Image De-raining for autonomous vehicle

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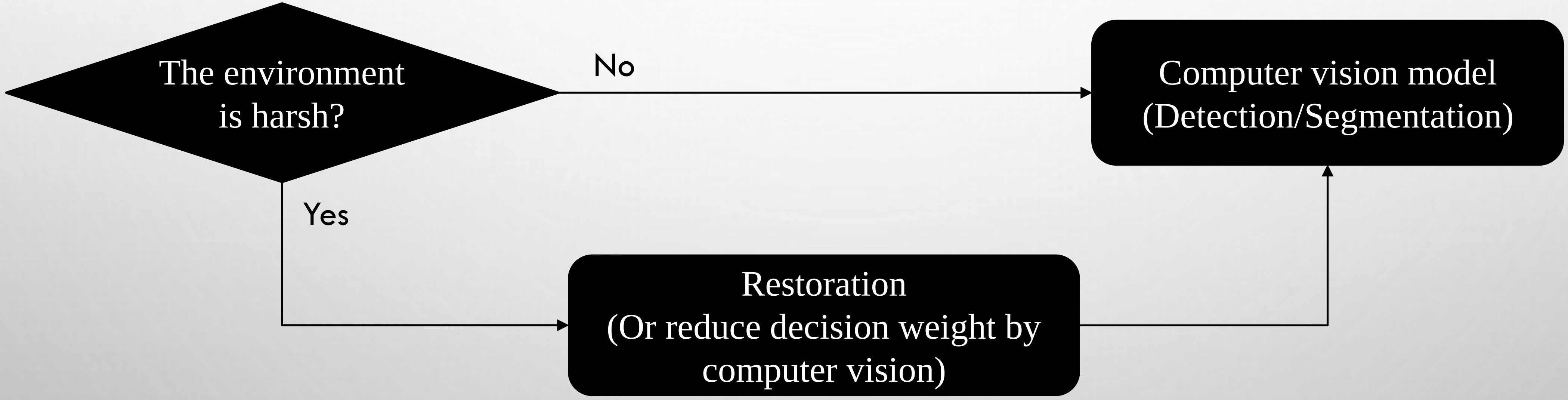
Rain impact our computer vision model performance a lot

Synthetic rain image

Raw Image

To solve the rain image problem or another harsh environment

We take a two-stage strategy



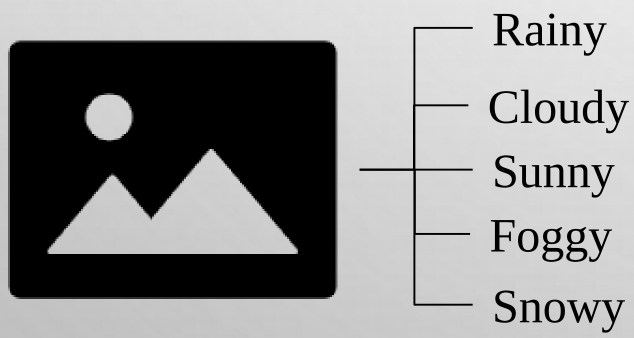
The environment is harsh?

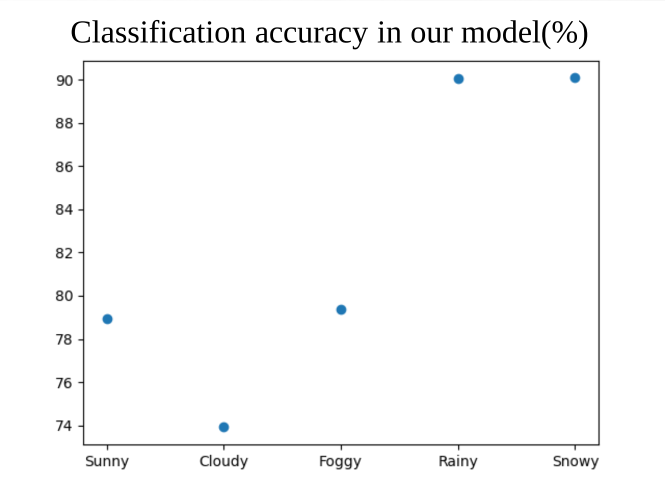
Action:

1. Use classification model
2. Periodically trigger classification model

We use EfficientNet (B3) as our network architecture

Collect image dataset from Flickr
(About 5000 image data with different weathers)





In rainy and snowy weather conditions can get about 90% accuracy

Inference time about 0.02(s) we also can use the faster network to classify our weather

Rain image restoration

We select Rain-free and Residue Hand-in-Hand: A Progressive Coupled Network for Real-Time Image Deraining (PCNet)

Traditional restore noise image: the degraded input (ID) is separated as degradation (D) and the ground truth (IB)

This Paper: Use progressive structure to separate rain and background image use coupled representation module (CRM) structure.

R
(rain image)

B
(background image)

