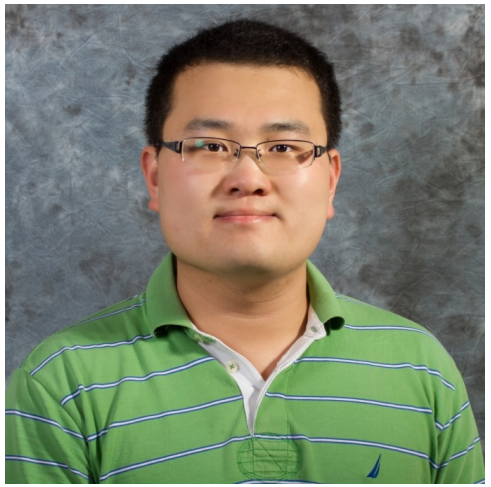
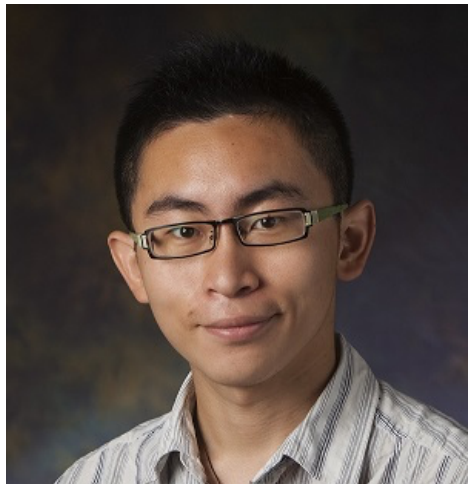
NAS-DIP: Learning Deep Image Prior with Neural Architecture Search

Yun-Chun Chen



Chen Gao

Esther Robb



Jia-Bin Huang

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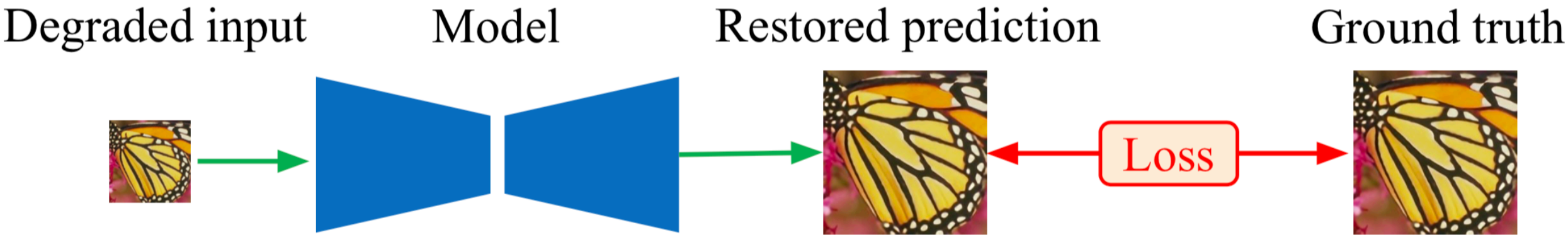
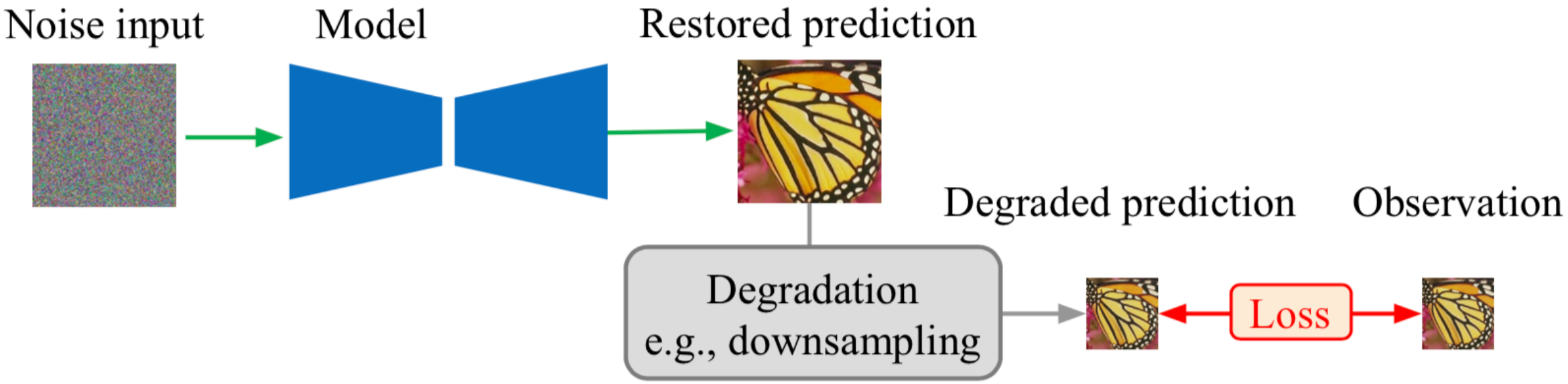
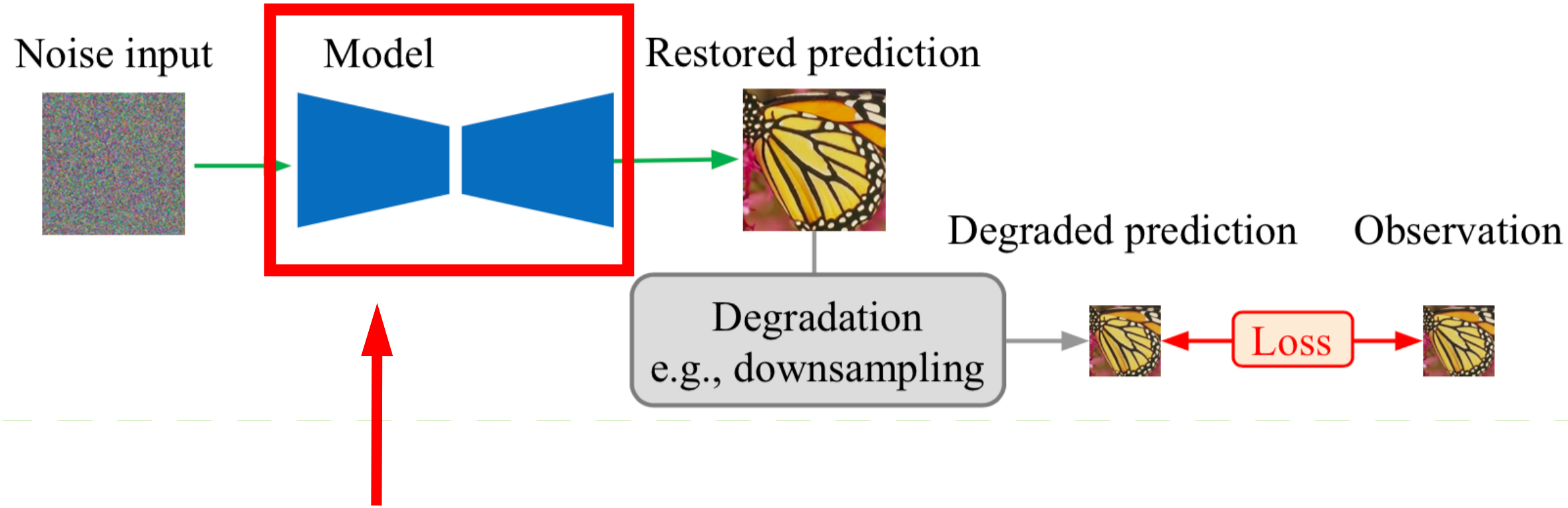
Learning-based Methods



