Reversing Image Signal Processors by Reverse Style Transferring

Furkan Kınlı, Barış Özcan, Furkan Kıraç
Özyeğin University

AIM2022 Advances in Image Manipulation workshop in conjunction with ECCV 2022

Reversing the ISP

- RAW images are better suited for ill-posed low-level vision tasks such as denoising, HDR, or super-resolution.

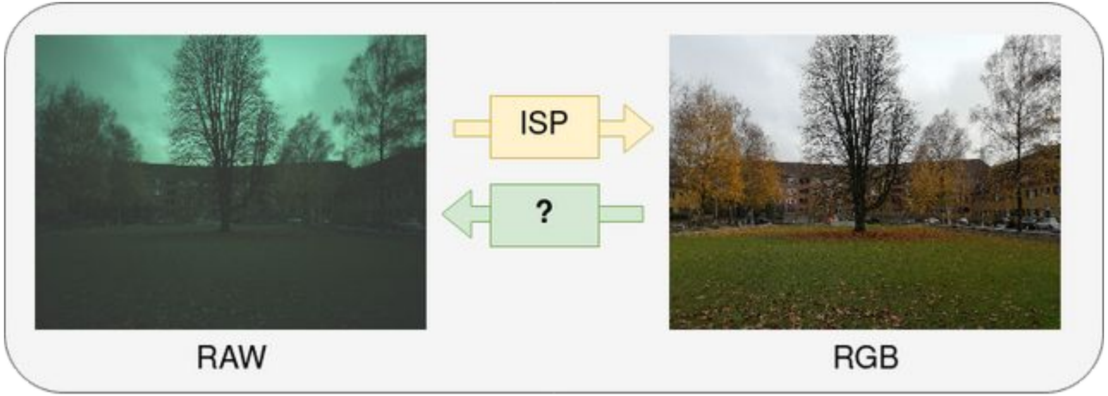
- There are very few RAW image datasets that are available.

- The use of synthetic data for training is an arguable practice.

- To improve the synthetic RAW image quality, we can estimate RAW image from sRGB data.

AIM 2022 Reversed ISP Challenge

- **Aim:** To obtain a network design or a solution, capable of producing high-quality RAW images from sRGB input images.



Retrieved [1]

[1] https://github.com/mv-lab/AISP#aim-2022-reversed-isp-challenge

Our Approach

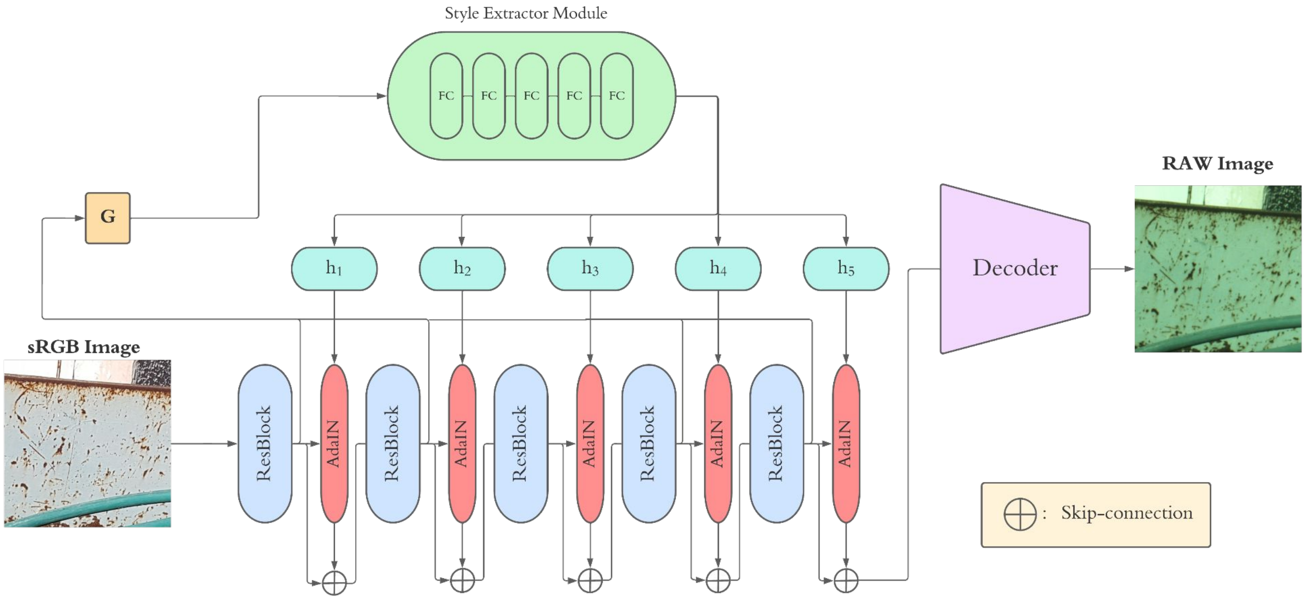
- We define the problem of reconstructing RAW images from sRGB input images as a reverse style transfer problem [2].

- Modeling the effects brought by the ISP’s operations as the style factor.
- Removing the injected changes to convert sRGB input images to its RAW format.

[2] F. Kınlı, B. Özcan, F. Kıraç; Instagram Filter Removal on Fashionable Images; CVPR Workshops, 2021.

