Edge-Preserving Multi-Scale Image Decomposition based on Local Extrema

Supplemental material

Online id 0207

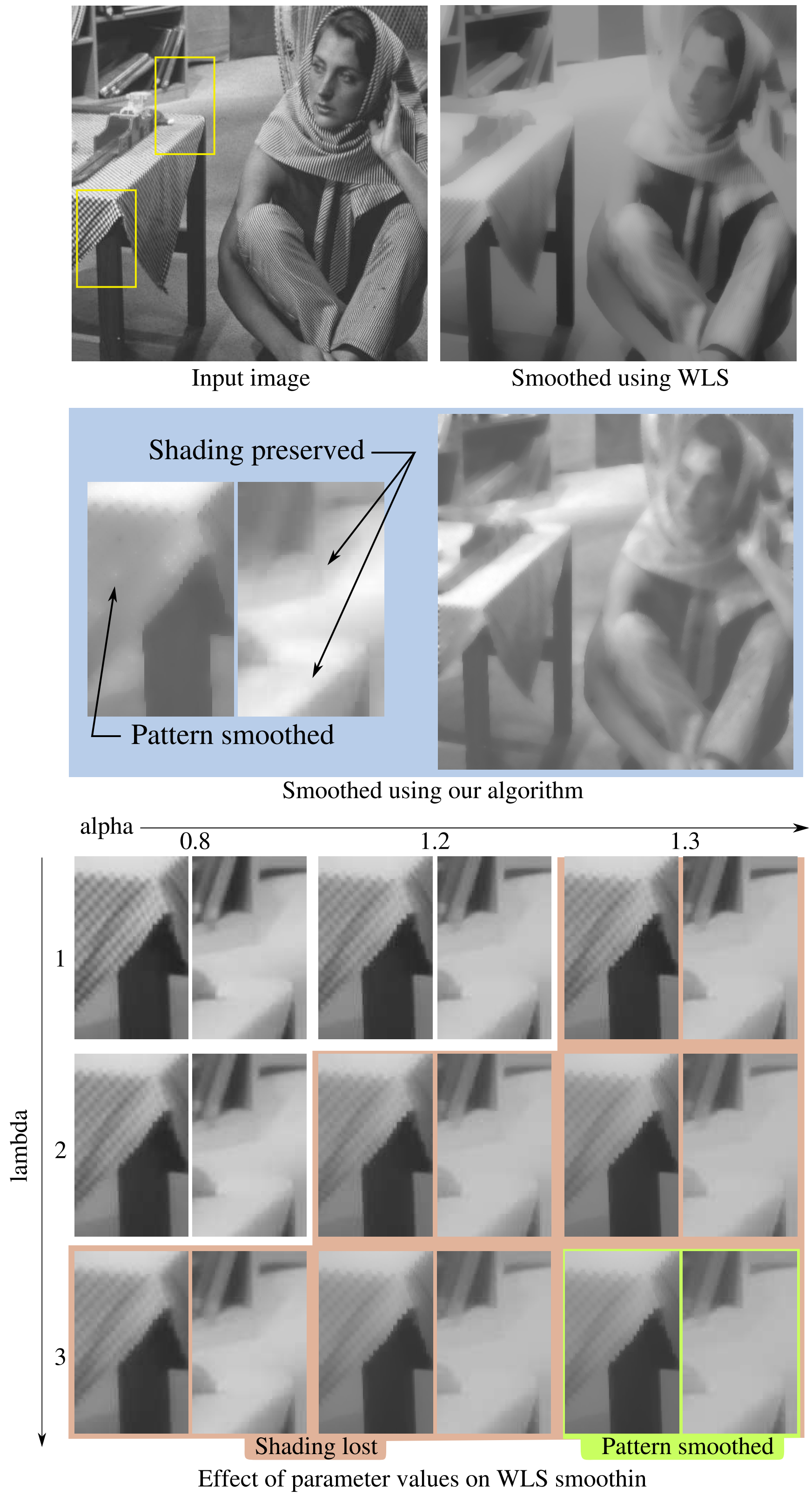


Figure 1: This is an extended version of Fig.6 in our submission showing more details for comparing Farbman's method to ours. Our method manages at the same time to smooth out the checkerboard pattern on the table and stripes on Barbara's trousers and to keep subtle shading effects especially on the character's face. This is not the case of Farbman's method which needs, in order ot smooth the checkerboard, to be pushed to a point where the shading is lost to a large extent.

