



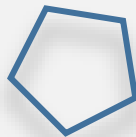
LSC-Lens Shading Correction



食鱼者



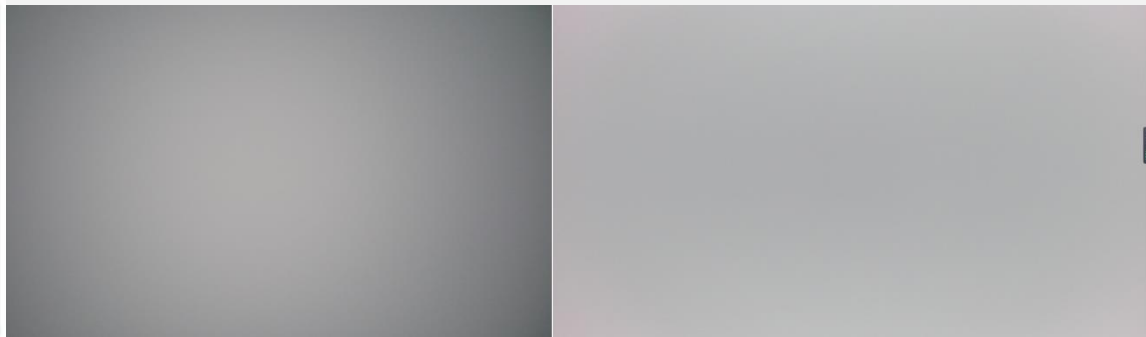
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LSC-Lens Shading Correction



color shading



Luma shading

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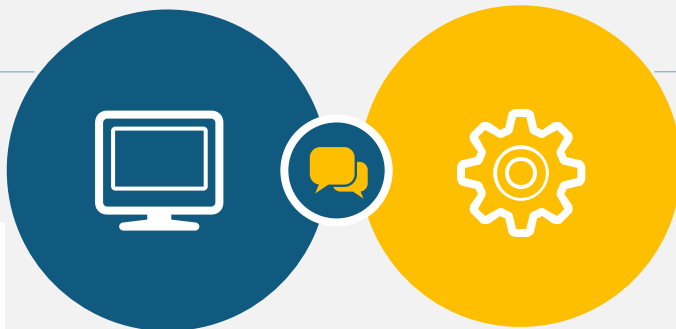
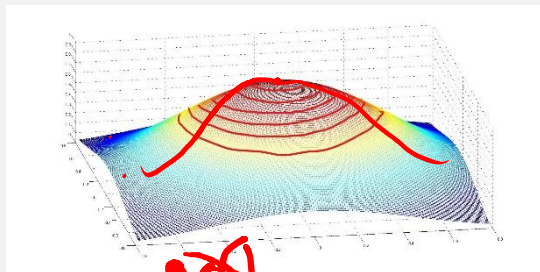
01 产生原因



