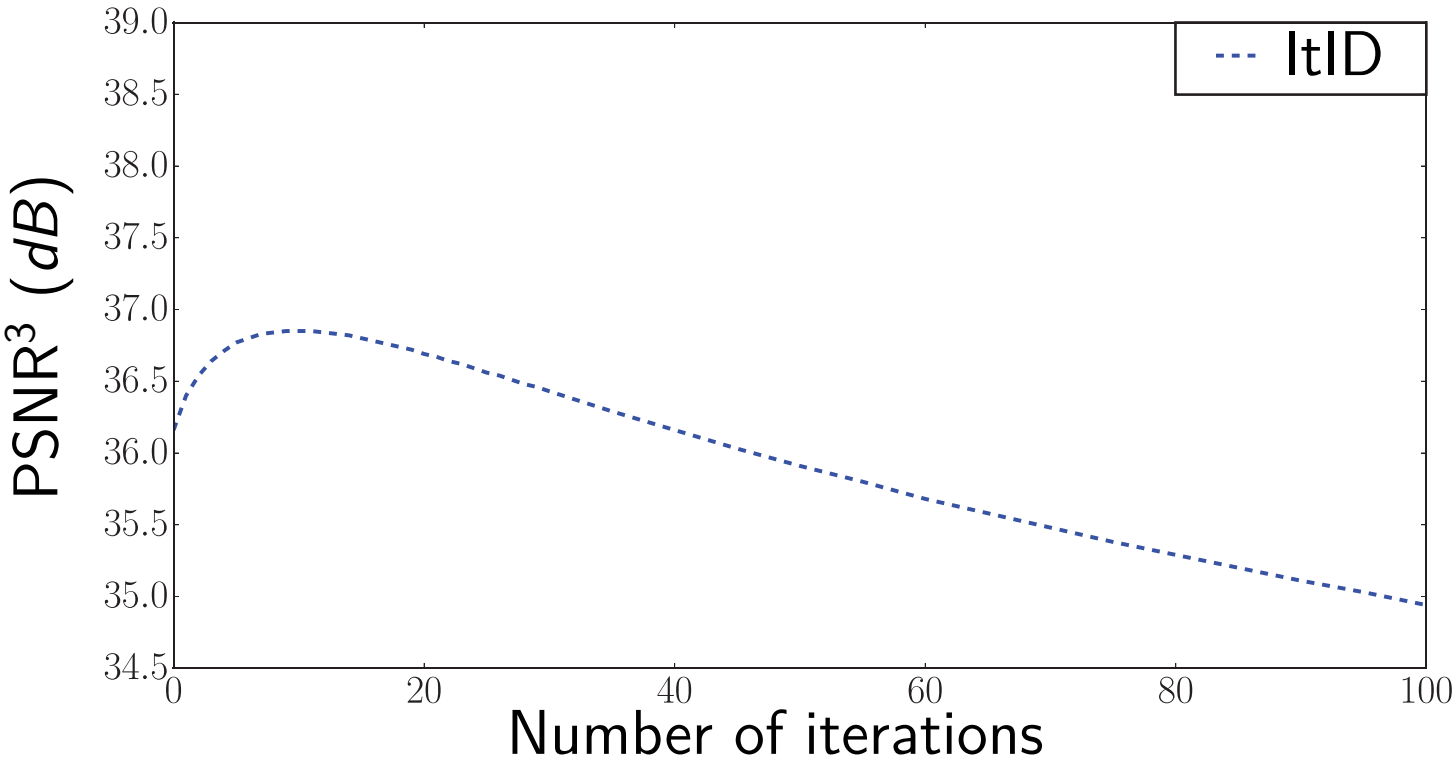
1. Update the intensity using previously estimated channels.



2. Iterate the ID algorithm using the updated intensity.

[2] S. Mihoubi *et al.* Multispectral demosaicing using intensity-based spectral correlation. Image Processing Theory, Tools and Applications (IPTA 15), Orléans, France, Nov. 2015.

Limitation



Conclusion:

Iterating improves the performances, but after 10 iterations, the performances decreases.

[3] F. Yasuma *et al.* Generalized assorted pixel camera: Postcapture control of resolution, dynamic range, and spectrum. IEEE Trans. Image Process. Sep. 2010.

