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Dual Cam VSDoF Tuning Sop

Outline

- 1. Dualcam vsdof Introduction
- 2. data Flow
- 3参数介绍
- 4. VSDOF Tuning

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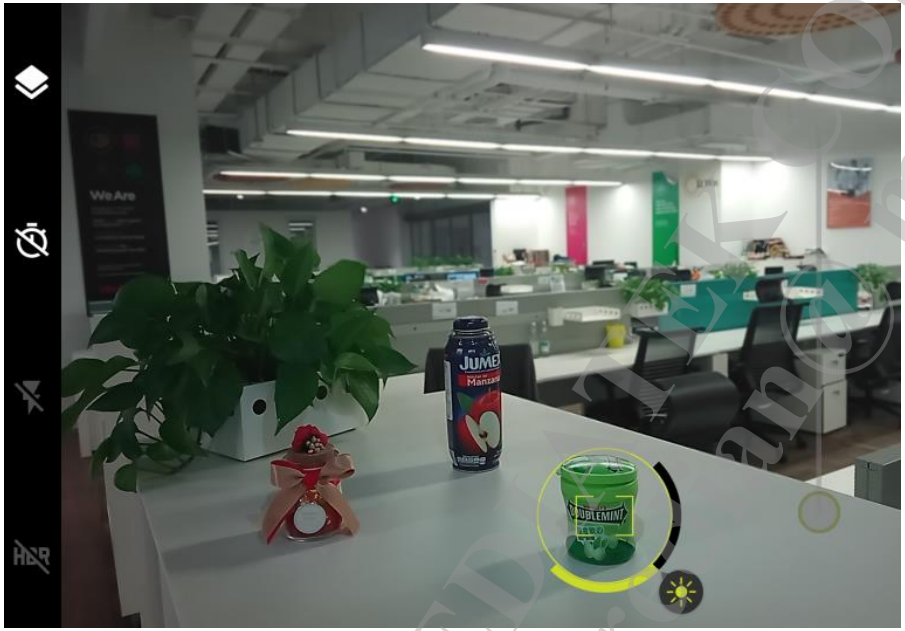
Dualcam VSDOF Introduction

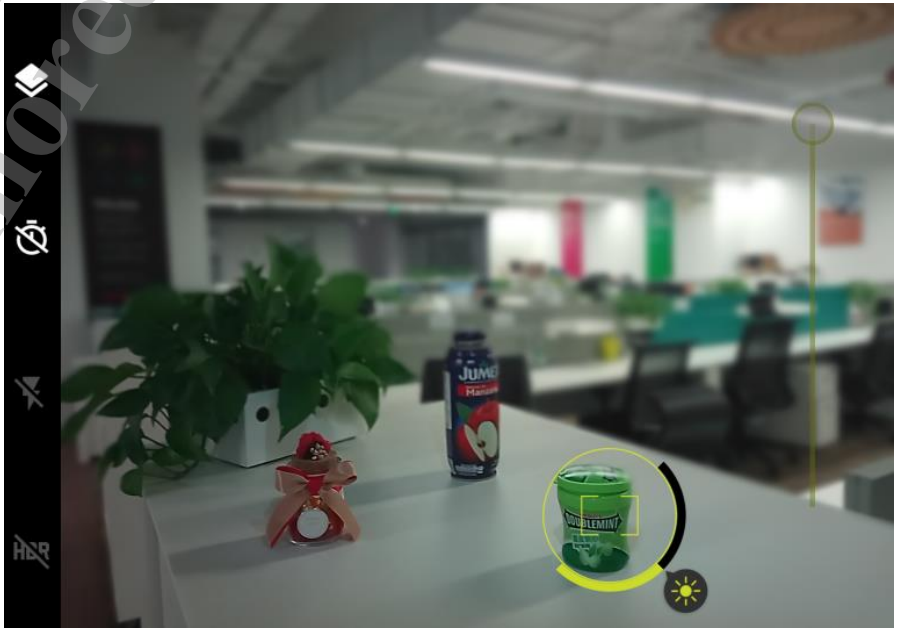
Dualcam VSDOF Introduction

- **VSDoF**：实时景深，可在手机预览时实现大光圈浅景深效果

- Normal preview:



- VSDoF preview :