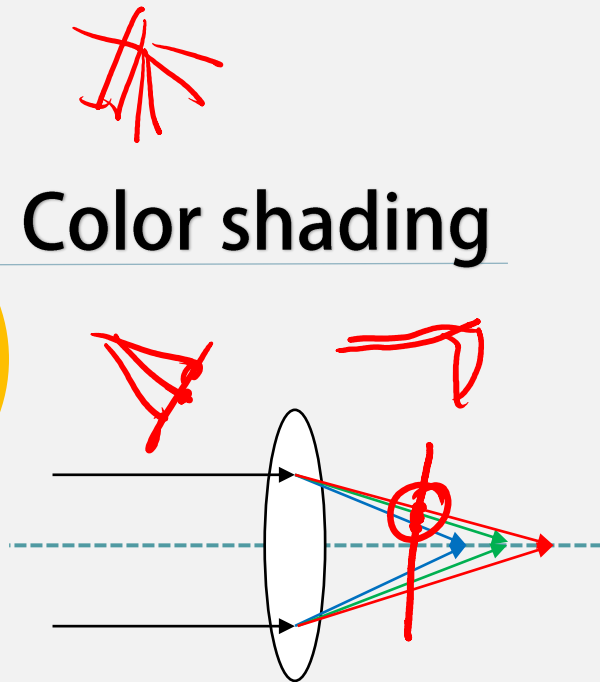
LS产生原因

Luma shading

$\cos^4 \theta$



Color shading





02

LS校正方法





LS校正-LUT校正法

Dot
0.50

target
for 2

增益

tuning

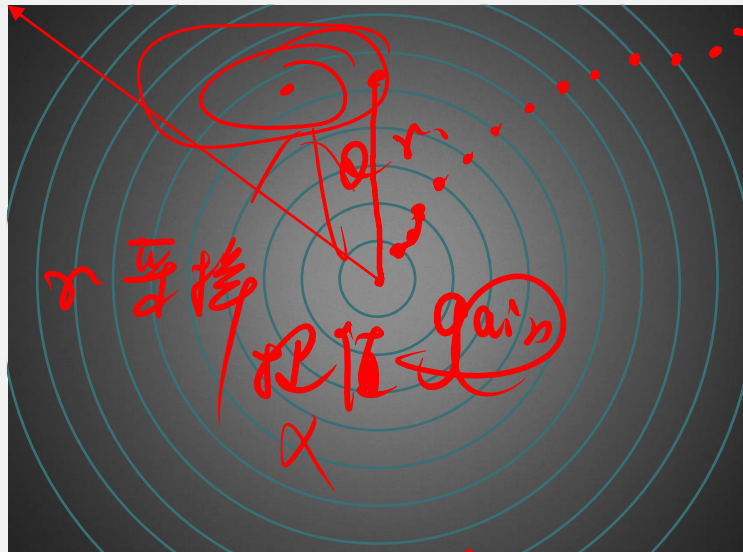
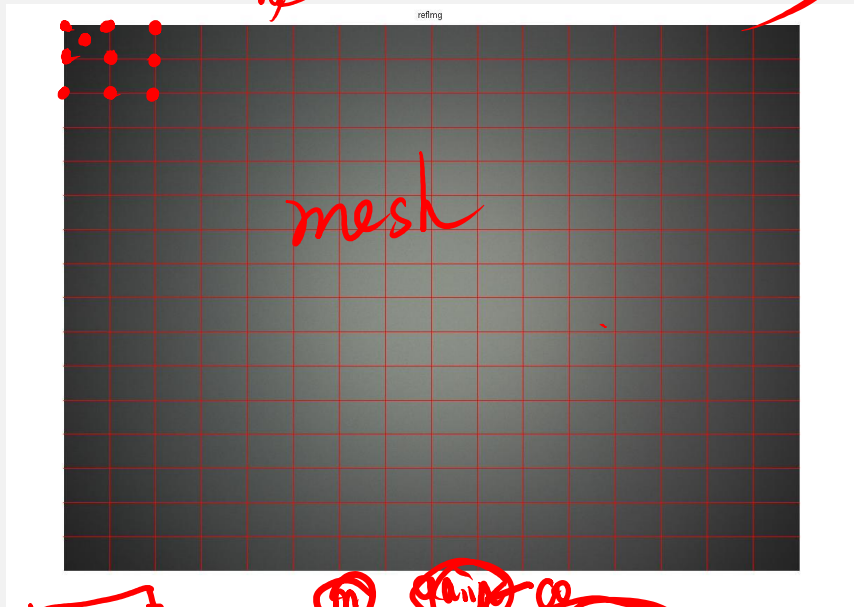
x_{gain}
200

200

200

LSC

$\cos \varphi_c(\theta)$



1.1 x 11
Data → mesh mean
gain 1000
red

$$r = \text{gain} \cdot (x, y) \rightarrow (x_c, y_c)$$
$$\sqrt{(x-x_c)^2 + (y-y_c)^2}$$



