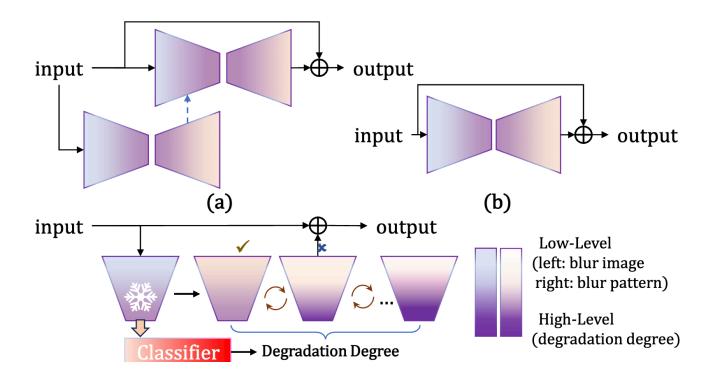# AdaRevD: Adaptive Patch Exiting Reversible Decoder Pushes the Limit of Image Deblurring(CVPR2024)
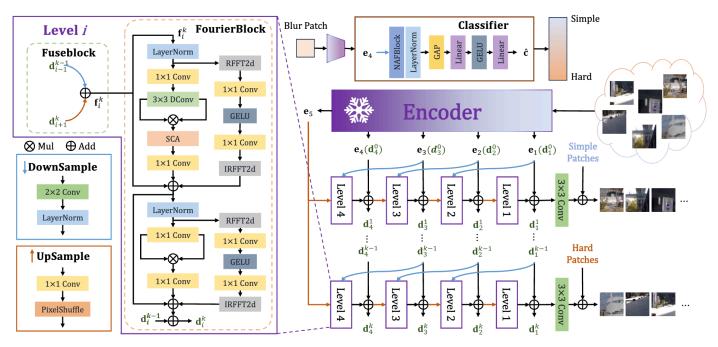
- https://arxiv.org/pdf/2406.09135
- https://github.com/INVOKERer/AdaRevD/tree/master
- https://github.com/DeepMed-Lab-ECNU/Single-Image-Deblur

Related work

- Deblurring Methods
  - DeepDeblur
  - DMPHN
  - MPRNet
  - NAFNet
  - Uformer
  - Stripformer
  - Restormer
  - DeepRFT
  - MRLPFNet
- Reversible Architectures
  - Reversible Residual Block(The reversible residual network: Backpropagation without storing activations. In Proc. NeurIPS, 2017)
  - Rev-ViT
  - RevBiFPN
  - BiFPN
  - RevCol
- Adaptive Inference
  - Slimmable networks
  - AdaDSR
  - ClassSR
  - APE-SR

Network

(AdaRevD全体図, 論文より引用)

- 近年のdeblurring networkは4つから構成される
  - head
  - encoder
  - decoder
  - tail

- headは3×3のconvolution layer
- tailの出力はblur patternで、この出力を元画像に足し合わせることでdeblurred imageを得る
- 入力であるblur image Bから出力のrestored sharp image$\hat{S}$を得るまでは以下

$$
\begin{aligned}
h &= \mathcal{H}\left(B; \Theta_{head}\right) \\
e_1, e_2, \cdots, e_N &= \mathcal{E}\left(h; \Theta_{enc}\right) \\
d_1 &= \mathcal{D}\left(e_1, e_2, \cdots, e_n; \Theta_{dec}\right) \\
t &= \mathcal{T}\left(d_1; \Theta_{tail}\right) \\
\hat{S} &= B + t
\end{aligned}
\tag{1}
$$

- AdaRevDではmulti-decoder structure
- j番目のsub-decoderのLevel iをd_i^jとすると以下のようにかける

$$
\begin{aligned}
h &= \mathcal{H}\left(B; \Theta_{head}\right) \\
e_1, e_2, \cdots, e_N &= \mathcal{E}\left(h; \Theta_{enc}\right) \\
d_1^1, \cdots, d_{N-1}^1 &= \mathcal{D}^1\left(e_1, e_2, \cdots, e_n; \Theta_{dec}^1\right) \\
d_1^k, \cdots, d_{N-1}^k &= \mathcal{D}^k\left(d_1^{k-1}, \cdots, d_{N-1}^{k-1}, e_N; \Theta_{dec}^k\right) \\
t^j &= \mathcal{T}^j\left(d_1^j; \Theta_{tail}^j\right) \\
\hat{S}^j &= B + t^j
\end{aligned}
\tag{2}
$$

- decoderはReversible Architecture

Adaptive Classifier

- degradation degreeを多クラス分類する
- これもtrainの対象

loss

- decoder training phaseは以下

$$
\begin{aligned}
L_m &= L_1 + 0.01 L_{fr} \\
L_1 &= \frac{1}{N}\sum_{j=1}^{K}\|\hat{S}^j - S\|_1 \\
L_{fr} &= \frac{1}{K}\sum_{j=1}^{K}\|\mathcal{F}\left(\hat{S}^j\right) - \mathcal{F}(S)\|_1
\end{aligned}
\tag{3}
$$

- $\mathcal{F}$は2D Fast Fourier Transform
- classifier training phaseは以下

$$L_c = CrossEntropy(\tilde{c}, \hat{c})$$

英語

- disentangle : もつれを解く, 複雑な問題や状況が自然に整理される
- delicately : 繊細に
- inaugural : 新任の、就任の
- endeavor : 努力
- slimmable : スリムな
- conducive : 助かる, 貢献する, 助けとなる