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X-CAUNET : Cross-color channel attention with underwater image-enhancing transformer

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MOTIVATION



Underwater ecosystem monitoring



Pollution control

Autonomous Underwater Vehicle (AUV)



Stereo camera



Gas pipeline inspection



Rescue missions

UNDERWATER CHALLENGES



Greenish



Bluish



Hazy



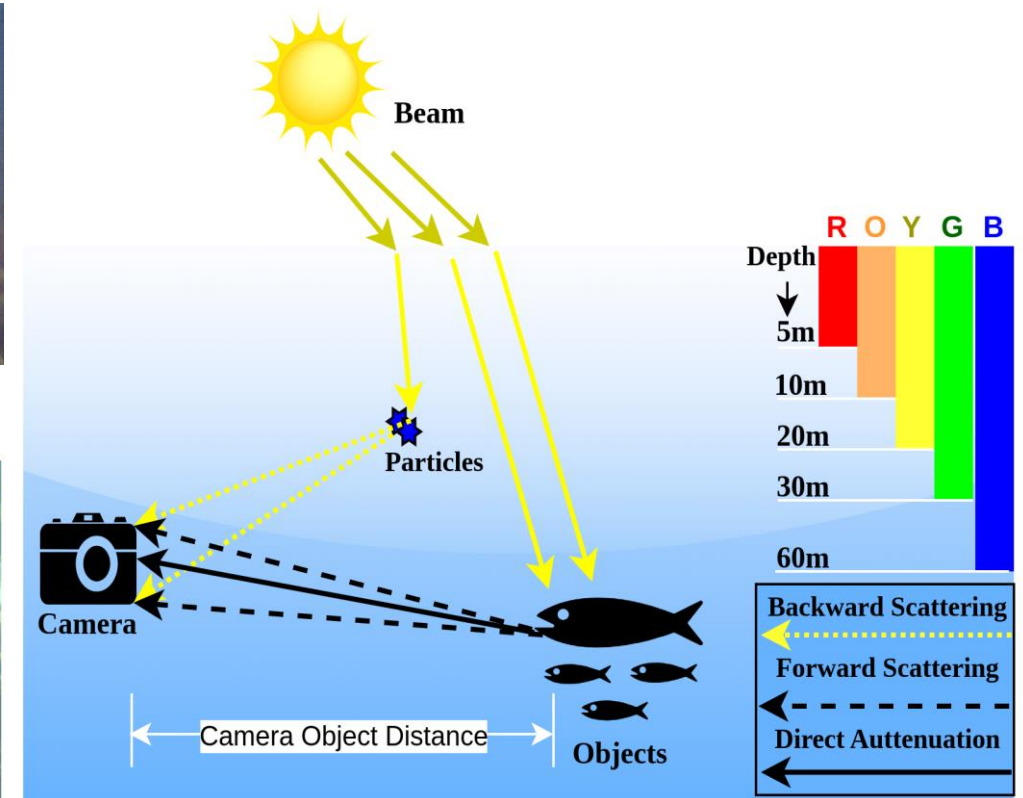
Unclear Image segment and Bright spot



Blurry

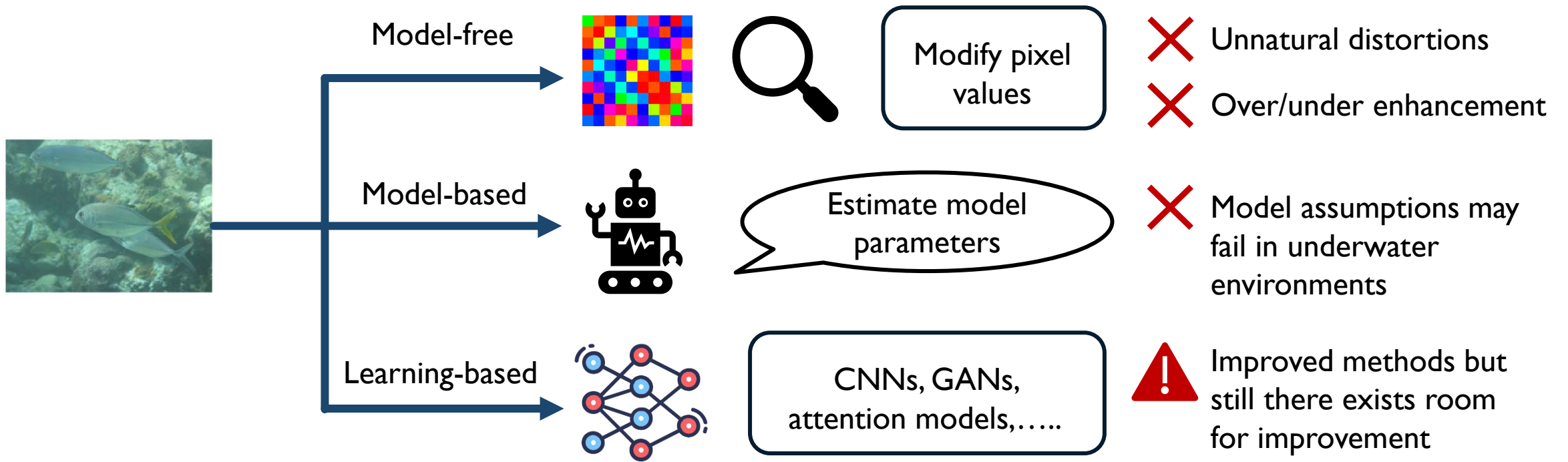


Low Contrast

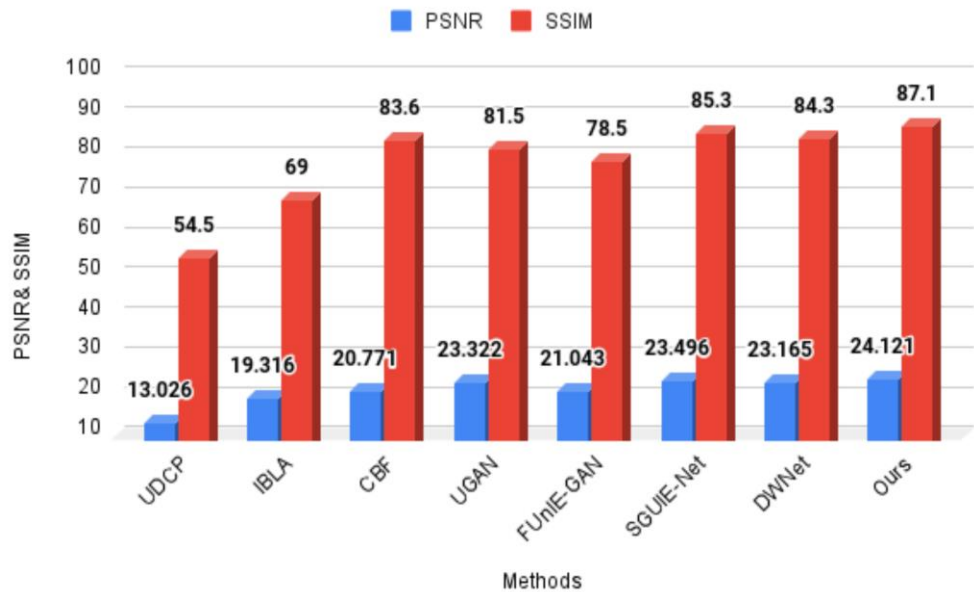


Underwater Imaging Model

