

Adding bloom and corona effects to image

František Dráček
dracek1@uniba.sk

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Basic steps

load image into python (preferable opencv imread)
transform image into Lab color scale :

```
Lab_img =cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
```

Select intensity channel of transformed image :

```
L = Lab_img[:, :, 0]
```

Select n brightest pixels with largest L value

Apply mask/filter/kernel as described in article to selected pixel

Cut of values of L larger than maximum range $L \rightarrow \text{Min}(L, 255)$

Mask construction

masks are essentially matrices

in this case, we will use matrix-coordinate system indexed from middle of matrix

the values of matrix are given by point spread function:

$$P(r, \phi) = \begin{cases} 1 - \epsilon, & \text{if } r = 0 \\ \epsilon f(r, \phi), & \text{otherwise} \end{cases} \quad (1)$$

for the bloom mask

$$f_b(r, \phi) = \frac{\epsilon}{(1 + (\frac{r}{R})^2)^\beta} \quad (2)$$

Indexing

in this case, we will use matrix-coordinate system indexed from middle of matrix relation between usual indices (i,j) in range $(0,2n+1)$ and middle indexed indices (k,l) in range $(-n,n)$ is $k=i-n$ $l=j-n$

$$\begin{bmatrix} (0,0) & (0,1) & \cdots & (0,2n) \\ (1,0) & (1,1) & \cdots & (1,2n) \\ \vdots & \vdots & \ddots & \vdots \\ (2n,0) & (2n,1) & \cdots & (2n,2n) \end{bmatrix} \rightarrow \begin{bmatrix} (-n,-n) & (-n,n+1) & \cdots & (-n,n) \\ (-n+1,-n) & (-n+1,-n+1) & \cdots & (-n+1,n) \\ \vdots & \vdots & \ddots & \vdots \\ (n,-n) & (n,-n+1) & \cdots & (n,n) \end{bmatrix} \quad (3)$$

the new (k,l) indices can be transformed into polar indices as

$$r = \sqrt{k^2 + l^2} \quad (4)$$

$$\phi = \tan^{-1}(k/l) \quad (5)$$

(I encourage you to use `np.arctan2(x,y)`)

Mask application

to calculate new value of selected pixel we apply mask K as

$$I(x, y) = \sum_{x_0, y_0} * K(x - x_0, y - y_0) \quad (6)$$

Thank you!