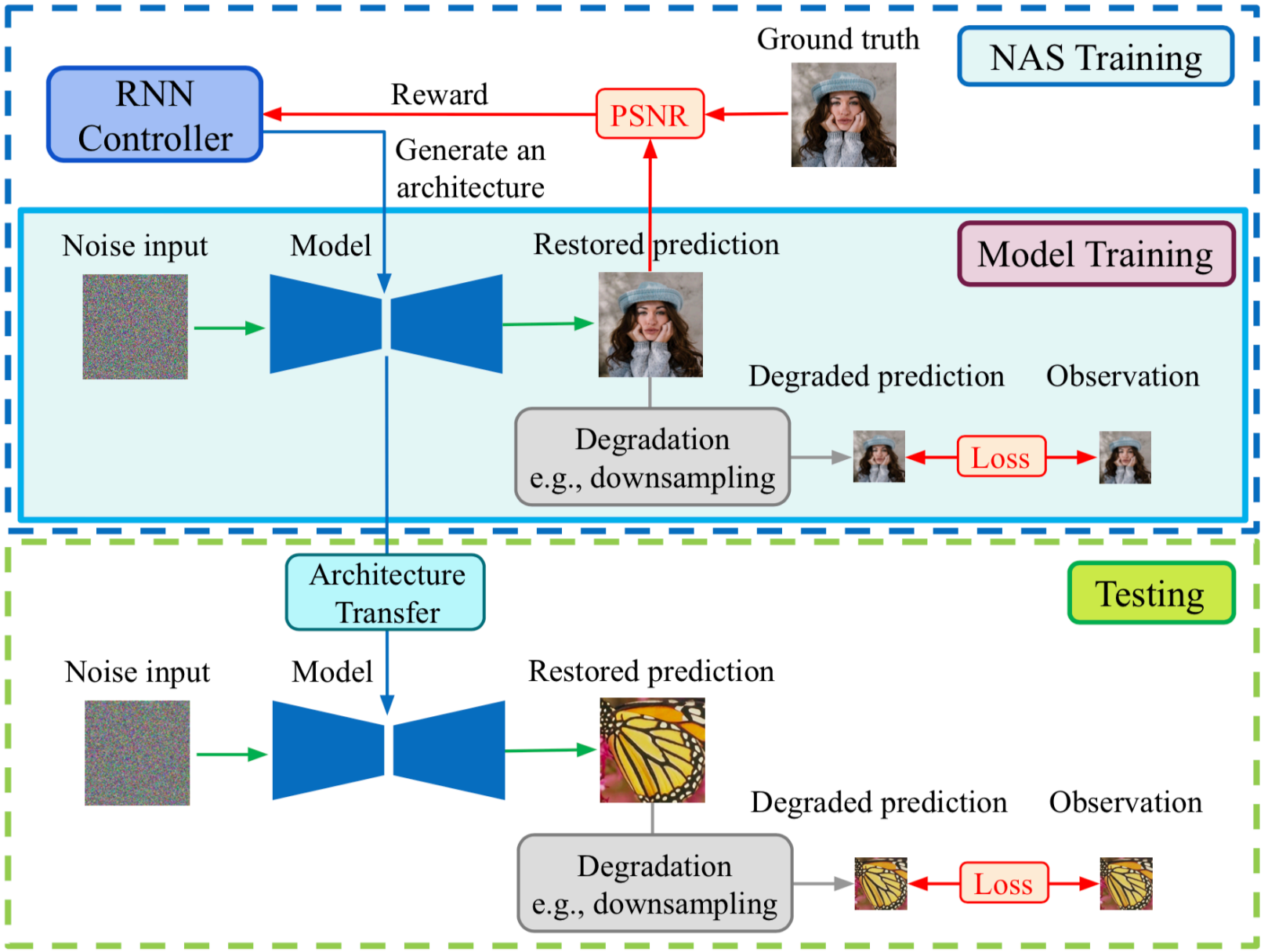
Deep Image Prior (DIP) [Ulyanov et al. CVPR 2018]



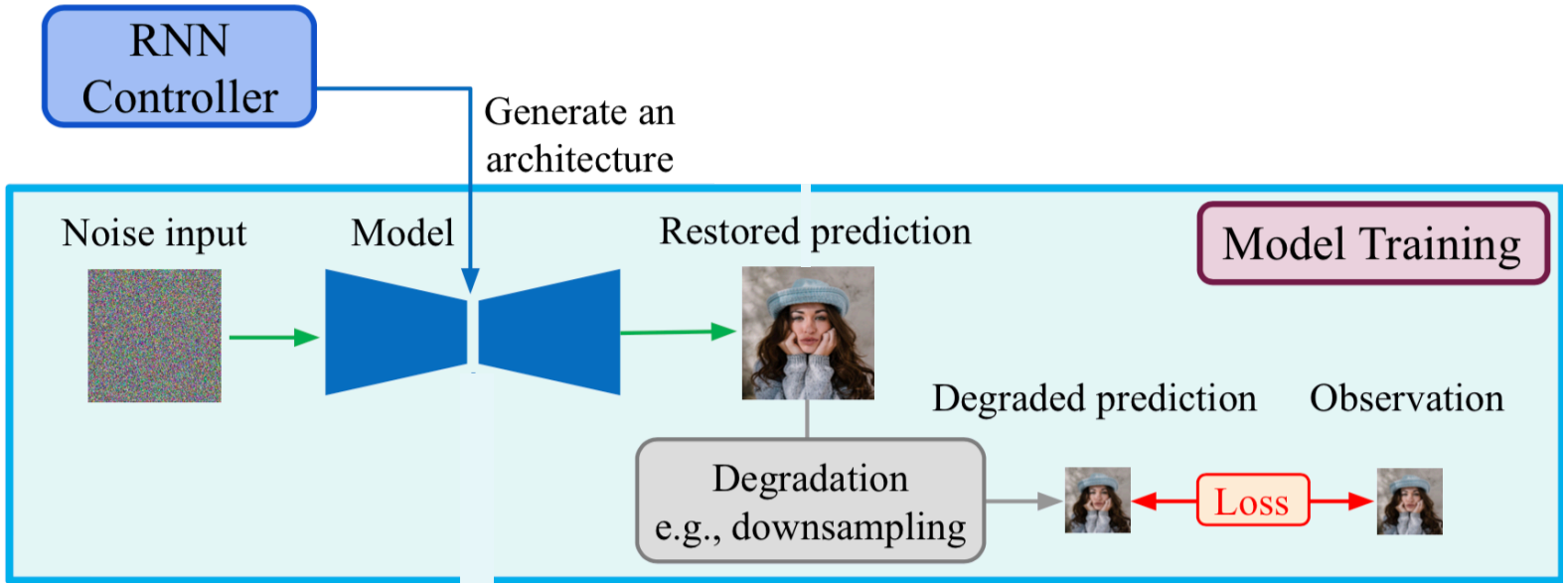
NAS-DIP (Ours)


