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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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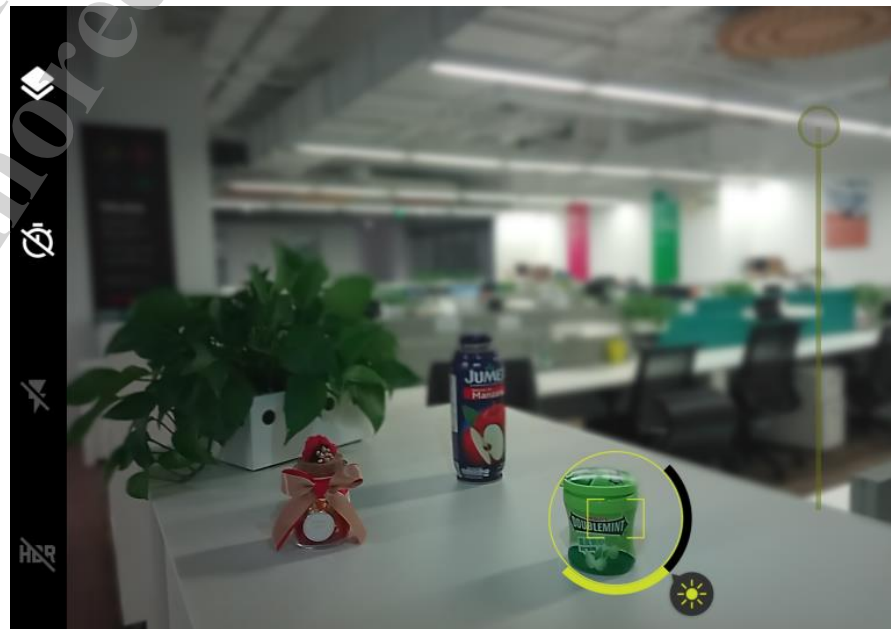
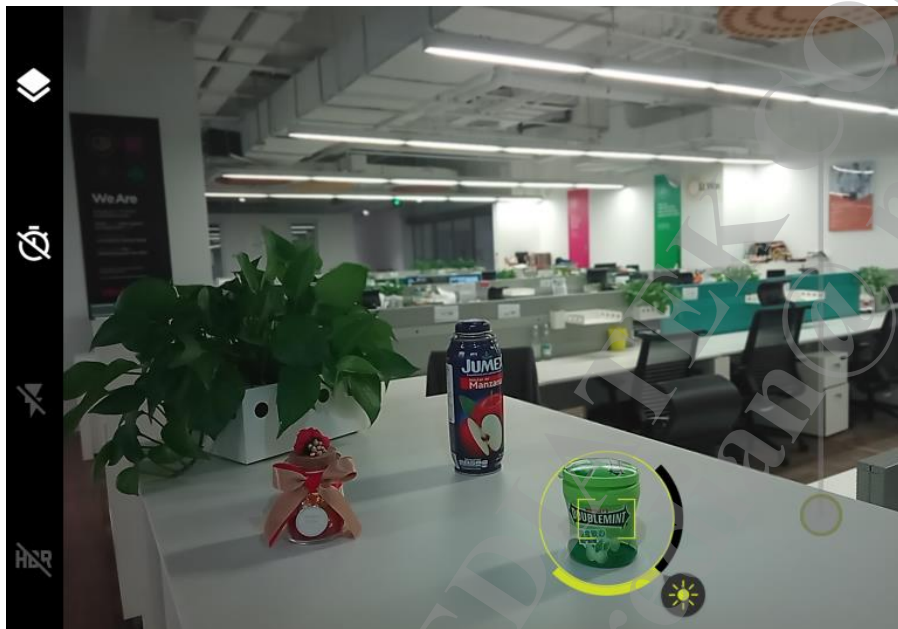
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Dualcam VSDOF Introduction