Outline

1 Intensity estimation

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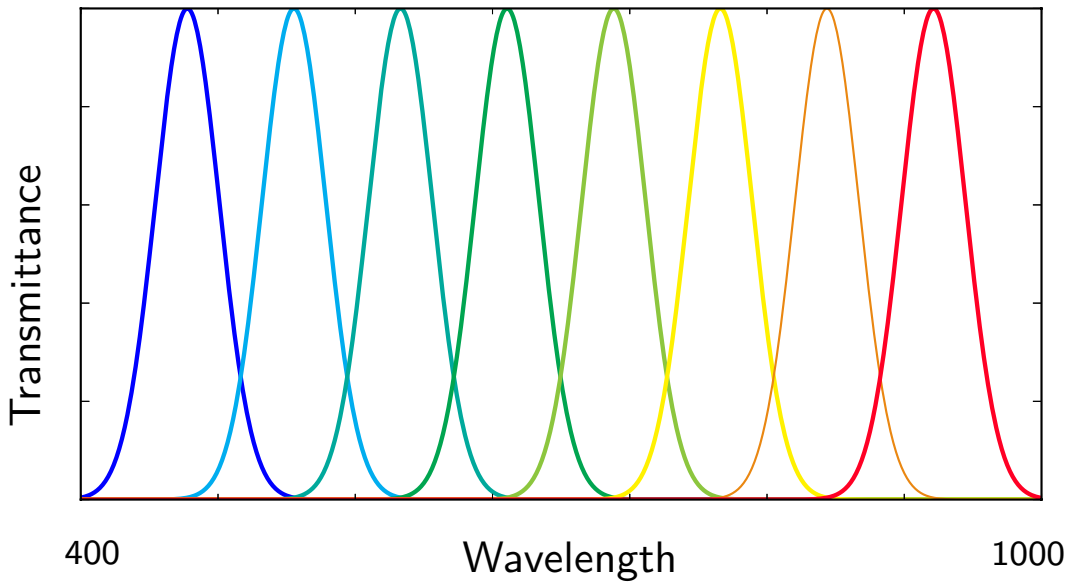
Spectral correlation

Assumption:

Each channel is strongly correlated with its spectrally close channels and may not be correlated with spectrally far away channels.

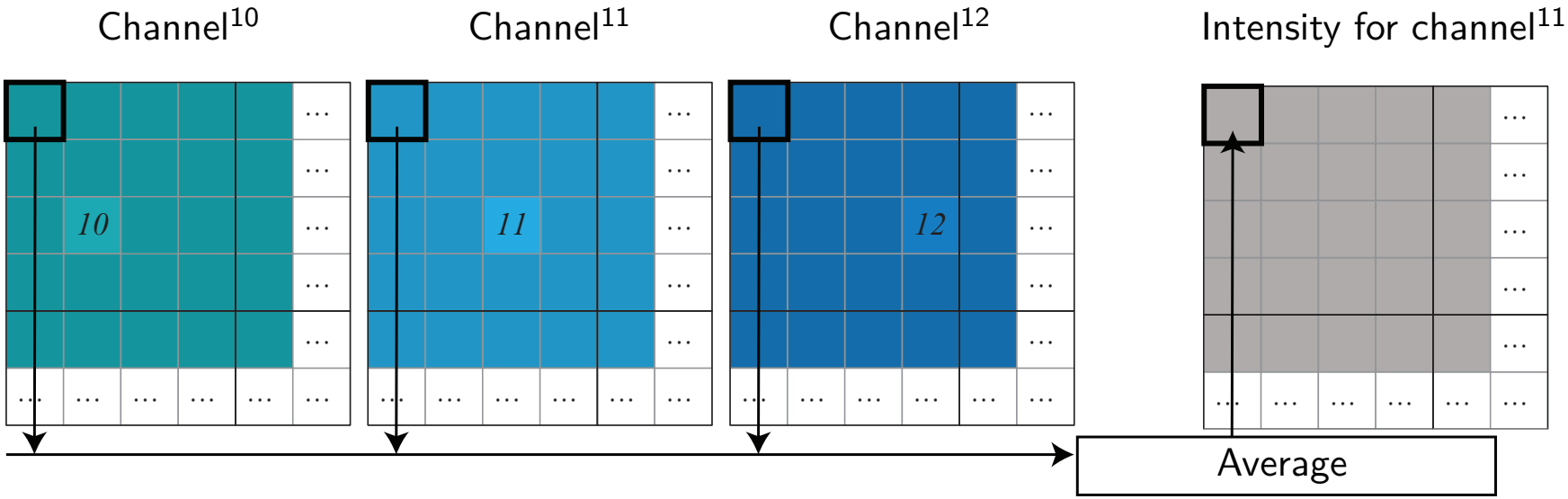


Spectral bands of channels of a multispectral image

➔ We propose a new intensity estimation to iterate ID algorithm.

Proposal: Iterative Nearby Channel Difference (ItNCD)

1. Instead of updating the intensity using all channels, compute a specific intensity for each channel, using only the spectrally closest channels.



