基于 FPGA 的图像处理

ISP 算法 开篇

作者:清霜一梦



O1 ISP pipeline 流程
Please add the title here

O2 ISP 模块概述
Please add the title here

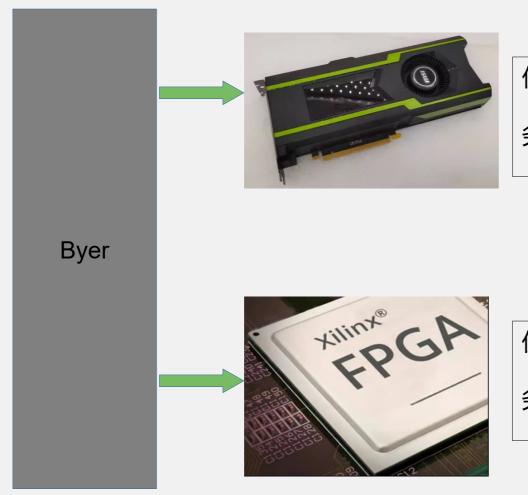
以程安排Please add the title here

第一部分

ISP pipeline 流程

ISP pipeline

处理平台



优势: 开发周期短, 开发难度小

劣势: 体积大, 功耗大

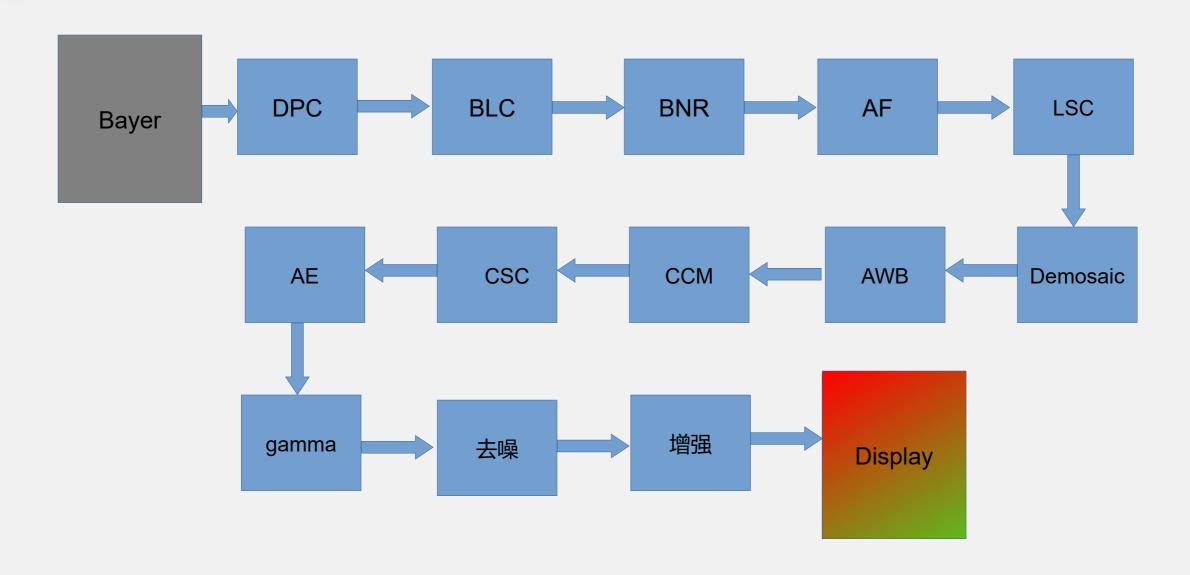
价格 与 处理速度 均与开发者相关

优势: 体积小, 功耗小

劣势: 开发周期长, 开发难度大

ISP pipeline

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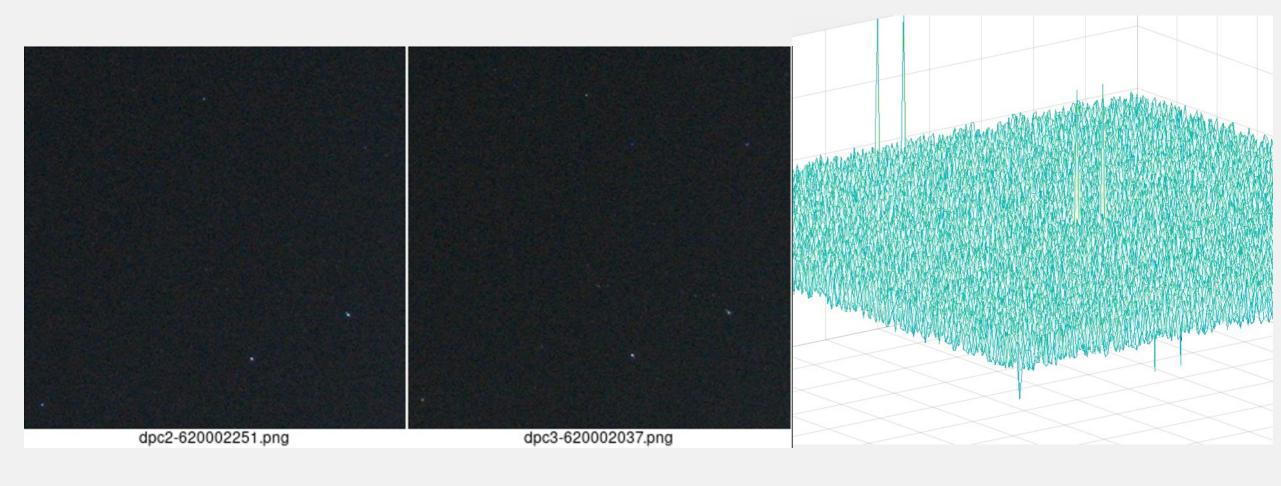


第二部分