Noise input
Model
Restored prediction
Degraded prediction
Observation
Degradation
e.g., downsampling
Loss
Neural Architecture Search (NAS)

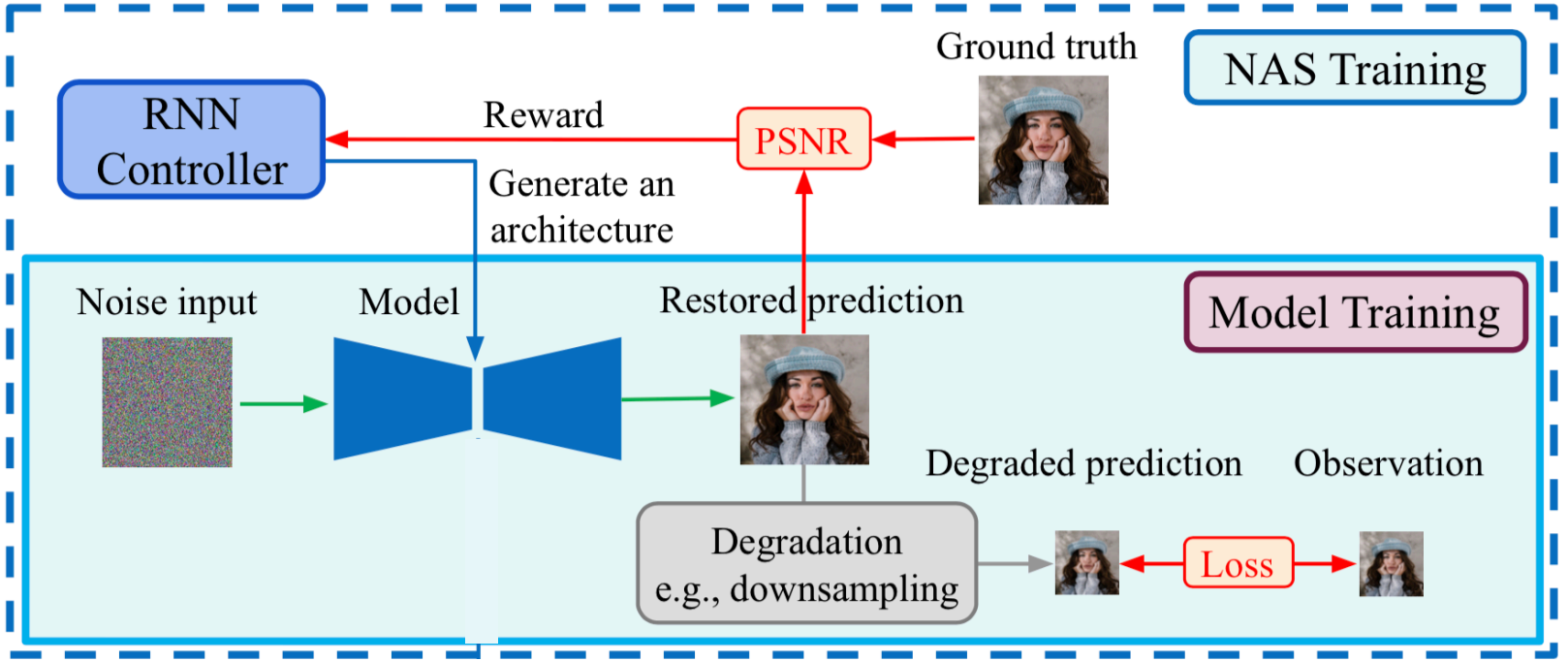
Overview of NAS-DIP



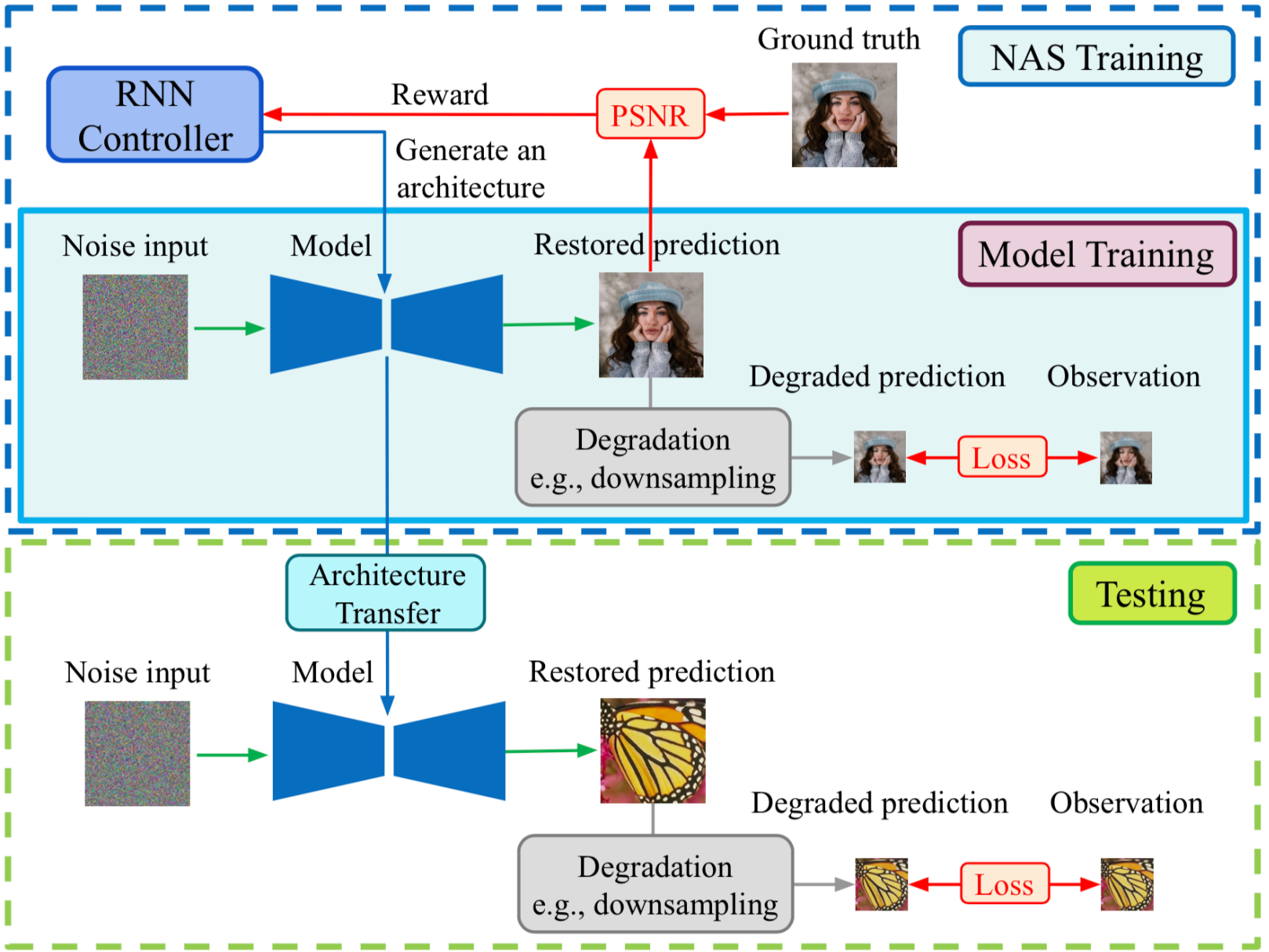
Model Training



NAS Training

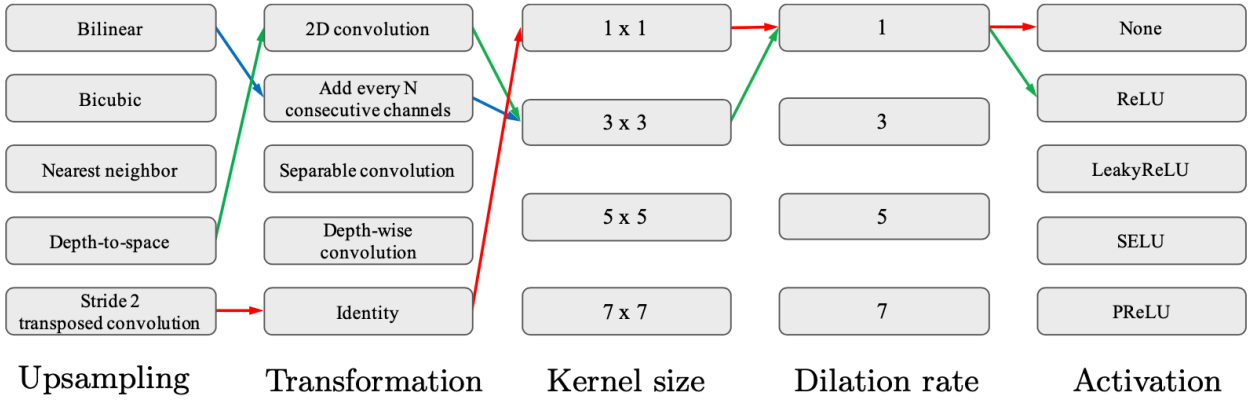


Testing

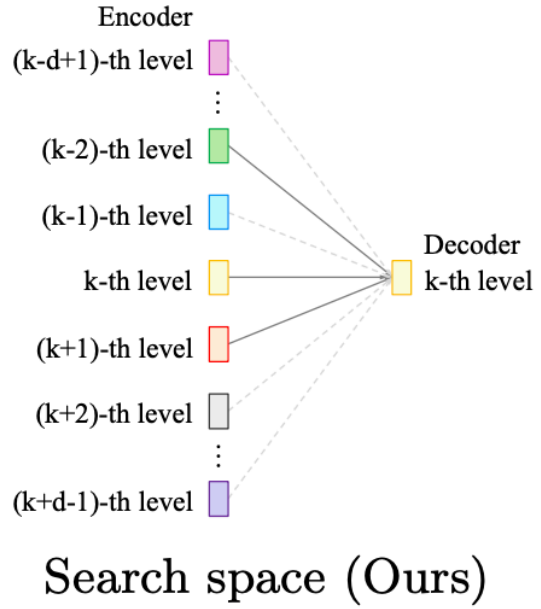

NAS Training
Ground truth
RNN Controller
Reward
PSNR
Generate an architecture
Model Training
