

Supplementary Material for “Heavy Rain Image Restoration: Integrating Physics Model and Conditional Adversarial Learning”

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1. Real-world Rain Results

Despite heavy rain scenarios, our method also works well in comparatively light rain scenes (with or without veiling effects). In the following figures, we directly choose the rain images from recent state of the art rain removal papers. We compare the derained image produced by our method with the results of baseline methods reported in their papers.

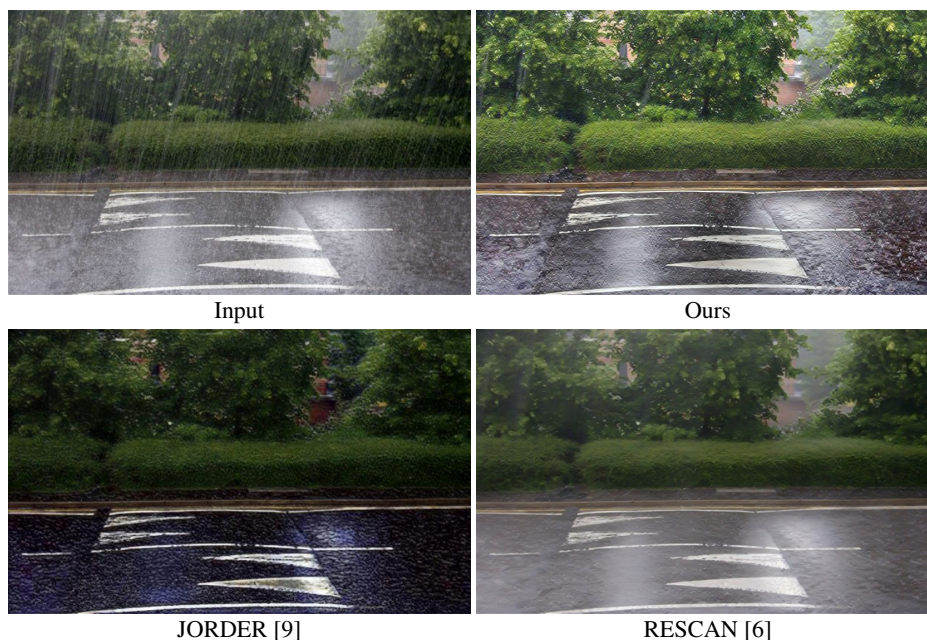


Figure 1: While JORDER [9] is able to remove rain streaks, it also changes the appearance of the background tree leaves. The haze removal step, as a post processing, also results in dark regions on the bushes, where many genuine details are lost.

By contrast, our method is able to retain the correct color, shape and details of the background trees and bushes.



Input

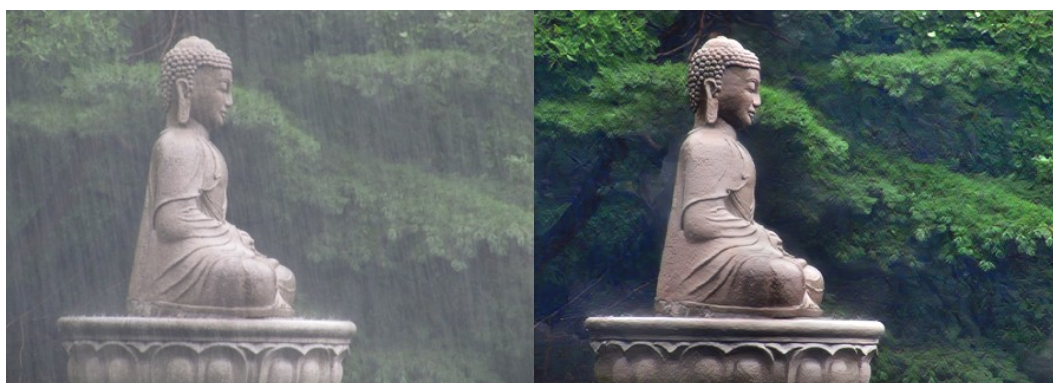
Ours

DSC [8]

LP [7]

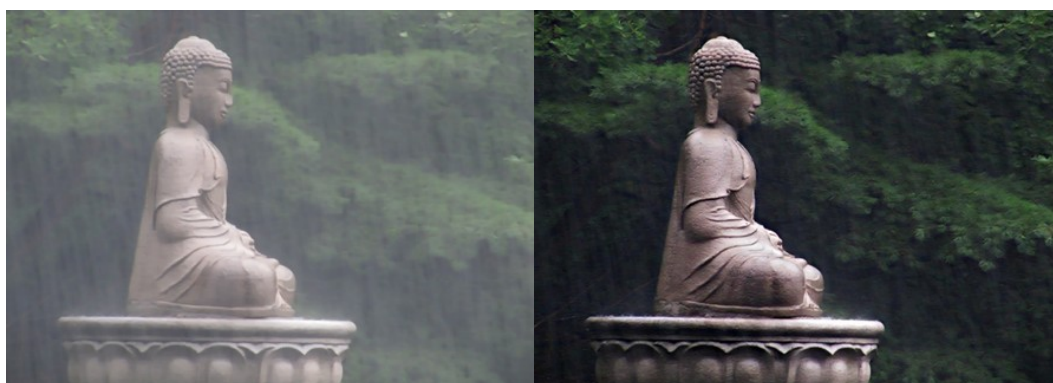
DDN [3]

