

FlareReal: A Real-Captured Paired Dataset for Nighttime Lens Flare Removal

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Motivation — Why Real Pairs?

Nighttime flare is a coupled camera-formation effect: strong lights interact with lens contamination, optical elements, sensor saturation, and automatic exposure, producing halos, streaks, ghosts, and color shifts. Synthetic compositing and rendering cannot fully reproduce these interactions, creating a synthetic-to-real gap. Robust restoration therefore needs pixel-aligned real flare-corrupted and flare-free pairs.

FlareReal Dataset — What We Collected?

FlareReal provides 4,037 physically captured flare/flare-free pairs from 241 scenes and 500 real pure-flare images. Figure 1 shows varied exposure settings, light-source geometries, and chromatic flare patterns across paired and isolated samples. Compared with Flare7K, Flare7K++, and FlareX, Table 1 highlights FlareReal's large-scale real-pair supervision and broader scene and light-source coverage, including indoor/outdoor captures and point, linear, area, single-, and multi-source cases.

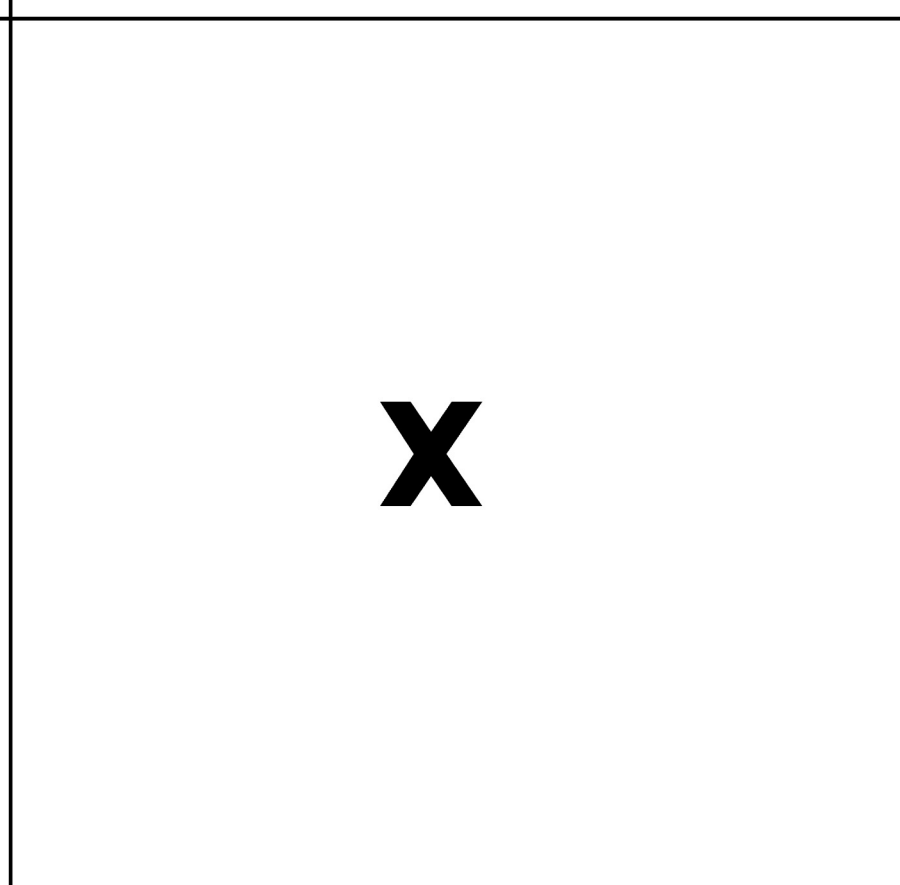
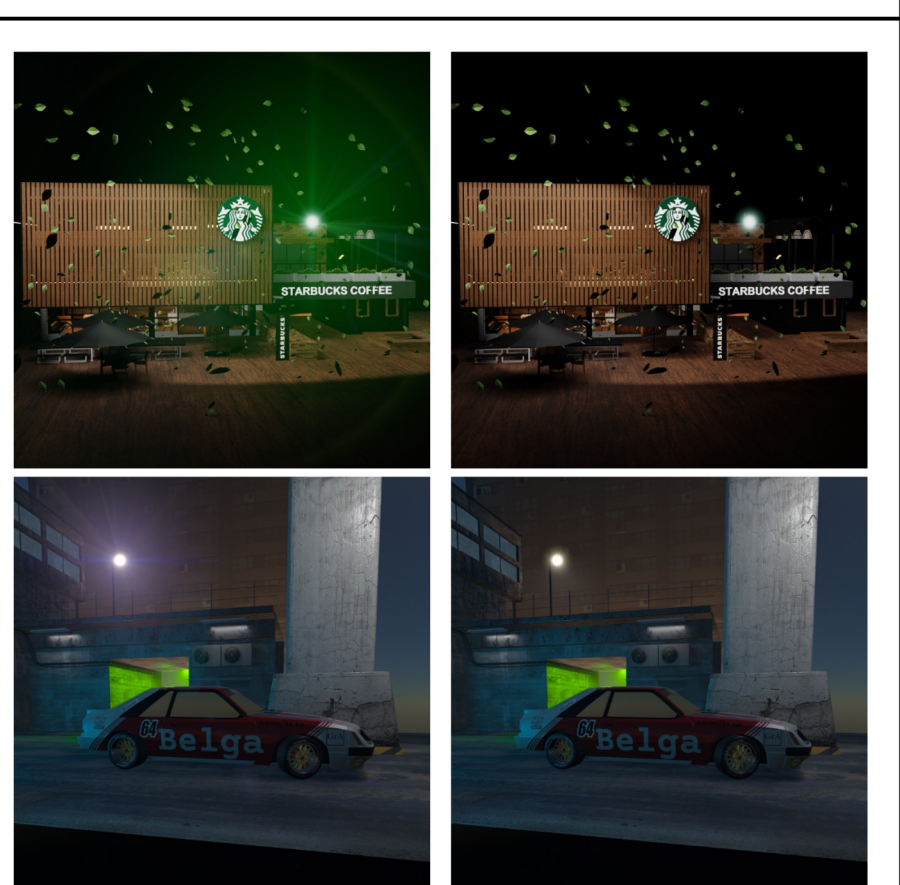
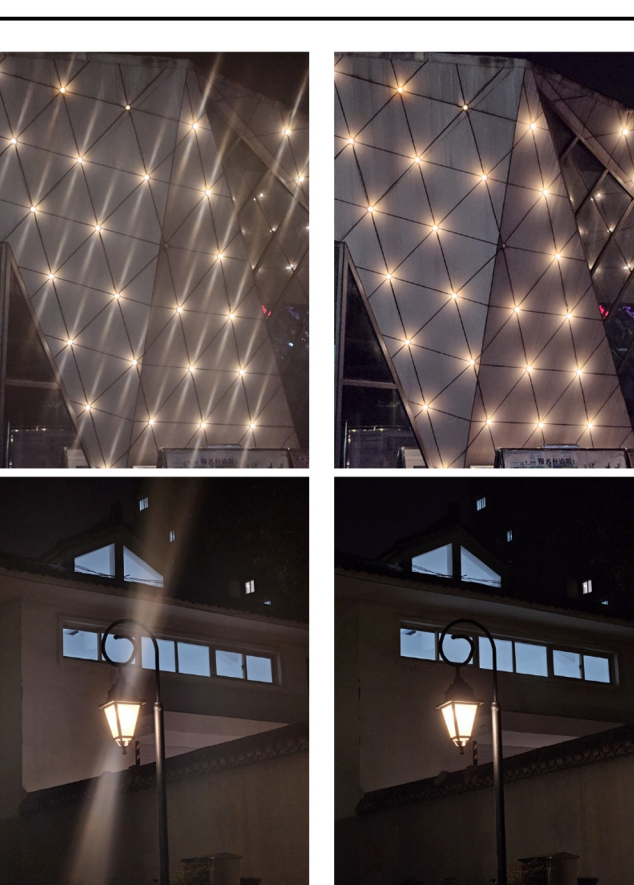
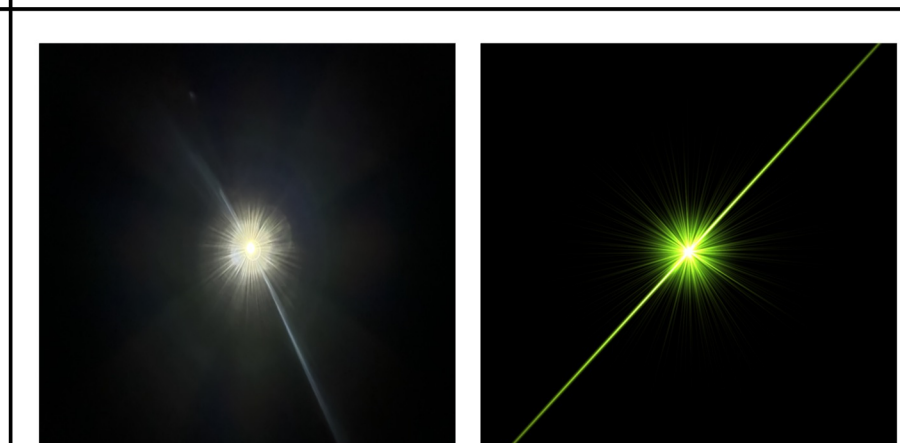
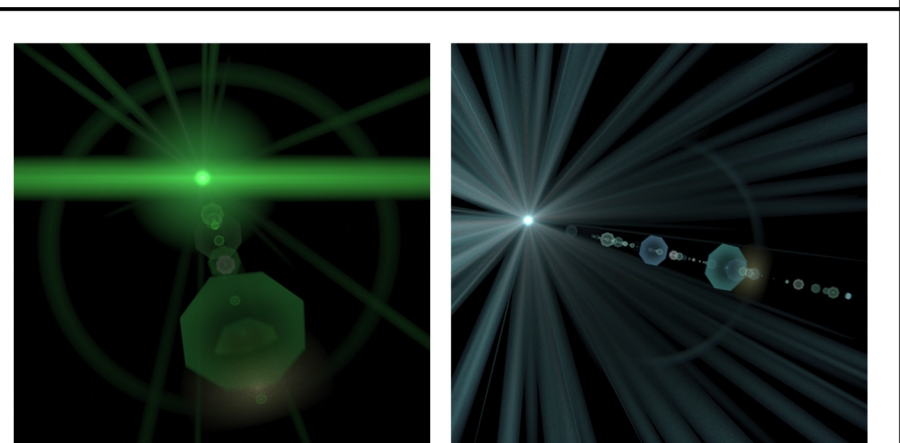
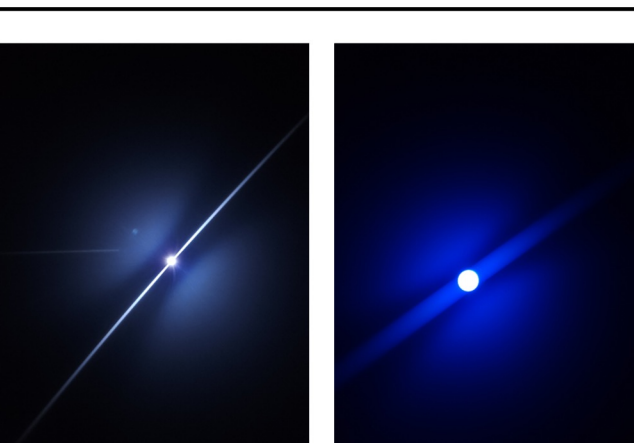
	Flare7K++	FlareX	FlareReal
Paired Dataset			
Pure Flare Image			