$\alpha = 1, \lambda = 0.1$

$\alpha = 1, \lambda = 0.2$

$\alpha = 1, \lambda = 1.2$

$\alpha = 1, \lambda = 1.3$

$\alpha = 2, \lambda = 0.1$

$\alpha = 2, \lambda = 0.2$

$\alpha = 2, \lambda = 1.2$

$\alpha = 2, \lambda = 1.3$

$\alpha = 3, \lambda = 0.1$

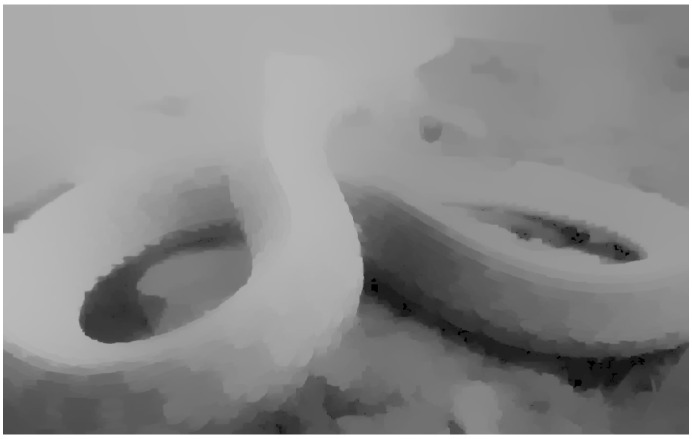
$\alpha = 3, \lambda = 0.2$

$\alpha = 3, \lambda = 1.2$

$\alpha = 3, \lambda = 1.3$

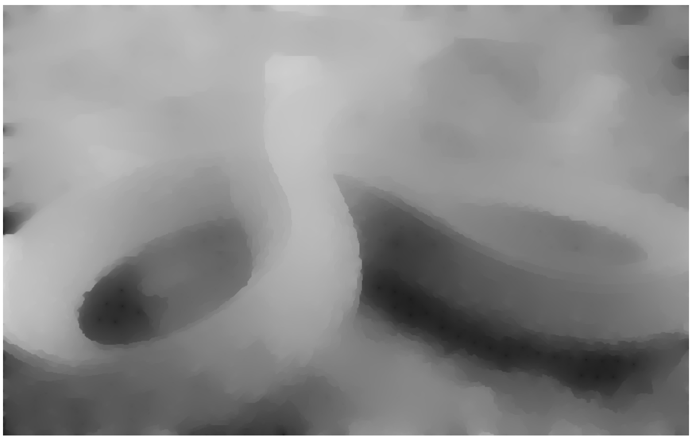
Farbman's method applied to the snake image, for 12 different parameter settings.

