CONFIDENTIAL B

Demosaic

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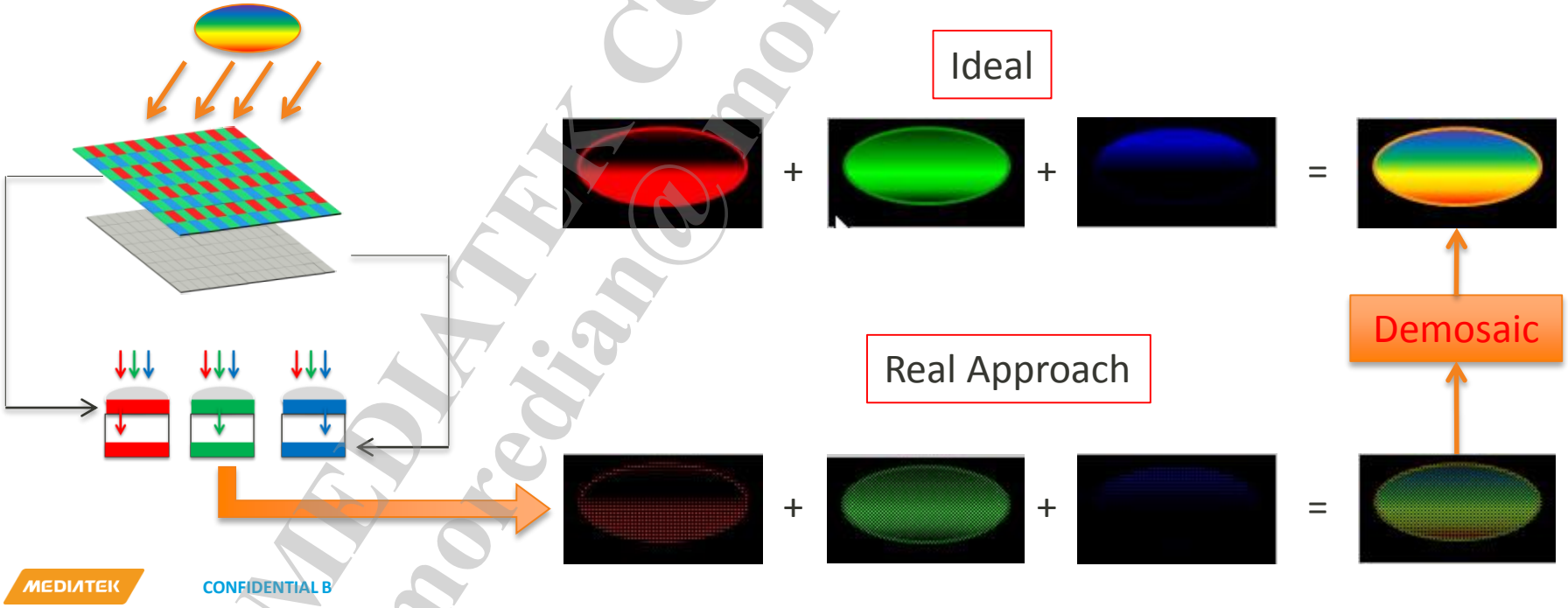
What is Demosaic?

In the past, digital camera can only record gray world. This is because CMOS sensor can only detect intensity of light source. They can not analyze component color of light. Therefore it is important for us to study how to recover the real color.

What is Demosaic?

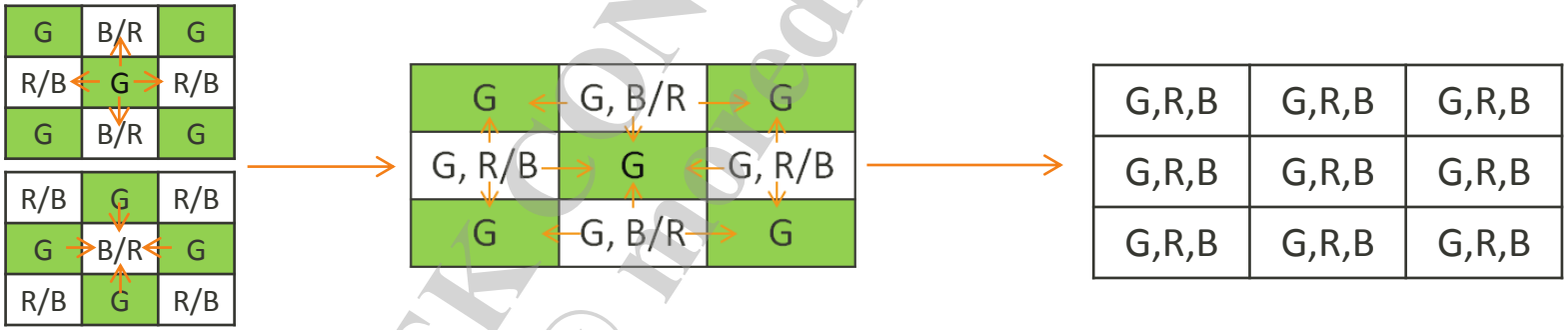
Recently, people analyzed the light which is composed of Red, Green and Blue light. However, every pixel can only get one of three colors by color filter. So how to get the other two colors will be the new problem. Dr. Bryce, who designed a color filter array, called Bayer Pattern, is the most popular one. Most of ISP designer focus on the algorithm to approach the real three colors of each pixel. We call the algorithm as demosaic.



