Progressive Feature Fusion Network for Realistic Image Dehazing

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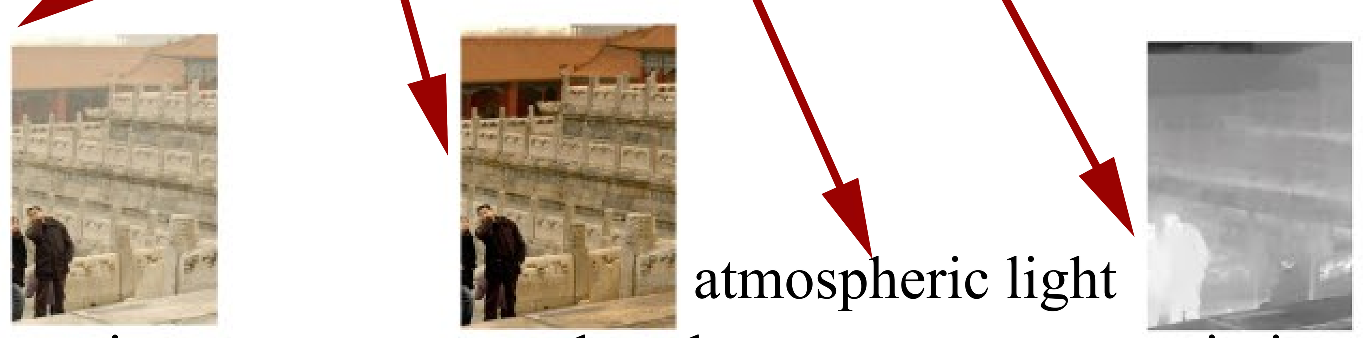
MOTIVATION

Haze is a common atmospheric phenomenon, which results in degradation of image quality. Therefore, image dehazing becomes an increasingly desirable technique. The widely used classic atmospheric scattering model cannot fit the realistic haze environment very well.

$$I(x) = J(x)\,t(x) + A \cdot (1 - t(x))$$

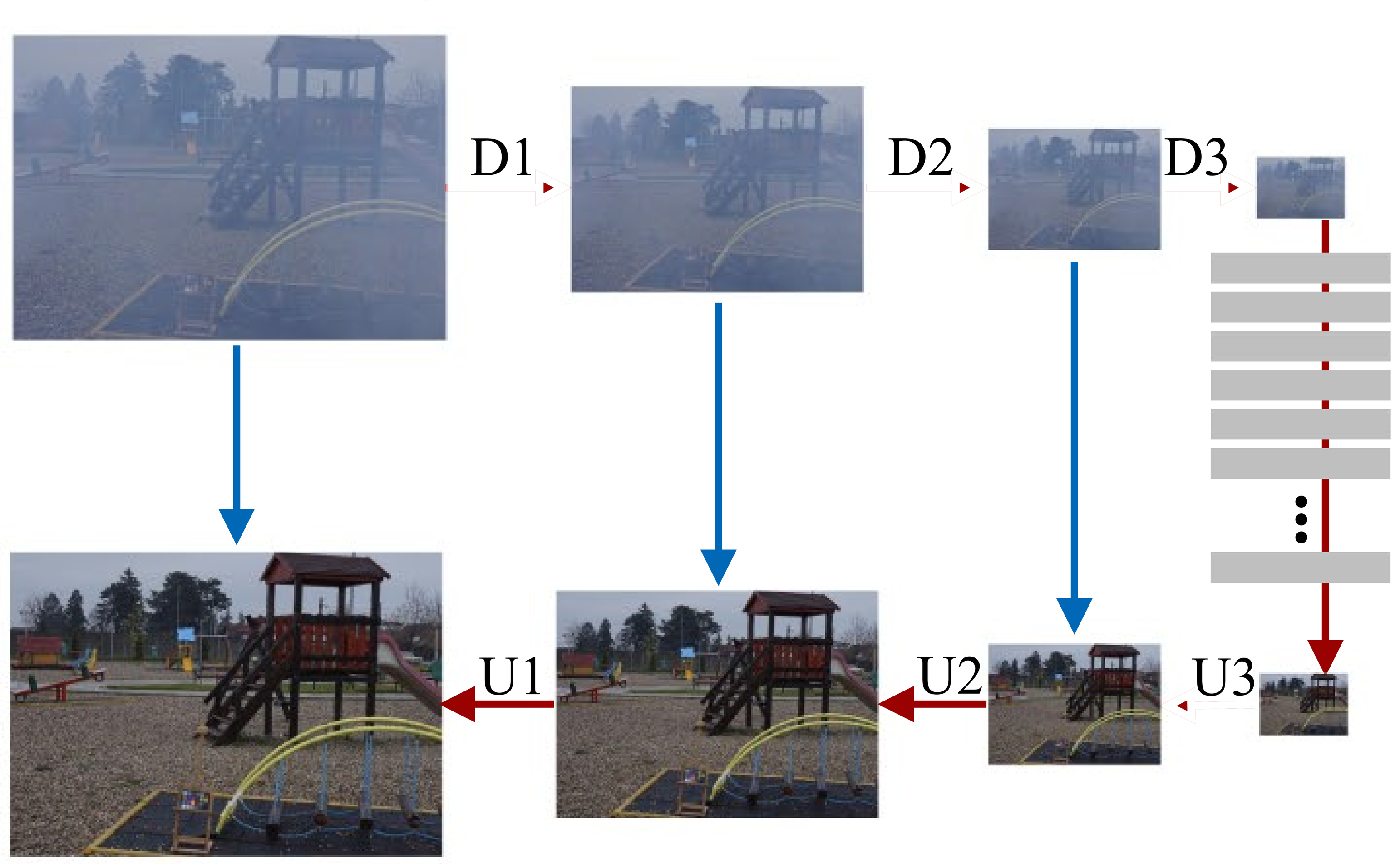


hazy image ground truth atmospheric light transmission map

However, the end-to-end dehazing is unavailable until the first real hazy datasets O-HAZE and I-HAZE released in NTIRE 2018 Dehazing challenge. By using the datasets, we can train a CNN to direct learn the nonlinear mapping between I(x) and J(x).

MAIN IDEA

In this paper, we proposed an effective trainable U-Net like end-to-end network for image dehazing. We introduced a progressive feature fusion mechanism in the encoder-decoder architecture, and resblocks is employed to learn the feature transformation from haze to haze-free. Since the feature mappings are learning after down-sampling operations, which greatly reduce memory usage during training and inference. The proposed Progressive Feature Fusion Network (PFF-Net) can directly recover ultra high definition hazed image up to 4K resolution on a single TITAN X GPU.



PROPOSED METHOD

The main architecture of PFF-Net is illustrated in the following figure. The encoder module consists of four convolution layers and performs down-sampling convolutional operations in pyramid scale.

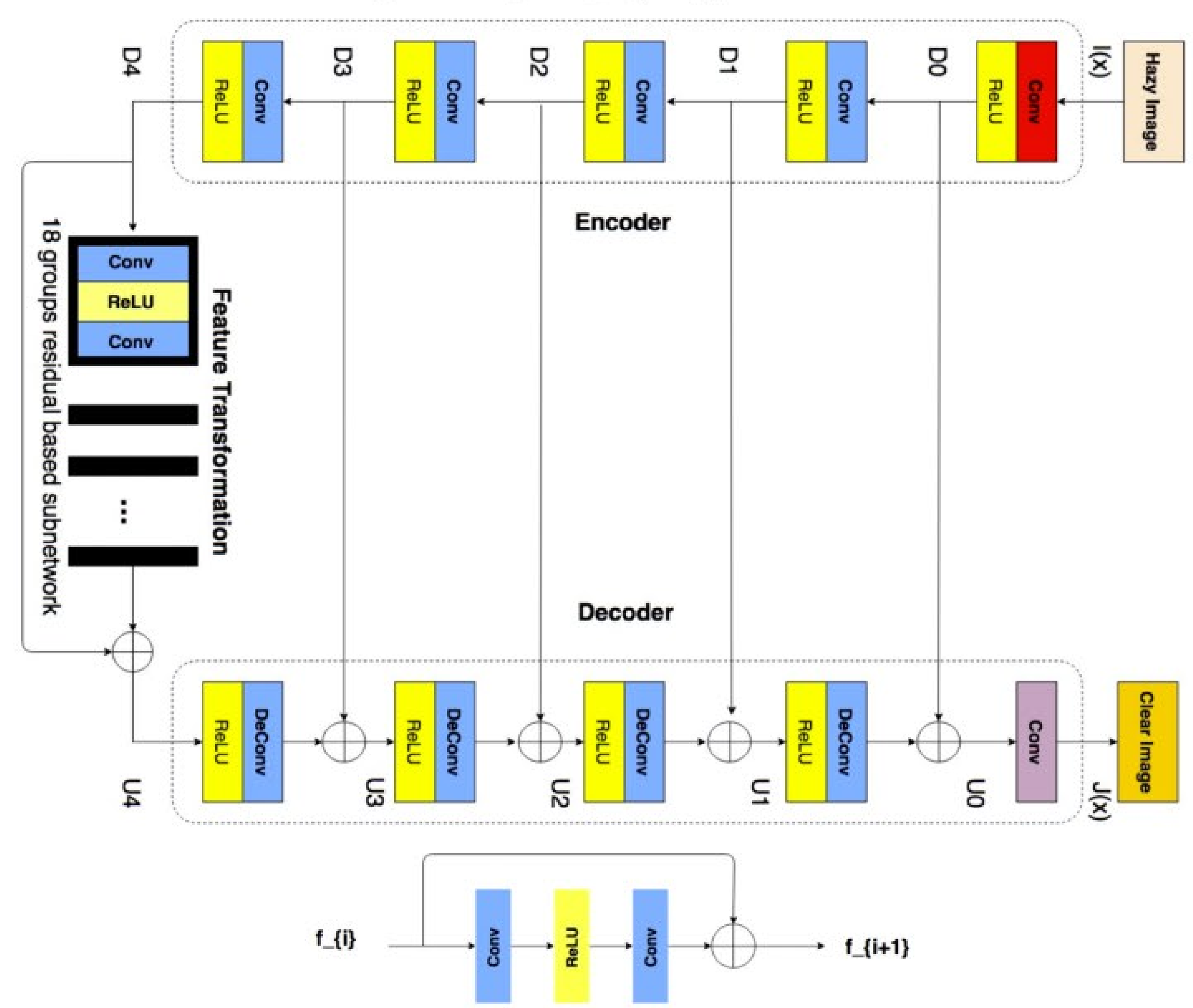
$$D_i = Conv_{en}^{i}(D_{i-1}), i = \{0,1,2,3,4\}, \text{where}, D_{-1} = I$$

Similarly, the decoder module recovers image structural details in contrast.

$$F_{j-1} = DeConv_{dec}^{j}(U_j), j = \{4,3,2,1\}$$

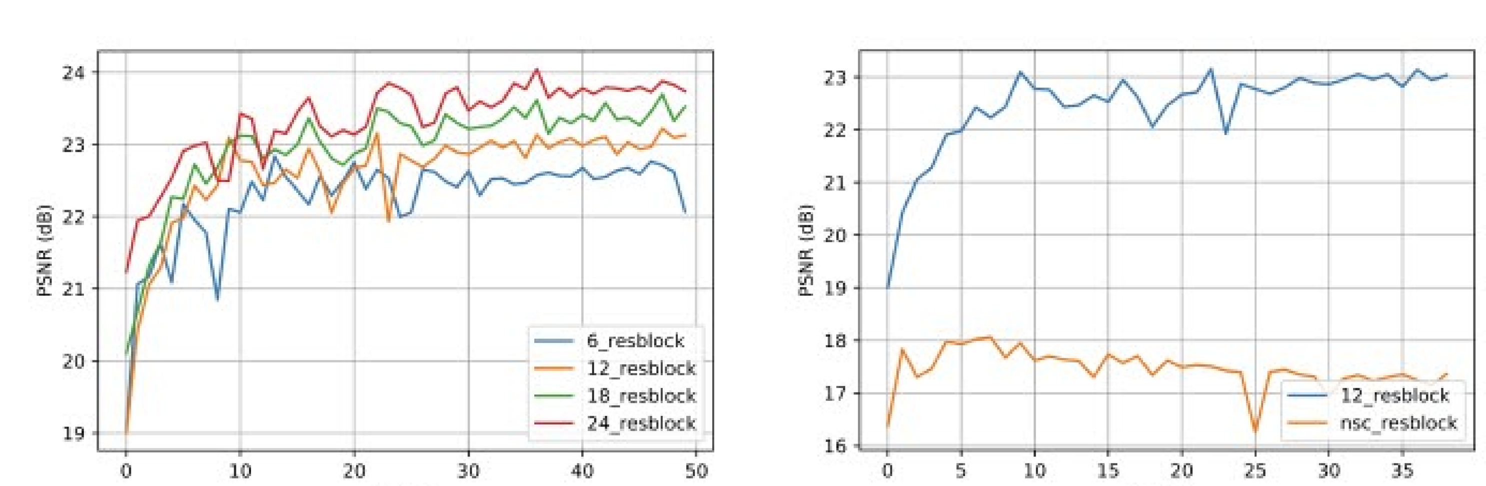
In order to maximize information flow along multi-level layers, global shortcut connections are applied between the input and the output of each encoder and decoder.

