README.md

High Dynamic Range Imaging

This is a python project from recovering the response curve to reconstruct the irradiance map(HDR) in the real scene.

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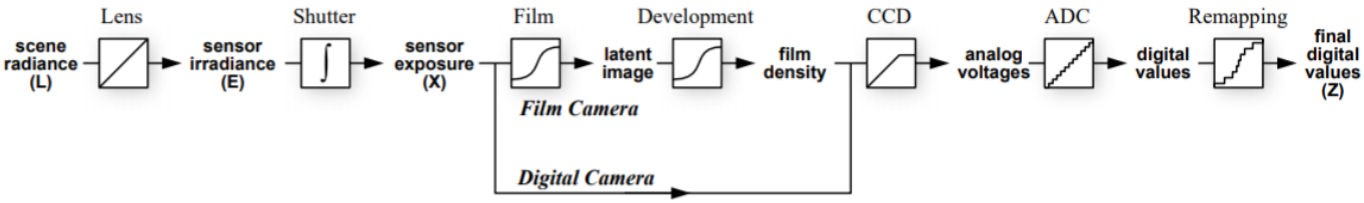
Summary for TA

- this project is based on high-dynamic-range-image
- modified most of the function
- rewrite the `computeRadianceMap()` function in `./hdrtool/hdr.py` and reduce running time down to **3%**.
- implemented the tone mapping function.
- great photography^^

Outline

Project Description

There are several steps(shown below) between the scene radiance and the image we see. Starting from taking few photographs in different exposures, we use Paul Debevec's method to recover the response curve by these photographs. After we got the response curve, we are now able to reconstuct the irradiance map also known as HDR images. Also, we developed a global tone mapping algorithm to see the combination of these photographs.



Algorithms

Recovering the Response Curve

The function of response curve is a general term for the many steps shown above. To recover from pixel values record on image to radiance map we need a function g which is: .

$$\mathcal{O} = \sum_{i=1}^{N}\sum_{j=1}^{P}\{w(Z_{ij})[g(Z_{ij}) - \ln E_i - \ln \Delta t_j]\}^2 + \sum_{z=Z_{min}+1}^{Z_{max}-1}[w(z)g''(z)]^2$$

- g is the unknown response function
- w is a linear weighting function. g will be less smooth and will fit the data more poorly near extremes (Z=0 or Z=255). Debevec introduces a weighting function to enphasize the smoothness fitting terms toward the middle of the curve.
- t_j is the exposure time in index j

- E_i is the unknown radiance in different pixel i
- Z_{ij}: is the observed value in pixel i and j exposure time
- i is the pixel location index, j is the exposure index and **P** is the total number of exposures.

Reconstruct the Irradiance Map

And now we can reconstruct the irradiance map by the formula below.

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

After this step, we are able to have the `output.hdr` file.

Global Tone Mapping

In this part, we implemented a naive global tone mapping algorithm(shown below) to get a image which can match our visual experience.

$$L_d(x,y) = \frac{L_m(x,y)(1 + \frac{L_m(x,y)}{L_w^2(x,y)})}{1 + L_m(x,y)}$$

and now we can have the result.

Usages

There are python file and ipython notebook for you to choose.

Prepare Images and Meta Data

Put your images in a single folder and prepare your meta data file. The meta file should contains filename and exposure time separated with spaces(see `./example/park3.csv`). There are meta file creator in `createMeta.ipynb` if your images contains EXIF data.

Start

here is an example to run the code.

```
python3 computeHDR.py --img-dir [IMG_DIR] --meta_path [META_PATH_IN_CSV]
```

to see more parameters

```
python3 computeHDR.py --help
```

Results

Original image

			
Exposure 1/4 sec	**Exposure 1 sec**	**Exposure 4 sec**	**Exposure 15 sec**

HDR image

Acknowledgements

- Digital Visual Effects
- high-dynamic-range-image
- HDR-Imaging