How to do Demosaic

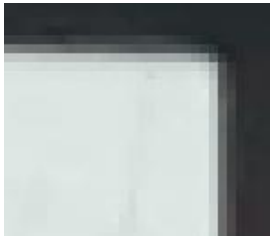
Interpolate the other two colors from neighborhood.
Use Direction filter to keep edge.
Use Low-pass Filter(LPF) to reduce noise
Use High Pass Filter(HPF) to enhance edge

1. Interpolation

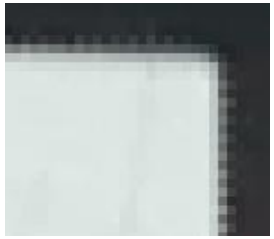


2. Edge Keeping

Preserve Edge



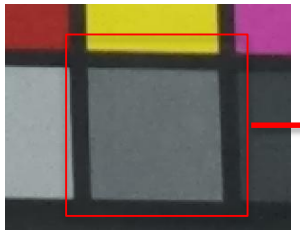
Without Preserve Edge



How to do Demosaic

Interpolate the other two colors from neighborhood.
Use Direction filter to keep edge.
Use Low-pass Filter(LPF) to reduce noise
Use High Pass Filter(HPF) to enhance edge

3. Low-Pass Filter



Without LPF

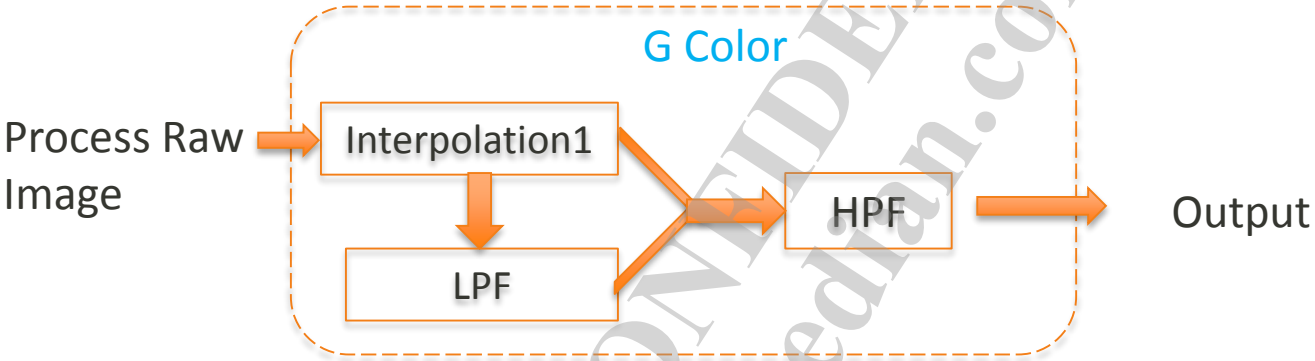
With strong LPF

4. High Pass Filter

Without HPF

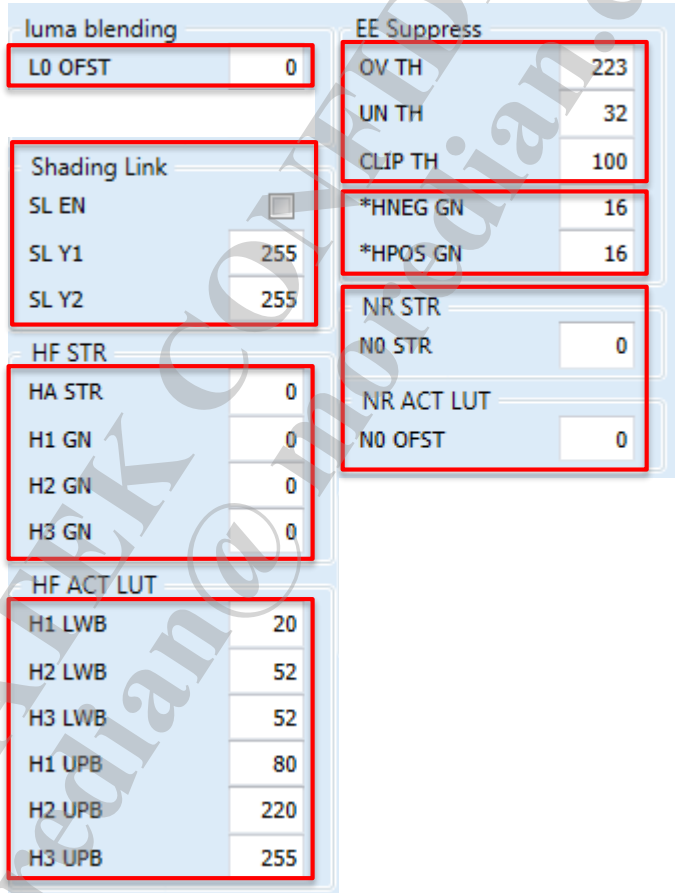
With strong HPF

Block Diagram



Interpolation1	-Interpolation G channel -Keep edge
LPF	-Denoise at flatness region -Edge recognition
HPF	-Edge enhancement
Interpolation2	-Interpolation R/B color to get R/G/B for every pixel.

MT6771 DM UI



Connectivity, Detail