RST-ISP-Net

- We propose a novel architecture, namely RST-ISP-Net, for learning to reverse the ISP operations with the help of adaptive feature normalization for transferring the style information.



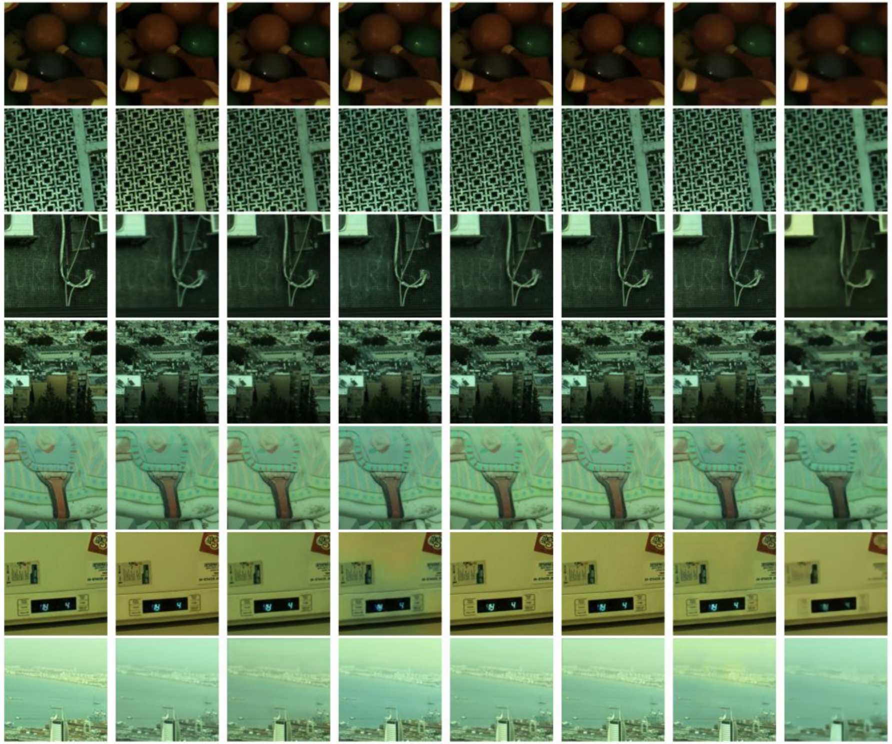
Experimental Details

- **Dataset:**
  - Samsung S7 DeepISP Dataset
  - ETH Huawei P20 Dataset
- **Metrics:**
  - Peak Signal-to-Noise Ratio (PSNR)
  - Structural Similarity (SSIM)
- **Hyper-parameters:**
  - **Optimizer:** Adam
  - **Batch size:** 8
  - **Learning Rate:** 1e-4 for generator
- **Misc.**
  - Not used any additional data for training and any ensembling strategy for inference.
  - 2 × NVIDIA RTX 2080Ti, ~1 day for training and validation.

Results

Team name	ED	ENS	Track 1 (Samsung S6) Test1 PSNR ↑	Track 1 (Samsung S6) Test1 SSIM ↑	Track 1 (Samsung S6) Test2 PSNR ↑	Track 1 (Samsung S6) Test2 SSIM ↑	Track 2 (Huawei P20) Test1 PSNR ↑	Track 2 (Huawei P20) Test1 SSIM ↑	Track 2 (Huawei P20) Test2 PSNR ↑	Track 2 (Huawei P20) Test2 SSIM ↑
NOAHTCV	✗	✗	31.86	0.83	32.69	0.88	38.38	0.93	35.77	0.92
MiAlgo	✗	✗	31.39	0.82	30.73	0.80	40.06	0.93	35.41	0.91
CASIA LCVG	✓	✓	30.19	0.81	31.47	0.86	37.58	0.93	33.99	0.92
HIT-IIL	✗	✗	29.12	0.80	29.98	0.87	36.53	0.91	34.07	0.90
CS2U	✓	✓	29.13	0.79	29.95	0.84	-	-	-	-
SenseBrains	✗	✓	28.36	0.80	30.08	0.86	35.47	0.92	32.63	0.91
PixelJump	✗	✓	28.15	0.80	n/a	n/a	-	-	-	-
HiImage	✗	✗	27.96	0.79	n/a	n/a	34.40	0.94	32.13	0.90
0noise	✗	✗	27.67	0.79	29.81	0.87	33.68	0.90	31.83	0.89
OzU VGL **(Ours)**	✗	✗	27.89	0.79	28.83	0.83	32.72	0.87	30.69	0.86
CVIP	✗	✗	27.85	0.80	29.50	0.86	-	-	-	-

Visual Comparison (Track S7)



0noise CASIA MiAlgo HiImage NOAH H-IIL Sense OzU

Visual Comparison (Track P20)

0noise CASIA MiAlgo HiImage NOAH H-IIL Sense OzU

Summary

- Thanks to the AIM Reversed ISP challenge, we have had a chance to try our idea for this problem.
- Removing the effects of the ISP operations by adaptive feature normalization leads to losing the high-frequency details in the output.
- The alignment issue among the pairs (Track 2) amplifies the problem.
- Wavelet-based discriminators for our adversarial training is not a proper solution.
- Need to reconsider to use of discriminative regularization on the output.
- Nevertheless, we believe that the style of being sRGB is successfully reverted back to the style of being RAW in our final outputs.

Thank you!

https://birdortyedi.github.io/