Noise input
Model
Restored prediction
Degraded prediction
Observation
Degradation e.g., downsampling
Loss
Architecture Transfer
Testing
Noise input
Model
Restored prediction
Degraded prediction
Observation
Degradation e.g., downsampling
Loss

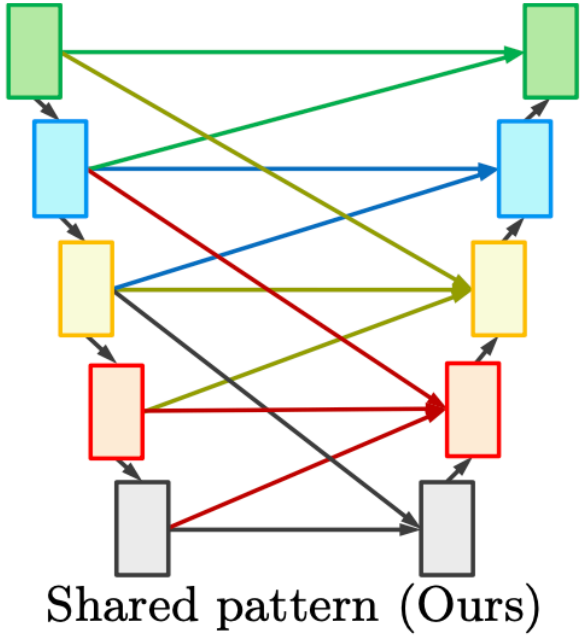
Search Space

- Upsampling cell

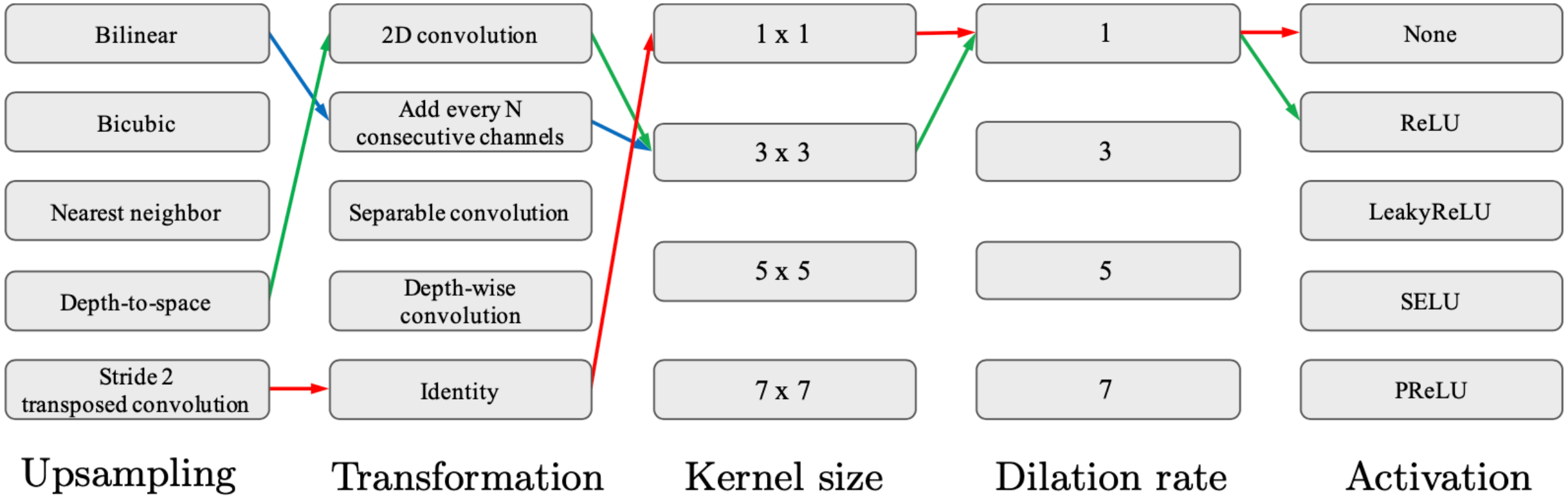


- Cross-scale residual connections
  - Shared cross-level patterns
  - Progressive upsampling

