Unified Transformer Network for Multi-Weather Image Restoration

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• Introduction

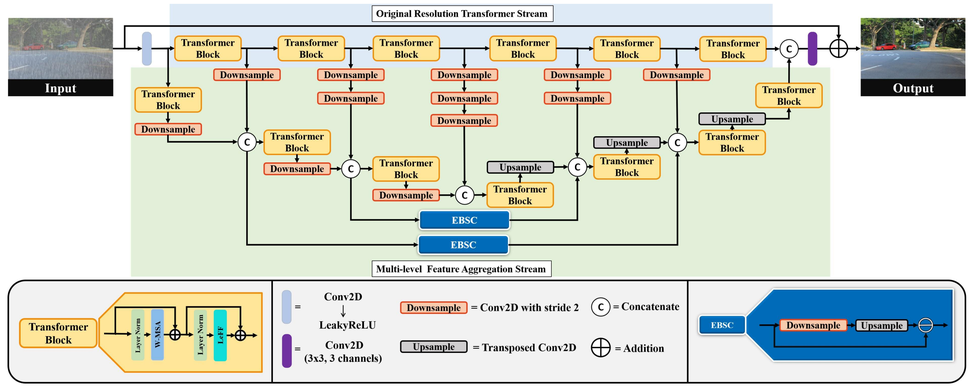
Weather degradations such as rain, haze and snow severely degrade the perceptual quality of an image, hence affecting the accuracy of computer vision tasks such as object detection, depth estimation, etc.

Multi-weather image restoration aims at restoring such weather degraded images in a unified (all in one) manner.

• Motivation

Existing methods are either weather-specific, or use separate encoders for capturing particular weather degradation. This increases the computational demand.

As image restoration is a pre-processing step, it is supposed to be light-weight in computation as well as produce better perceptual quality in the outputs.



Overview of the proposed network for multi-weather image restoration

a)

Methods	Publication	Sequence	PSNR	SSIM
GCANet	WACV-19	Derain + Dehaze	16.89	0.69
PReNet	CVPR-19	Derain + Dehaze	16.77	0.67
MPRNet	CVPR-21	Dehaze + Derain	17.87	0.74
Restormer	CVPR-22	Dehaze + Derain	18.37	0.77
HRR	CVPR-19	-	21.56	0.84
NAS	CVPR-20	-	24.71	0.89
Ours	-	-	**27.49**	**0.94**

b)

Methods	Publication	PSNR	SSIM
DCP	TPAMI-10	17.54	0.848
GCANet	WACV-19	26.20	0.930
RefineDNet	TIP-21	28.82	0.953
MSBDN	CVPR-20	33.79	0.984
USID	TMM-22	23.89	0.919
TSDNet	TII-22	24.24	0.959
MADN	TII-21	28.13	0.957
PSD	CVPR-21	26.33	0.942
Ours	-	**33.87**	**0.986**

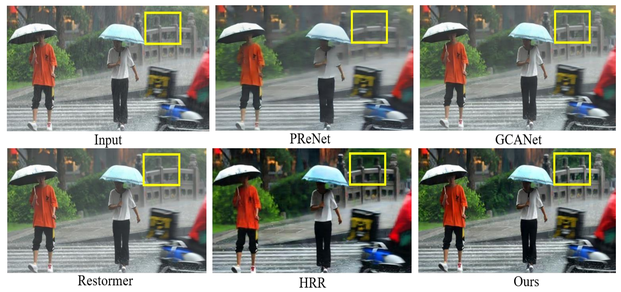
c)

Methods	NAS	ASR	DeSnowNet	JSTASR	Ours
Publication	CVPR-20	ICCV-21	TIP-18	ECCV-20	-
PSNR	24.98	27.78	20.38	25.82	**29.7**
SSIM	0.88	0.92	0.84	0.89	**0.95**

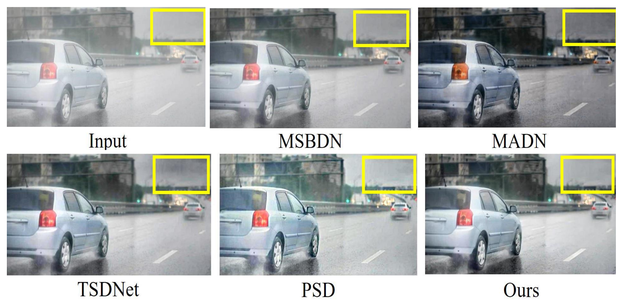
d)

Method	Venue	Parameters (M)	FLOPs ($\times 10^{11}$)
GCANet	WACV-19	0.70	1.48
PReNet	CVPR-19	**0.16**	3.55
MPRNet	CVPR-21	3.67	5.64
HRR	CVPR-19	40.63	15.87
MSBDN	CVPR-20	31.35	3.32
RefineDNet	TIP-21	65.78	6.03
Restormer	CVPR-22	26.12	5.34
Ours	-	4.5	**0.99**

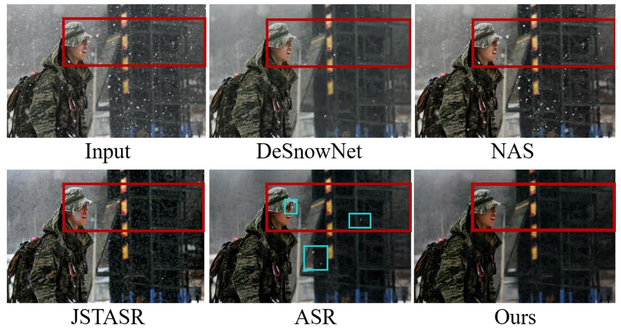
Quantitative results on a) Outdoor-Rain, b) SOTS, c) SRRS datasets and d) Computational complexity.



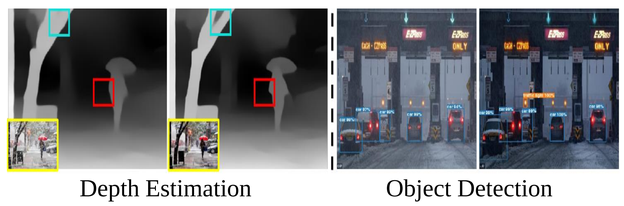
Results on real-world rain removal



Results on real-world haze removal



Results on real-world snow removal



Real-world Computer Vision Applications

• Methodology

A comparatively lightweight unified transformer based architecture is designed for multi-weather image restoration.

The network consists of original resolution transformer stream (ORTS), multi-level feature aggregation stream (MFAS) and edge boosting skip connections (EBSC).

The ORTS consists of transformer blocks for processing the input features in their original scale. This helps in retaining the fine level features in the images.

The MFAS learns different scales and densities of the degradations present in the image.

The EBSC is used for enhancing the crucial edge details in the image.

The network is trained in “memory replay setting” where, some data samples are considered from previous task for training two tasks simultaneously.

For more details, please visit the project page: