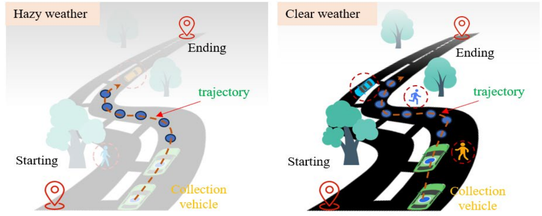
Driving-Video Dehazing with Non-Aligned Regularization for Safety Assistance

Junkai Fan[1], Jiangwei Weng[1], Kun, Wang[1], Yijun Yang[2], Jianjun Qian[1], Jun Li[1*] , and Jian Yang[1*]
[1]PCA Lab, Nanjing University of Science and Technology, China
[2]The Hong Kong University of Science and Technology (Guangzhou)

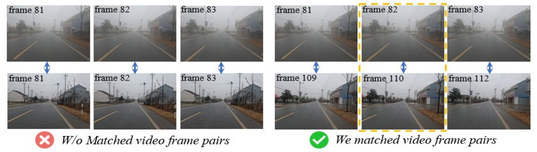
CVPR SEATTLE, WA JUNE 17-21, 2024

Motivation

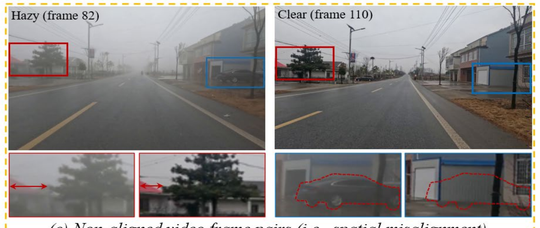
- Difficulty in acquiring precisely aligned hazy/clear video pairs for effective model training
- Temporal misalignment and spatial misalignment in the hazy/clear video pairs.
- Large motion poses a challenge in real-world driving scenes.



(a) Time-spatial misalignment due to avoiding pedestrians and vehicles.



(b) Temporal misalignment in real-world scene hazy video pairs

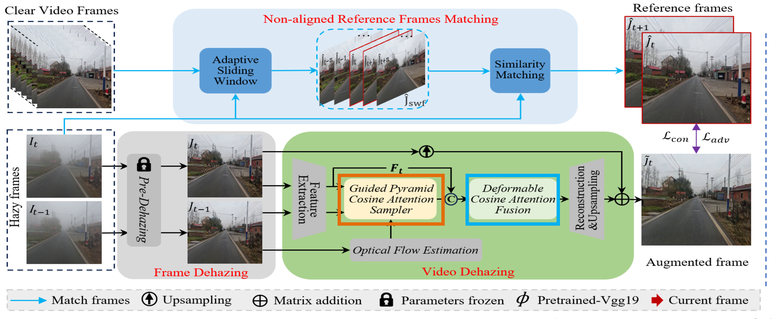


(c) Non-aligned video frame pairs (i.e., spatial misalignment)

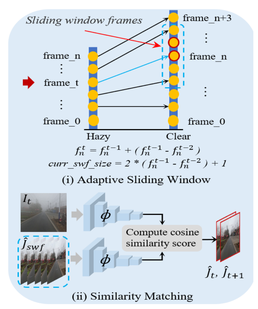
- Spatial and temporal misalignments in real driving hazy/clear video pairs due to inconsistent driving speeds, different driving paths and moving objects.

Method

- Our method effectively trains the video dehazing network using real-world hazy and clear videos without requiring strict alignment, resulting in high-quality results.



(a) Non-aligned video supervision dehazing and visual enhancement framework

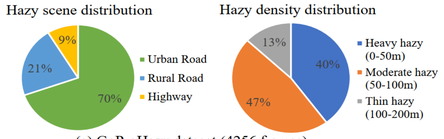


(b) Non-aligned Reference Frames Matchin

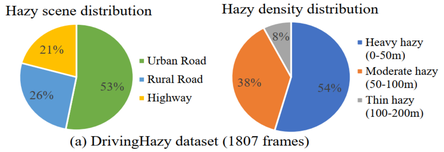
GoProHazy

- We proposed the GoProHazy dataset for real-world hazy scenes.