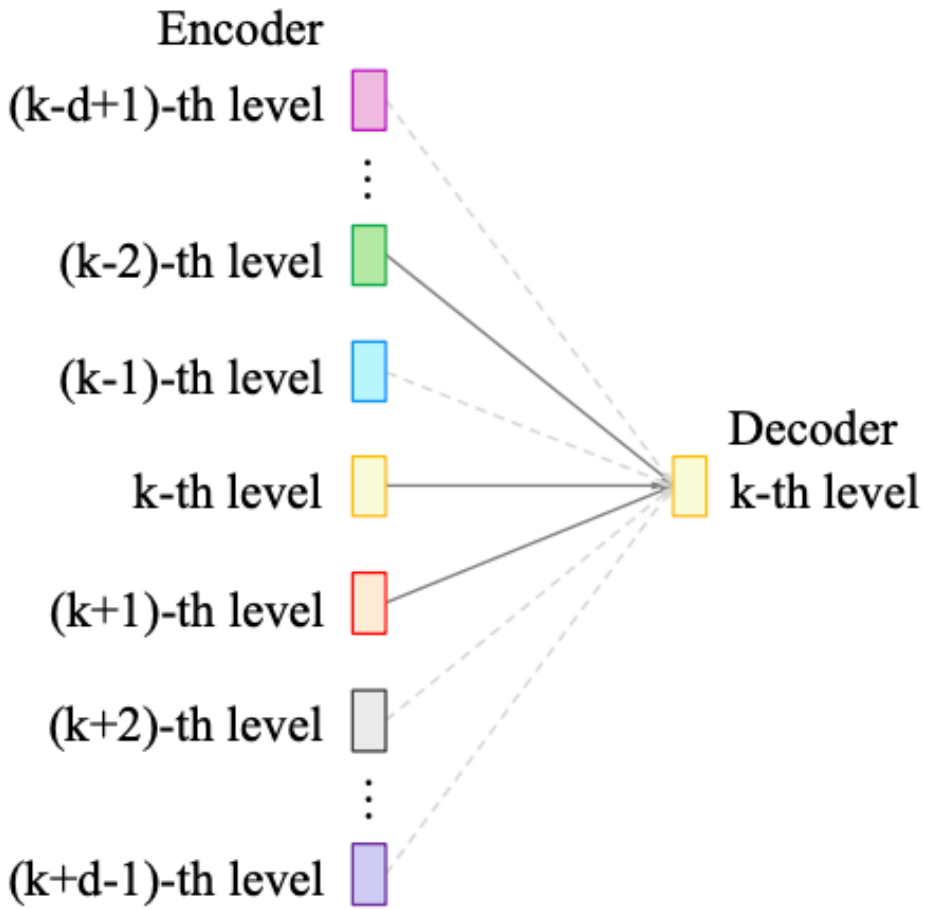




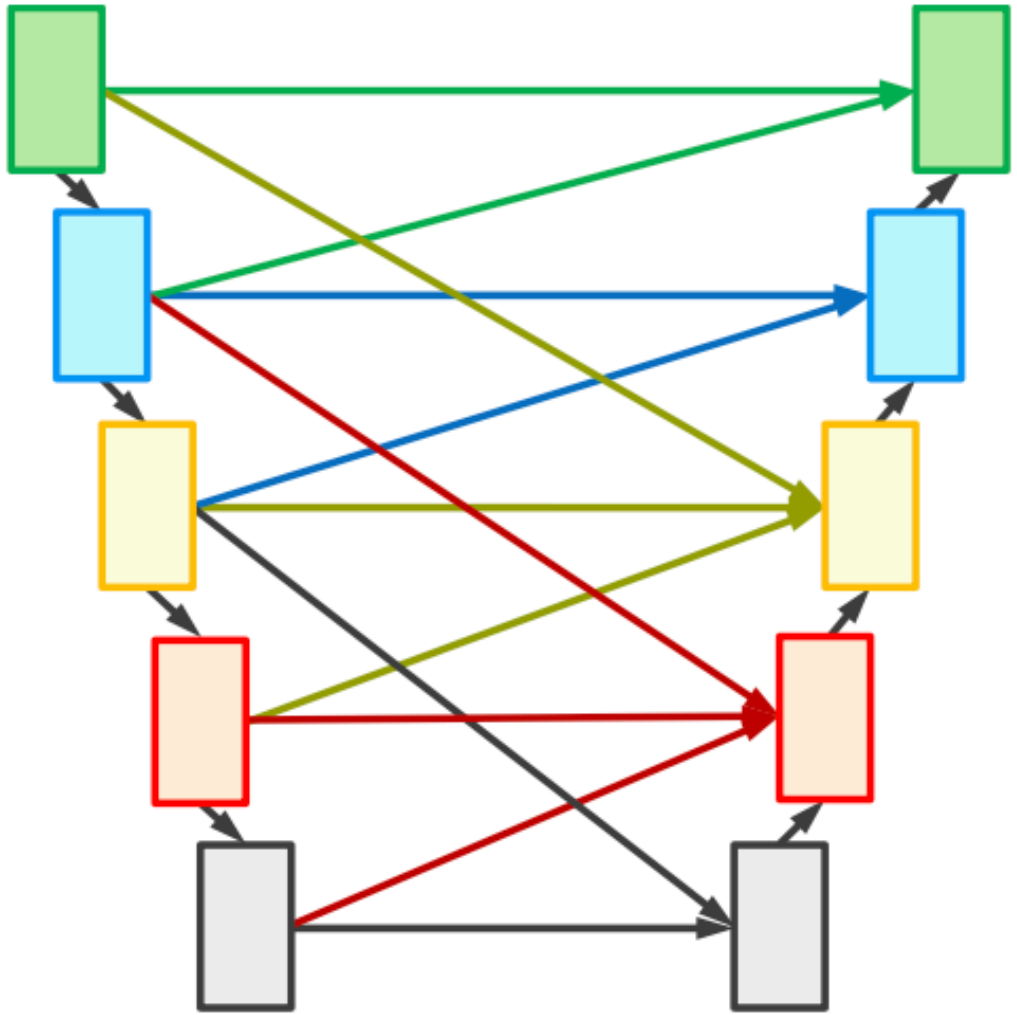
Search Space for the Upsampling Cell



Cross-scale Residual Connections