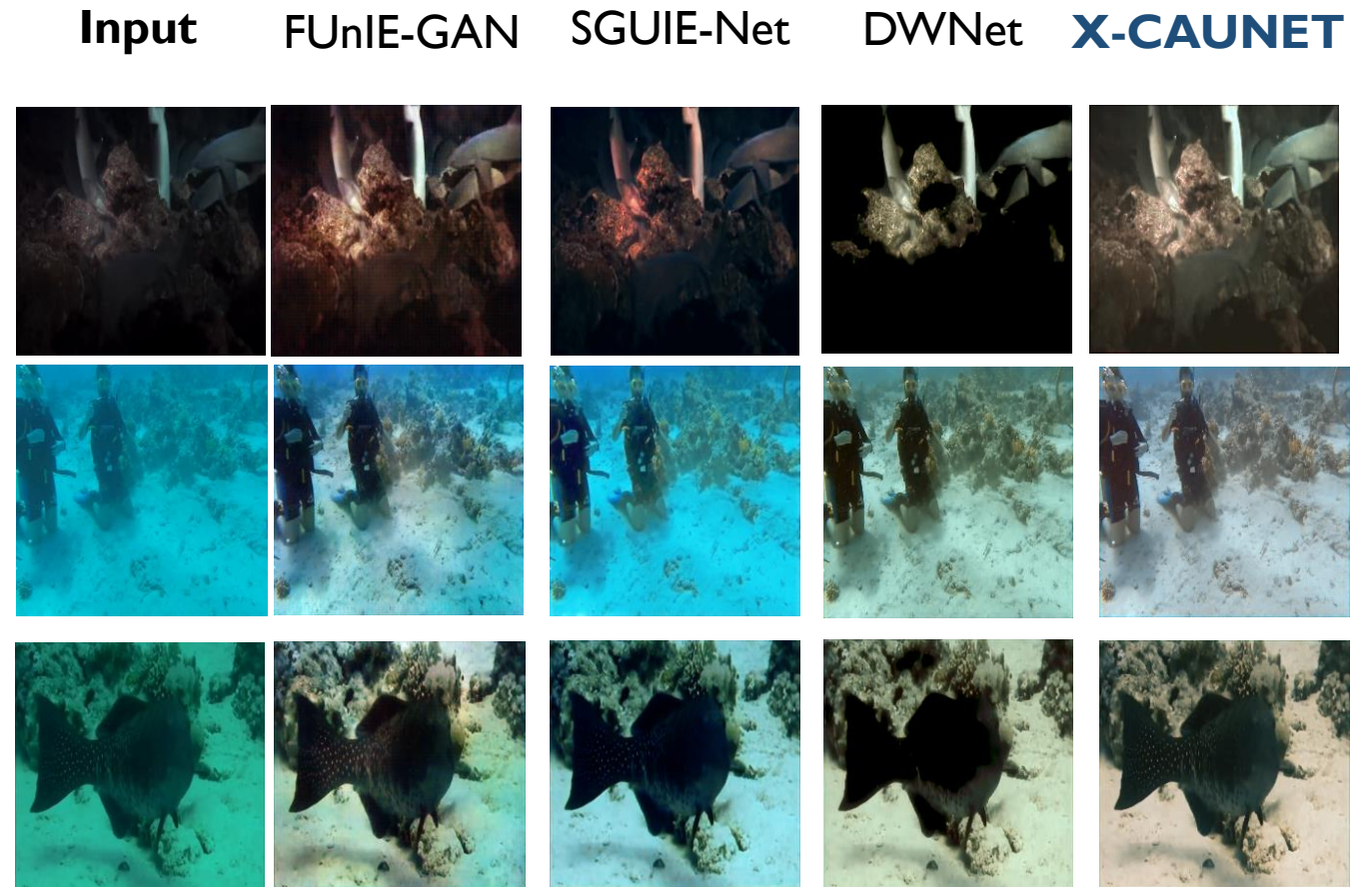
EXISTING APPROACHES FOR UIE



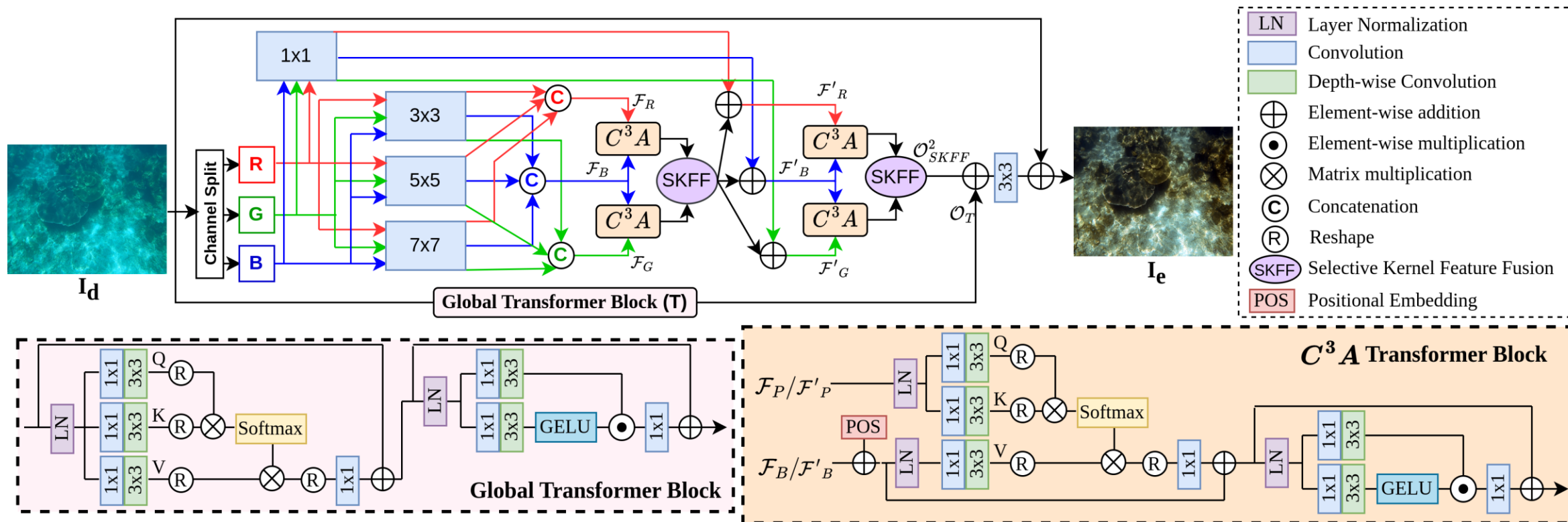
MAJOR OBSERVATION



Despite significant advancements in the enhancement of underwater images, current approaches still suffers from visual artifacts, such as color distortion, poor visibility, low contrast, hazy, blurriness.



