Blind Image Decomposition

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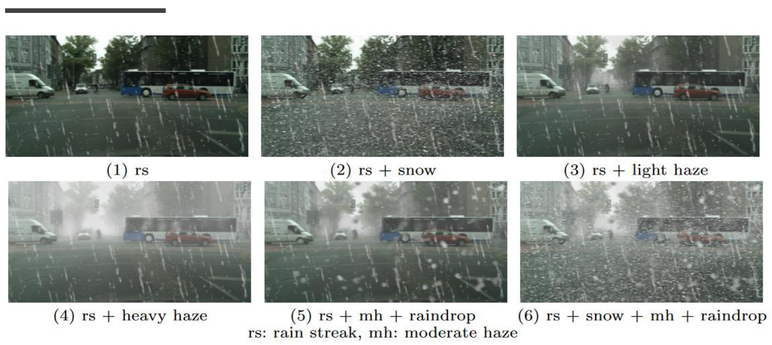
Image Decomposition

Definition: Separate a superimposed image into distinct components/layers with only a single observation.

Many applications: Deraining, haze removal, shadow removal, reflection removal, water removal, desnowing, fence removal, flare removal, texture separation, foreground-background segmentation, intransic mixture decomposition…

Motivation

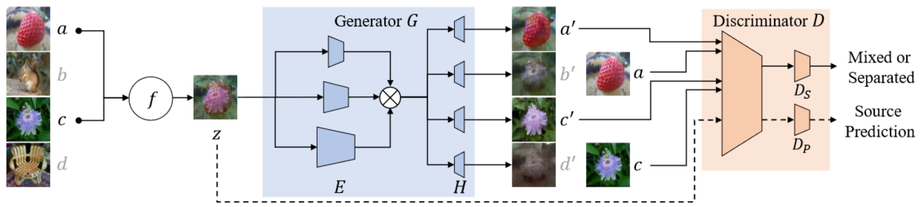


Multiple raining components may occur solely, or as an arbitrary combination in real-world.

BID Setting

Randomly choose images from pre-defined source components, then mix these images. Our goal is to predict sources involved in mixing, as well as separate and reconstruct individual images involved in mixing.

Solution: BIDeN

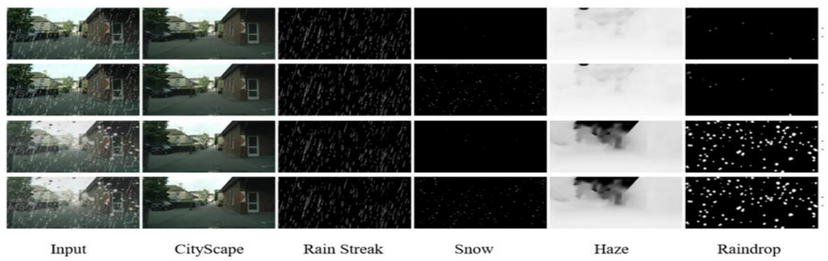


Blind Image Decomposition Network is designed to perform all kinds of BID tasks. We introduce a multiple-scale encoder, and multiple heads to perform the separate and reconstruct task. The source prediction task is performed in the Discriminator.

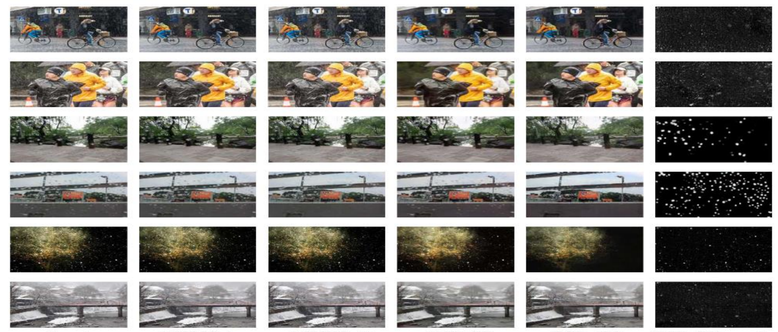
BID Datasets and Tasks

Task I: Mixed image decomposition across multiple domains

Task II.A: Real scenario deraining in driving



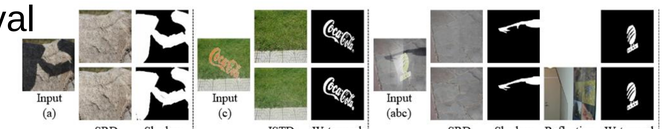
Task II.B: Real scenario deraining in general



* Indicates models trained under the BID settings, without * indicates image decomposition setting

Task III: Joint shadow/reflection/watermark removal

a: shadow
b: reflection
c: watermark



Results (Task II)

Case	Input PSNR↑	Input SSIM↑	MPRNet PSNR↑	MPRNet SSIM↑	Restormer PSNR↑	Restormer SSIM↑	RCDNet PSNR↑	RCDNet SSIM↑	BIDeN PSNR↑	BIDeN SSIM↑
(1)	25.69	0.786	33.39	0.945	34.29	0.951	32.38	0.937	30.89	0.932
(2)	18.64	0.564	30.52	0.909	30.60	0.917	28.45	0.892	29.34	0.899
(3)	17.45	0.712	23.98	0.900	23.74	0.905	27.14	0.911	28.62	0.919
(4)	11.12	0.571	18.54	0.829	20.33	0.853	19.67	0.865	26.77	0.898
(5)	14.05	0.616	21.18	0.846	22.17	0.859	24.23	0.889	27.11	0.898
(6)	12.38	0.461	20.76	0.812	21.24	0.821	22.93	0.846	26.44	0.870

Task II.A: BIDeN show balanced results.

Method	Rain Streak NIQE↓	Rain Streak BRISQUE↓	Raindrop NIQE↓	Raindrop BRISQUE↓	Snow NIQE↓	Snow BRISQUE↓
Input	4.86	27.84	5.61	24.85	4.74	22.68
MPRNet	4.14	28.72	4.94	29.42	4.60	25.93
MPRNet*	4.34	28.00	4.81	25.86	4.24	24.55
BIDeN	4.71	25.39	5.39	22.94	4.97	22.64
BIDeN*	4.31	26.55	4.71	22.22	4.28	22.40

Task II.B: Models trained under the BID setting are more robust in restoring natural images.