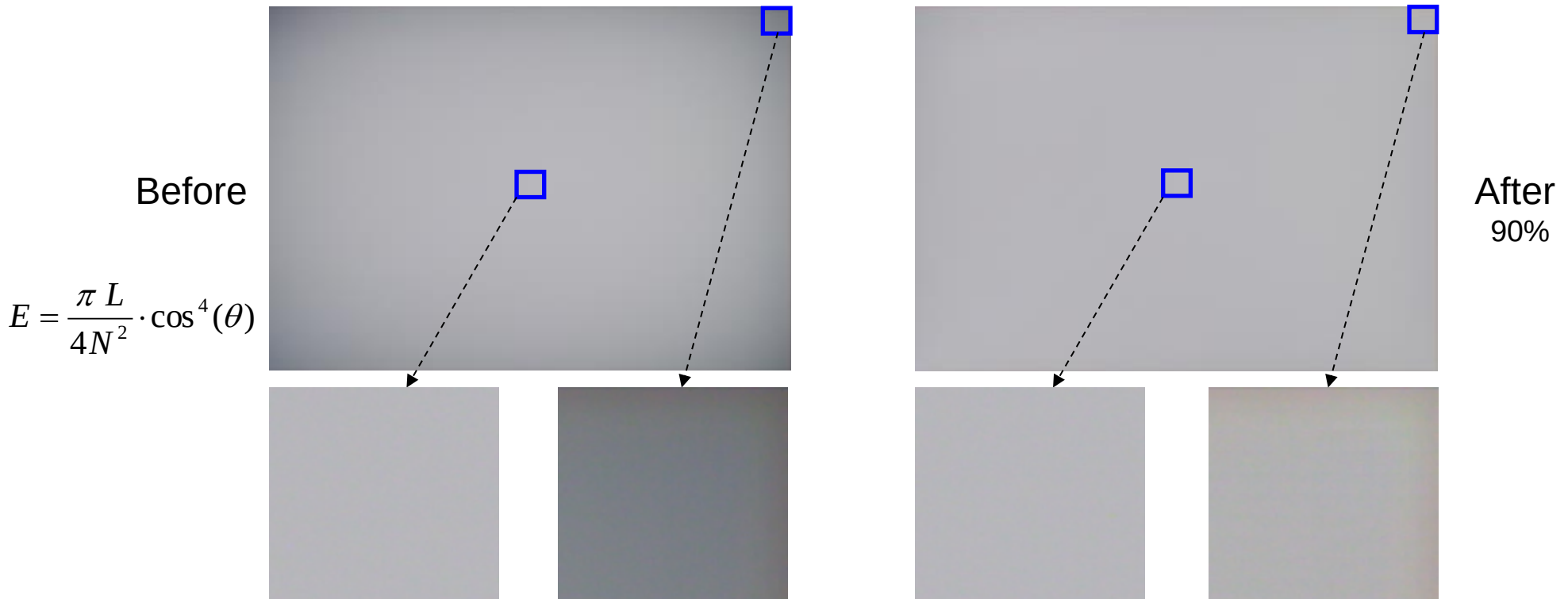


RAWFE LSC

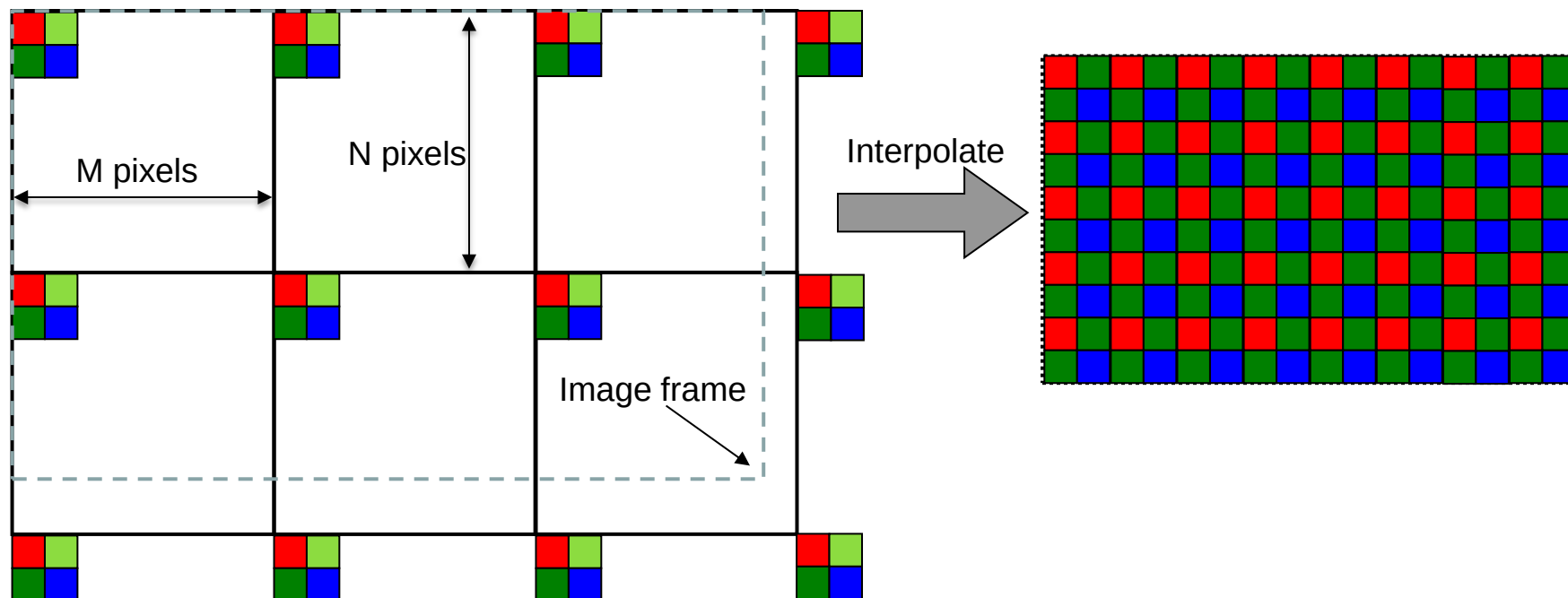
Lens Shading Correction (LSC)

- 2D gain map: one 8-bit LUT for each of the 4 color channels
 - MxN down-sampled: M (horizontal), N (vertical) = 8,16,32,64,128
 - LUT has 8-bit entries in U8Q8, U8Q7, U8Q6 or U8Q5 with optional “+1.0”
- Tuning tips
 - LSC may amplify noise around image corners and NSF4 has LSC compensation
 - LSC input image has been pre-processed by PWL-LUT



LSC: LUT Down-Sampling and Color Pattern

- LUT down-sampling and interpolation
 - Extra entries at the ends of rows and columns



- Order of color pattern (differ from TDA2/3)

- Logical order in tuning tool:
- Physical order in memory:

[G0 G1 G2 G3]

[G0 G1 G2 G3]