PROPOSED MODEL



QUANTITATIVE RESULTS

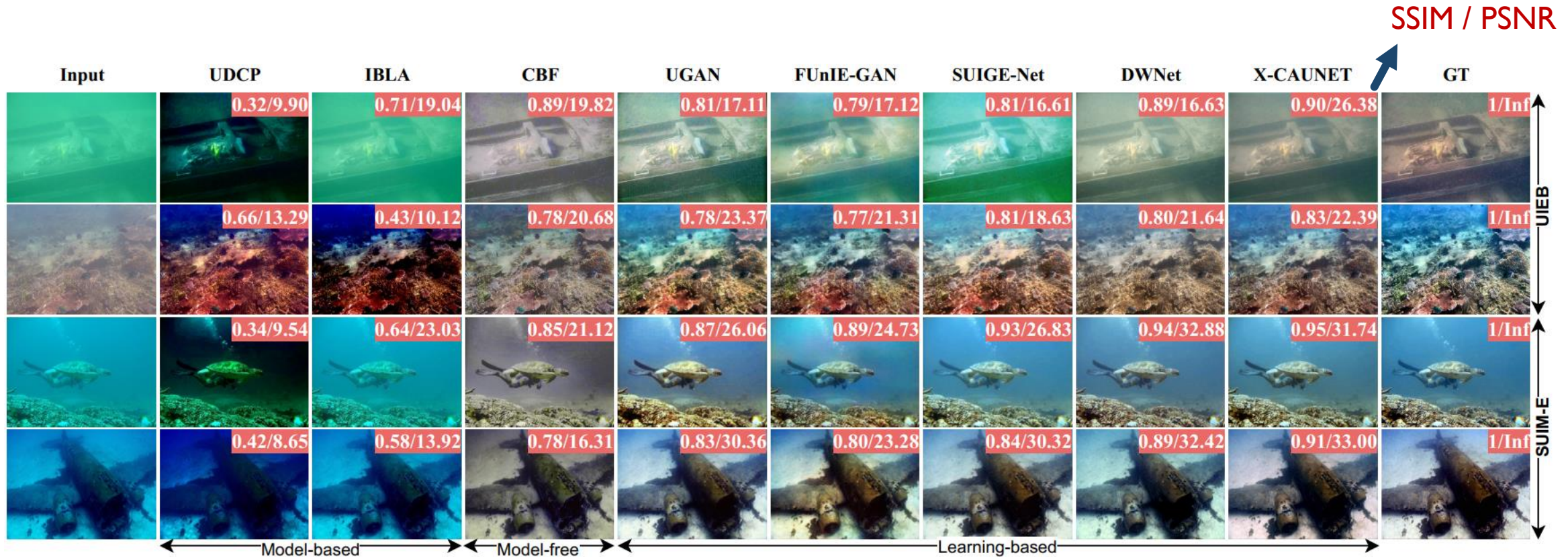
Table 1: UIQM comparison on U45 dataset. The first, second, and third best performances are represented in red, blue, and green respectively.

Method	FE	UDCP	FGAN	RB	RED	IBLA	WSCT	CycleGAN	AGCycleGAN	X-CAUNET
UIQM	2.984	2.339	3.158	3.101	2.979	2.401	2.890	3.138	3.183	3.287

Table 2: Comparison with the state-of-the-art on three datasets across six different evaluation metrics.

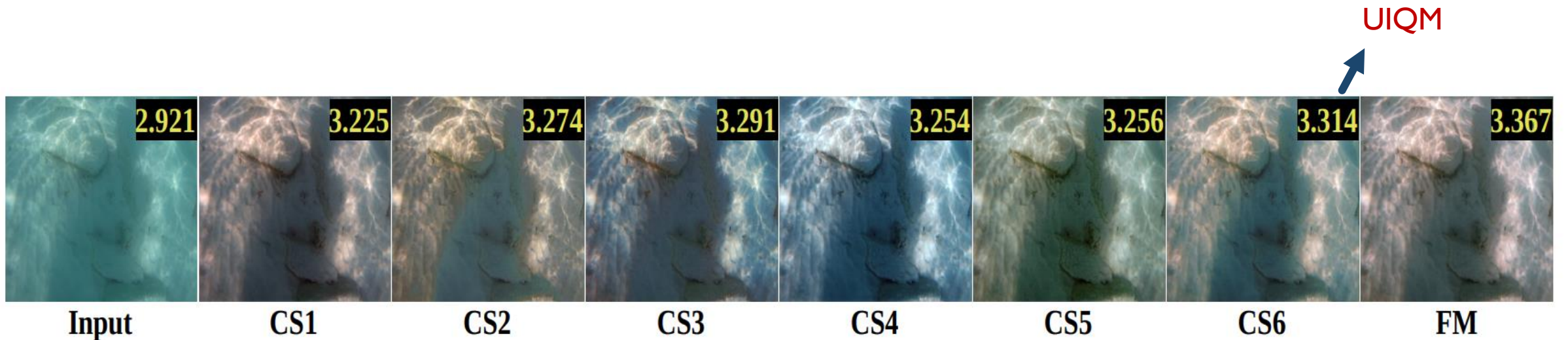
Methods	UIEB					SUIM-E					UIEB Challenge	
	PSNR	SSIM	MS-SSIM	LPIPS	UIQM	PSNR	SSIM	MS-SSIM	LPIPS	UIQM	BRISQUE	UIQM
UDCP [11]	13.026	0.545	0.769	0.283	1.922	12.074	0.513	0.742	0.270	1.648	29.658	1.566
IBLA [2]	19.316	0.690	0.855	0.233	2.108	18.024	0.685	0.849	0.209	1.826	24.972	2.142
CBF [1]	20.771	0.836	0.890	0.189	3.318	20.395	0.834	0.884	0.194	3.003	29.213	2.810
UGAN [12]	23.322	0.815	0.932	0.199	3.432	24.704	0.826	0.941	0.190	2.894	25.118	2.662
FUnIE-GAN [13]	21.043	0.785	0.890	0.173	3.250	23.590	0.825	0.913	0.189	2.918	24.743	2.768
SGUIE-Net [4]	23.496	0.853	0.926	0.136	3.004	25.987	0.857	0.945	0.153	2.637	27.320	2.527
DWNNet [5]	23.165	0.843	0.929	0.162	2.897	24.850	0.861	0.940	0.133	2.707	31.160	2.269
X-CAUNET	24.121	0.871	0.939	0.135	3.132	24.721	0.886	0.947	0.121	2.855	23.980	2.712

