Report

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Abstract

Heavy rain image restoration is a key problem for many computer vision tasks. While fully supervised methods can achieve promising results on the synthetic heavy rain images and some real images, the generalization of these fully supervised methods on diverse testing images remains a challenging problme.

This work tries to focus on the unsupervised domain adaptation in heavy rain removal.

1 Pipelines

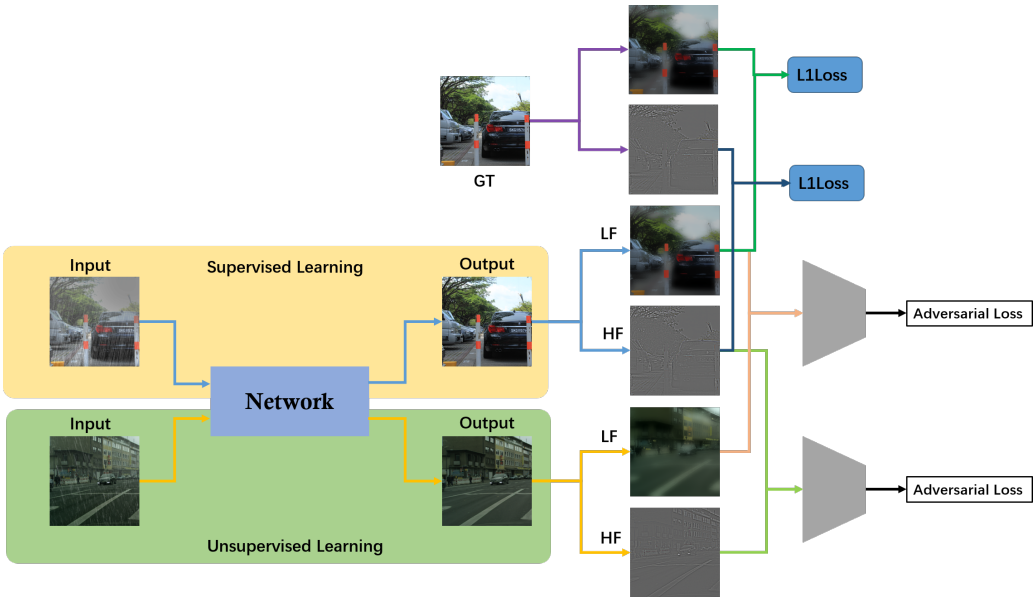


Figure 1: Frequency Level discrimination with Gaussian smoothing. The up part is the source domain, training with pixel-level loss. The bottom part is the target domain.

Contributions:

- First work tries to focus on domain adaptation for single image heavy rain removal.
- Propose an adversarial learning based semi-supervised learning for heavy rain removal, which allows for the utilization of both synthesized heavy rain images and real collected heavy rain images.
- Frequency decomposition for rain-streak removal and mist removal spontaneously.

Source domain: synthesized rainy/clean image in [3].
Target domain: real rain images collected from the Internet.

Some results:
Quantitative results on source domain:

Methods	PSNR	SSIM
Test on source domain	24.9878	0.8150

Table 1: Results.

(a) In (b) Pred (c) GT

Figure 2: Qualitative results on source domain.

2 Previous Results

Simple Image Discrimination

Methods	PSNR	SSIM
Test on source domain	25.5212	0.8303
Test on target domain	13.9828	0.6817

Table 2: Simple image discrimination

A direct adversarial learning on the prediction images. This discrimination supervision will make the target outputs have severe color deviation from the original input image.