LS校正-多项式拟合

基于FPGA的镜头光照度补偿算法研究与实现

摘要

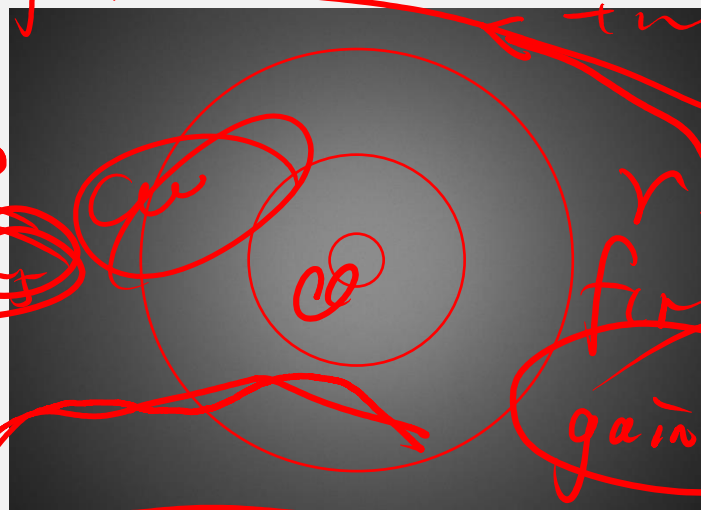
当今,CMOS成像技术已经获得主流成像市场的认可,诸如笔记本电脑、PDA、数码相机、智能手机相机等手持电子设备均采用了CMOS图像传感器技术。然而,单纯经过CMOS图像传感器得到的图像并不可以直接使用,它存在图像亮度不均匀、边缘亮度不足、画质的质量缺陷,还需经过图像处理器进一步进行处理,方可得到较为满意的图像。

文章首先对镜头光照度衰减成因进行了深入研究。镜头光照度补偿为图像处理器的一部分,其作用在于提升图像亮度均匀性,重点提高图像边缘的亮度,消除因镜头光照度衰减导致的图像中心与边缘亮度差异较大的缺陷,保证图像信息的完整性。采用分段线性补偿、高次曲线拟合技术手段,以高拟合曲线的平滑度,使处理后的图像亮度分布较分段线性处理更加均匀,运用MATLAB软件编写光照度补偿算法对图像进行处理,根据处理结果调整算法和参数,具有计算方便、参数调整简易的特点。运用Verilog语言设计论文算法,给出了数据流程图及实际编译后的顶层模块图,引入便于硬件实现的近似计算,减少芯片面积、降低功耗,设计结果符合算法要求。采用操作数隔离与时钟门控技术对设计进行了功率优化。

经Imatest软件对处理后图像进行测试,测试表明论文的算法达到了镜头光照度补偿的目的,与处理前图像相比,图像亮度平滑度明显提升,满足了图像边缘与中心亮度差不高于20%的预期性能指标要求。

关键词: CMOS图像传感器; 图像处理; 光照度补偿; 暗角修正

$$f(x) = ax^4 + bx^3 + cx^2 + dx + e$$



$$\begin{aligned} & \text{gain} = 22 + (r-x(2)) \cdot (r-x(3)) \cdot (r-x(4)) \cdot (r-x(5)) \\ & / ((x(1)-x(2)) \cdot (x(1)-x(3)) \cdot (x(1)-x(4)) \cdot (x(1)-x(5)) \cdot rGain(1) \\ & + (r-x(1)) \cdot (r-x(3)) \cdot (r-x(4)) \cdot (r-x(5))) \\ & / ((x(2)-x(1)) \cdot (x(2)-x(3)) \cdot (x(2)-x(4)) \cdot (x(2)-x(5)) \cdot rGain(2) \\ & + (r-x(1)) \cdot (r-x(2)) \cdot (r-x(4)) \cdot (r-x(5))) \\ & / ((x(3)-x(1)) \cdot (x(3)-x(2)) \cdot (x(3)-x(4)) \cdot (x(3)-x(5)) \cdot rGain(3) \\ & + (r-x(1)) \cdot (r-x(2)) \cdot (r-x(3)) \cdot (r-x(5))) \\ & / ((x(4)-x(1)) \cdot (x(4)-x(2)) \cdot (x(4)-x(3)) \cdot (x(4)-x(5)) \cdot rGain(4) \\ & + (r-x(1)) \cdot (r-x(2)) \cdot (r-x(3)) \cdot (r-x(4))) \\ & / ((x(5)-x(1)) \cdot (x(5)-x(2)) \cdot (x(5)-x(3)) \cdot (x(5)-x(4)) \cdot rGain(5)) \end{aligned}$$



LS校正-多项式拟合

(54) LENS SHADING CORRECTION METHOD AND IMAGE SIGNAL PROCESSOR FOR PERFORMING THE SAME

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(72) Inventors: Po-Chang Chen, Tainan (TW); Yuan-Chih Peng, Tainan (TW); Kuan-Hua Chen, Tainan (TW)

(73) Assignee: Himax Imaging Limited, Tainan (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0.