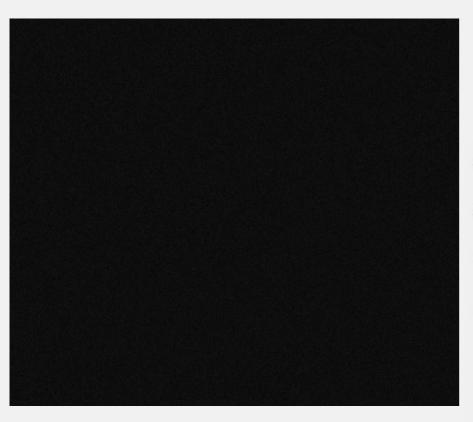
ISP 模块概述

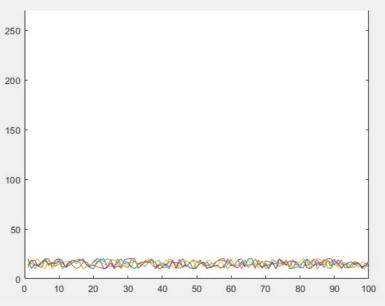
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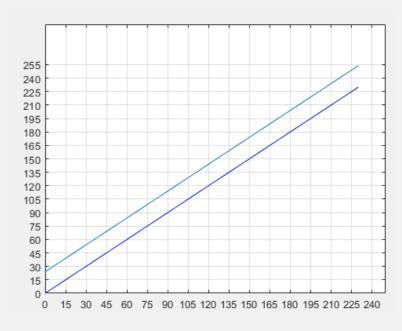
DPC (Dead Pixel Correction): 图像中会有一些特别突兀的点,会对图像的质量产生干扰。动态的去掉这些点



BLC (Black Level Correction): 在无光照的情况下,黑色图像在数值上并不是 0. 需要减去一个平均值,让纯黑图像在数值上回归到 0.







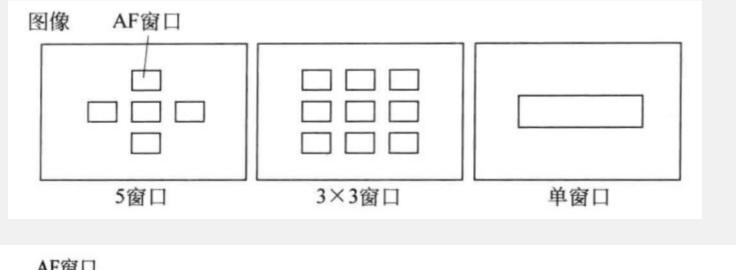
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BNR (Bayer Noise Reducation): 在 bayer 域上对图像进行降噪.

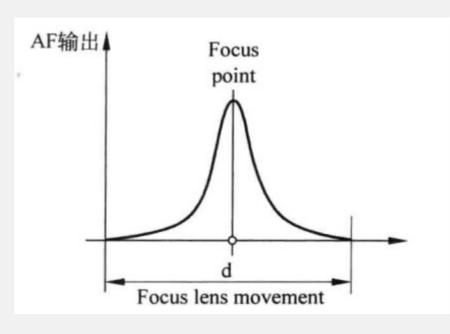
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	_	. 2	3	4	5	6	<i>'</i>	8	9	10	11	12					1						2		
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2	G	R	G	R	G	R	G	R	G	R	G	R										G		G	
3	В	G	В	G	В	G	В	G	В	G	В	G			В		В		В		G		G		G
4	G	R	G	R	G	R	G	R	G	R	G	R										G		G	
5	В	G	В	G	В	G	В	G	В	G	В	G			В		В		В				G		
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9	В	G	В	G	В	G	В	G	В	G	В	G				G		G							
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15	В	G	В	G	В	G	В	G	В	G	В	G													

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AF (Auto Focus): 指相机以特定区域(一般指中央,但现在的系统已经可以指定在观景窗内看到的任何一点角落),进行通过多种函数(灰度,梯度,拉普拉斯等)进行评估、进而调整镜头中镜片形成焦点,使照相机内的影像看起来清晰

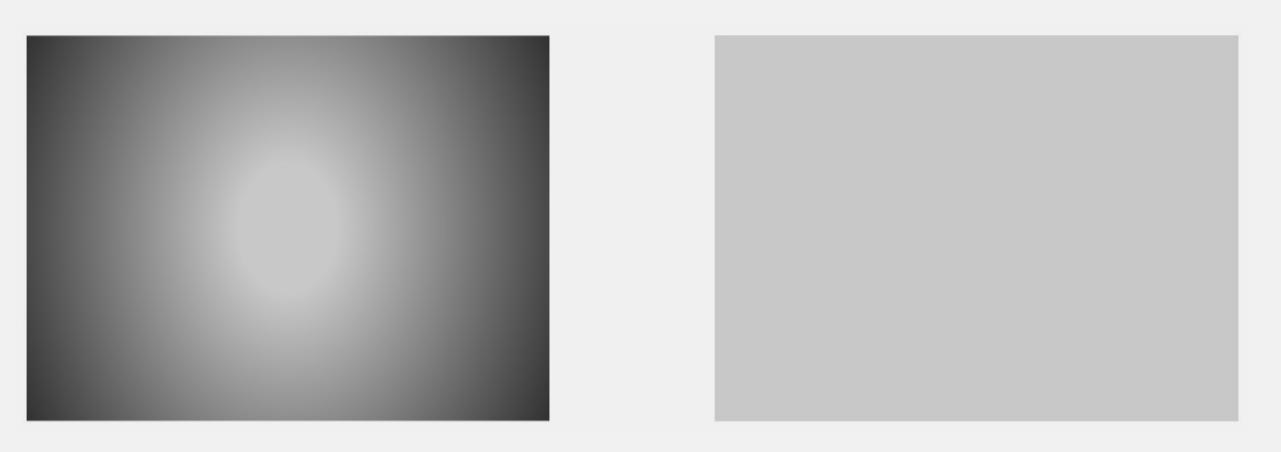






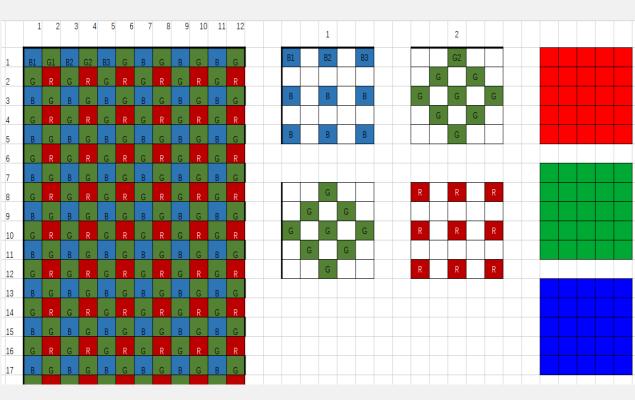
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LSC (Lens Shading Correction): 镜头阴影矫正,镜头在捕捉图像时会因为物理结构的限制,在图像的边缘产生暗角或色彩失真