Dualcam VSDOF Introduction

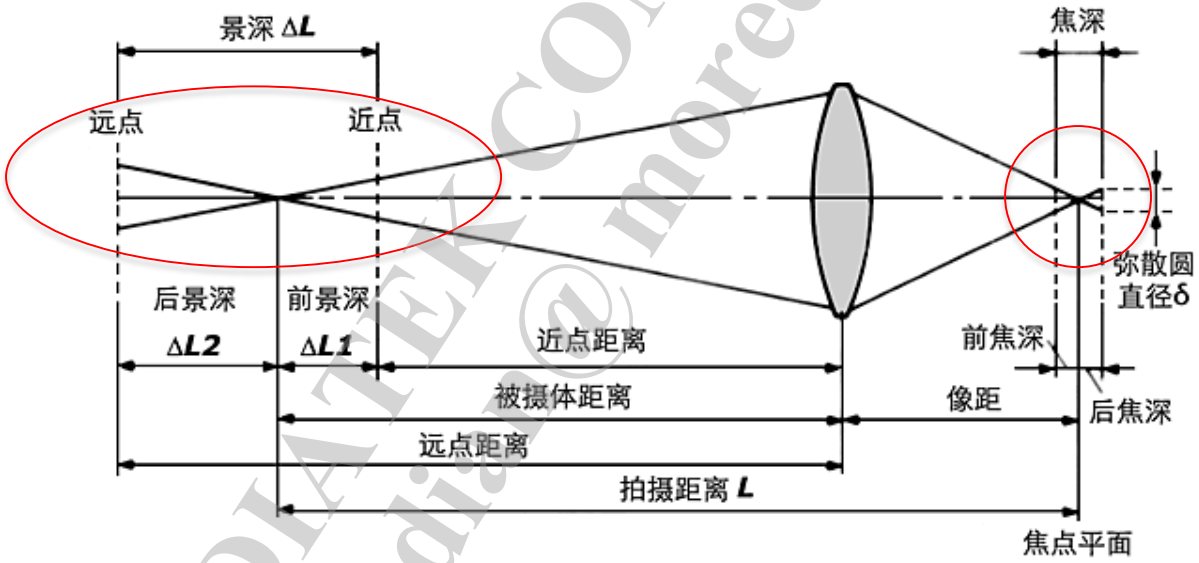
名词解释

常见名词	英文释义	意义
B+B	Bayer+Bayer	主眼+副眼
B+M	Bayer+Mono	彩色+黑白
W+T	Wide+Tele	广角+长焦
Depth	Distance	深度
DoF	Depth of Field	景深
VSDoF	Video Shallow Depth of Field	实时景深
Bokeh	Bokeh	焦外成像
Refocus	Re-Focus	重对焦
N3D	Native 3D	两眼3D矫正、配准
LDC	Lens Distortion Correction	镜头畸变校正
DPE	Depth Engine	硬件生成depth map
GF	Generate Depth-of-Field	生成blur map

Dualcam Bokeh Introduction

景深

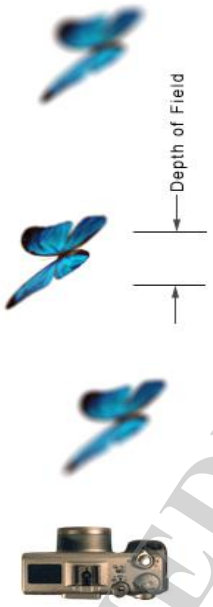
- 焦点前后各有一个容许弥散圆，这两个弥散圆之间的距离就叫**焦深**。以此推到被摄主体，相对于对焦点的前后，其影像也有一段清晰范围的就是**景深**。



Dualcam VSDOF Introduction

名词	英文释义	意义	Feature
B+B	Bayer+Bayer	主眼+副眼	VSDoF
B+M	Bayer+Mono	彩色+黑白	Denoise/VSDoF
W+T	Wide+Tele	广角+长焦	10x Zoom/VSDoF
Depth	Distance	深度	
DoF	Depth of Field	景深	

- What is **Depth** of Field?



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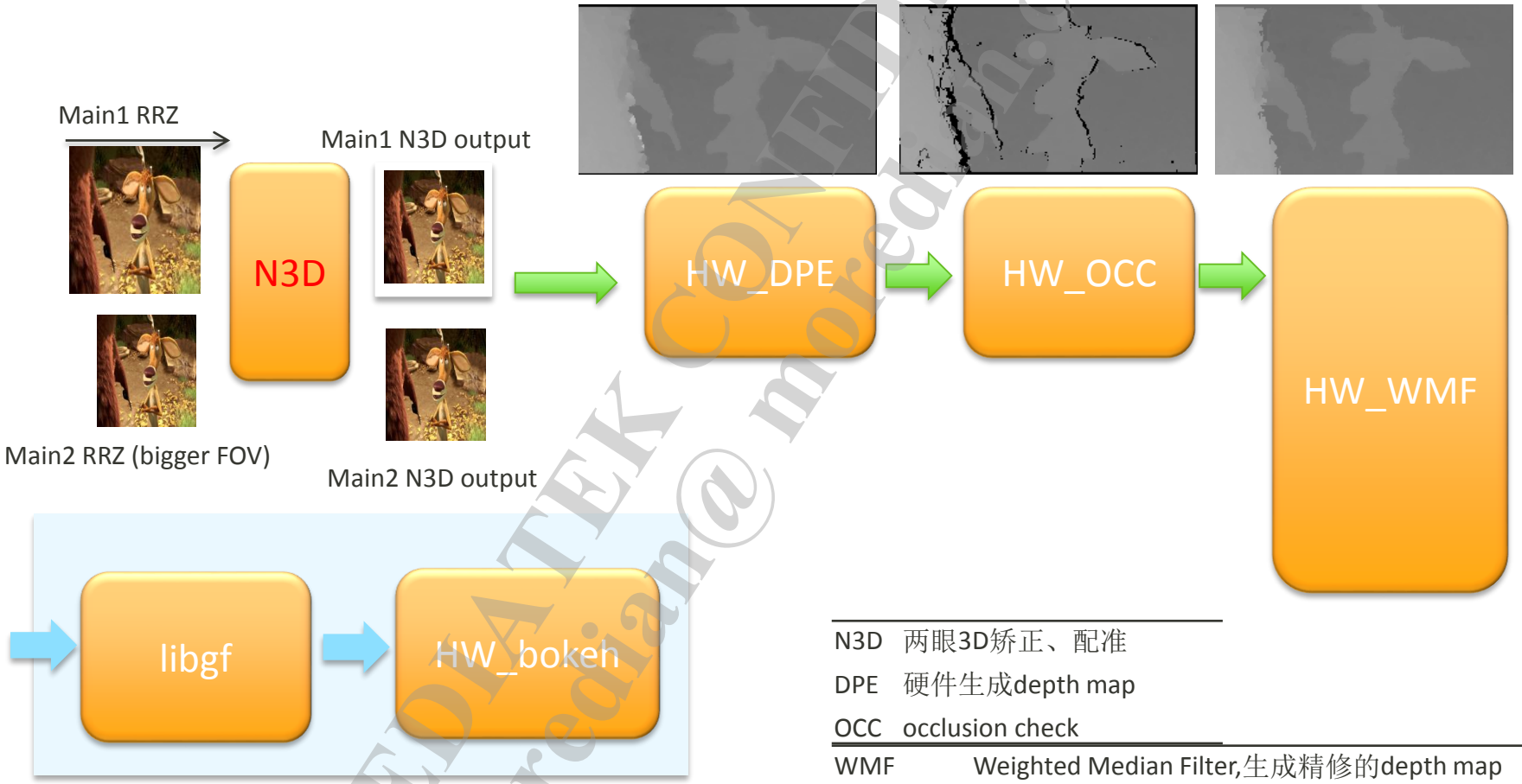
Data Flow