Corner NR, Enable signal

Corner NR, Strength

Overall EE Strength
EE Strength, Detail
EE Strength, Edge
EE Strength, Strong Edge

EE Noise Level, Detail
EE Noise Level, Edge
EE Noise Level, Strong Edge

Edge Suppression, White
Edge Suppression, Dark
Edge Suppression, Threshold

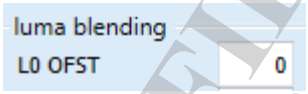
Positive/Negative EE Response

NR, Strength

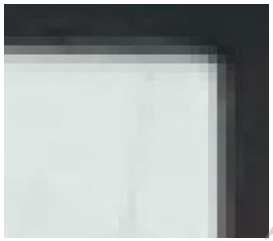
NR, Noise Level

Interpolation1

Connectivity, Detail, 0~255



edge



0

255

Trade off

flatness

High pass Filter – EE Strength

HA STR	0

: Overall EE strength control. 0: No EE

EE Strength, Detail, 0~31
EE Strength, Edge, 0~31
EE Strength, Strong Edge, 0~31

H1 GN	0
H2 GN	0
H3 GN	0

EE Strength ↑ → Detail & Edge ↑

H1 GN	0
H2 GN	0
H3 GN	0

H1 GN	8
H2 GN	8
H3 GN	8

High pass Filter – Noise Level

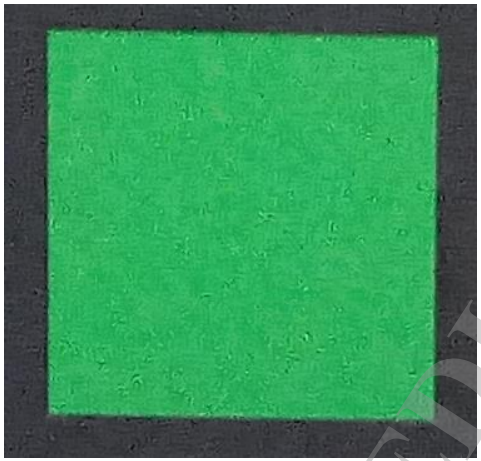
EE Noise Level, Detail, 0~255
EE Noise Level, Edge, 0~255
EE Noise Level, Strong Edge, 0~255
EE Edge Level, Detail, 0~255
EE Edge Level, Edge, 0~255
EE Edge Level, Strong Edge, 0~255