Low-&High-Frequency iscrimination

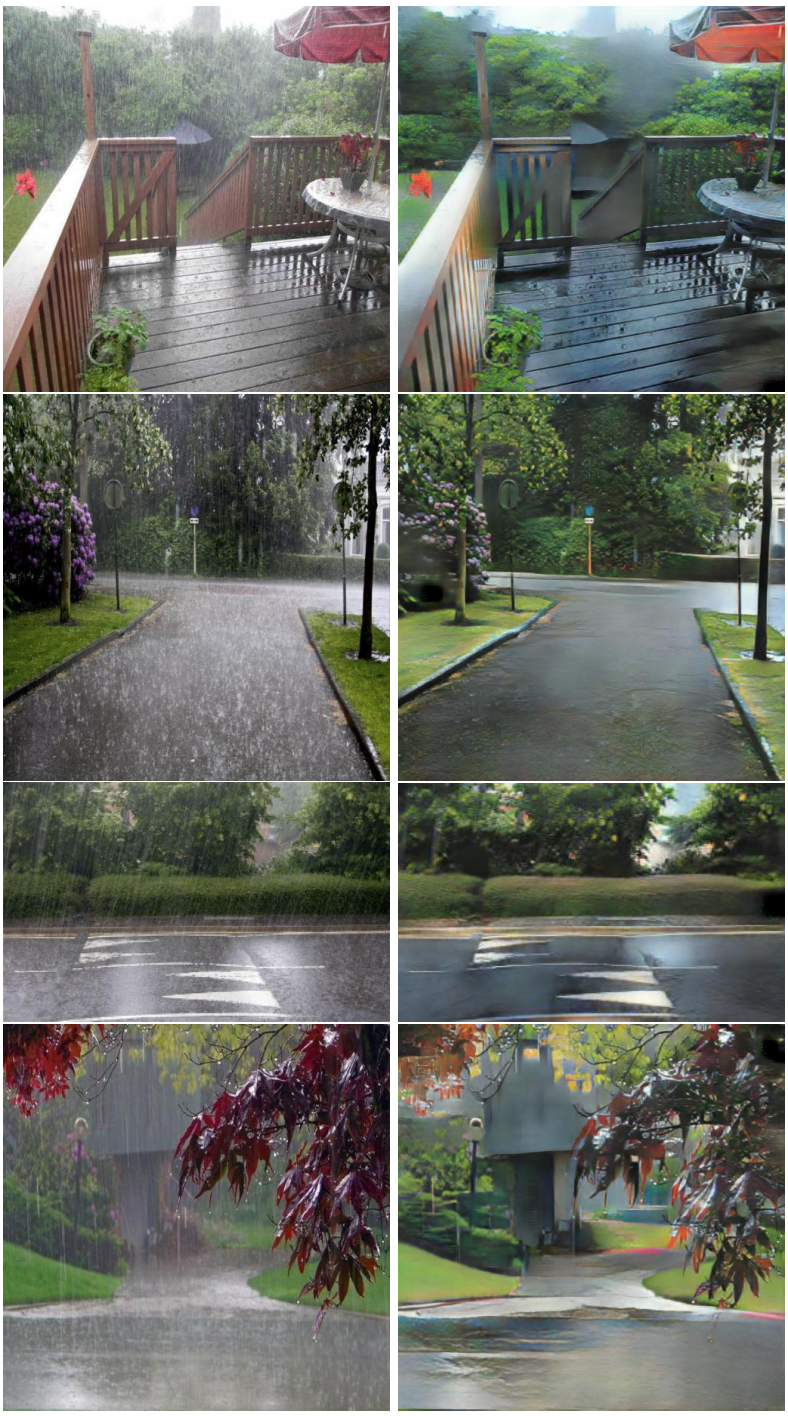
Methods	PSNR	SSIM
Test on source domain	24.4893	0.8114
Test on target domain	14.7995	0.7058

Table 3: Both low and high frequency discrimination

Do discrimination on both low-frequency and high-frequency components. It seems have some good effects on rain streak removal, but for the heavy fog, it doesn't work well. Besides, there are severe color distortion, just like the direct image discrimination. Nonetheless, it works poor on the source domain. The pixel-wise loss seems not enough.

Methods Mutual Test

Methods	PSNR	SSIM
Test [3] on [2] dataset	14.8945	N/A
Test [3] on it's subset we used	21.9508	N/A
Test [2] on [3] dataset		N/A



(a) In (b) Pred

Figure 3: Qualitative results on real images.

References

[1] K. He, J. Sun, and X. Tang. Single image haze removal using dark channel prior. *IEEE transactions on pattern analysis and machine intelligence*, 33(12):2341–2353, 2010.

[2] X. Hu, C.-W. Fu, L. Zhu, and P.-A. Heng. Depth-attentional features for single-image rain removal. In *The IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, June 2019.

[3] R. Li, L.-F. Cheong, and R. T. Tan. Heavy rain image restoration: Integrating physics model and conditional adversarial learning. In *The IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, June 2019.