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

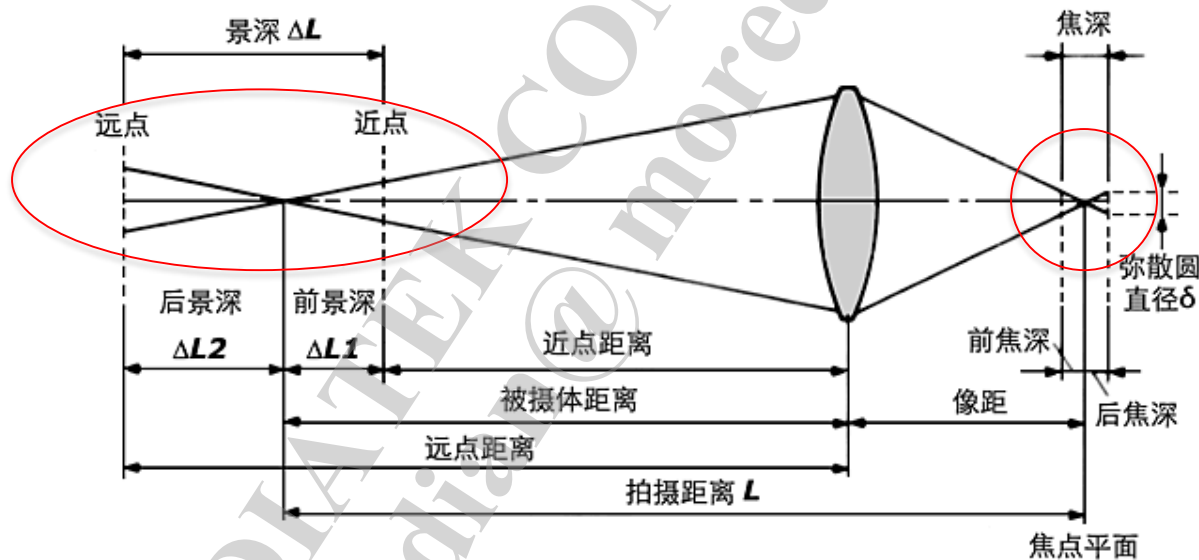
名词解释

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

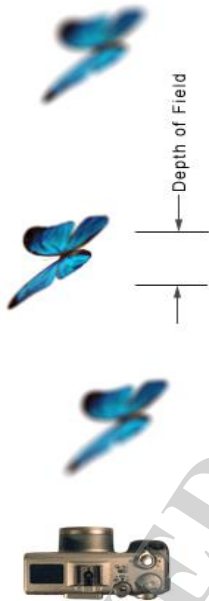
- 焦点前后各有一个容许弥散圆，这两个弥散圆之间的距离就叫**焦深**。以此推到被摄主体，相对于对焦点的前后，其影像也有一段清晰范围的就是**景深**。



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?



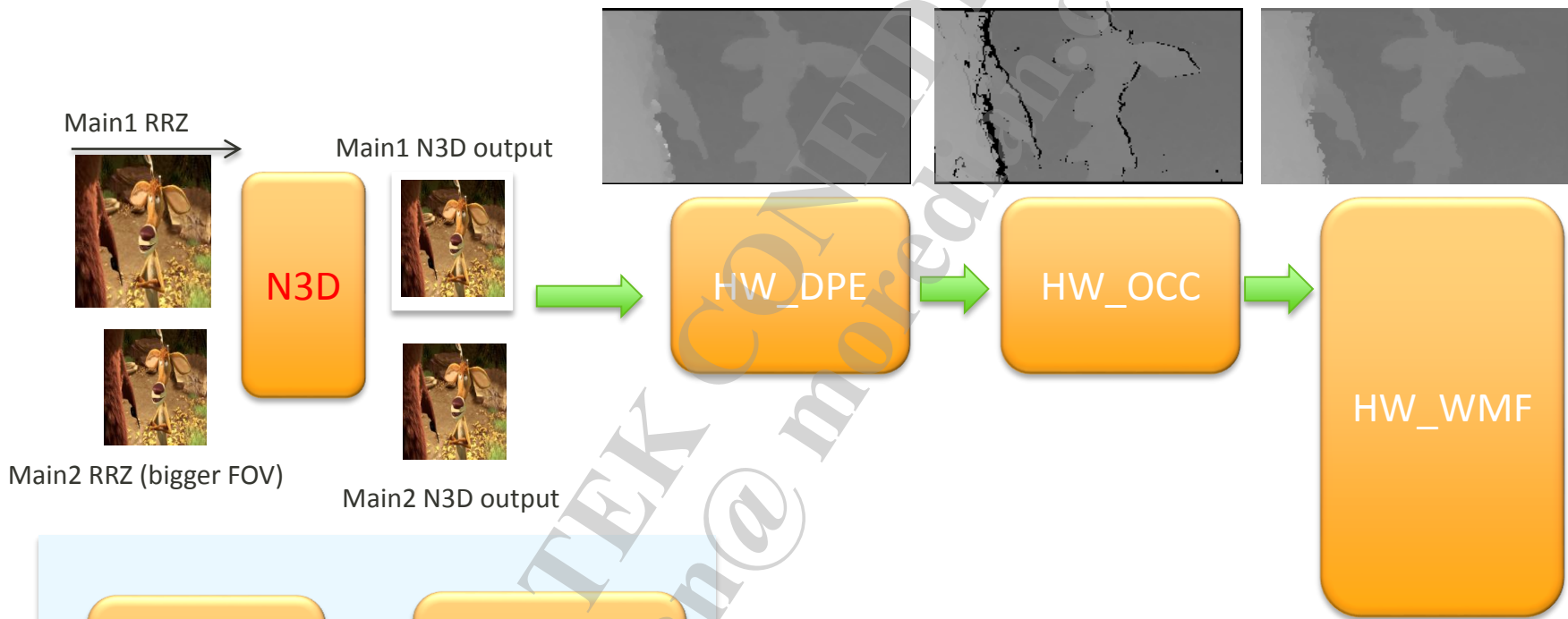
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Data Flow



