Image Processing GNN: Breaking Rigidity in Super-Resolution

Supplementary Material

A. Method Details

IPG Variants We have designed three variants of IPG: IPG-Tiny, IPG-S, and IPG. Their detailed configurations are shown in Table 6. We compare IPG-S with competitive baselines, as shown in Table 7.

	IPG-Tiny	IPG-S	IPG
Depths ($M \times G$)	$2 \times 6 + 2 \times 8$	6×6	6×6
Dimension	48	144	180
MLP Ratio	2	2	4
Avg. Node Degree	48	64	256
Search Size	20	32	32
Upsampler	PixShuf.-Direct	PixShuf.	PixShuf.
ChannelAttn (CA)	Depthwise	Depthwise	No
FLOPs	17.4G	210.8G	372.1G

Table 6. Configurations of IPG variants on SR×4. FLOPs are measured on 512×512 output.

	Params	FLOPs	Set5	Set14	Urban100
CAT-R [6]	16.6M	292.7G	32.89	29.13	27.62
ART-S [47]	11.9M	250.9G	32.86	29.09	27.54
GRL-B* [22]	20.2M	303.4G	32.90	29.14	27.53
HAT-S [5]	9.6M	219.6G	32.92	29.15	27.87
SRFormer [53]	10.4M	194.9G	32.93	29.08	27.68
IPG-S (Ours)	8.1M	210.8G	**32.99**	**29.17**	**27.96**

Table 7. Comparison of IPG-S with smaller SR models. SR×4 results are reported with FLOPs measured on 512×512 output.

Degree-Flex Details. We scale the variance of D_F linearly at a certain ratio while keeping the mean to reduce the difference of node degrees. The first layer is needs significant reduction, as it directly inherits sharp, low-level details from the input image. The rest of the layers are scaled at equal ratios that are much milder. Specifically, the *std* of the first and other layers are scaled down by 10 and 1.5.

B. Additional Experiments

Computation Costs. To understand the amount of computation of proposed parts, we also inspect the computation costs of IPG components in FLOPs theoretically as shown in Table 8. The calculation of the proposed detail-aware indicator D_F and the depthwise convolution in ConvFFN have minor FLOPs costs in IPG.

Component	FLOPs (G)
Graph Construction	38.3
D_F calculation	0.89
ConvFFN Module	156.7
Depth-wise Conv	3.83
IPG	**372.1**

Table 8. The overall FLOPs cost of IPG components.

Other Edge Selection Strategies. In the paper, we have compared KNN with the detail-aware Degree-Flex graph strategy. As shown in Table 9, here we compare some other strategies for edge selection: 1. **Thresholding.** Apart from the proposed detail-aware degree flex solution, setting a threshold based on node similarities could be a simple degree-variant baseline. Once the Gram matrix of vertices is calculated, thresholding of edges are performed based on a pre-set edge budget. Edges with similarities above the threshold are selected. At the same number of edges (the same budget for fair comparison), this measure is not performant. 2. **Full Connect.** We also conduct experiments when all edges are selected, *i.e.* each node is connected to all nodes in the search size. It is surprising that though "Full Connect" adds additional FLOPs, it performs worse compared to our "Detail-Rich" strategy. The effectiveness of our "Detail-Rich" strategy is thus demonstrated.

	Deg.-Flex	Set5	Set14	Urban100
Full Connect	✗	33.11	**29.25**	28.10
KNN	✗	33.09	29.19	28.06
Thresholding	✓	33.14	29.16	28.05
Detail (Ours)	✓	**33.15**	29.24	**28.13**

Table 9. Comparison of degree-flexible graphs against plain KNN graphs in IPG. SR×4 results are reported.

Ablations on Search Size. We investigate the effect of search size on IPG-Tiny. As search size changes, We rescale edge budgets for fair comparison under similar FLOPs (calculated at SR×4, output image size 1280×720).

Search Size	FLOPs	Set5	Set14	Urban100
24	61.8G	32.48	28.84	26.75
20	61.3G	**32.51**	28.85	**26.79**
16	61.7G	32.43	**28.86**	26.78

Table 10. Ablations on window size.

Baseline Replications. As some baselines could have different train/test settings, we replicate them with standard setting and yield results shown in Table 11. In the paper, baselines appended with a supermark "*" are replicated results from ourselves.

	Set5	Set14	Urban100
GRL-B×2 (Reported by [22])	38.67	35.08	35.06
GRL-B×2 (Our Replication)	38.48	34.64	33.97
GRL-B×3 (Our Replication)	35.05	31.00	29.83
GRL-B×4 (Reported by [22])	33.10	29.37	28.53
GRL-B×4 (Our Replication)	32.90	29.14	27.53
HAT×2 (Reported by [5])	38.63	34.86	34.45
HAT×2 (Our Replication)	38.61	34.77	34.45

Table 11. Reported results of baselines and our replications.