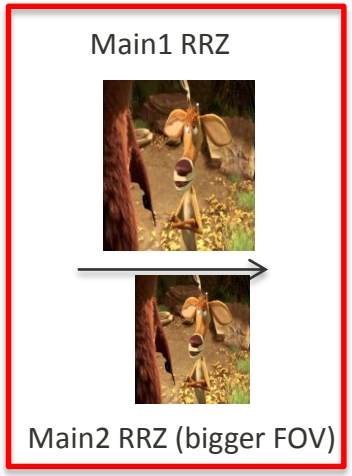
Data Flow



N3D	两眼3D矫正、配准
DPE	硬件生成depth map
OCC	occlusion check
WMF	Weighted Median Filter,生成精修的depth map
libgf	生成blur map
HW_bokeh	硬件虚化

data precheck

Data Input



双摄调试前要保证输入的data满足要求，首先要进行precheck,具体如何check可以参考上一次的培训文档
《MT6757_Dual_Cam_VSDoF_Refocus_PreCheck_and_Tuning.pptx》

	Item
IQ	ISP/3A Check
	3A fuctional Sync
HW	Module Info
Config Para	camera_custom_stereo.cpp
SW	Dual Cam Patch
	Dual Cam Spec
	Sensor Driver/Scenario
	Frame sync
	CameraAP
	Gallery
	AF Tuning
Algo Input	N3D check
	Algo version and tuning para
Factory Verification	Module Verification

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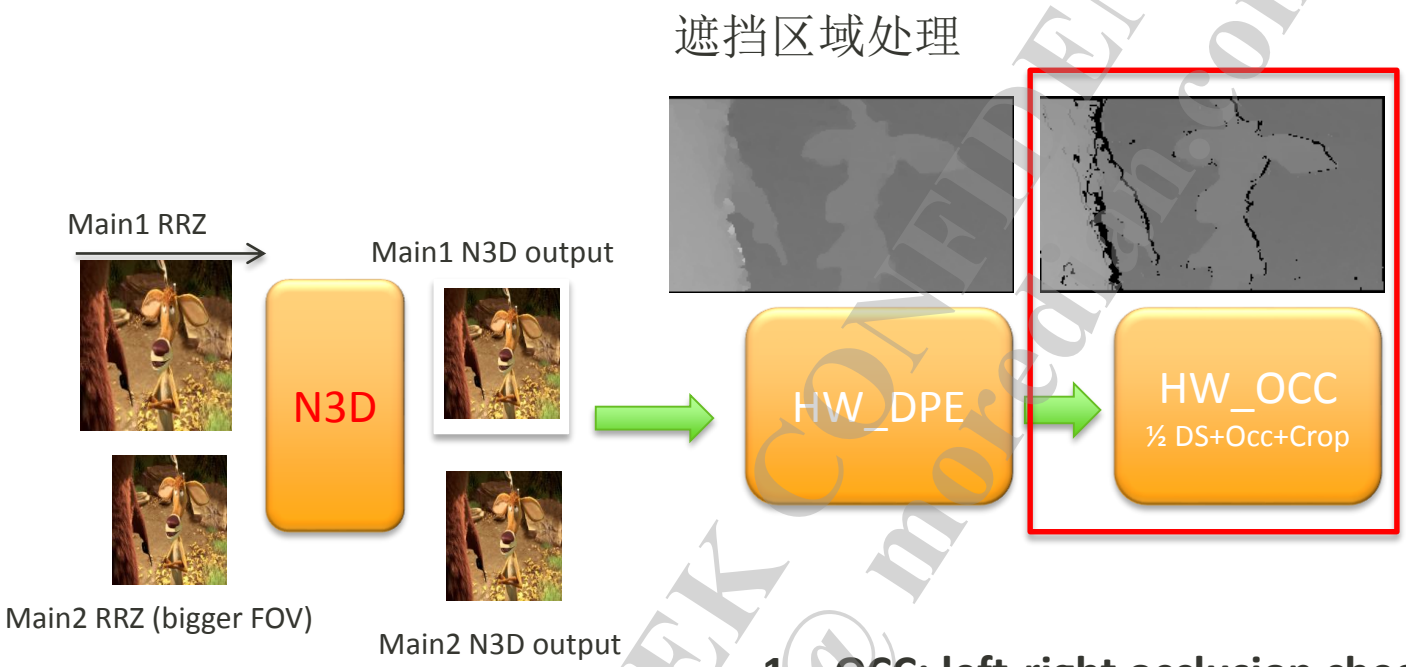
参数介绍

Data Flow



1. OCC: left-right occlusion check
2. ½ DS: down-sample depth map to ½ width
3. Crop: crop padding boundaries
4. 4. OWC: occlusion width check removal

