Digital Vision Project #1

High Dynamic Range Imaging

M11015053 黃俊翰 M11015Q21 易可鈞

拍照設備:

Samsung Galaxy Note 20 Ultra

開發環境:

Python 3.8.12

Library

1. **Opencv**
2. **Scipy**
3. **Numpy**
4. **Matplotlib**

實作內容

1. **MTB alignment** 根據上課所說實作 MTB ，

   第一步 : 轉灰階

   第一步 : 將圖片 pixel 值<=median =0, 反之=255,取得 mask

   第三步 : 圖片 resize 5 次後,依 9 種移動的組合位移 pixel 值,選擇誤差最大的

(-1,1)	(0,1)	(1,1)
(-1,0)	(0,0)	(1,0)
(-1,-1)	(0,-1)	(1,-1)

   第四步 : 把圖片依序回推最佳的移動 pixel 值,最後在原圖上位移得到的最佳 pixel 值

   將所有圖片對齊第一張圖片。

2. **HDR** 實作課堂提到的 Paul Debevec's method，

使用 python 的 scipy library 來填 sparse matrix 和解 least square solution

然後將得到的 g(x) function 經由下面式子得到 irradiance map

$$\ln E_i = \frac{\sum_{j=1}^{P} w(Z_{ij})(g(Z_{ij}) - \ln \Delta t_j)}{\sum_{j=1}^{P} w(Z_{ij})}$$

3. **Tone mapping** 實作 Durand 的方法。

參考了 Durand 的 GitHub 上詳細的步驟

```
 3- The algorithm
##################

Here is the pseudo-code for the algorithm:
(a) load a HDR RGB image
(b) compute an intensity layer I
(c) compute log(I)
(d) filter log(I) using the bilateral filter to get log(F)
(e) compute a detail channel D = log(I) - log(F)
(f) compute: delta = max[log(F)] - min[log(F)]
(g) compute: gamma = log(constrast) / delta
(h) compute the new intensity layer: N = 10^[gamma*log(F) + D]
(i) scale the RGB values by N/I
(j) save a LDR image

Comments
--------

(b) We use the simple formula: I = (20R + 40G + B) / 61;

(c) We use the logarithm in base 10.

(g) 'constrast' is the parameter given on the command line

(j) To ensure a correct display, the image should be
gamma-corrected. First, we scale the RGB values by
1/max[gamma*log(F)]. This ensures that the new intensity of the base
layer F spans [0:1]. Second, we gamma-correct the RGB values using a
standard gamma value (2.2). Finally, we quantize the RGB values down
to 8 bits.
```

首先拿出得到圖片的 intensity

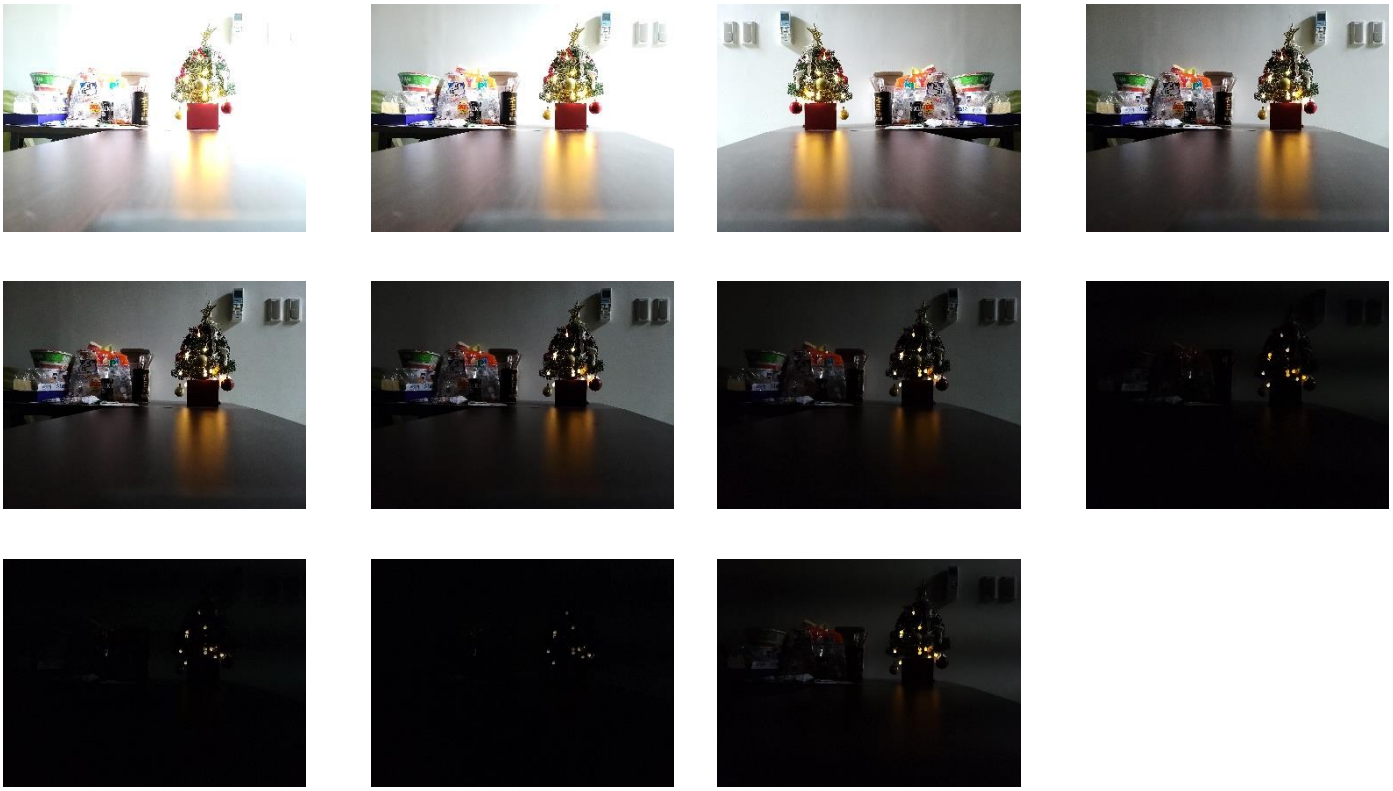
接著在 log domain 上用 bilateralFilter 取得 low_pass 的圖(),將 log(intensity)-log(low_pass)取得 log(high_pass)的部分,把 low_pass 的部分壓縮後+回 high_pass 的部分並還原回一般的 domain