QUALITATIVE RESULTS



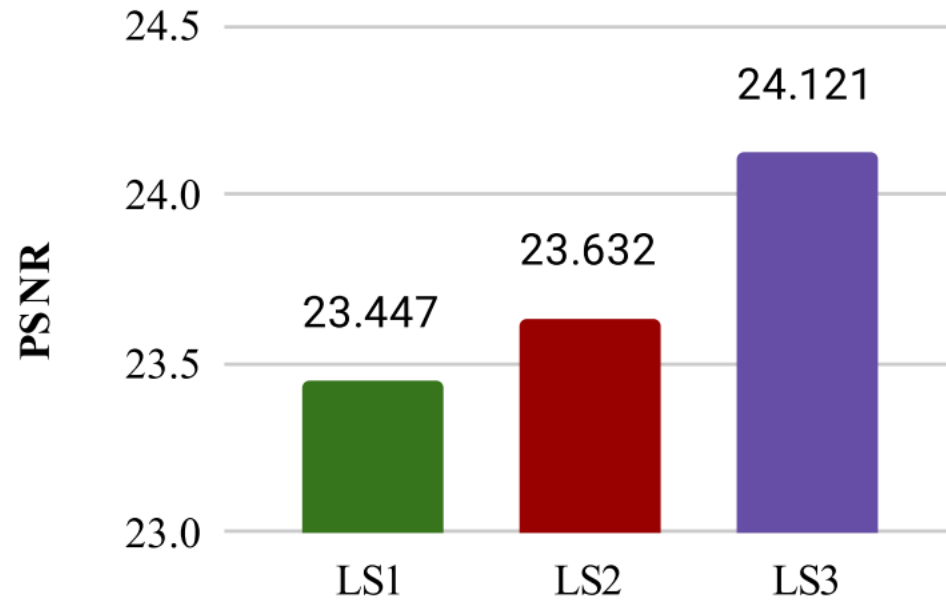
- Effective haze removal
- Bluish/greenish tone correction