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Demosaic: Bayer 图转成 RGB 图





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CCM: Color Correction Matrix

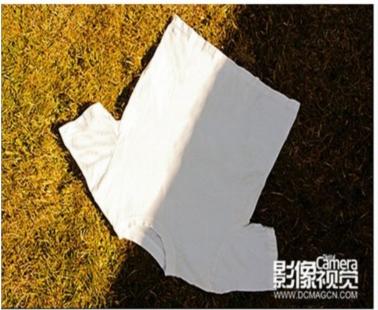
$$\begin{bmatrix} R_{out} \\ G_{out} \\ B_{out} \end{bmatrix} = \begin{bmatrix} C_{00} & C_{01} & C_{02} \\ C_{10} & C_{11} & C_{12} \\ C_{20} & C_{21} & C_{22} \end{bmatrix} \begin{bmatrix} R_{in} \\ G_{in} \\ B_{in} \end{bmatrix}$$



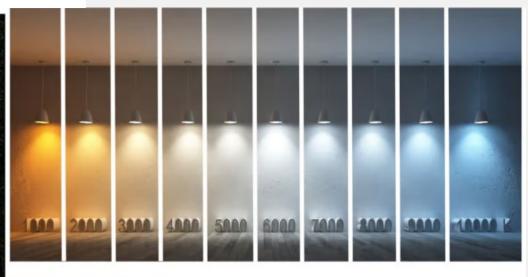
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AWB: Auto White Balance

$$egin{cases} ext{R}^{'} = ext{gain}_{ ext{R}} * ext{R} \ ext{B}^{'} = ext{gain}_{ ext{B}} * ext{B} \ ext{G}^{'} = ext{gain}_{ ext{G}} * ext{G} \end{cases}$$







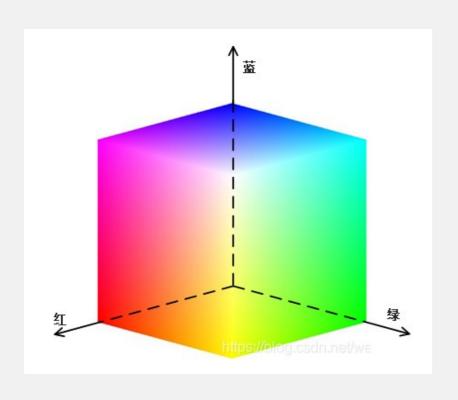
暖白 2700K-3300K

日光白

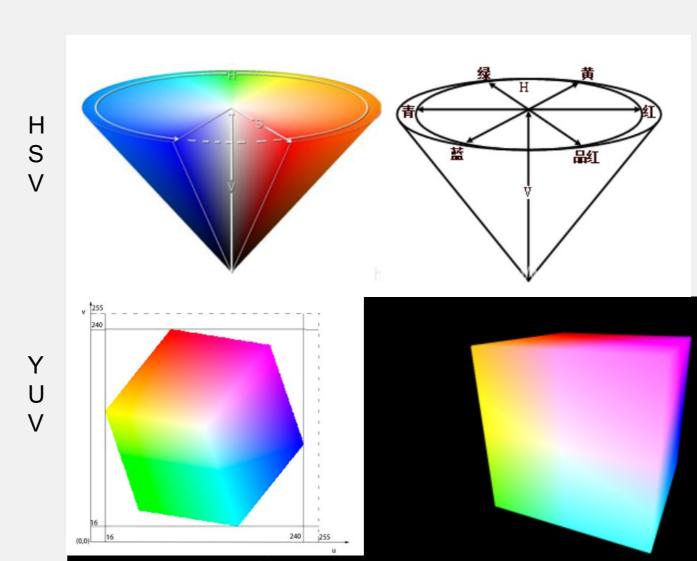
5500-7000K

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CSC coloer space convert: 不同的颜色有着不同的色彩模型