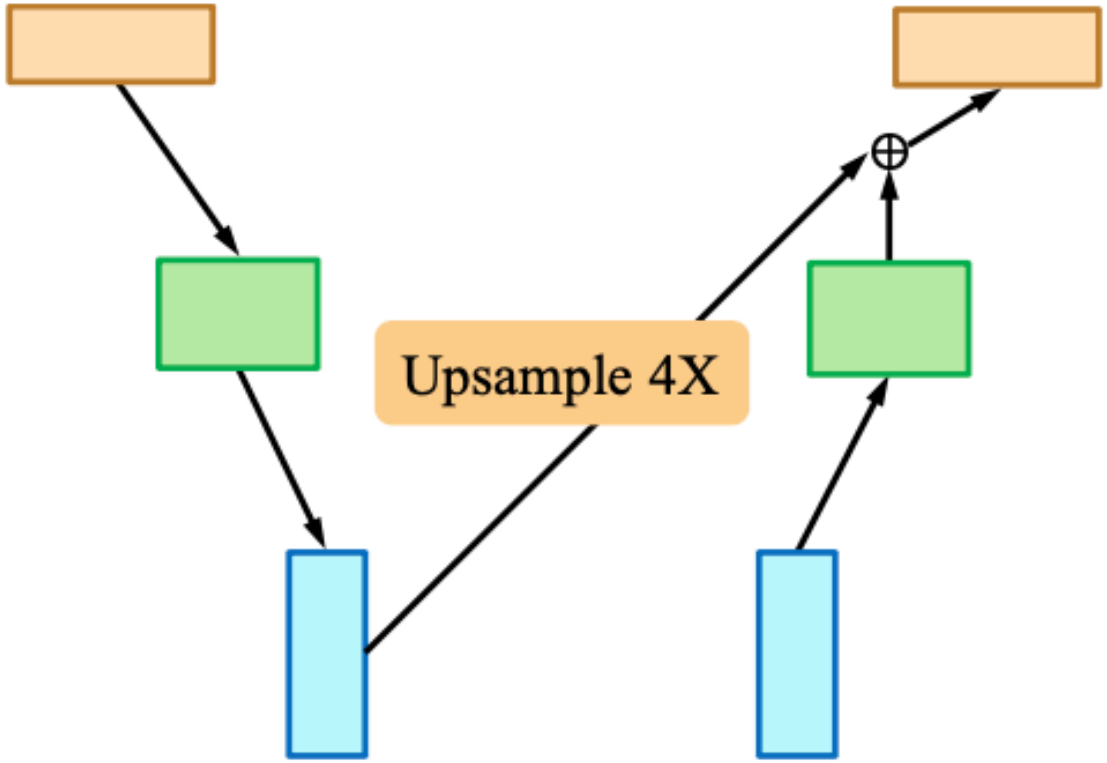


Search space (Ours)

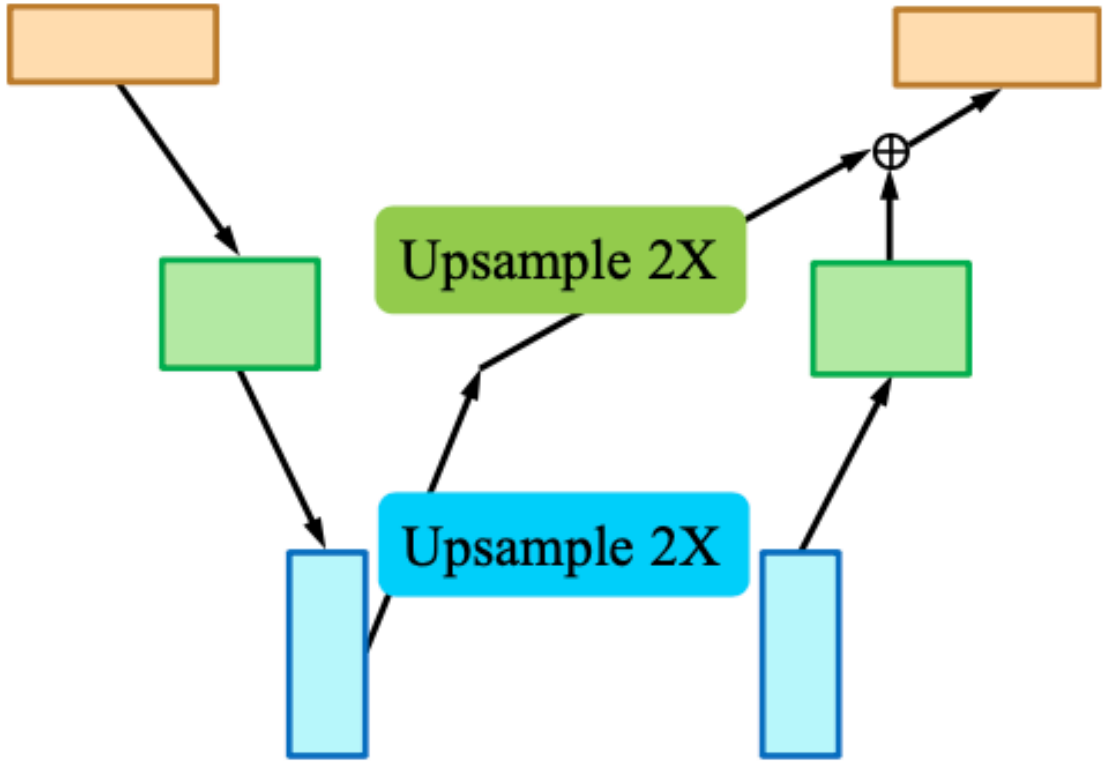


Shared pattern (Ours)