(21) Appl. No.: 14/027,620

(22) Filed: Sep. 16, 2013

(51) Int. Cl.

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G06K 9/40 (2006.01)

H04N 5/357 (2011.01)

(52) U.S. CL.

CPC H04N 5/3572 (2013.01)

(58) Field of Classification Search

CPC H04N 5/3572; G06K 9/40

USPC 348/251; 382/174; 2/5

See application file for complete search history.

(56) References Cited

U.S. PATENT DOCUMENTS

2005/0179793 A1 8/2005 Sheng 348/251

2008/0044011 A1 2/2008 Kim et al. 348/251

2009/0210011 A1 8/2009 Yamaoka 348/251

2010/0007031 A1 1/2010 Wang et al. 348/251

* cited by examiner

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ABSTRACT

A lens shading correction method for pixels of an image is provided. The method includes the steps of: inputting coordinates of the pixels; setting a threshold range on the image; providing a first gain function and a second gain function, each relating the coordinates of the pixels to brightness gains; performing the first gain function on the pixels located at the interior of the threshold range for calculating the brightness gains; and performing a blended gain function on the pixels located at the exterior of the threshold range for calculating the brightness gains, wherein the blended gain function is the combination of the first gain function and the second gain function.

1. A lens shading correction method for pixels of an image is provided. The method includes the steps of: inputting coordinates of the pixels; setting a threshold range on the image; providing a first gain function and a second gain function, each relating the coordinates of the pixels to brightness gains; performing the first gain function on the pixels located at the interior of the threshold range for calculating the brightness gains; and performing a blended gain function on the pixels located at the exterior of the threshold range for calculating the brightness gains, wherein the blended gain function is the combination of the first gain function and the second gain function.

2. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

3. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

4. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

5. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

6. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

7. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

8. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

9. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

10. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

11. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

12. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

13. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

14. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

15. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

16. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

17. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

18. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

19. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

20. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

21. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

22. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

23. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

24. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

25. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

26. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

27. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

28. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

29. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

30. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

31. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

32. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

33. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

34. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

35. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

36. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

37. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

38. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

39. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

40. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

41. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

42. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

43. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

44. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

45. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

46. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

47. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

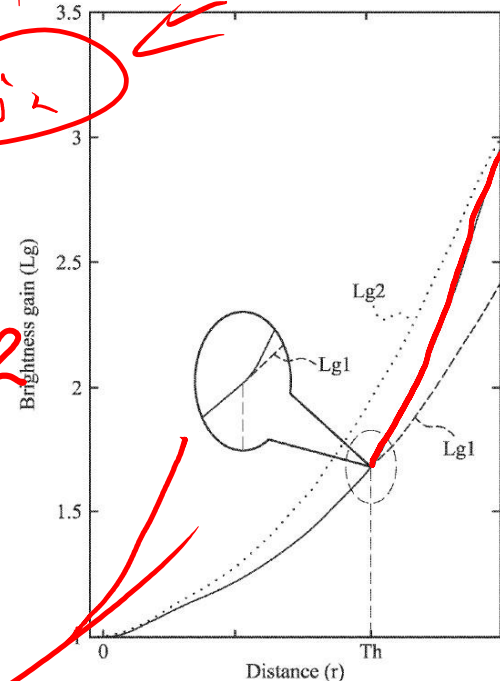
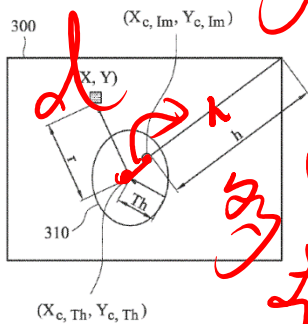
48. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.