HW_OCC Tuning

```
occ_horz_ds4                    = 0;
occ_vert_ds4                    = 0;

occ_th_luma                     = 64;

occ_th_h                        = 4;
occ_th_v                        = 4;

occ_vec_shift                   = 0;

occ_vec_offset                  = 128;

occ_invalid_value               = 255;

occ_owc_th                      = 3;

occ_owc_en                      = 1;

occ_depth_clip_en               = 1;
occ_spare                       = 0;
```

LRC luma threshold

LRC vertical and horizontal vector threshold

0: disable disp lsb shift / 1: enable disp lsb shift

convergence : 128 / one-way search : 0

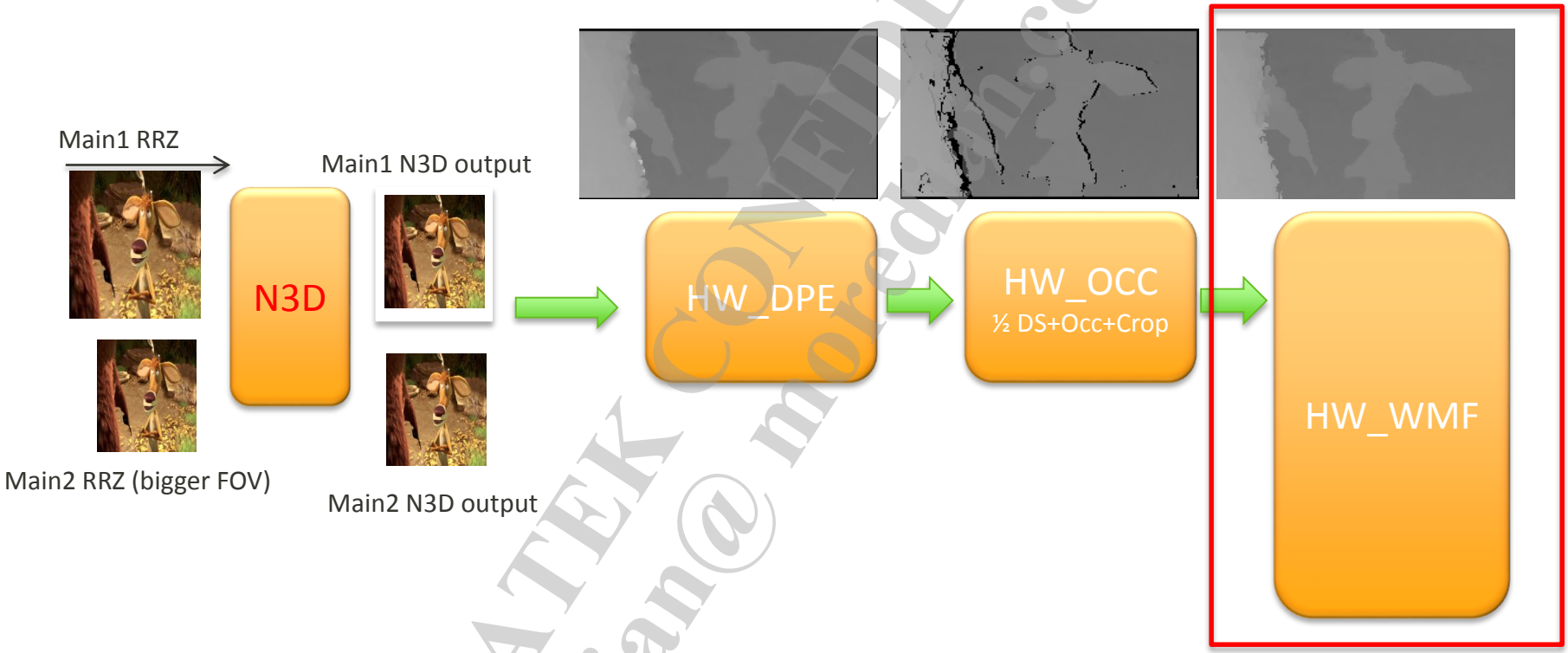
hole value

occlusion width check threshold

1: enable OWC / 0: disable OWC

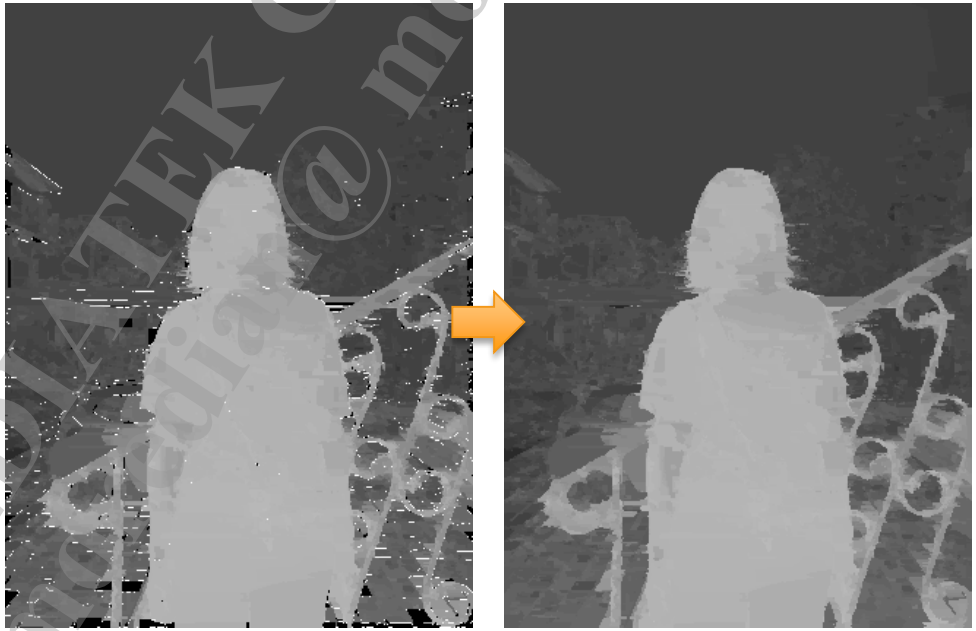
Data Flow

硬件生成精修的depth map的值



HW_WMF

- Weighted Median Filter
  - Filter
  - Hole Filling
    - 2 rounds: top-down and bottom-up