Decomposition

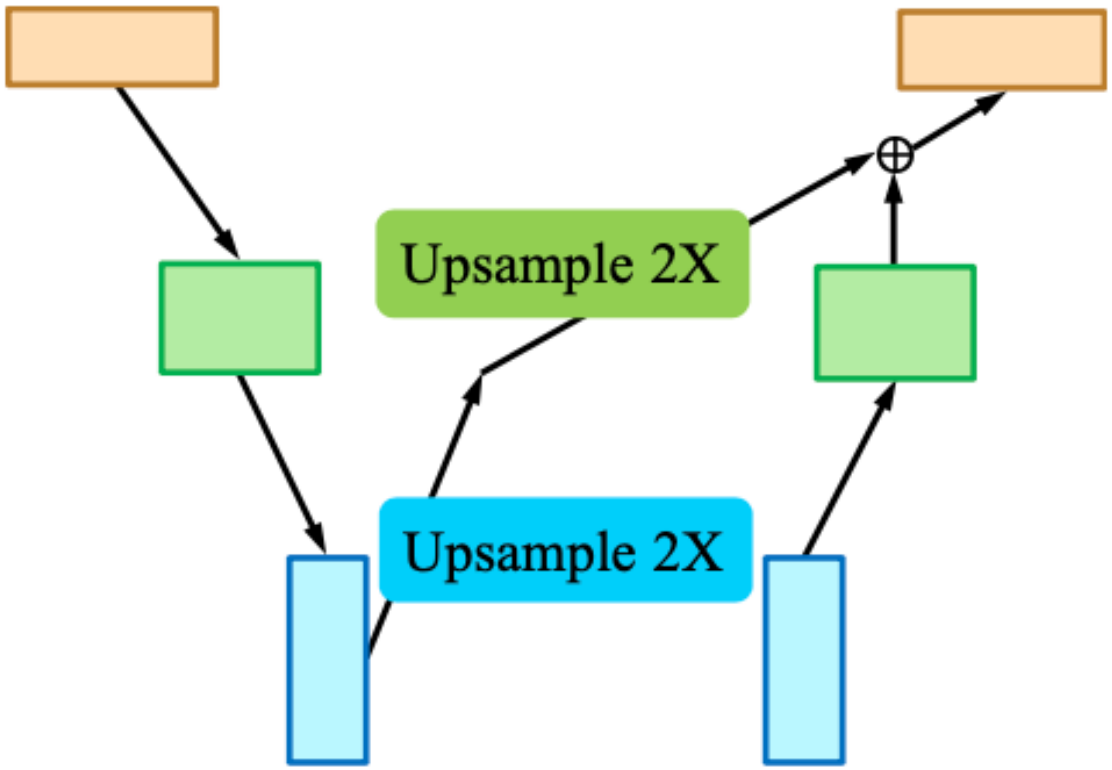


Direct upsampling

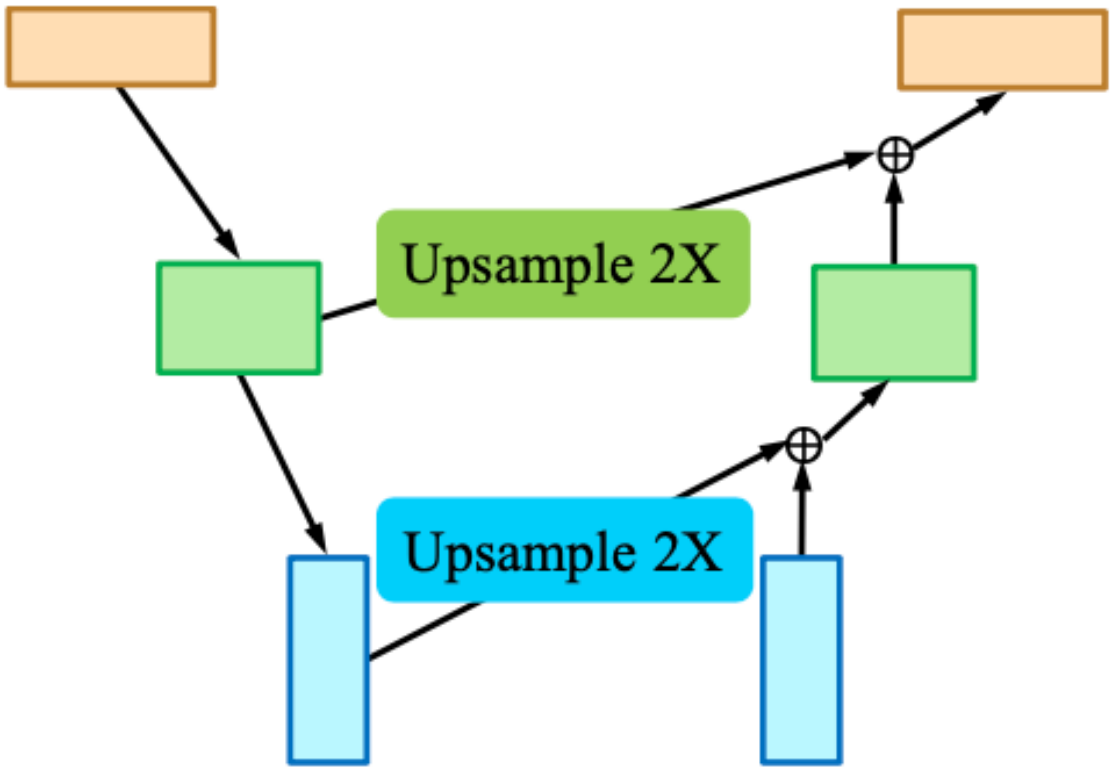


Progressive upsampling (Ours)

Weight Sharing



Progressive upsampling (Ours)



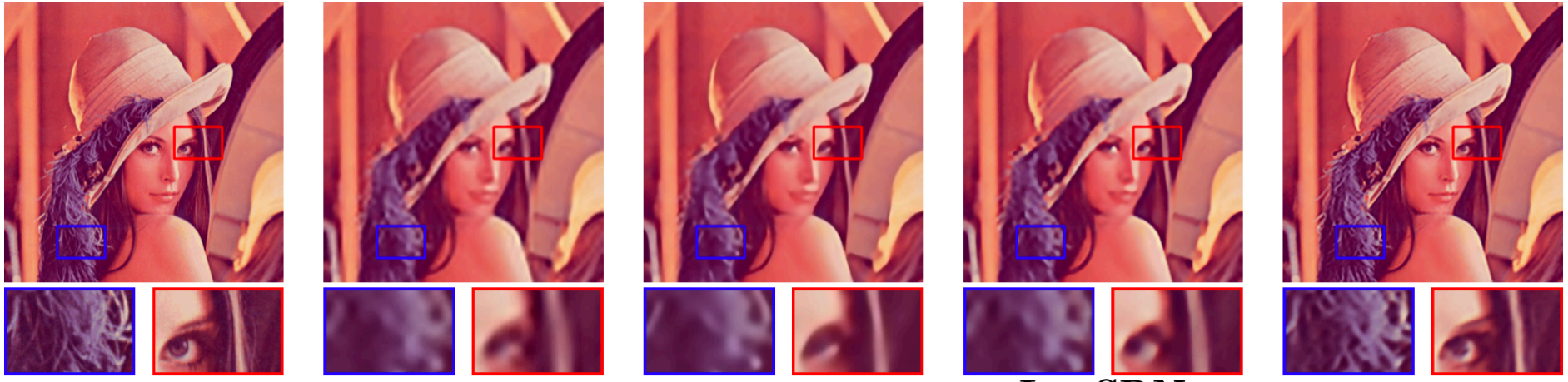
Weight sharing (Ours)