Figure 1. Comparison between our FlareReal training data and existing Flare7K++ and FlareX training data. FlareReal contains physically captured paired images with diverse exposure settings, light-source geometries, and chromatic flare appearances.

Dataset	Pairs (Real)	Pairs (Syn.)	Pure Flare (Real)	Pure Flare (Syn.)	Scene Count	Indoor	Outdoor	Point Source	Linear Source	Area Source	Single Source	Multi Source
Flare7K	-	-	-	7,000	-	-	-	7,000	-	-	7,000	-
Flare7K++	-	-	962	7,000	-	-	-	7,962	-	-	7,962	-
FlareX	-	3,000	-	9,500	15	400	2,600	12,500	-	-	12,500	-
FlareReal	4,037	-	500	-	241	34	4,003	4,261	152	124	2,624	1,913

Table 1. A comparison between our FlareReal with Flare7K, Flare7K++ and FlareX dataset.

Capture & Alignment — How We Built It?

Acquisition Protocol & Equipment:

We capture paired images with flagship Samsung phones, Galaxy S23/S24/S25 Ultra, Z Flip5, and Z Fold5/6/7, to cover diverse sensors and optics. Each phone is tripod-mounted. We introduce realistic contamination, including fingerprints, oil, dust, and textile fibers, capture the flare-corrupted input, clean the lens, and immediately capture a flare-free reference from the same viewpoint. Default auto mode preserves realistic exposure and ISP behavior.

Robust Alignment Strategy:

Lens cleaning can cause small shifts despite tripod stabilization, while flare makes dense optical flow unreliable. We convert each pair to grayscale, extract up to 1,000 ORB features, match them by Hamming distance, retain the top 50%, and estimate a homography with RANSAC. We warp the clean reference into the input coordinates, crop invalid borders, and manually reject failed pairs. This global alignment suits the mostly fixed scene geometry.