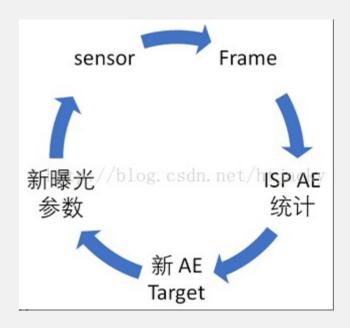
RG B



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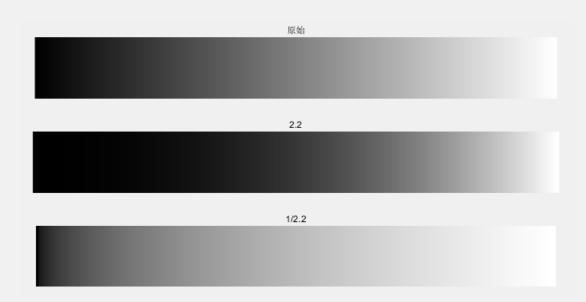
AE: Auto Exposure 自动曝光

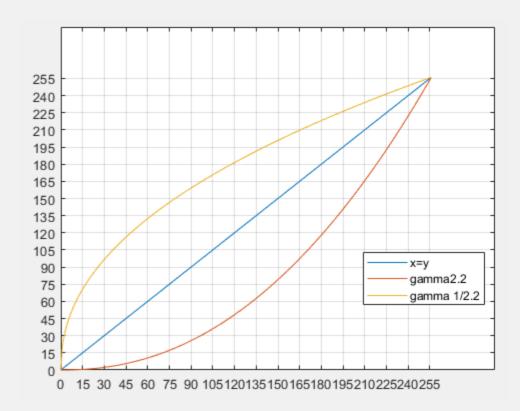
曝光程度	P 值	V 分量直方图
曝光不足	o	9 8 7 6 5 4 3 2 1 0 0 01 02 03 04 05 06 07 08 09
曝光正常	0.546	2.5 2 1.5 1 0.5 0 0.1 0.2 0.3 0.4 0.5 0.8 0.7 0.8 0.9
曝光过度	11.428	2.5 ×10°



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Gamma: 使亮度均匀变换



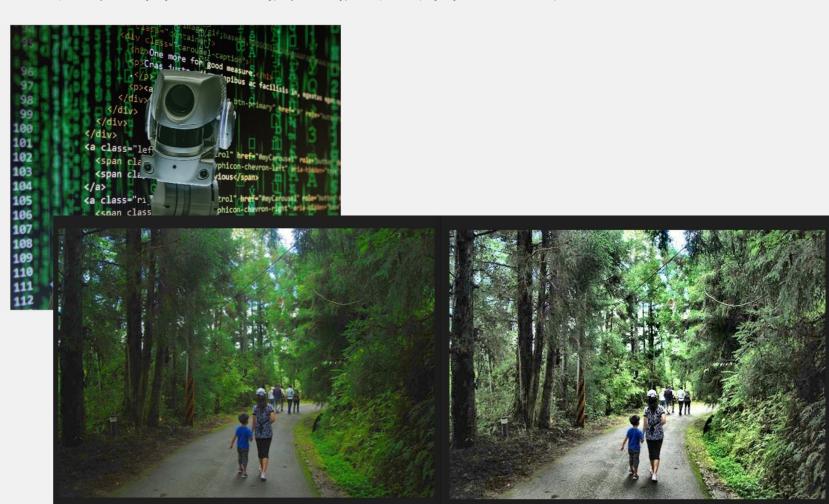


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图像增强与去噪:

图像的增强在很多时候会导致噪音被放大,而图像去噪在很多时候会导致图像细节丢失





第三部分

课程安排



1. 算法原理介绍



2. matlab 源码实现



3. matlab 源码量化



On 4. FPGA 算法架构



5. 分模块设计



6. 时序收敛



7. 功能仿真

感谢观看