49. The method of claim 1, wherein the blended gain function is the combination of the first gain function and the second gain function.



$$\alpha = \left| \frac{r^2 - Th^2}{d^2 - Th^2} \right|$$

$$r = g_{\text{env}} \cdot x$$



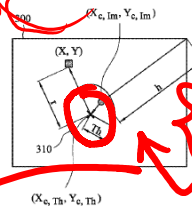
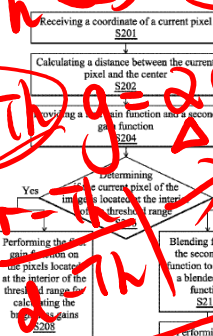
target

$$r < Th \Rightarrow$$

$$r > Th \Rightarrow$$

$$\alpha = \left| \frac{r^2 - Th^2}{d^2 - Th^2} \right|$$

$$\alpha = h + \sqrt{1 - h^2}$$



gain1
gain2



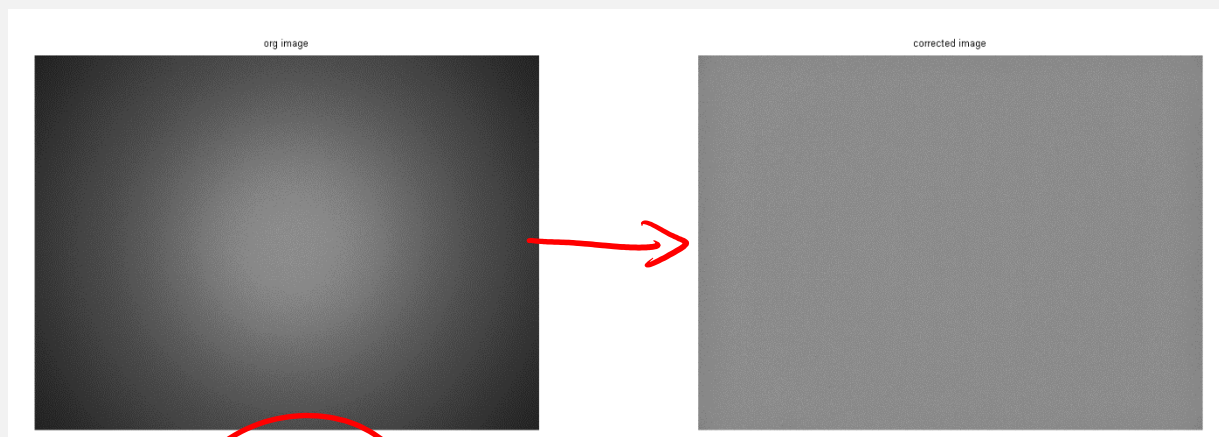
02

LSC的实现

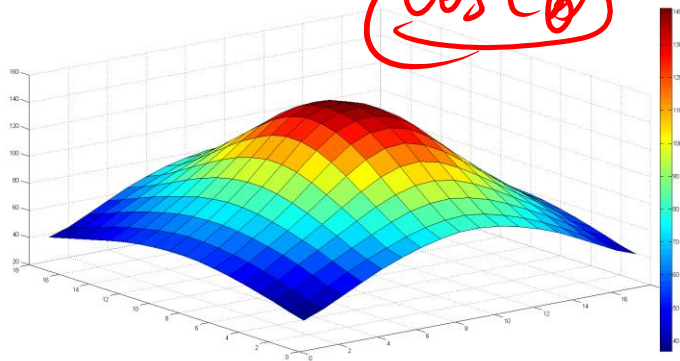




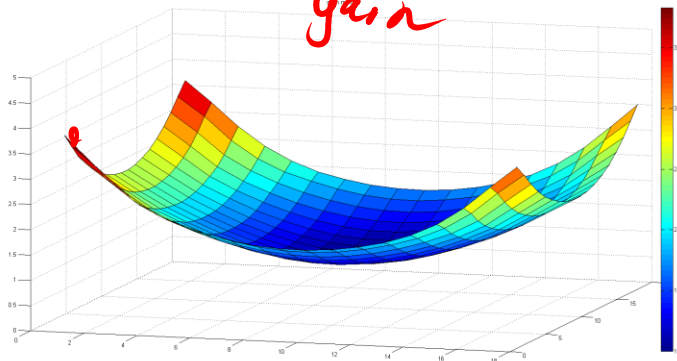
LSC实现



$\cos \epsilon$



gain





食鱼者



202106



wtzhu13



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猪猪爱吃鱼



wtzhu__13

See You!