HF ACT LUT	
H1 LWB	20
H2 LWB	52
H3 LWB	52
H1 UPB	80
H2 UPB	220
H3 UPB	255

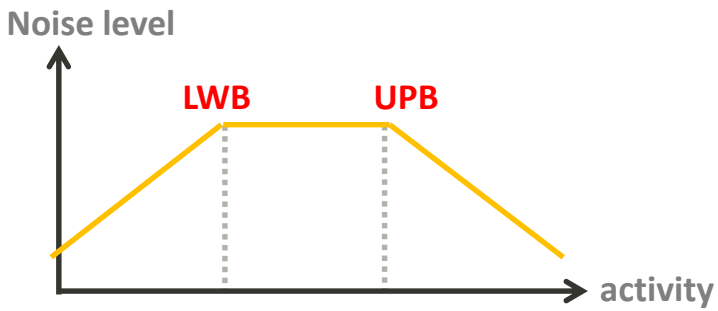
Noise LV ↑ → Noise ↓ , Blur ↑

Edge LV ↑ → Edge ↑ , Blur ↓

Small value



Large value

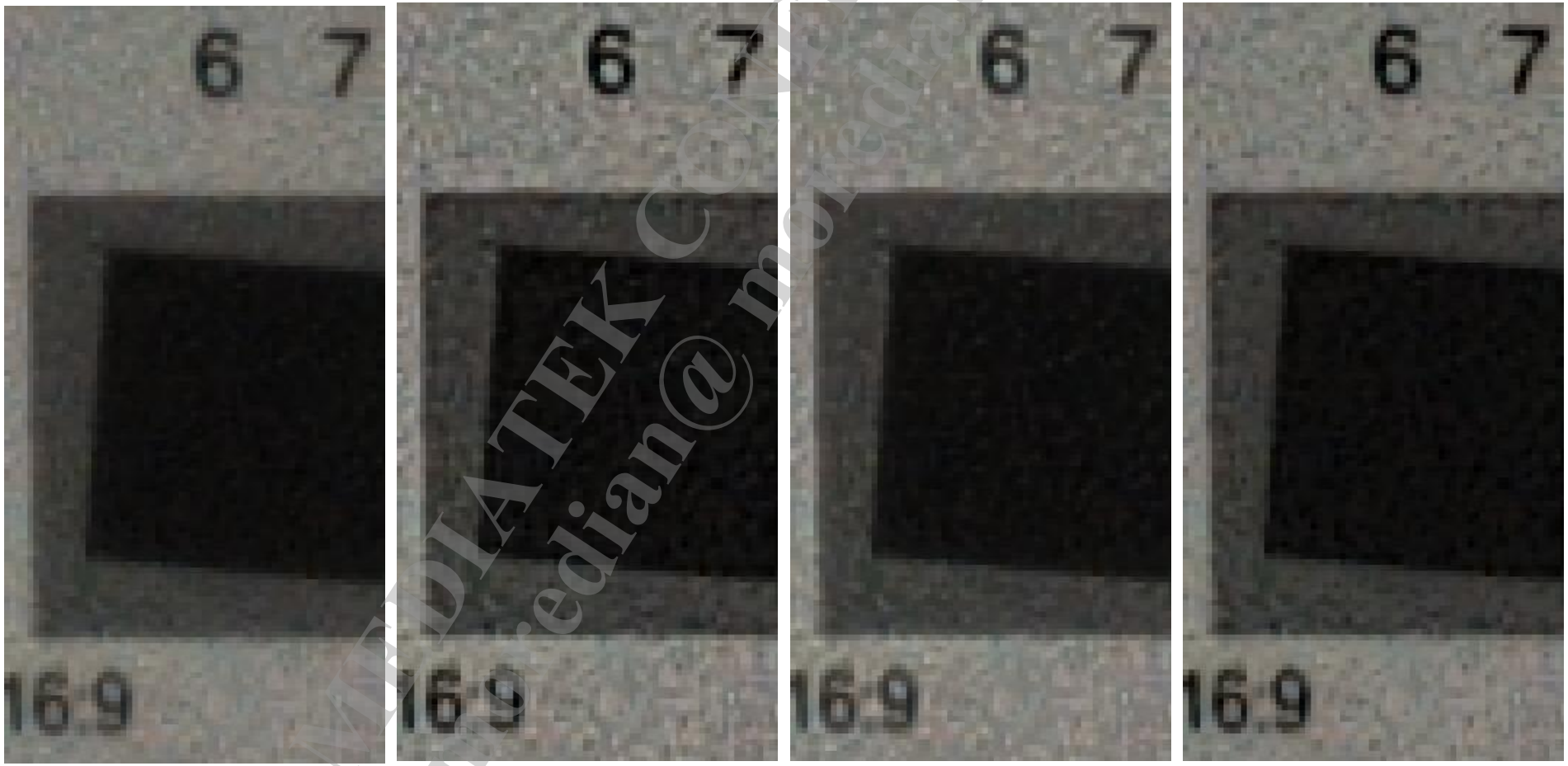


*HNEG GN	16
*HPOS GN	16

Positive/Negative EE Response

(※ Default)