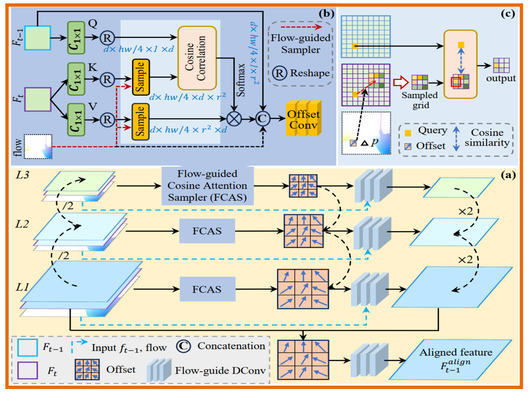
(a) GoProHazy's capture setting (b) DrivingHazy's capture setting

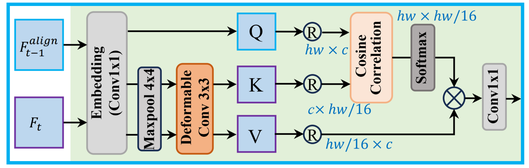


(a) GoProHazy dataset (4256 frames)



(a) DrivingHazy dataset (1807 frames)





Experiment

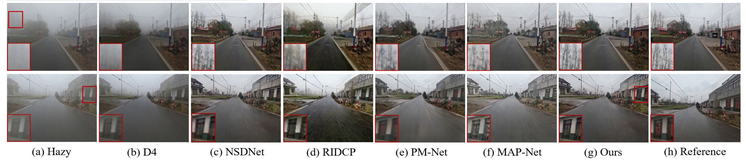
- Our method achieves SOTA results on three real hazy video datasets.

Data Settings	Methods	Data Type	GoProHazy		DrivingHazy (NoRef)			InternetHazy (Only testing)			Params (M)	Flops (G)	Ref.
			FADE ↓	NIQE ↓	FADE ↓	NIQE ↓	Votes ↑	FADE ↓	NIQE ↓	Votes ↑			
Unpaired	DCP [20]	Image	0.9835	5.8309	0.9692	5.6799	-	0.9223	6.4744	-	-	-	CVPR'09
	RefineNet [72]	Image	1.5694	5.3693	1.1837	5.5500	-	1.1801	5.8742	-	11.38	75.41	TIP'21
	CDD-GAN [6]	Image	1.1942	4.9787	1.4423	5.0349	-	1.2120	5.1049	-	29.27	56.89	ECCV'22
	D^4 [63]	Image	1.9272	5.7865	1.8658	5.6864	-	1.3277	6.2150	-	**10.70**	**2.25**	CVPR'22
Paired	PSD [7]	Image	1.0529	6.0010	0.9672	5.3520	-	0.9275	5.2187	-	33.11	182.5	CVPR'21
	RIDCP [59]	Image	0.8010	4.6640	1.1077	4.3889	0.315	0.9391	4.6610	0.265	28.72	182.69	CVPR'23
	PM-Net [38]	Video	1.1011	4.1211	0.9434	3.8944	0.220	1.1517	4.0590	0.150	151.20	5.22	ACMM'22
	MAP-Net [60]	Video	1.0611	4.2359	1.0440	4.2542	0.025	1.2130	5.3241	0.030	28.80	8.21	CVPR'23
Non-aligned	NSDNet [15]	Image	0.7996	4.1547	0.9348	4.0529	-	0.8934	4.3835	-	11.38	56.86	arXiv'23
	DVD (Ours)	Video	**0.7598**	**3.7753**	**0.8207**	**3.5825**	**0.440**	**0.8745**	**3.7480**	**0.555**	15.37	73.12	-

GoProHazy Results

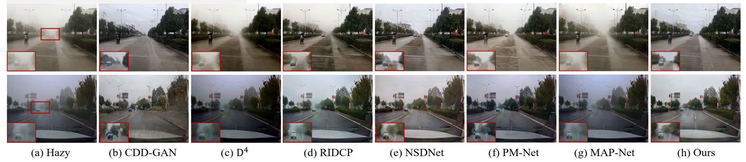
(a) Hazy (b) CDD-GAN (c) D^4 (d) RIDCP (e) NSDNet (f) PM-Net (g) MAP-Net (h) Ours

DrivingHazy Results



(a) Hazy (b) D4 (c) NSDNet (d) RIDCP (e) PM-Net (f) MAP-Net (g) Ours (h) Reference

InternetHazy Results



(a) Hazy (b) CDD-GAN (c) D^4 (d) RIDCP (e) NSDNet (f) PM-Net (g) MAP-Net (h) Ours

- If you want more details and video demos, please scan the QR code beside it. Thanks for your attention. 🙂

Project Page