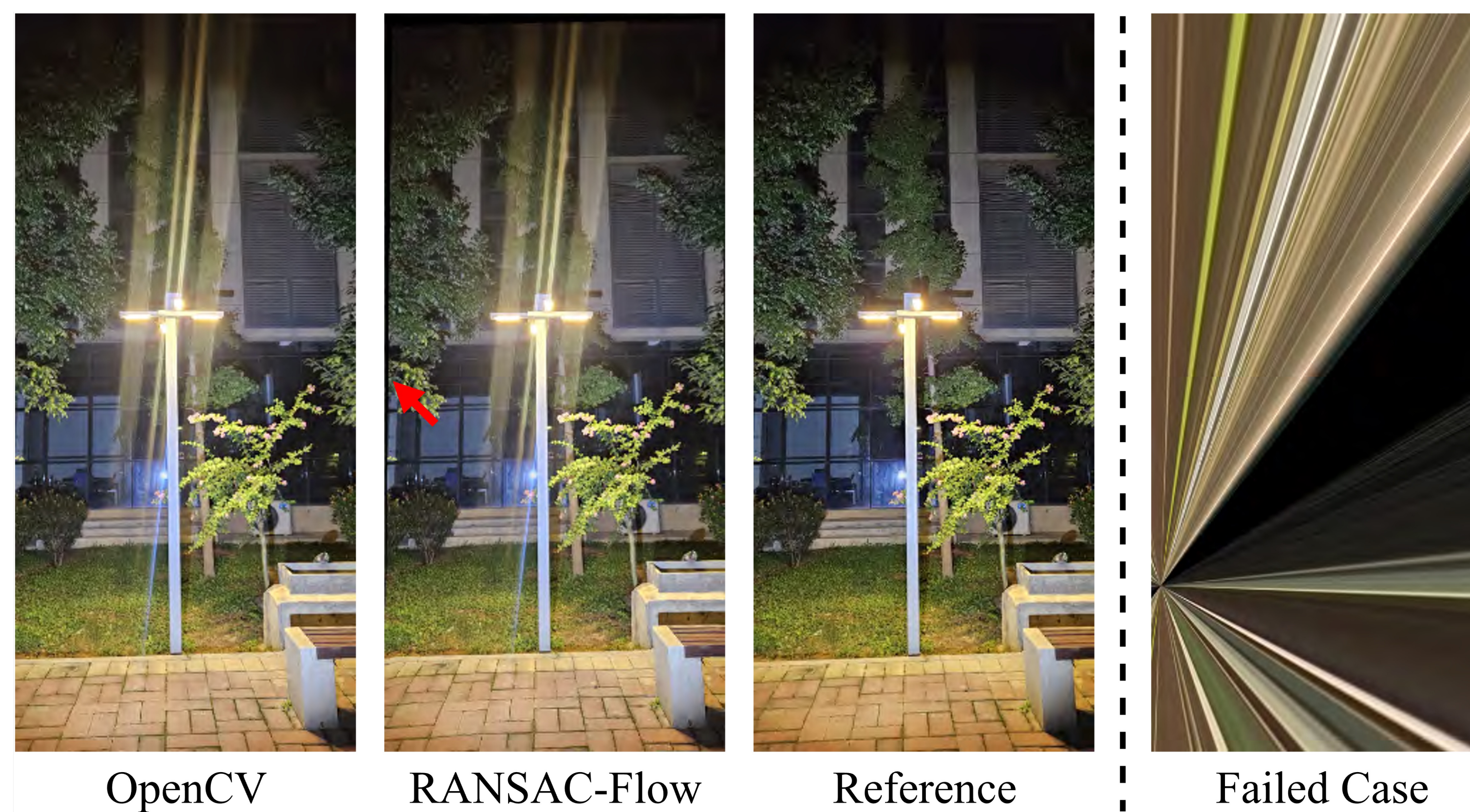


Figure 2. Alignment strategy comparison.

Pure Flare Image Collection:

We capture 500 pure-flare images in a darkroom under varied light spectra, shapes, positions, and intensities, isolating patterns from veiling glare to saturated starbursts and colored ghosts. To obtain light-source masks, we train a mapping network on synthetic Flare7K image-mask pairs and apply it to the real images. This subset supports flare-aware compositing, augmentation, and component analysis.

Experimental Results

Training Dataset	HINet			MPRNet			Uformer			Restormer		
	PSNR	SSIM	LPIPS	PSNR	SSIM	LPIPS	PSNR	SSIM	LPIPS	PSNR	SSIM	LPIPS
Test Dataset: Flare7K												
Flare7K	26.740	0.882	0.048	26.140	0.878	0.050	26.980	0.890	0.047	26.280	0.883	0.054
Flare7K++	27.548	0.892	0.046	27.036	0.893	0.048	27.633	0.894	0.043	27.597	0.897	0.045
FlareX	26.658	0.894	0.052	25.892	0.890	0.059	25.259	0.887	0.057	26.196	0.889	0.055
FlareReal	29.603	0.918	0.031	28.520	0.916	0.034	28.998	0.916	0.033	29.039	0.918	0.032
Test Dataset: FlareX												
Flare7K	37.796	0.610	0.140	38.127	0.637	0.136	37.746	0.632	0.140	38.174	0.631	0.139
Flare7K++	39.251	0.652	0.136	38.016	0.649	0.138	37.397	0.631	0.142	39.404	0.650	0.133
FlareX	39.691	0.652	0.132	38.086	0.626	0.136	39.292	0.658	0.133	39.137	0.658	0.131
FlareReal	40.113	0.654	0.125	39.325	0.646	0.127	39.884	0.655	0.126	40.706	0.668	0.123
Test Dataset: FlareReal												
Flare7K	19.247	0.576	0.2003	19.066	0.575	0.1997	18.991	0.574	0.1999	19.074	0.573	0.2021
Flare7K++	19.411	0.578	0.2087	18.785	0.574	0.2024	19.335	0.577	0.1988	19.553	0.581	0.1990
FlareX	18.972	0.576	0.2032	18.807	0.575	0.2025	18.630	0.574	0.2041	18.768	0.576	0.2009
FlareReal	21.120	0.600	0.1876	20.974	0.598	0.1866	21.206	0.603	0.1858	21.198	0.602	0.1870

Table 2. Quantitative comparison of different flare removal methods trained on various datasets and evaluated on Flare7K, FlareX, and FlareReal datasets.