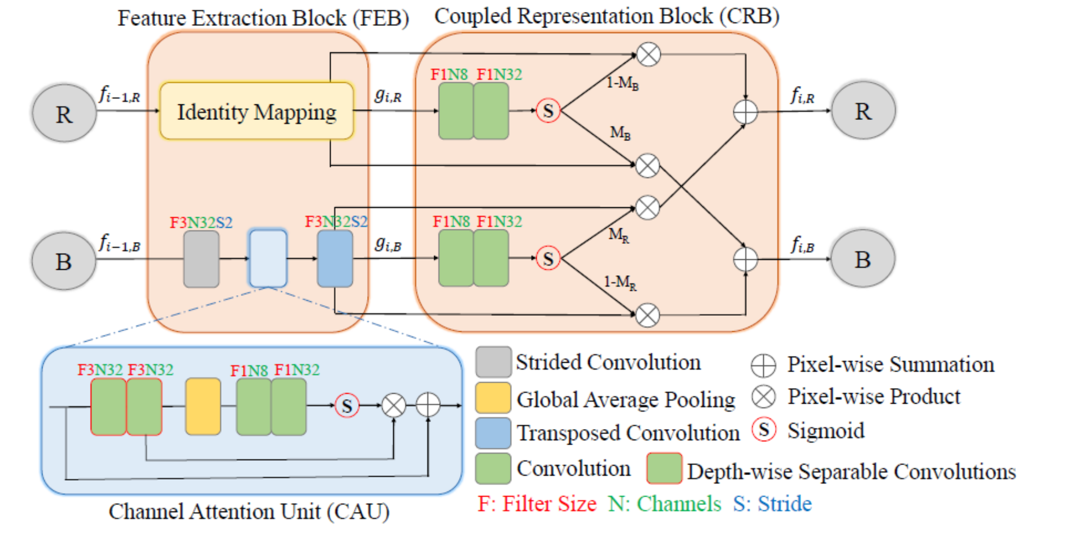


Fig. 3. Architecture of our proposed coupled representation module (CRM).

Use depth-wise separable convolutions (MobileNet) to reduce calculate loading

Rain image restoration

PCNet architecture

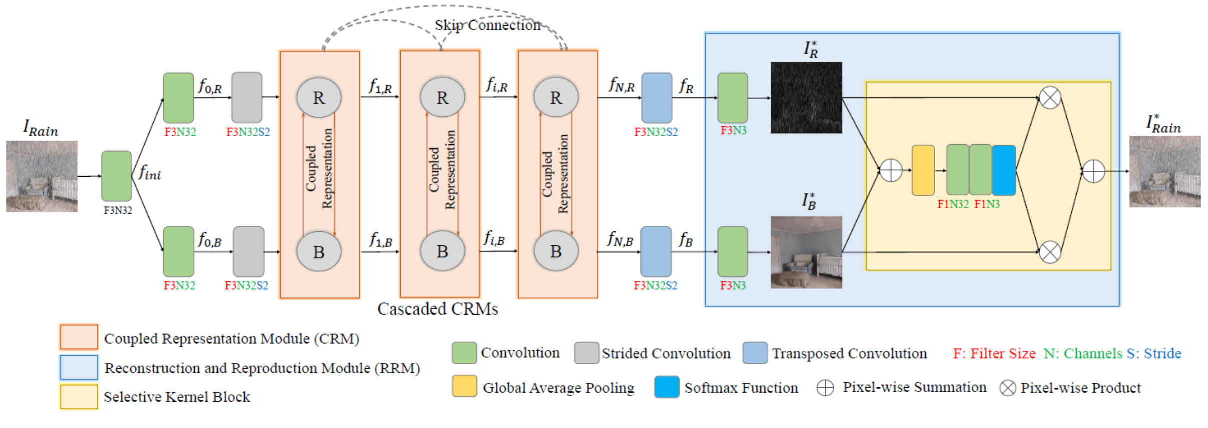


Fig. 2. Framework of our proposed progressive coupled network (PCNet). PCNet contains several cascaded CRMs as the backbone for feature extraction and one RRM to generate the predicted rain-free image I_B^*, rain streaks I_R^* and the reproduced rainy image I_{Rain}^*.

Use cascaded CRMs to separate rain and background information

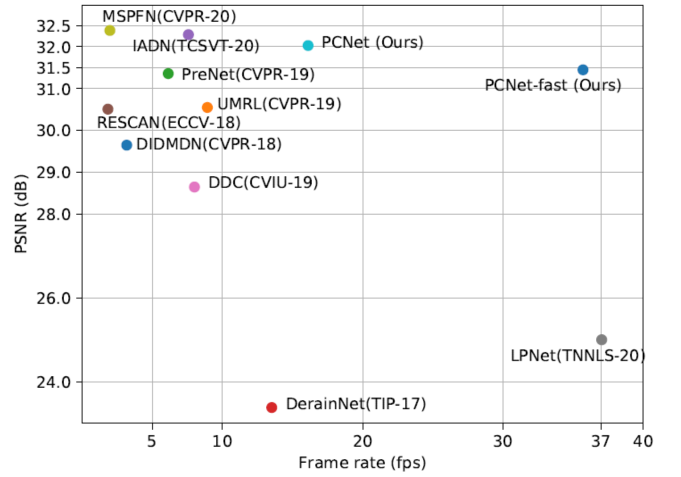


Fig. 1. Comparison of state-of-the-art detraining methods in terms of efficiency (processing speed (fps)) *vs.* performance (PSNR). The results are reported on the *TEST1200* dataset with image size of 512×512. Compared with the top-performing method MSPFN [1], our proposed PCNet achieves comparable deraining performance (*32.03dB vs. 32.39dB*) with about $8\times$ faster inference speed (*16.1 fps vs. 1.97 fps*). Our light-weight model PCNet-fast not only achieves real-time throughput (*35.7fps*) but also outperforms the representative high-accuracy method PreNet [2].

Inference speed

Rain image restoration

Use PCNet to restore our rainy image from Flickr (real)

Rain video restoration

Use PCNet to restore the NTURain dataset

(In this 3-second image were detected to a rainy image by our classification model)

Raw video

Restore video

Some problems have to solve

Weather classification dataset

Image label error from Flickr creator misleading our classification network

Label: Cloudy Predict: Foggy

Label: Rainy Predict: Snowy

Some problems have to solve

Raining dataset

Difficult to get ground truth data

Use synthetic dataset

But…

Some problems have to solve

Rain video restoration

The raindrop blur problem
(Related video sampling rate or
moving motion blur)