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

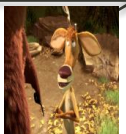
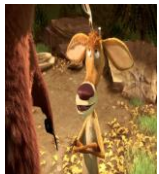
libgf 生成blur map

HW_bokeh 硬件虚化

data precheck

Data Input

Main1 RRZ



Main2 RRZ (bigger FOV)

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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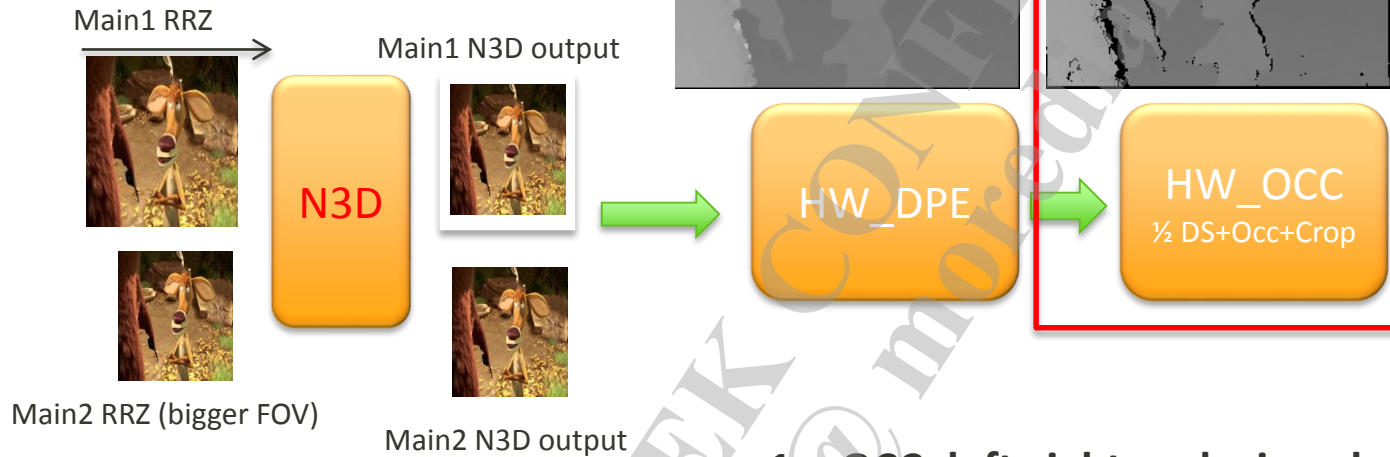
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参数介绍



Data Flow

遮挡区域处理



1. OCC: left-right occlusion check
2. 1/2 DS: down-sample depth map to 1/2 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;
```

LRC luma threshold

```
occ_th_h          = 4;  
occ_th_v          = 4;
```

LRC vertical and horizontal vector threshold

```
occ_vec_shift     = 0;
```

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