HW_WMF Tuning

```
"HW_WMF": [{
        "Parameters": {
            "Round": "WMF"
        },
        "Values": {
            "Wmfe_Enable": 0,
            "WmfeFilterSize": 3,
            "Wmfe_Dpnd_En": 0,
            "Wmfe_Mask_En": 0,
            "Wmfe_Mask_Value": 255,
            "Wmfe_Mask_Mode": 0,
            "Table": [1000, 920, 846, 778, 716, 659,
        }
    }, {
        "Parameters": {
            "Round": "Hole Filling 1"
        },
        "Values": {
            "WmfeFilterSize": 3,
            "Wmfe_Dpnd_En": 1,
            "Wmfe_Mask_En": 1,
            "Wmfe_Mask_Value": 255,
            "Wmfe_Mask_Mode": 1,
            "Table": [1000, 920, 846, 778, 716, 659,
        }
    }, {
        "Parameters": {
            "Round": "Hole Filling 2"
        },
        "Values": {
            "WmfeFilterSize": 3,
            "Wmfe_Dpnd_En": 1,
            "Wmfe_Mask_En": 1,
            "Wmfe_Mask_Value": 255,
            "Wmfe_Mask_Mode": 1,
            "Table": [1000, 920, 846, 778, 716, 659,
```

WMF filter

0 : disable filter / 1: enable filter
3 : filter size

Hole value. Should be the same with occ_invalid_value

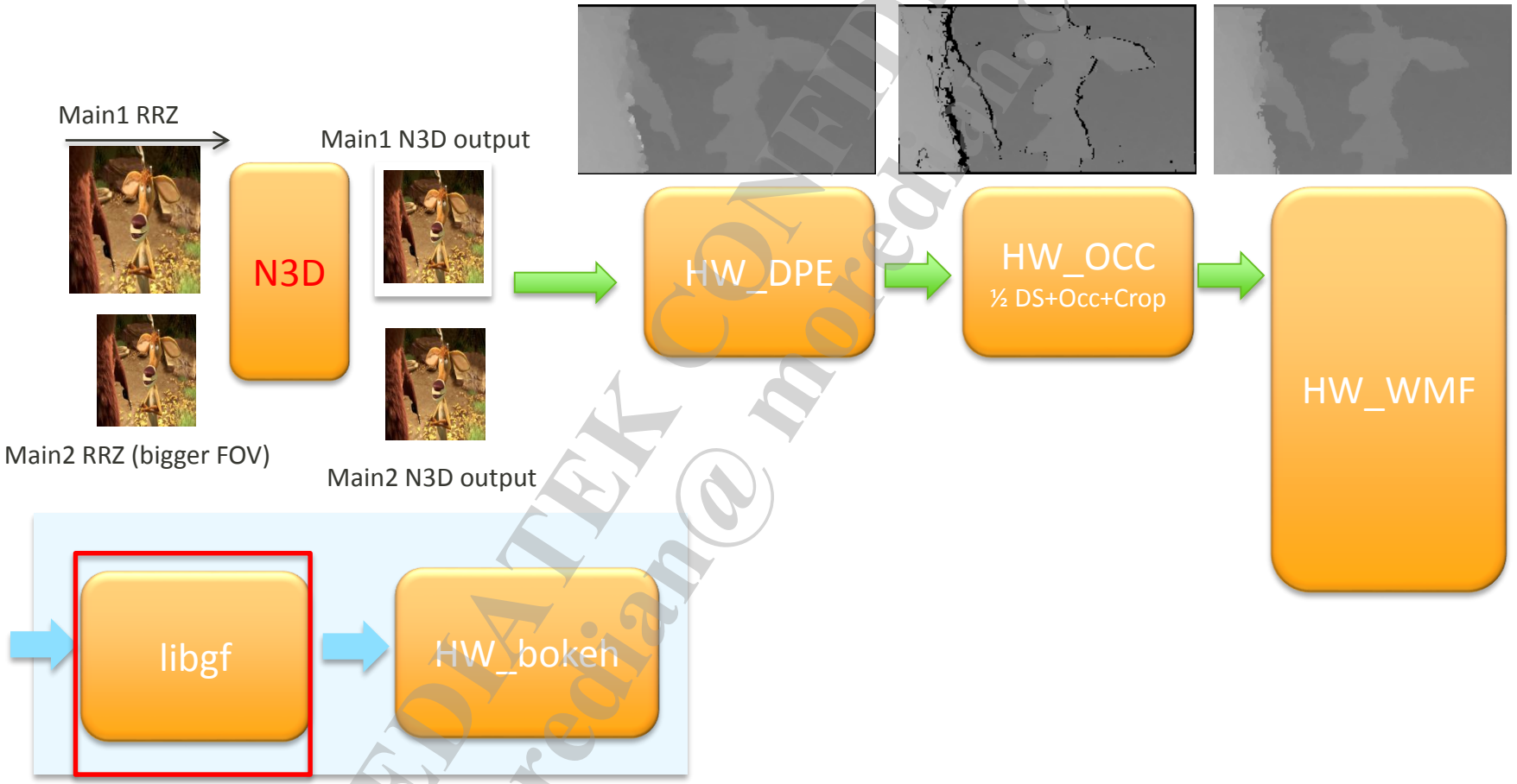
First round. Top-down

FilterSize of HoleFilling1 and HoleFilling2 should be the same.
Hole value. Should be the same with occ_invalid_value.