Best of Farbman, smoothed once



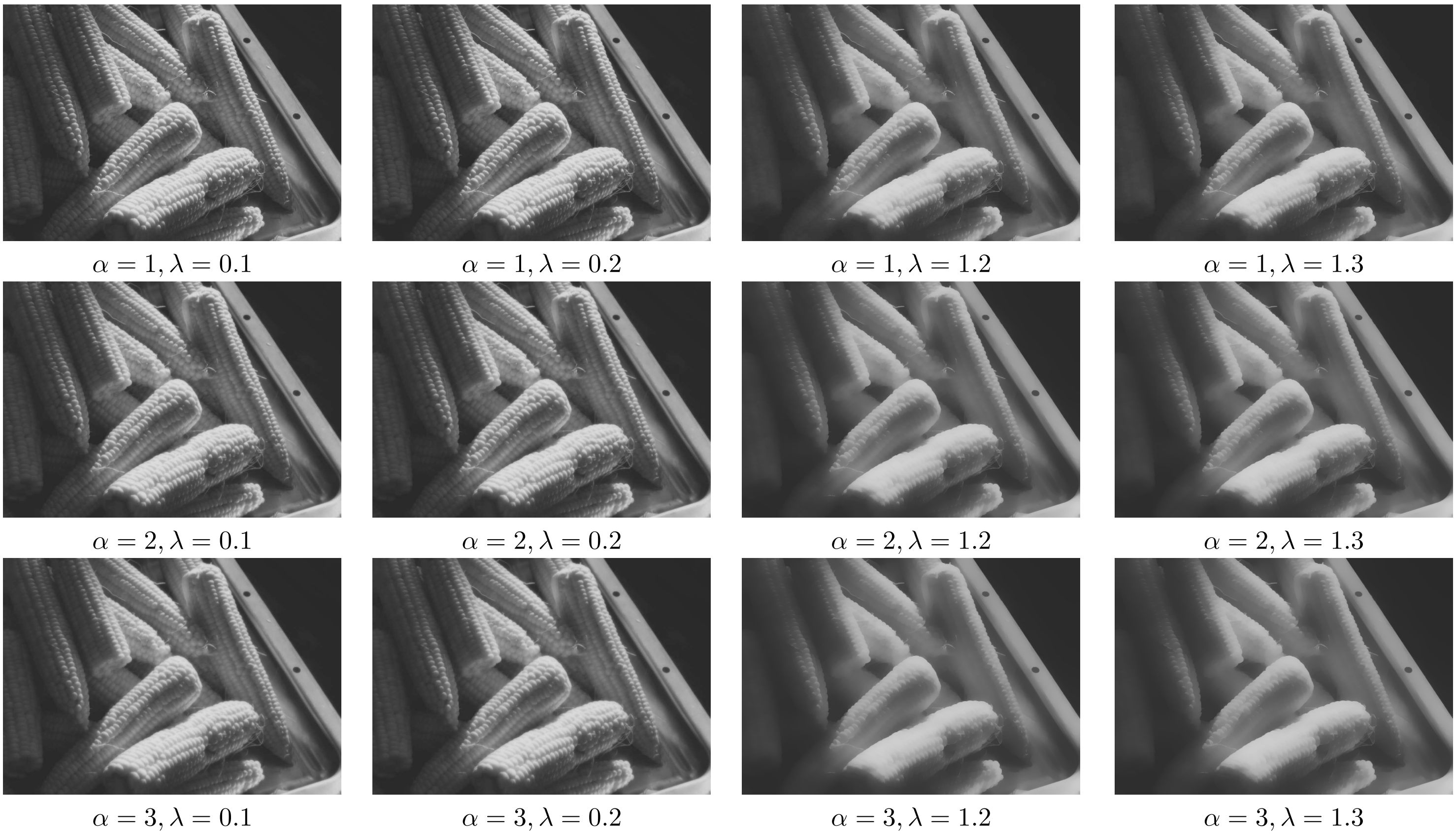
Best of Farbman, smoothed twice

Our method, smoothed once



Our method, smoothed twice

Figure 2: Comparison between our method and Farbman's method on the snake image. For the 2 smoothed images, we tried our best to find the most suitable combination of parameters so as to achieve a multi-scale smoothing. However, in order to have Farbman's method smooth out all patterns on the the snake's skin, we had to push the parameters to a point where the coarse shading regions flatten significantly. Our method better captures the coarse scale shading on the snake.



Farbman's method applied to the corn image, for 12 different parameter settings.