Figure 2: LP [7] and DDN [3] render blur results on background grass. Ours is able to recover fine textural details.



(a) Input

(b) Ours



(c) RESCAN [6]

(d) CNN [2]

Figure 3: This example is reported in [2]. One can see that the result of CNN method [2] still contains observable fringes of rain streaks. In contrast, our method is able to remove rain streaks thoroughly and enhance the background genuine details. In addition, we run the state of the art RESCAN [6] method on this example, rain streaks are still apparently observed in the results.

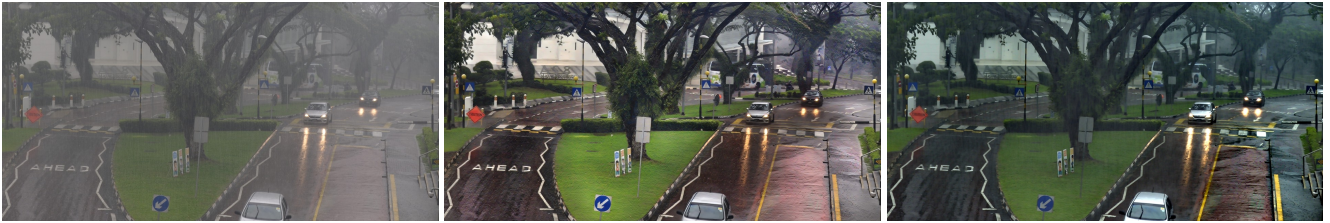


Figure 4: A comparison between ours results and RESCAN [6] + [1].

2. Synthetic Rain Results

In this section, we show more qualitative results of synthetic rain data in the following figures. From the figures below, one can see that all the combination of derain methods and dehaze methods cannot remove rain streaks or rain accumulation effectively because the appearance of the rain images are different from the ones in the training sets of the deraining methods. Pix2Pix[5] trained on *Outdoor-Rain* dataset also fails to remove atmospheric veils around object's boundary because the transmission information is not particularly provided during the training process.