Second round. Bottom-up

Hole value. Should be the same with occ_invalid_value.

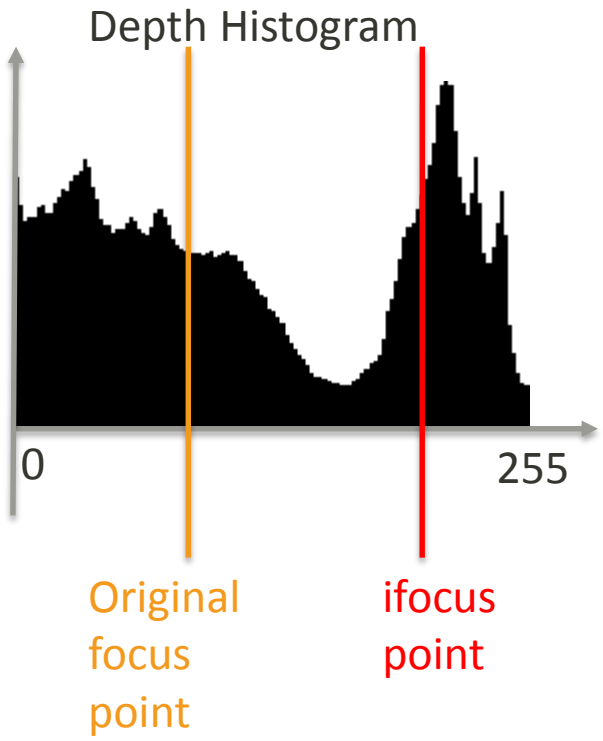
Data Flow



软件生成blur map的值

libgf

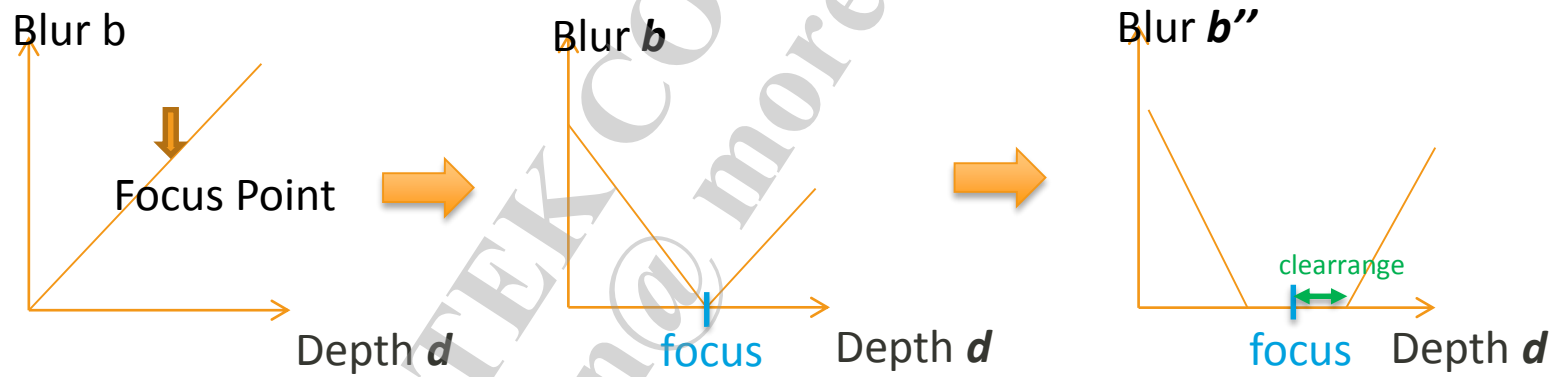
- **1. ifocus**
  - Make depth focus on the foreground
  - Choose the n% depth in the window as depth focus



libgf

- **2.Compute focus: need camera offset and new focus**
- **3.Blur mapping: map depth map to blur map**

B(x, y)=abs((D(x, y)-focus-clearrange),0);



- **3.other smoothing和Edge的处理**

libgf: Parameters

```
"SW_GF": [{
        "Parameters": {
            "Scenario": "Preview"
        },
        "Values": {
            "CoreNumber": 1,
            "ClearRangeTable": [1, 3, 5, 12, 14, 17, 20, 24, 28, 32, 36, 39, 42, 46, 49, 50, 50],
            "TuningParams": {
                "gf.logLevel": 0,
                "gf.debugLevel": 0,
                "gf.sigma": 3,
                "gf.sigmat": 50,
                "gf.tempbase": 800,
                "gf.alpha": 100,
                "gf.wessiter": 1,
                "gf.dofptl": 4,
                "gf.dofpth": 24,
                "gf.bk_single_side": 0,
                "gf.bk_ifocus": 10,
                "gf.bk_ifocus_touch": 5,
                "gf.bk_ifocus_ratio": 20,
                "gf.be_lbound_ratio": 0,
                "gf.be_tbound_ratio": 0,
                "gf.be_rbound_ratio": 0,
                "gf.be_bbound_ratio": 0,
                "gf.be_hist_ratio": 25,
                "gf.be_depth_limit": 128,
                "gf.be_occ_dia_radius": -1,
                "gf.be_weight_spatial": 1,
                "gf.be_weight_color": 1,
                "gf.calibrate_en": 0,
                "gf.offset_en": 0,
                "gf.focus_abs_depth_max": 128
            }
        }
```

