

DATASETS

Name	Path	N	Desc
Relighted Cube+ complex segmentation	project/dataset_relighted	13950	Corrected Cube+ images relighted by finding edges and contours, combination of saturated and non-saturated images
Combined dataset	project/dataset_combined	3064/2589 ¹	Corrected Cube+ images relighted using all tried segmentation models (convex hull, threshold, erosion, edges...) which contains saturated images
Adaptive threshold dataset	project/complex6	1030	Corrected Cube+ images relighted using adaptive threshold ² segmentation which contains saturated images
Lab - projector	project/lab/combined[_tiff]	248	Images taken of objects illuminated by one projector projecting an image simulating two illuminants
Lab - projector+ambient	project/lab/realworld[_tiff]	10	Images taken of scenes where one illuminant is ambient, and one is generated by a projector
Crf - laboratory	project/dataset_crf/lab	58	Images of objects in a dark environment illuminated by two light sources, small difference between illuminants
Crf - realworld	project/dataset_crf/realworld	20	Images of real-world scenes with one artificial illuminant, has many unbalanced masks
Test	project/dataset_test	70	Test images combined from all datasets to evaluate model performance

¹ Regression/Segmentation

² Adaptive threshold – threshold for detecting contours was acquired taking the mean luminance and adding a random shift vector

Dataset directory structure:

__ images	- Images used as the input for the regression model and model testing
__ gt	- The groundtruth information about the illumination for each pixel
__ img_corrected_1	- Images corrected for one illuminant, used to train segmentation models
__ gt_mask	- The mask used for segmentation ³

³ Obtained by clustering illuminant values in groundtruths and comparing each pixel to one of the centers to determine to which illuminant it is closer

RESULTS

Segmentation						
Model	Dataset		Dice			
	Train	Test	Mean	Std	Max (id)	Min (id)
U-Net efficientnet b0	Combined	V1@dataset_test	0.570	0.177	0.809 (9)	0.003 (37)
	Adaptive thresh	V1@dataset_test	0.587	0.104	0.803 (9)	0.292 (64)
Custom U-Net	Adaptive thresh	V1@dataset_test	0.357	0.200	0.797 (5)	0.101 (10)
U-Net efficientnet b2	Desaturated	V1@dataset_test	0.586	0.158	0.807 (2)	0.005 (66)

Table 2. Results of the segmentation model on the test dataset. The desaturated dataset refers to the original generated dataset with ~ 9000 images with only desaturated illuminants.

Discussion:

- Custom architecture was too simple to achieve any sort of competitive results
- Little difference between the EfficientNet U-Nets, however the B2 architecture is still being trained and could improve
- There isn't much difference in between the median and the mean values, so only mean is shown

Regression								
Model	Dataset		Angular error per-pixel					
	Train	Test	Mean	Std	Med.	Trimean	Min (id)	Max (id)
U-Net EfficientNet b2	Desaturated	V1@dataset_test	11.56	10.37	5.125	9.353	1.094 (15)	26.50 (68)
		Crf laboratory	25.52	0.779	25.51	25.51	24.14 (47)	25.82 (1)
		Crf realworld	26.24	0.953	26.21	26.17	24.45 (5)	28.73 (9)
		Generated test set	4.561	4.543	2.884	3.168	1.032 (15)	22.06 (22)
	Cube 12500 (desaturated + saturated)	V1@dataset_test	10.232	9.081	4.134	8.261	1.488 (1)	25.75 (64)
		Crf laboratory	22.63	1.233	22.41	22.53	20.84 (23)	25.83 (1)
		Crf realworld	25.60	1.025	25.86	25.95	22.95 (5)	26.80 (9)
		Generated test set	3.840	2.327	3.312	3.262	1.488 (1)	13.22 (5)
	Cube 15000 (desaturated + saturated)	V1@dataset_test	10.57	10.52	3.835	8.686	1.094 (0)	27.18 (64)
		Crf laboratory	25.74	0.959	25.66	25.69	24.46 (23)	28.25 (1)
		Crf realworld	26.69	1.007	26.96	27.03	24.16 (5)	28.24 (12)
		Generated test set	3.021	1.351	2.897	2.901	1.094 (0)	8.587 (5)

Table 3. Results of the regression models trained on different datasets. Experiments were conducted on the test dataset and the crf⁴ dataset

Discussion:

- High mean value and low trimean and median values indicate that there are numerous images for which the regression works well and a few for which it does not
- That is why additional experiments were conducted on the crf dataset, and the results show that the models perform bad on those images, which suggests overfitting on the train dataset
- It was noted that the saturated colors were problematic for these models (Appendix)

⁴ Shida Beigpour, Christian Riess, Joost Weijer, i Elli Angelopoulou. Multi-illuminant estimation with conditional random fields. *IEEE transactions on image processing: a publication of the IEEE Signal Processing Society*, 01 2014. doi: 10.1109/TIP. 2013.2286327.