再來將 HDR 的 RGB 值分別除以 intensity 再乘上上一步還原回一般 domain 的結果分別得到 LDR 的 RGB

最後把結果轉型成 unsign int8 並輸出

INPUT

Data1



Data2

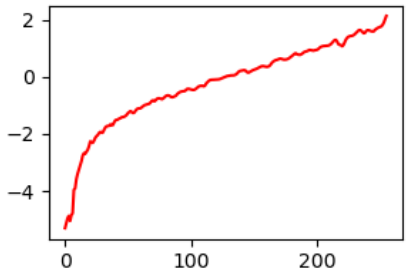
Result :

recovered HDR :

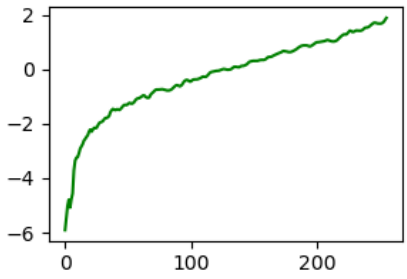
Data1

Response curve

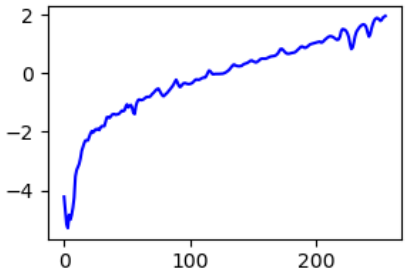
R :