Should tune by module

Smoothing相关的参数

Dof Ap 设置下来的值

$$dof' = \frac{dof}{\min\left(\max\left(\frac{clr}{dofptl}, 1\right), dofpth\right)}$$

Ifocus window tap size for AF mode

Ifocus window tap size for touch focus mode

Percentage of choosed disparity

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Vsdof Tuning

3. Vsdof Tuning

Camera_custom_stereo_tuning.h（关注红框中的参数就好）

- HW_FE
- HW_FM
- HW_DPE
- HW_WMF
- HW_BOKEH
- HW_MDP_PQ
- SW_GF
- HW_OCC
- SW_OCC
- SW_BOKEH

```
"\"HW_WMF\": [{"
    "\"Parameters\": {"
        "\"Round\": \"WMF\""
    "},"
    "\"Values\": {"
        "\"Wmfe_Enable\": 0,"
        "\"WmfeFilterSize\": 3,"
        "\"Wmfe_Dpnd_En\": 0,"
        "\"Wmfe_Mask_En\": 0,"
        "\"Wmfe_Mask_Value\": 0,"
        "\"Wmfe_Mask_Mode\": 0,"
        "\"Wmfe_Chroma_En\": 1,"
        "\"Table\": [1000, 920, 846, 778,
    "}"
"}, {"
    "\"Parameters\": {"
        "\"Round\": \"Hole Filling 1\""
    "},"
    "\"Values\": {"
        "\"WmfeFilterSize\": 3,"
        "\"Wmfe_Dpnd_En\": 1,"
        "\"Wmfe_Mask_En\": 1,"
        "\"Wmfe_Mask_Value\": 255,"
        "\"Wmfe_Mask_Mode\": 1,"
        "\"Wmfe_Chroma_En\": 1,"
        "\"Table\": [1000, 920, 846, 778,
    "}"
"}, {"
    "\"Parameters\": {"
        "\"Round\": \"Hole Filling 2\""
    "},"
    "\"Values\": {"
        "\"WmfeFilterSize\": 3,"
        "\"Wmfe_Dpnd_En\": 1,"
        "\"Wmfe_Mask_En\": 1,"
        "\"Wmfe_Mask_Value\": 255,"
        "\"Wmfe_Mask_Mode\": 1,"
        "\"Wmfe_Chroma_En\": 1,"
        "\"Table\": [1000, 920, 846, 778,
    "}"
"}],"
```

```
"\"HW_OCC\": [{"
    "\"Parameters\": {"
        "\"Scenario\": \"Preview\""
    "},"
    "\"Values\": {"
        "\"occ_th_luma\": 64,"
        "\"occ_th_h\": 4,"
        "\"occ_th_v\": 4,"
        "\"occ_vec_shift\": 0,"
        "\"occ_vec_offset\": 128,"
        "\"occ_invalid_value\": 255,"
        "\"occ_owc_th\": 3,"
        "\"occ_owc_en\": 1,"
        "\"occ_depth_clip_en\": 1,"
        "\"occ_spare\": 0"
    "}"
"}, {"
```

注意事项：

1）HW occ中occ_invalid_value的值跟HW WMF中的Wmfe_Mask_Value的值必须要一致

2） HW WMF中Hole Filling1和Hole Filling2中的Wmfe_Mask_En和Wmfe_Dpnd_En的值必须要设置为1

3） HW WMF中除了Wmfe_Enable和WmfeFilterSize的值建议可以调试以外，其他参数不建议修改

3. Vsdof Tuning

Camera_custom_stereo_tuning.h（关注红框中的参数就好）

- HW_FE
- HW_FM
- HW_DPE
- HW_WMF
- HW_BOKEH
- HW_MDP_PQ
- SW_GF
- HW_OCC
- SW_OCC
- SW_BOKEH

```
"\"SW_GF\": [{"
    "\"Parameters\": {"
        "\"Scenario\": \"Preview\""
    "},"
    "\"Values\": {"
        "\"GF_CoreNumber\": 1,"
        "\"ClearTable0\": 3,"
        "\"ClearTable1\": 3,"
        "\"ClearTable2\": 3,"
        "\"ClearTable3\": 4,"
        "\"ClearTable4\": 6,"
        "\"ClearTable5\": 8,"
        "\"ClearTable6\": 12,"
        "\"ClearTable7\": 16,"
        "\"ClearTable8\": 20,"
        "\"ClearTable9\": 24,"
        "\"ClearTable10\": 28,"
        "\"ClearTable11\": 32,"
        "\"ClearTable12\": 32,"
        "\"ClearTable13\": 32,"
        "\"ClearTable14\": 32,"
        "\"ClearTable15\": 32,"
        "\"ClearTable16\": 32,"
        "\"gf.logLevel\": 0,"
        "\"gf.debugLevel\": 0,"
        "\"gf.DPP_output_resize\": 1,"
"}, {"
        "\"gf.mode_dl\": 1,"
        "\"gf.sigma\": 3,"
        "\"gf.sigmat\": 50,"
        "\"gf.tempbase\": 400,"
        "\"gf.alpha\": 100,"
        "\"gf.wessiter\": 1,"
        "\"gf.dofptl\": 6,"
        "\"gf.dofpth\": 8,"
        "\"gf.max_blur_level\": 8,"
        "\"gf.bk_single_side\": 0,"
        "\"gf.bk_ifocus\": 0,"
        "\"gf.bk_ifocus_touch\": 0,"
        "\"gf.bk_ifocus_ratio\": 0,"
        "\"gf.be_lbound_ratio\": 0,"
        "\"gf.be_tbound_ratio\": 0,"
        "\"gf.be_rbound_ratio\": 0,"
        "\"gf.be_bbound_ratio\": 0,"
        "\"gf.be_hist_ratio\": 25,"
        "\"gf.be_depth_limit\": 128,"
        "\"gf.be_occ_dia_radius\": -1,"
        "\"gf.be_weight_spatial\": 1,"
        "\"gf.be_weight_color\": 1,"
        "\"gf.calibrate_en\": 0,"
        "\"gf.offset_en\": 0,"
        "\"gf.focus_abs_depth_max\": 128"
    "}"
```