C0	C1
C2	C3

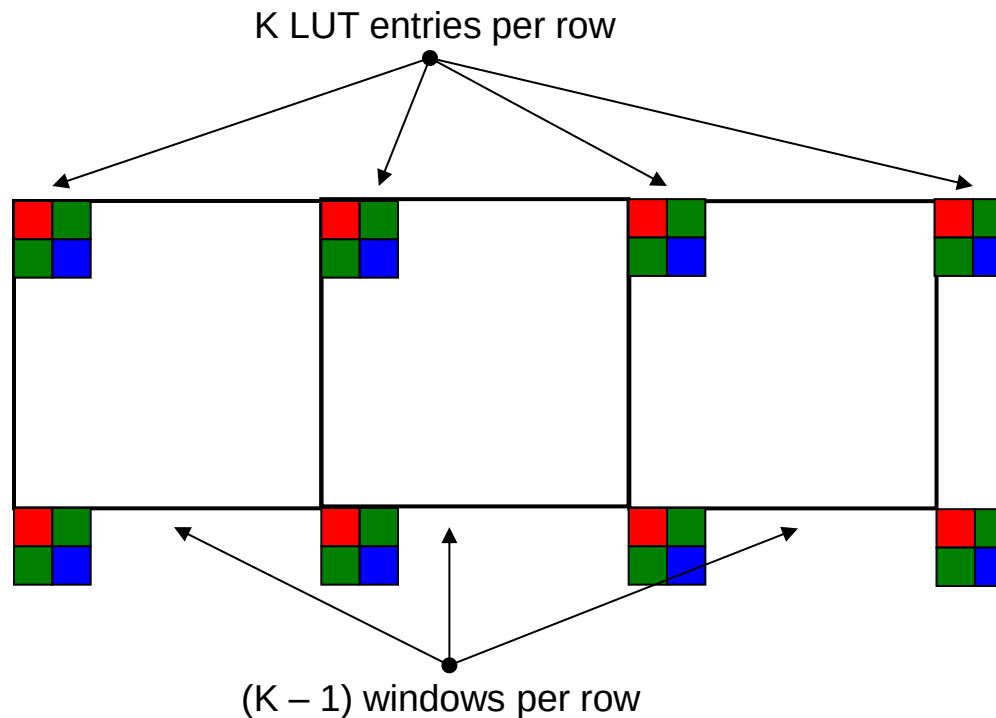
2x2 color pattern

G1	G0	G3	G2
----	----	----	----

32-bit word

LSC LUT Memory Limitation

- LSC LUT memory is 19KB
 - Image size: $W \times H$ pixels
 - Down sampling: $M \times N$
 - LUT size: $\text{ceil}(W / M + 1) \times \text{ceil}(H / N + 1) \times 4$ Bytes
 - Limitation: $\text{ceil}(W / M + 1) \times \text{ceil}(H / N + 1) \leq 4864$



LSC: Generate LUT from Lens Spec

- Read lens shading specification table (in text file with 2 columns)

```
1 function [spec_lut] = read_spec(spec_file, pitch_in_mm)
2 spec_lut = dlmread(spec_file);
3 spec_lut(:, 1) = spec_lut(:, 1) / pitch_in_mm;
4 spec_lut(:, 2) = 100 ./ spec_lut(:, 2);
```

Image Height (mm)	Relative Illumination (%)
0	100
0.269	99.5
0.538	98.2
0.807	95.8
...	...

- Generate LSC LUT text file

```
1 function gen_lsc_lut(spec_file, pitch_in_mm, W, H, hc, vc, N)
2 % read lens shading spec file
3 spec_lut = read_spec(spec_file, pitch_in_mm);
4 % calculate LSC LUT table size
5 hs = ceil(W / N) * N;
6 vs = ceil(H / N) * N;
7 [xx, yy] = meshgrid(0:N:hs, 0:N:vs);
8 r = sqrt((xx - hc).^2 + (yy - vc).^2);
9 r = min(r, spec_lut(end, 1));
10 % calculate LSC LUT
11 gain = interp1(spec_lut(:,1), spec_lut(:,2), r);
12 g_tbl = round((gain - 1) * 256/4);
13 g_tbl = min(255, max(g_tbl, 0));
14 % write LUT into a text file with 4 color channels
15 g_tbl_4c = kron(g_tbl, [1,1,1,1]);
16 dlmwrite('lsc_lut_dec.txt', g_tbl_4c, 'delimiter', '');
```

Input image size: W x H
LSC image center: hc x vc
LSC down sampling: N x N

Pixel size in mm: pitch_in_mm

LSC gain format: U8Q6 + 1

- Generate LSC LUT in GNU Octave or Matlab
 - gen_lsc_lut('spec.txt', 4.2/1000, 1280, 720, 640, 360, 64)