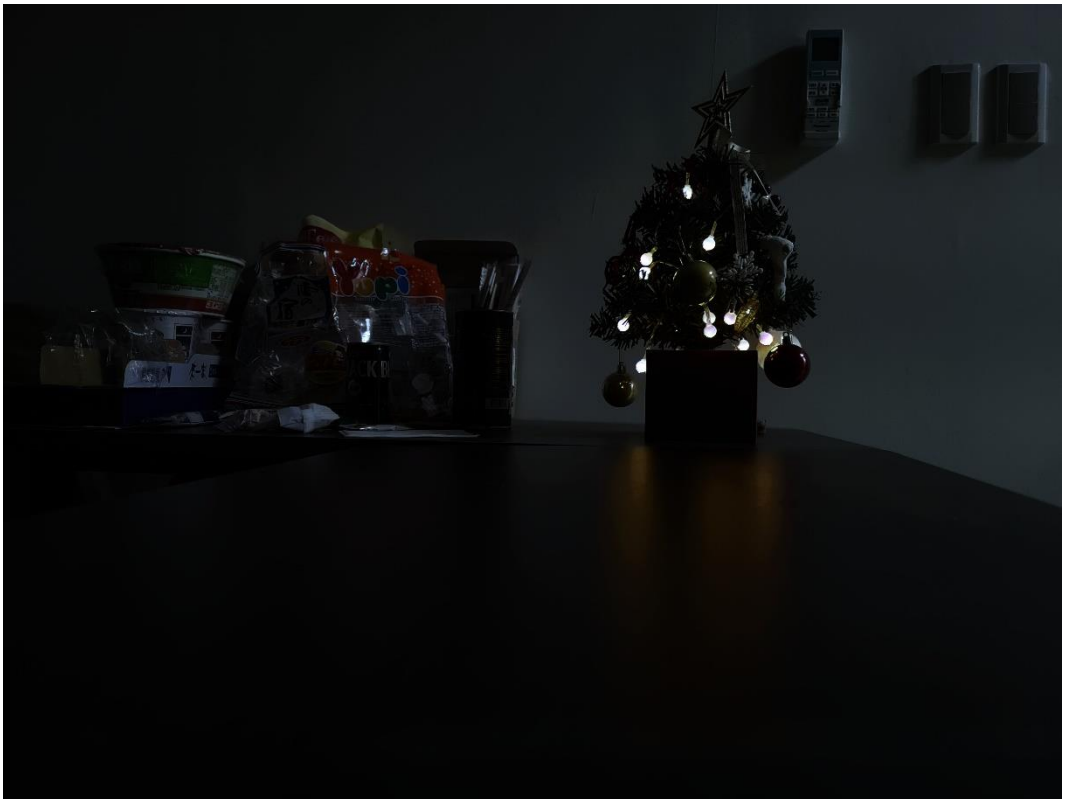


G :



B :

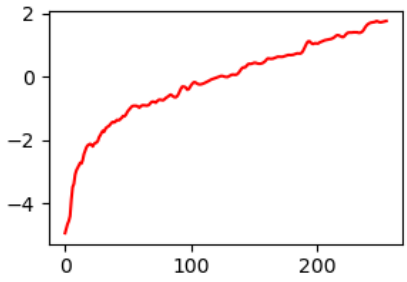




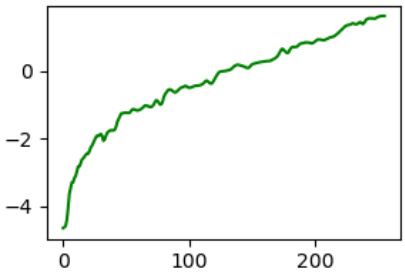
Data2

Response curve

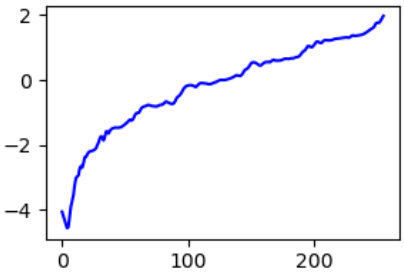
R :



G :

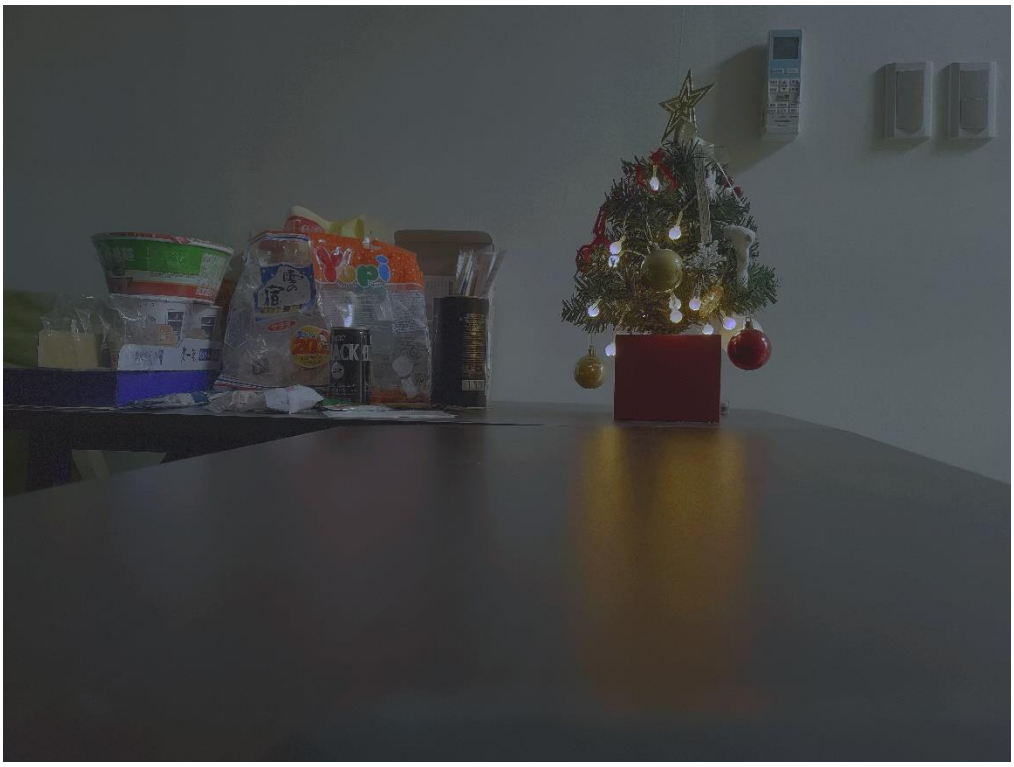


B :



tone mapping result :

Data1



Data2