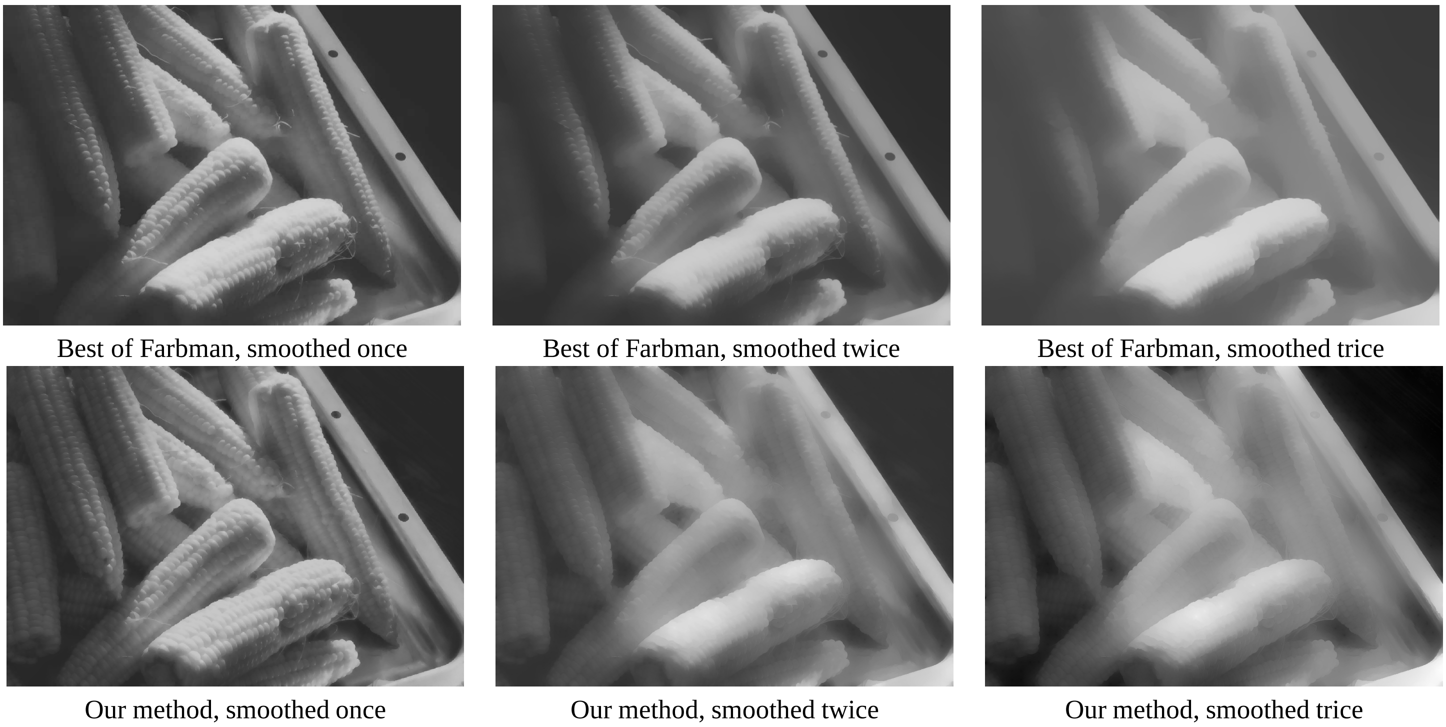


Figure 3: Comparison between our method and Farbman's method on the corn image. For the 3 smoothed images, we tried our best to find the most suitable combination of parameters so as to achieve a multi-scale smoothing. However, in order to have Farbman's method smooth our the corn grains, we had to push the parameters to a point where the shading starts to suffer significantly. Our method better captures the subtle shading on the cylindrical corn shapes.