QUALITATIVE ABLATION STUDY

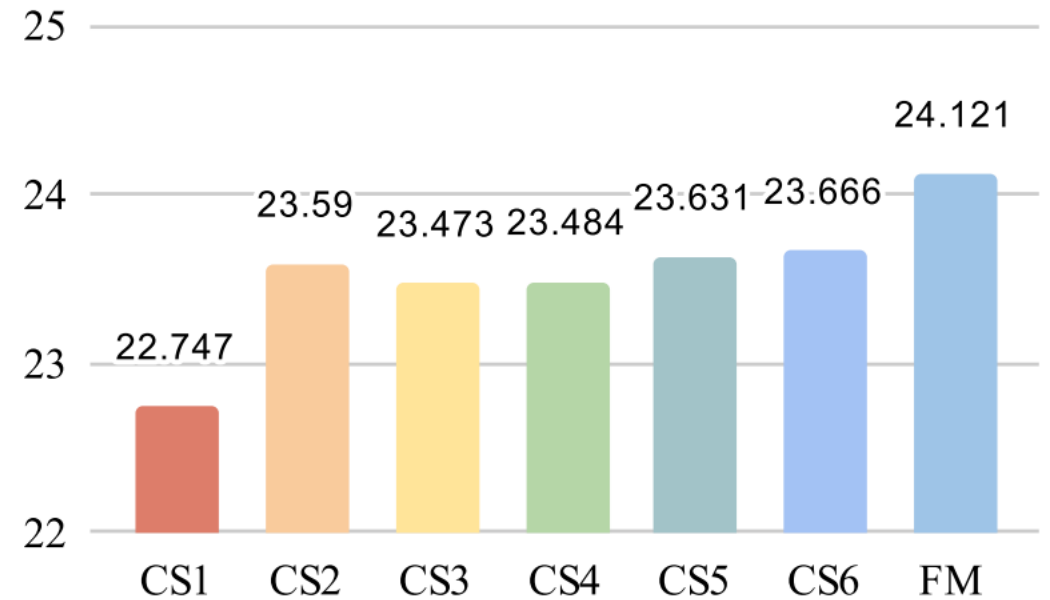


- ❑ CS1: Without global transformer
- ❑ CS2: Green channel as common input to cross-attention branches
- ❑ CS3: Red channel as common input to cross-attention branches
- ❑ CS4: Passing R-G-B channels in a one-to-one manner through 3x3, 5x5, and 7x7 kernels respectively
- ❑ CS5: Without 5x5 and 7x7 CONV blocks
- ❑ CS6: Without 7x7 CONV block
- ❑ FM: Full model

QUANTITATIVE ABLATION STUDY



Loss Setting
(a)



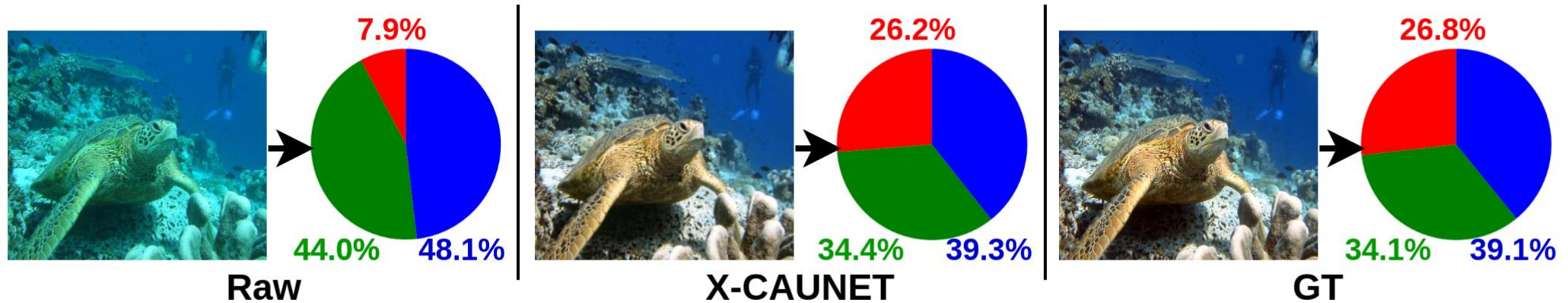
Component Setting
(b)

- LS1: LI loss
- LS2: LI loss + CLIP loss
- LS3: LI loss + CLIP loss + SSIM loss

INFLUENCE ON DOWNSTREAM TASKS



Underwater Semantic Segmentation



Color correction

UIE RESULTS OF X-CAUNET ON VIDEOS



THANK YOU !

QUESTIONS ?

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