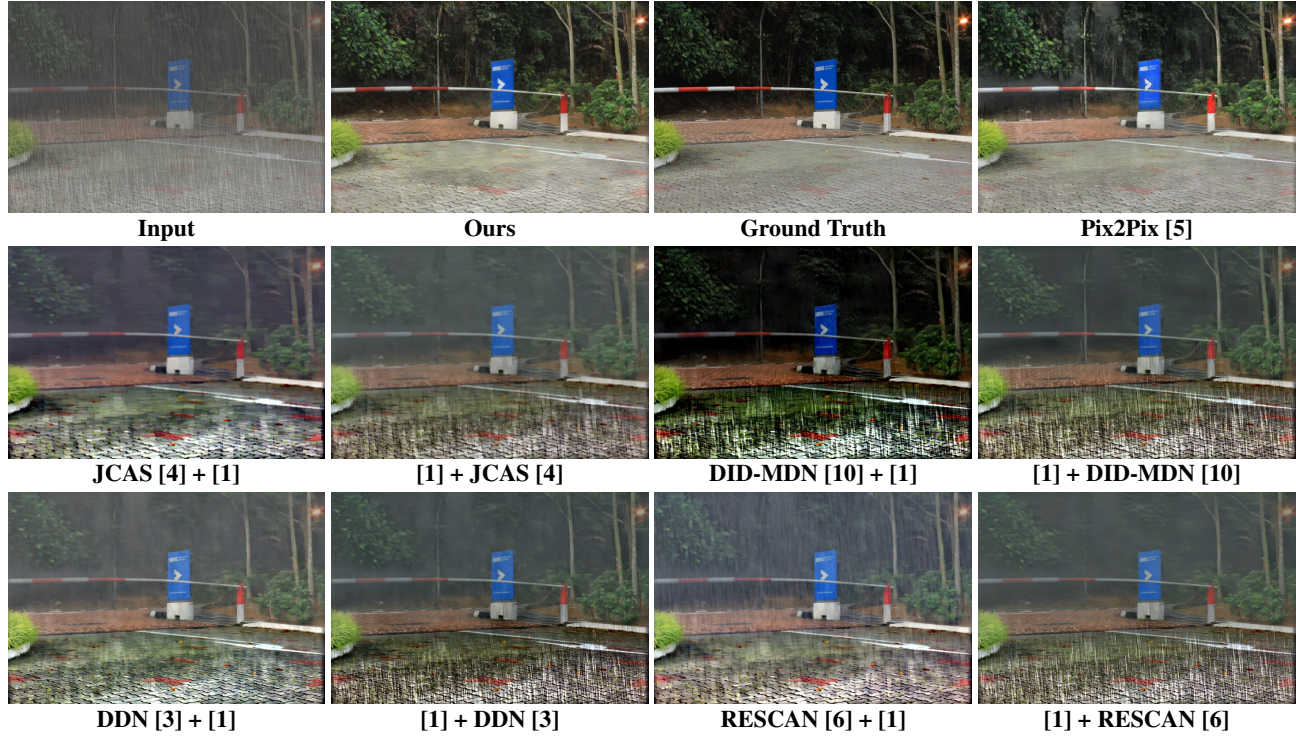


Figure 4: Pix2Pix[5] trained on *Outdoor-Rain* dataset can remove rain streaks. But it produces some atmospheric veils around object's boundary. Our method does not only removes rain streaks, but also enhance the background.

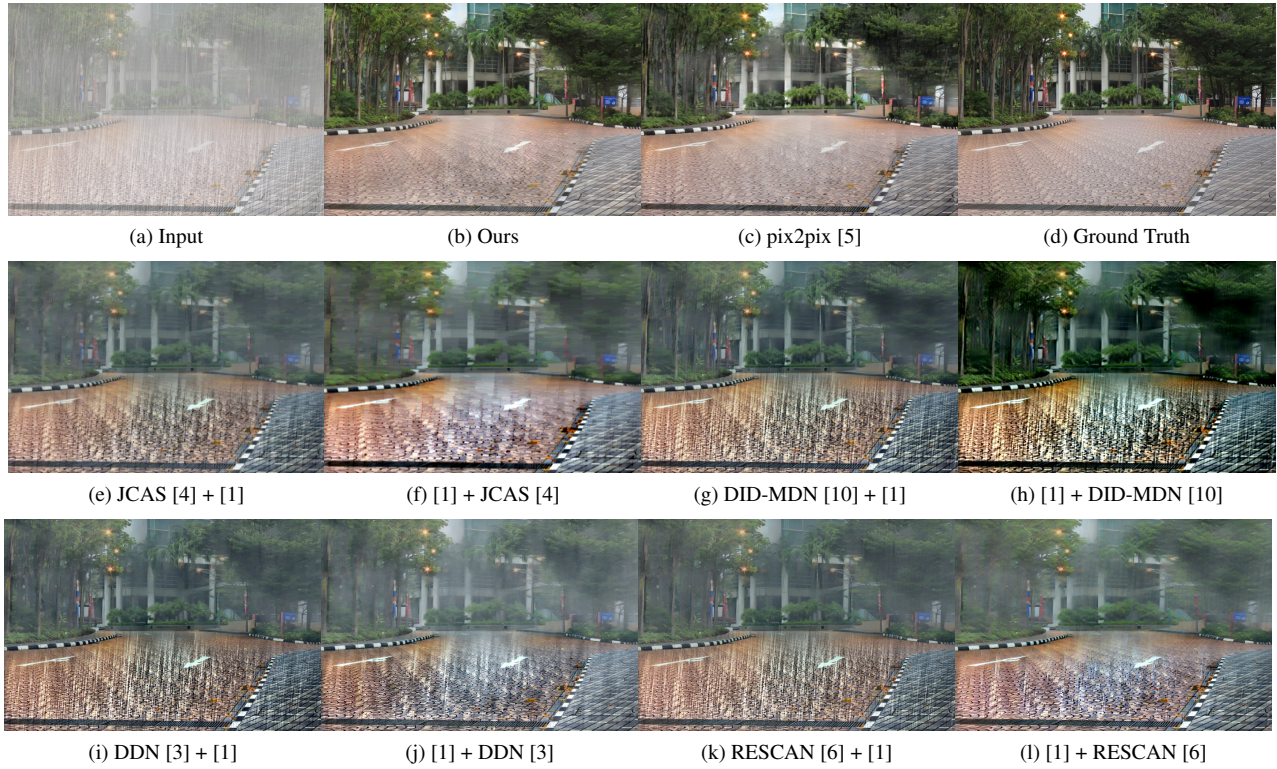


Figure 5: A comparison between our method with baseline methods on synthetic Test1 dataset.



Figure 6: A comparison between our method with baseline methods on synthetic Test1 dataset.

References

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