HNEG_GN = 0 HPOS_GN = 0	HNEG_GN = 16 HPOS_GN = 16	HNEG_GN = 0 HPOS_GN = 16	HNEG_GN = 16 HPOS_GN = 0



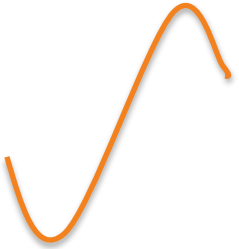
Over/Under Shoot

Edge Suppression, White, 255~0
Edge Suppression, Dark , 0~255
Edge Suppression, Threshold , 0~255

EE Suppress	
OV TH	223
UN TH	32
CLIP TH	100

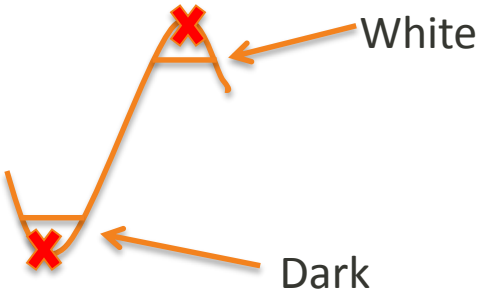
Used when HPF enhance too much

Too sharp



OVTH ↓
or
UN TH ↑
or
CLIP TH ↓

smoother



Corner Noise

Corner NR, Enable signal

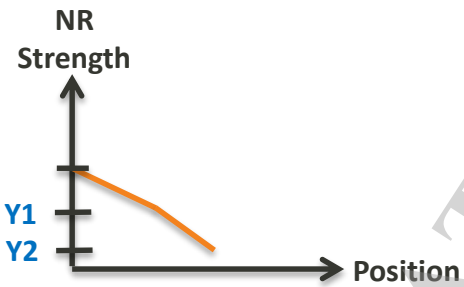
Corner NR, Strength

SL EN	
SL Y1	255
SL Y2	255

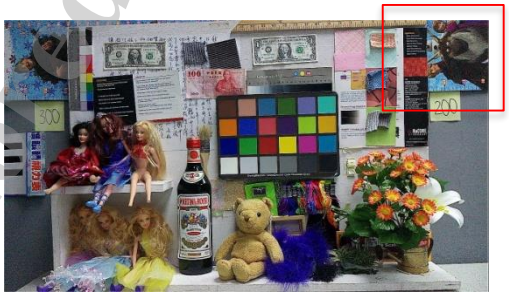
255~0

255~0

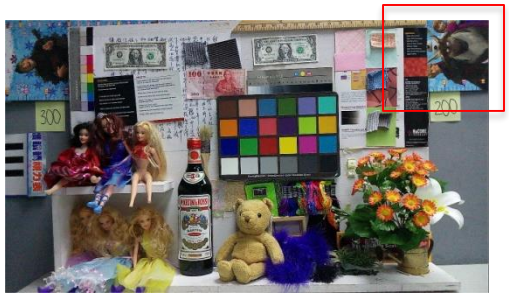
Used if Corner is too much noise caused by HPF , especially at high ISO



Large value



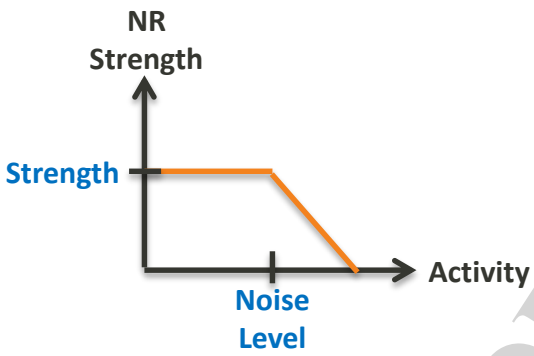
Small value



Low Pass Filter

NR, Strength, 0~16

NR, Noise Level, 0~255



	Large STR		Small STR	
Large OFST				
Small OFST				

everyday genius