```
occ_vec_offset    = 128;
```

convergence : 128 / one-way search : 0

```
occ_invalid_value = 255;
```

hole value

```
occ_owc_th        = 3;
```

occlusion width check threshold

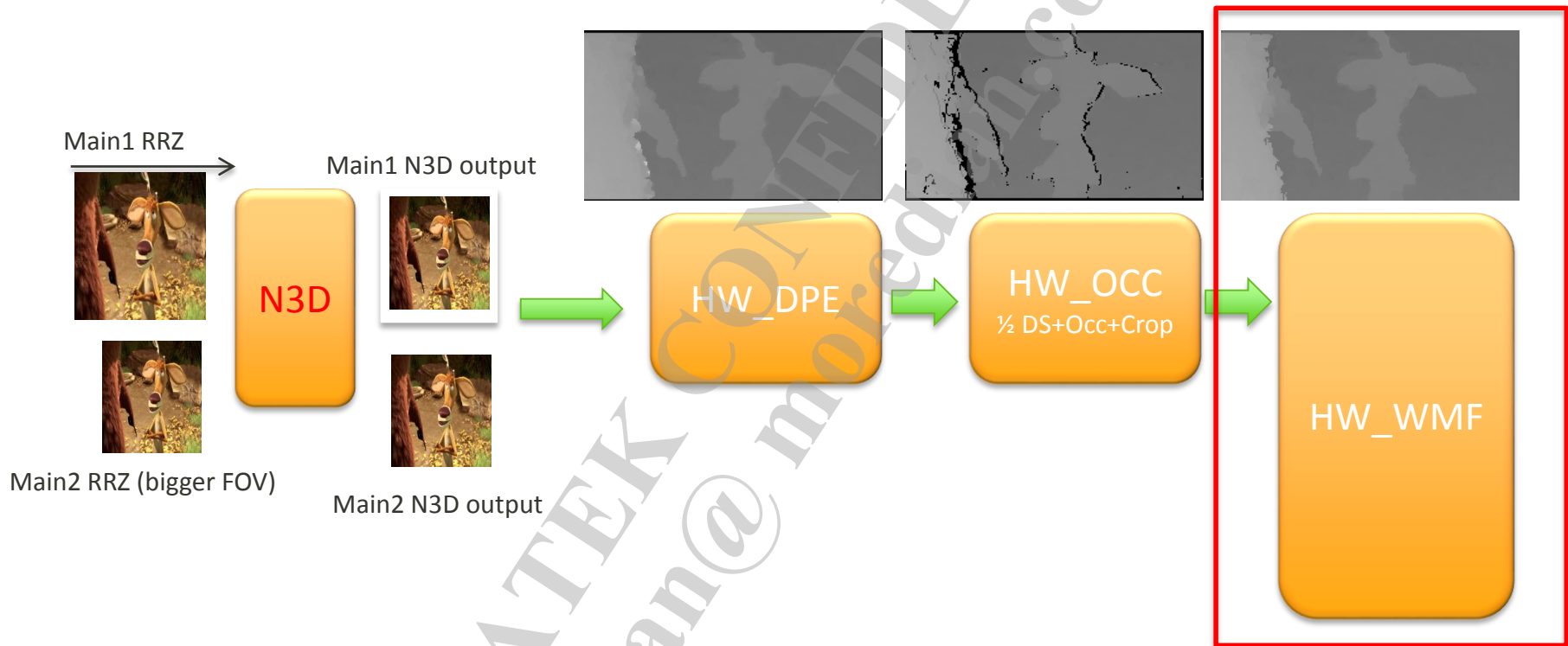
```
occ_owc_en        = 1;
```

1: enable OWC / 0: disable OWC