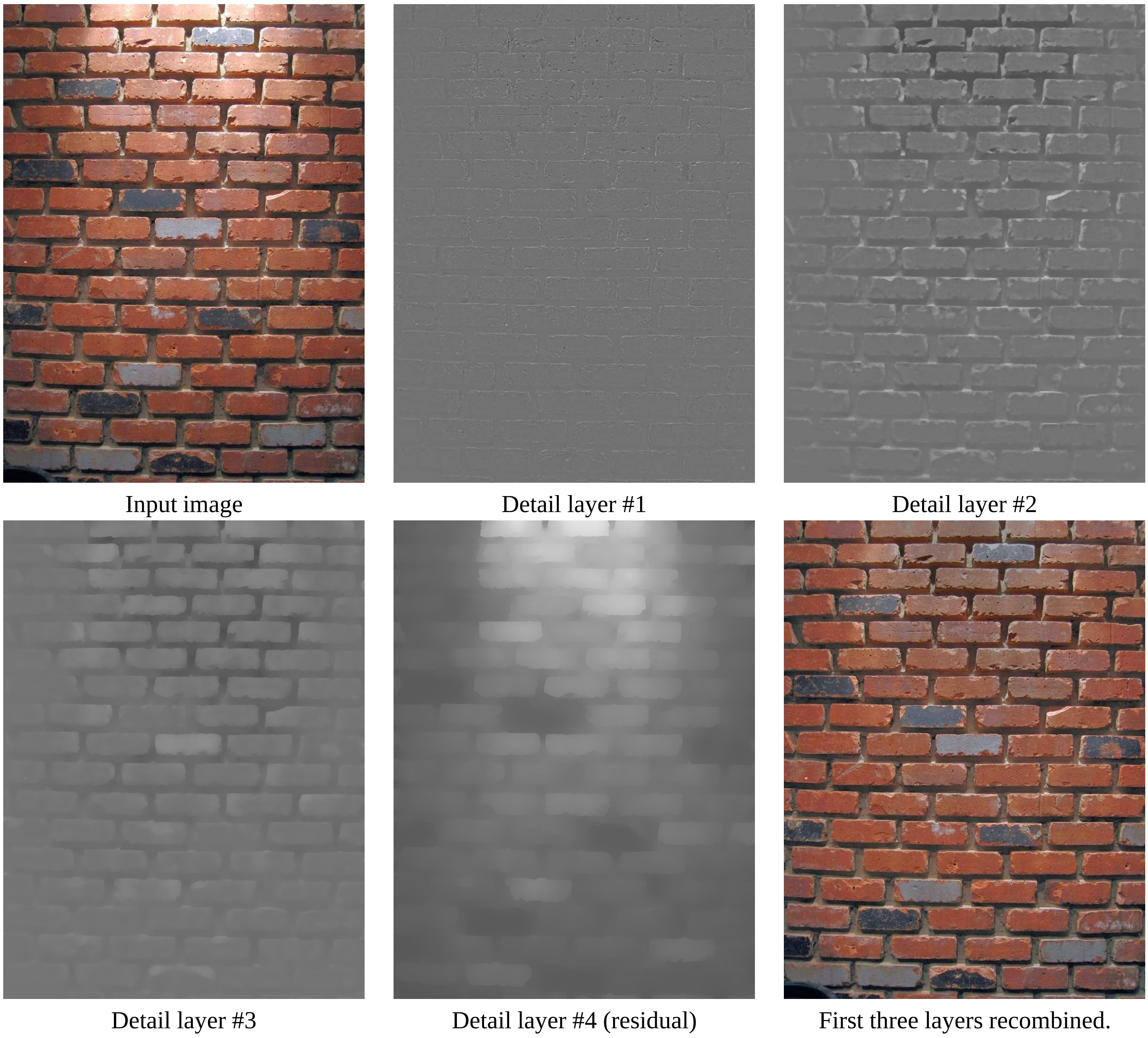


Figure 4: Applying our multi-scale decomposition to a brick wall naturally separate meaningful layers of details. Layer #1 is the finest stone grain, layer #2 contains larger brick imperfections, layer #3 mainly holds the inter-brick spaces and layer #4 is the coarse scale illumination. This is precisely removed in the last image by recombining all layers except the last one. This however preserves fine scale detail such as texture. This is possible because our algorithm smoothes according to the scale of oscilations rather than their amplitude.

input image

Detail #1

Detail #2

Detail #3

Detail #4 (residual)

Figure 5: Example of image decomposition. The first level of detail mostly contains all smallest features throughout the image. Detail #2 shows interesting second order oscillations on the coach. Details #3 and #4 respectively contain close range illumination and distant illumination. Although our method is not targetted to capture illumination, it performs this nask naturally in many of our test cases.

Original image

Levels multiplied by
$(1, 1.0, 1.76, 2.12)$

Levels multiplied by
$(2, 1.38, 1, 2)$

Figure 6: Example of modulating the different layers on a low dynamic range image. As shown in Fig.5, detail layers 3 and 4 mostly contain illumination. Consequently boosting 3 and 4 gives the image a more natural effect (*center*), while adding more fine scale details gives a more dramatic appearence to the image (*bottom*) by increasing reflexions on the table and on the artifacts in the cupboard. Note that no after tone mapping was performed to get this effect. Once the image is decomposed, modulation is performed real time.

Input image

Layer combination between input and matted images.

Figure 7: Application of our empirical mode decomposition to re-texturing an image: From the input (*top*) we produced a matted image by geometrically transforming a flat texture to replace the floor patterns. Then, both the input and matted images are converted into four layers of details with our method. The finest detail layer from the matted image is then mixed with the three other layers of the input image to obtain the result (*bottom*). This allows us to insert the new floor detail in the image while keeping some larger (and meaningful) details such as the specular reflexions and shadows of the pillars on the floor.