$$dof' = \frac{dof}{\min(\max\left(\frac{clr}{dofptl}, 1\right), dofpth)}$$

Vsdof Tuning

如何run-time tuning

虚化算法会run-time吃/sdcard/stereo_tuning.json中的参数，
实现run-time tuning的效果

- 如何产生json file

  1.adb shell setprop debug.STEREO.tuning 1
  2.Launch camera and enter vsdof flow.
  3.adb pull /sdcard/stereo_tuning.json to local

- 如何修改json file并让其作用于camera

  1. Edit stereo_tuning.json，for example change " gf.$dofptl$/gf.$dofpth$" from (4 24) to (1 1)
  1. adb push stereo_tuning.json /sdcard/
  2. Launch camera and enter vsdof

Vsdof Tuning

如何run-time tuning

- 如何将修改后的JSON参数导出为tuning .h文件，给到程序编译

1. adb push stereo_tuning.json /sdcard/
2. adb shell setprop debug.STEREO.tuning 1
3. adb shell setprop debug.STEREO.tuning.export 1
4. Launch camera and enter vsdof flow
5. adb pull /sdcard/camera_custom_stereo_tuning.h

Vsdof Tuning

打开log的cmd

vsdof

```
adb root
adb remount
adb shell setprop debug.STEREO.log 1
adb shell setprop debug.STEREO.log.hal.n3d 1
adb shell setprop debug.STEREO.log.setting 1
adb shell setprop debug.STEREO.log.tuning 1
adb shell setprop gf.logLevel 1
adb shell setprop debug.STEREO.tuning 1
adb shell setprop debug.STEREO.tuning.export 1
adb shell setprop debug.STEREO.log 1
adb shell setprop debug.STEREO.log.hal.gf 1
adb shell setprop debug.STEREO.custom_setting 1
adb shell setprop debug.STEREO.custom_setting.exp 1

dump preview data
adb shell setprop gf.debugLevel 3(sdcard/gf)
```

GF_HAL : [__logSetProcData][DoF Level] 0

GF_HAL : [__logSetProcData][DoF Level] 14

GF_HAL : [__logSetProcData][DoF Level] 30

```
StereoTuningProviderKernel: "gf.calibrate_en": 0
GF_HAL   : [__logSetProcData][DoF Level]    14
AppGF    : clearRange(3)
AppGF    : focus abs depth 86, index_ca -1 clearRange_ca 3
AppGF    : ori dof(14) dof_m(16)
AppGF    : dofPTL=1 dofPTH=2
AppGF    : scale=2 dof_m=8
```

```
StereoTuningProviderKernel: "gf.calibrate_en": 0
GF_HAL   : [__logSetProcData][DoF Level]    14
AppGF    : clearRange(3)
AppGF    : focus_abs_depth 2, index_ca -1 clearRange_ca 3
AppGF    : ori dof(14) dof_m(16)
AppGF    : dofPTL=4 dofPTH=10
AppGF    : scale=1 dof_m=16
```

```
StereoTuningProviderKernel: "gf.calibrate_en": 0
GF_HAL   : [__logSetProcData][DoF Level]    14
AppGF    : clearRange(3)
AppGF    : focus_abs_depth 86, index_ca -1 clearRange_ca 3
AppGF    : ori dof(14) dof_m(16)
AppGF    : dofPTL=1 dofPTH=2
AppGF    : scale=2 dof_m=8
```

```
StereoTuningProviderKernel: "gf.calibrate_en": 0
GF_HAL   : [__logSetProcData][DoF Level]    14
AppGF    : clearRange(8)
AppGF    : focus_abs_depth 41, index_ca -1 clearRange_ca 8
AppGF    : ori dof(14) dof_m(16)
AppGF    : dofPTL=1 dofPTH=2
AppGF    : scale=2 dof_m=8
```


```
"HW_WMF": [{
        "Parameters": {
            "Round": "WMF"
        },
        "Values": {
            "Wmfe_Enable": 0,
            "WmfeFilterSize": 3,
```

```
HW_WMF": [{
        "Parameters": {
            "Round": "WMF"
        },
        "Values": {
            "Wmfe_Enable": 1,
            "WmfeFilterSize": 3,
```

log

如何查看log

Preview

```
GF_HAL   : [__logSetProcData][DoF Level]    14
GF_HAL   : [__logSetProcData][DAC]          565 (580-655)
AppGF    : clearRange(8)
AppGF    : focus_abs_depth 52, index_ca -1 clearRange_ca 8
AppGF    : ori dof(14) dof_m(16)
AppGF    : dofPTL=1 dofPTH=2
AppGF    : scale=2 dof_m=8
AppGF    : [setProcInfo] dof(14) dof_m(8) cOffset(0.000000)
```

感谢