Appendix

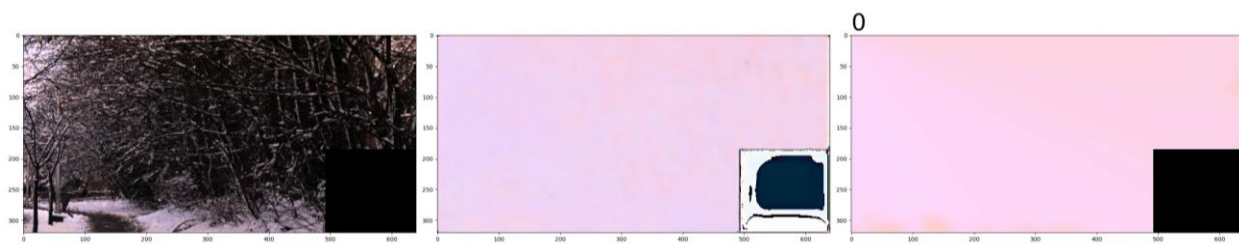


Figure 1: Output of the first regression model on the image with index 0 from the generated dataset, good performance of the model

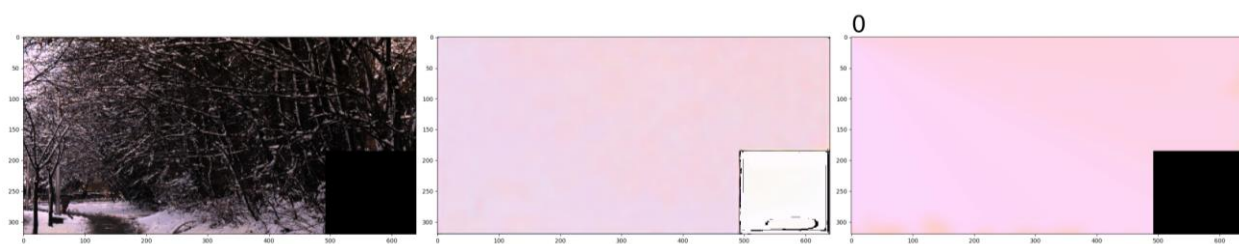


Figure 2: Output of the second regression model on the image with index 0 from the generated dataset, good performance of the model

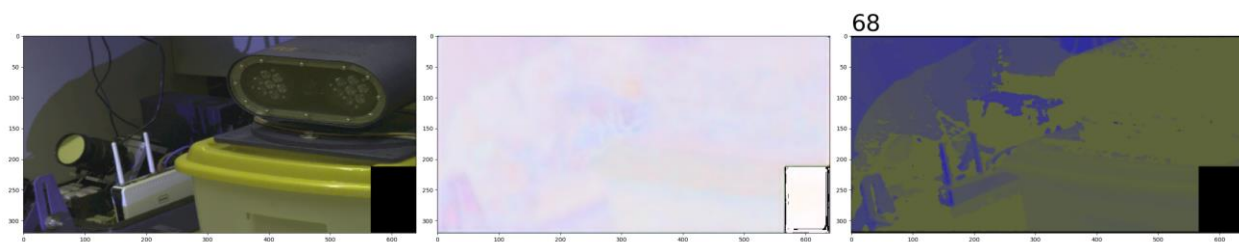


Figure 3: Output of the first regression model on the image with index 68 from the crf realworld dataset, poor performance of the model

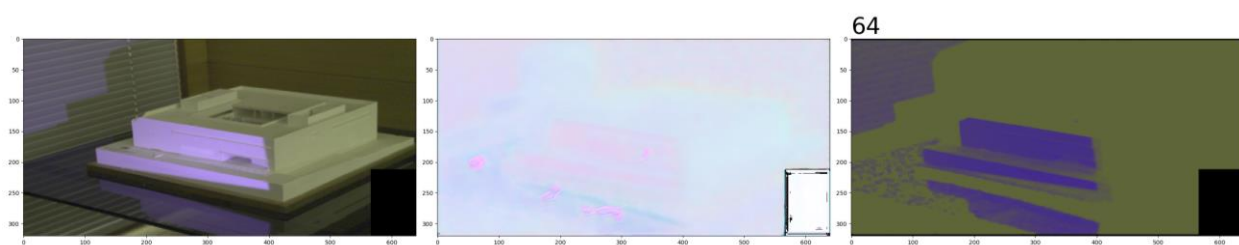


Figure 4: Output of the third regression model on the image with index 64 from the crf realworld dataset, poor performance of the model