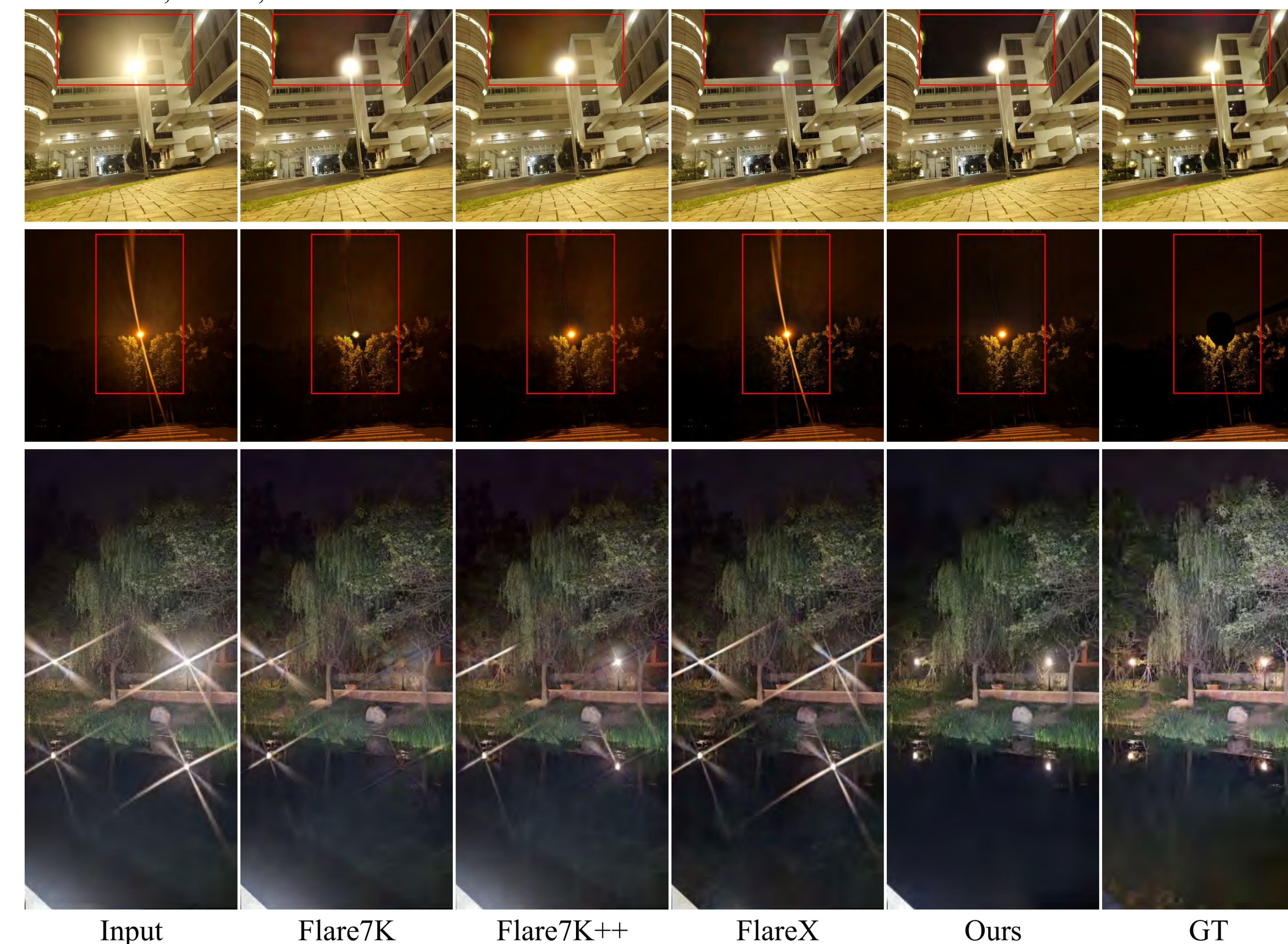


Figure 3. Comparative qualitative results across diverse real-captured test sets.