2. Iterate the ID algorithm using the new intensities.

Outline

1 Intensity estimation

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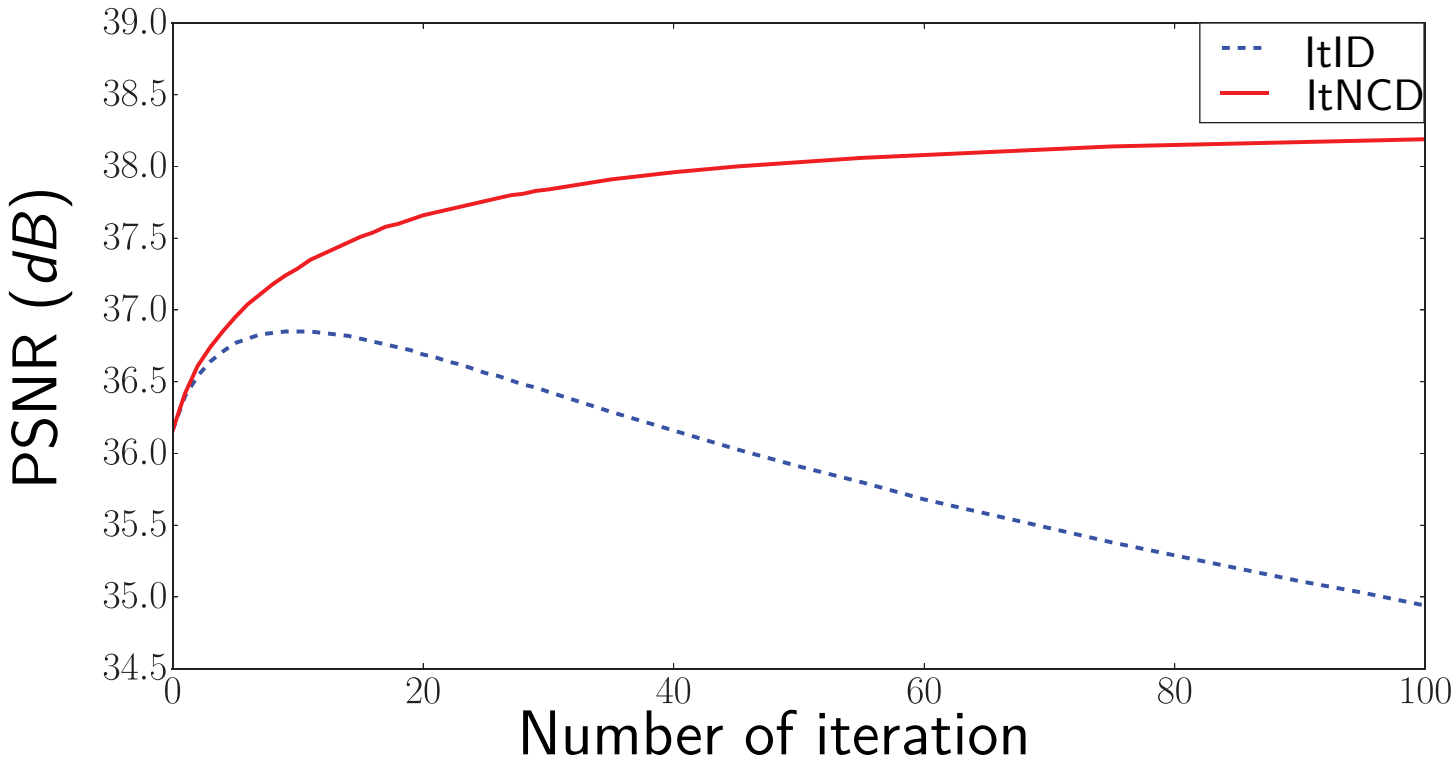
4 Experimental results

5 Conclusion

PSNR comparison



Conclusion:

- There is no regression of performances.
- For all iterations our new Proposal always provides better performances.

Visual comparison

Size=512×512

Channel 8 of Egyptian statue

(a) Reference.

(b) ID

(c) ItID

(d) ItNCD

Outline

1 Intensity estimation

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4 Experimental results

5 Conclusion

Conclusion

- Single sensor camera provides MSFA RAW image and need to be demosaiced.
- The intensity can be estimated from this raw image, and can be efficiently used for demosaicing.
- We propose a new estimation for the intensity based on nearby channel difference, and use it in iterative method.

Thank you for your attention

Previous visual comparison

(a) Reference.

(b) *WB*, 34.46 *dB*

(c) *SD*, 35.12 *dB*

(d) *ISD*, 35.98 *dB*

(e) *ID*, 36.16 *dB*

(f) *ItID*, 36.83 *dB*