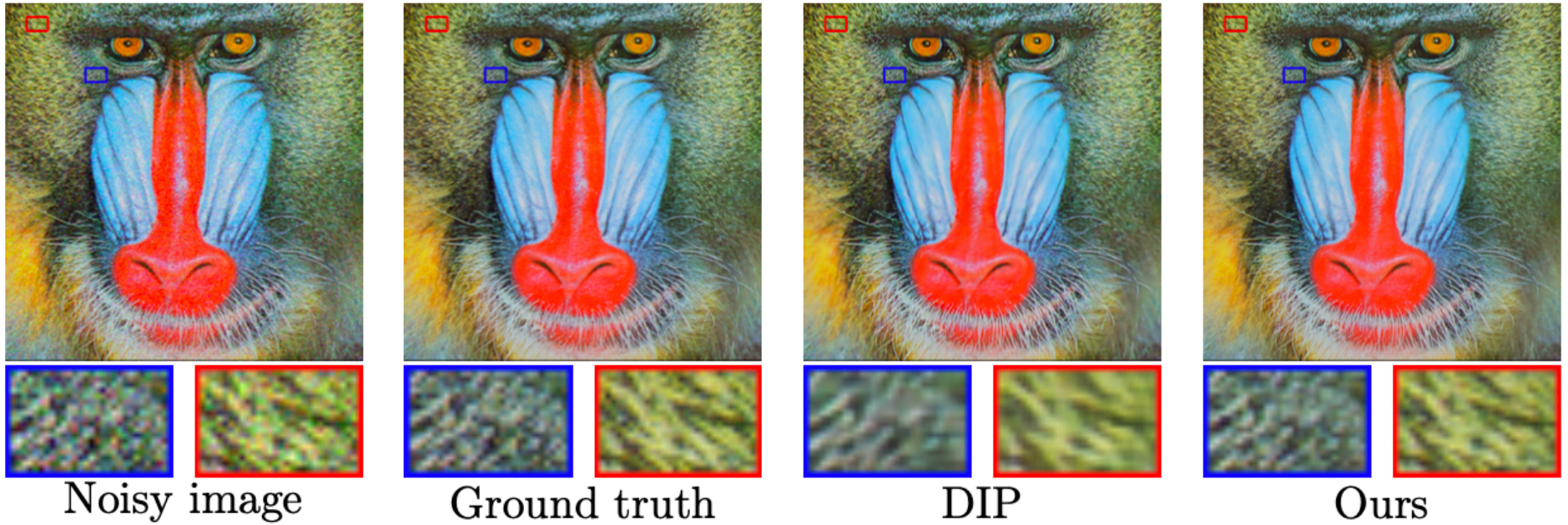
Quantitative Results

Method	Set5			Set14		
	2×	4×	8×	2×	4×	8×
Bicubic	33.66	28.44	24.37	30.24	26.05	23.09
Glasner et al.	-	28.84	-	-	26.46	-
TV prior	-	28.85	24.87	-	26.42	23.48
RED	-	30.23	25.56	-	27.36	23.89
DeepRED	-	30.72	26.04	-	27.63	24.28
SelfExSR	**36.60**	30.34	25.49	**32.24**	27.41	23.92
DIP	33.19	29.89	25.88	29.80	27.00	24.15
Ours	35.32	**30.81**	**26.41**	31.58	**27.84**	**24.59**

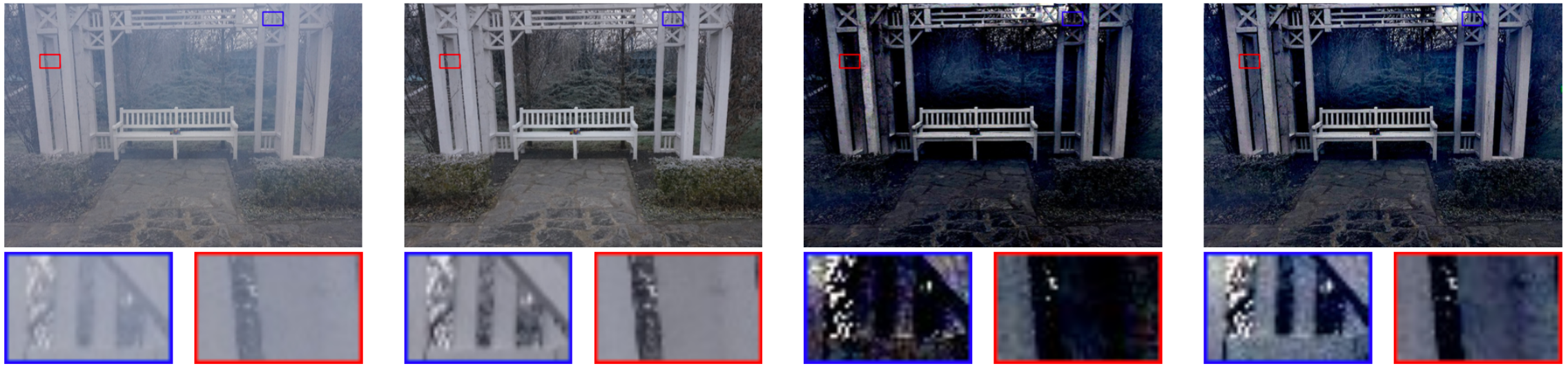
Method	Inpainting	Denoising
Papyan et al.	31.19	-
DIP	33.48	30.43
SGLD	34.51	30.81
Ours	**34.72**	**31.42**

Visual Comparisons



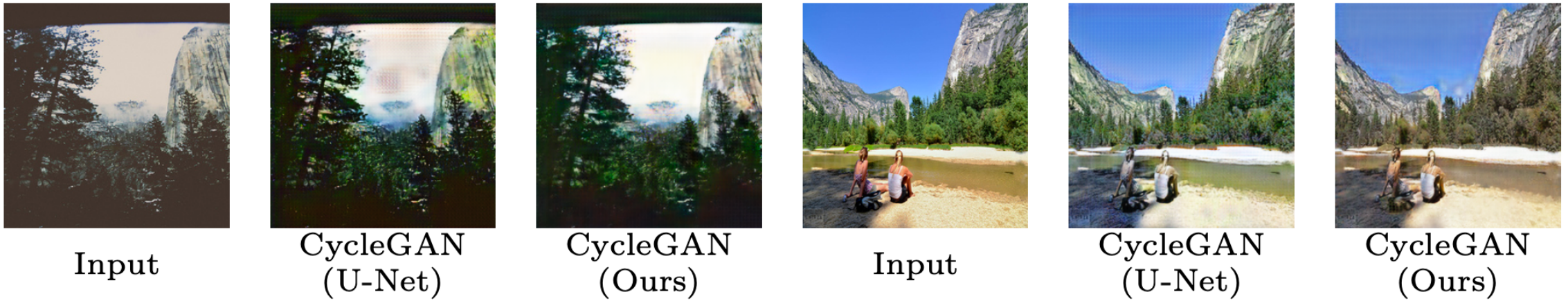


Model Transferability



Winter → Summer

Summer → Winter



Summary

bit.ly/NAS-DIP

- Search for neural architectures for inverse image problems.
- Search spaces for the upsampling layer and cross-level residual connections.
- State-of-the-art results on image restoration tasks.
- Model transferability.

Super-Resolution

Denoising

Inpainting

Dehazing

Translation