```
occ_depth_clip_en = 1;  
occ_spare          = 0;
```


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

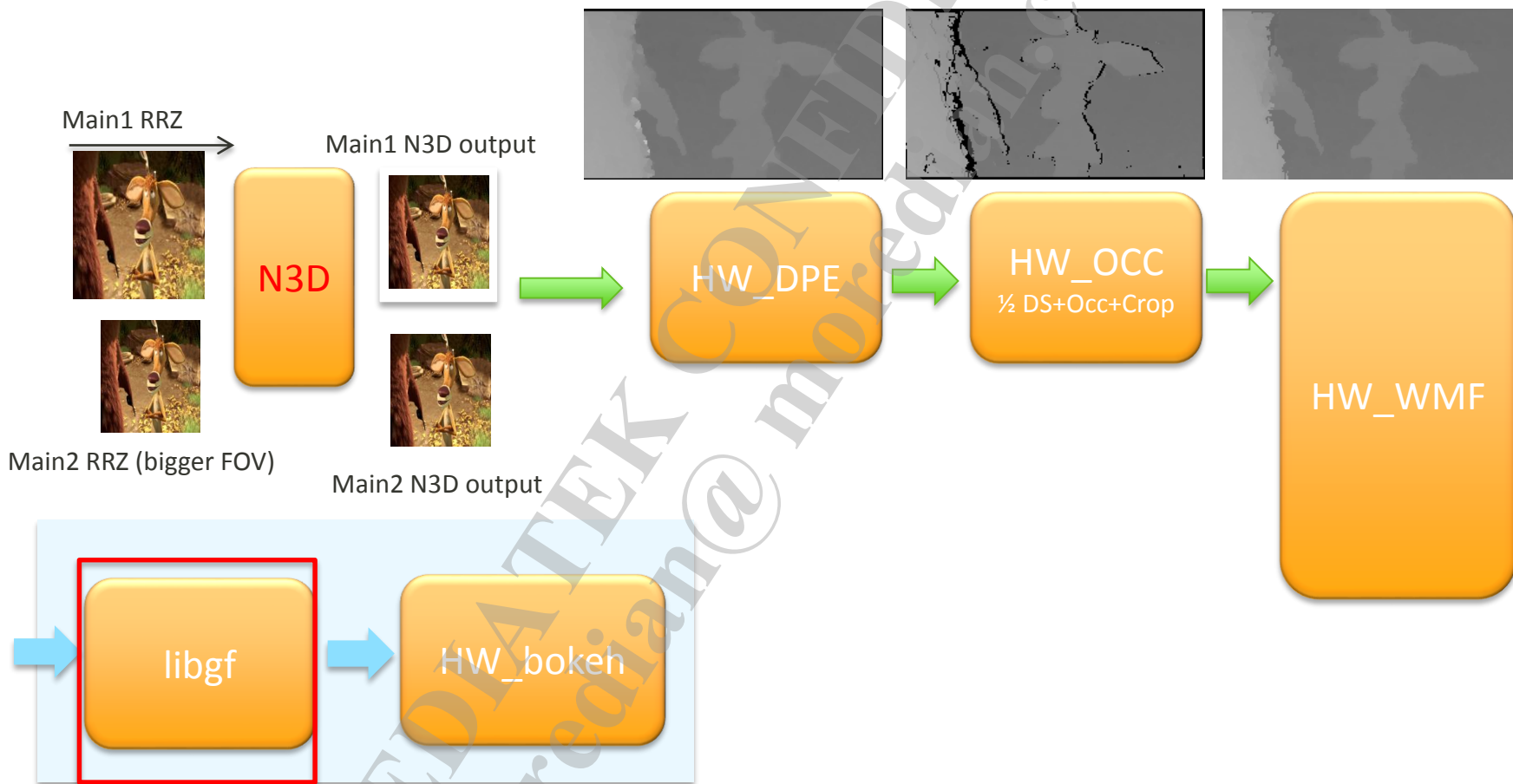
FilterSize of HoleFilling1 and HoleFilling2 should be the same.

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

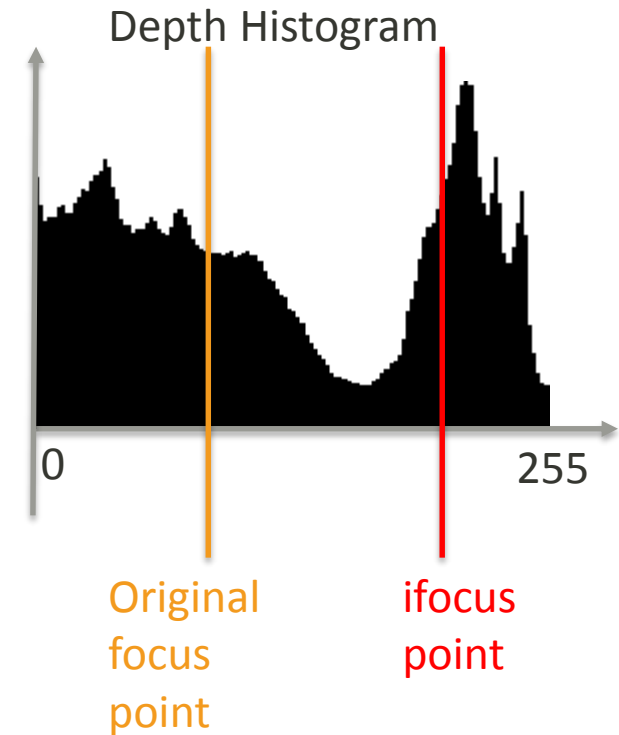


软件生成blur map的值

libgf

■ 1. ifocus

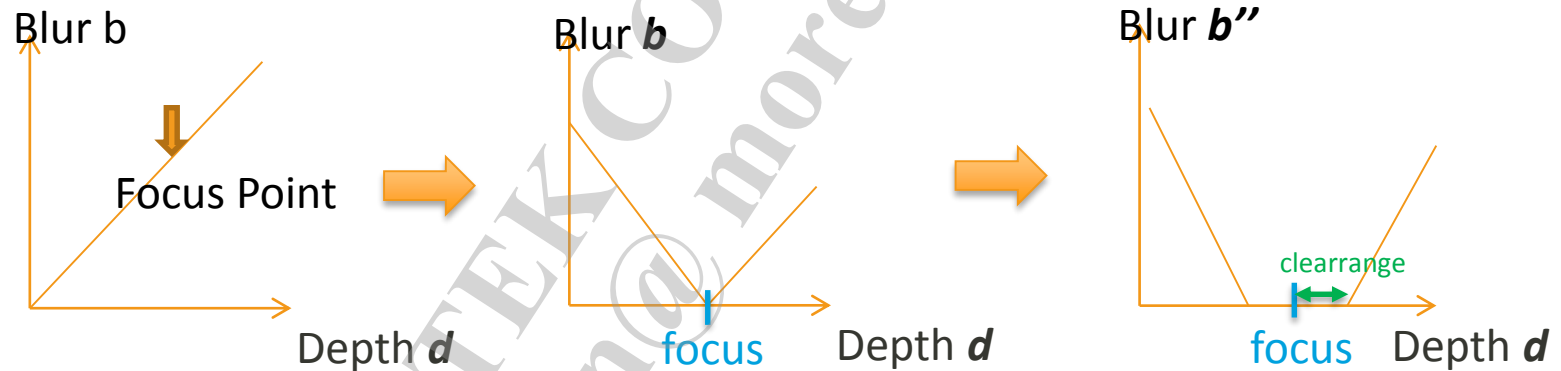
- Make depth focus on the foreground
- Choose the n% depth in the window as depth focus



libgfm

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

$$B(x, y) = \text{abs}((D(x, y) - \text{focus} - \text{clearrange}), 0);$$



- 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.temphase": 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

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

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
```

o tuning.h（关注红框中的参数就好）

```
"\"HW WMF\":" {{"Parameters\":" {"Round\":" \"WMF\""}, "Values\":" {"Wmfe_Enable\":" 0,"Wmfe_FilterSize\":" 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\":" {"Wmfe_FilterSize\":" 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\":" {"Wmfe_FilterSize\":" 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\":" \"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}}}, {"Parameters\":" {"Round\":" \"Hole Filling 1\""}, "Values\":" {"Wmfe_FilterSize\":" 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\":" {"Wmfe_FilterSize\":" 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\":" \"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Wmfe_FilterSize的值建议可以调试以外，其他参数不建议修改

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,
    "gfLogLevel": 0,
    "gf.debugLevel": 0,
    "gf.DPP_output_resize": 1,
    "gf.mode_d1": 1,
    "gf.sigma": 3,
    "gf.sigmat": 50,
    "gf.tempbase": 400,
    "gf.alpha": 100,
    "gf.wessiter": 1,
    "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
  }
}
    
```

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

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)
```







dofptl=6; dofptl=8; clr=3

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



dofptl=1; dofptl=8; clr=3

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









```
"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)
```

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