$$U_i = D_i \oplus F_i, i = \{3,2,1,0\}$$
$$U_4 = D_4 \oplus \Psi(D_4)$$

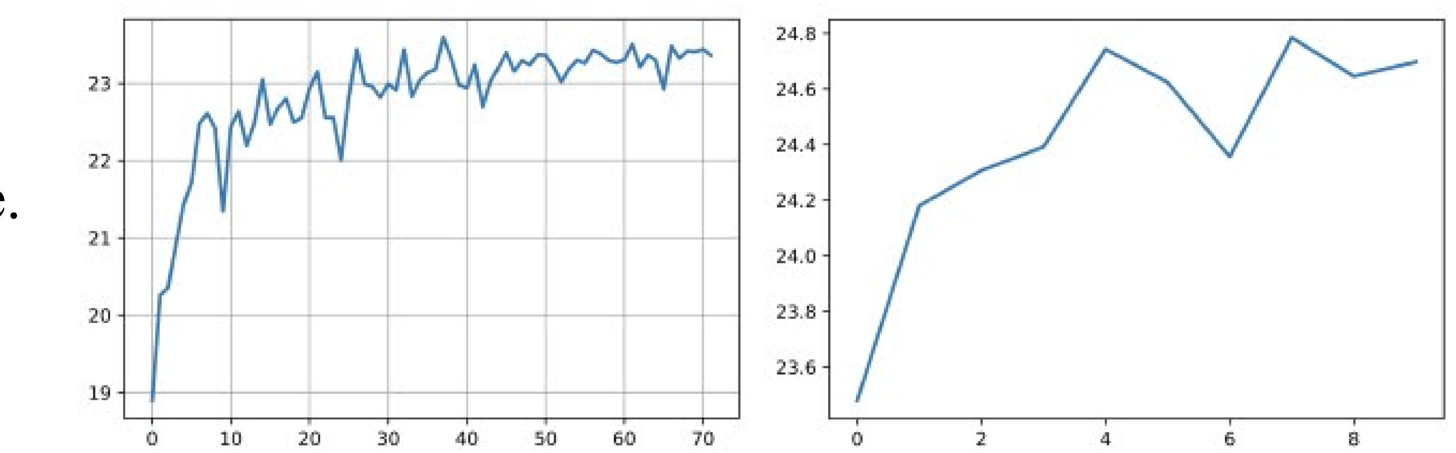


EXPERIMENTS

Ablation parameter comparisons on networks settings



Testing curves on O-HAZE dataset (left) and RESIDE dataset (right).



Dehazing performance evaluated on RESIDE dataset

	DCP	CAP	NLD	DehazeNet	MSCNN	AOD-Net	GFN	PFF-Net(ours)
PSNR	16.62	19.05	17.29	21.14	17.57	19.06	22.30	**24.78**
SSIM	0.8179	0.8364	0.7489	0.8472	0.8102	0.8504	0.88	**0.8923**

Dehazing examples from O-HAZE dataset

Dehazing examples from real hazy images

Hazy Image DCP DehazeNet MSCNN GFN PFF-Net (ours)

Our code can be found at https://github.com/MKFMIKU/PFFNet
Contact me (mikumkf@gmail.com) if you take any interest in our project.
Thanks for your reading!