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LIIF-GAN: Representation Learning With Local Implicit Image Function and GAN for Realistic Images on a Continuous Scale

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Problems

We want to design a model that can represent a high fidelity and well-structured image on a continuous scale.

Previous method: LIIF

Fig. 1. Problem of LIIF – Low fidelity image

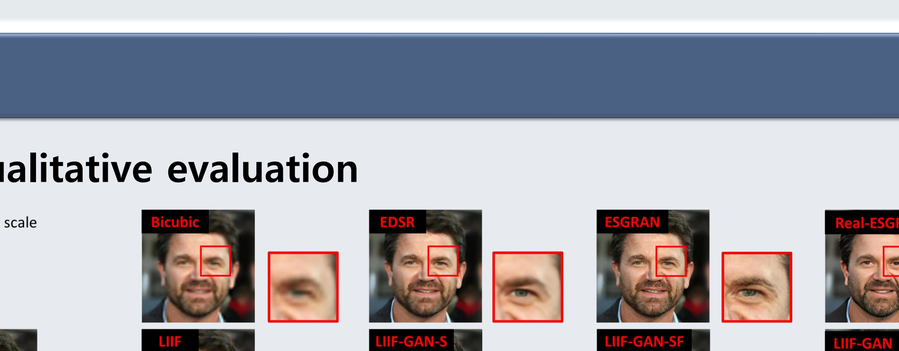

Fig. 2. Structure of LIIF

LIIF*: Can learn **continuous image representation, but** Provide **low-fidelity**.

Naïve solution:

Simply adding **adv/perceptual loss** to gain fidelity can **harm** the **image structure.** *see the results of **LIIF-GAN-S**

***LIIF: Local implicit image function, CVPR2021**

Proposed: LIIF-GAN

Fig. 3. Example results of LIIF-GAN

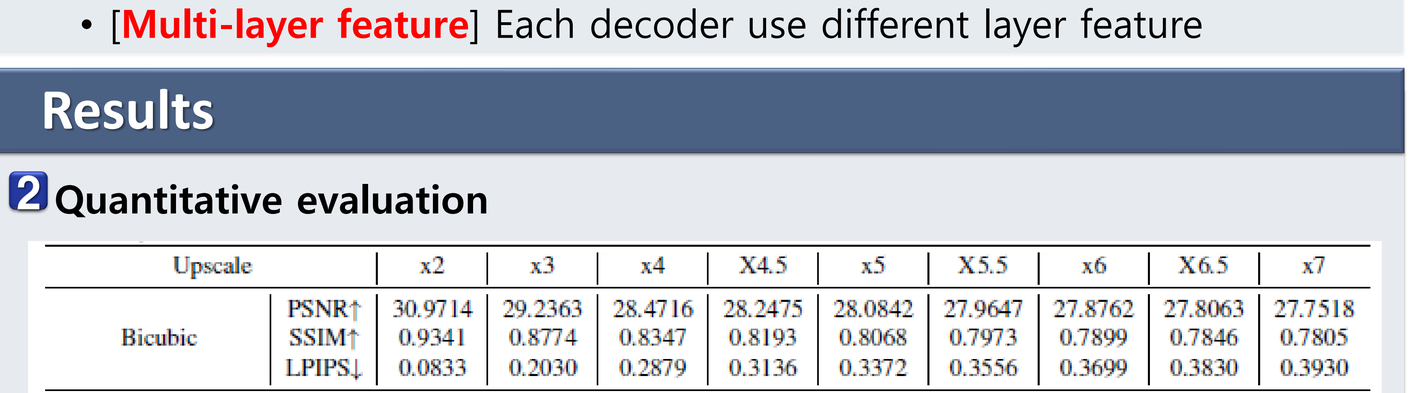

Fig. 4. Structure of LIIF-GAN

LIIF-GAN: Gaining **reality** + Preserving **image structure**

Contributions:

- [**Adv/perceptual** loss] Gain the image fidelity
- [**Multi-decoders**] One for preserving image structure, the other for gaining the image fidelity. Each decoder trained by different loss function
- [**Multi-layer feature**] Each decoder use different layer feature

Results

1 Qualitative evaluation

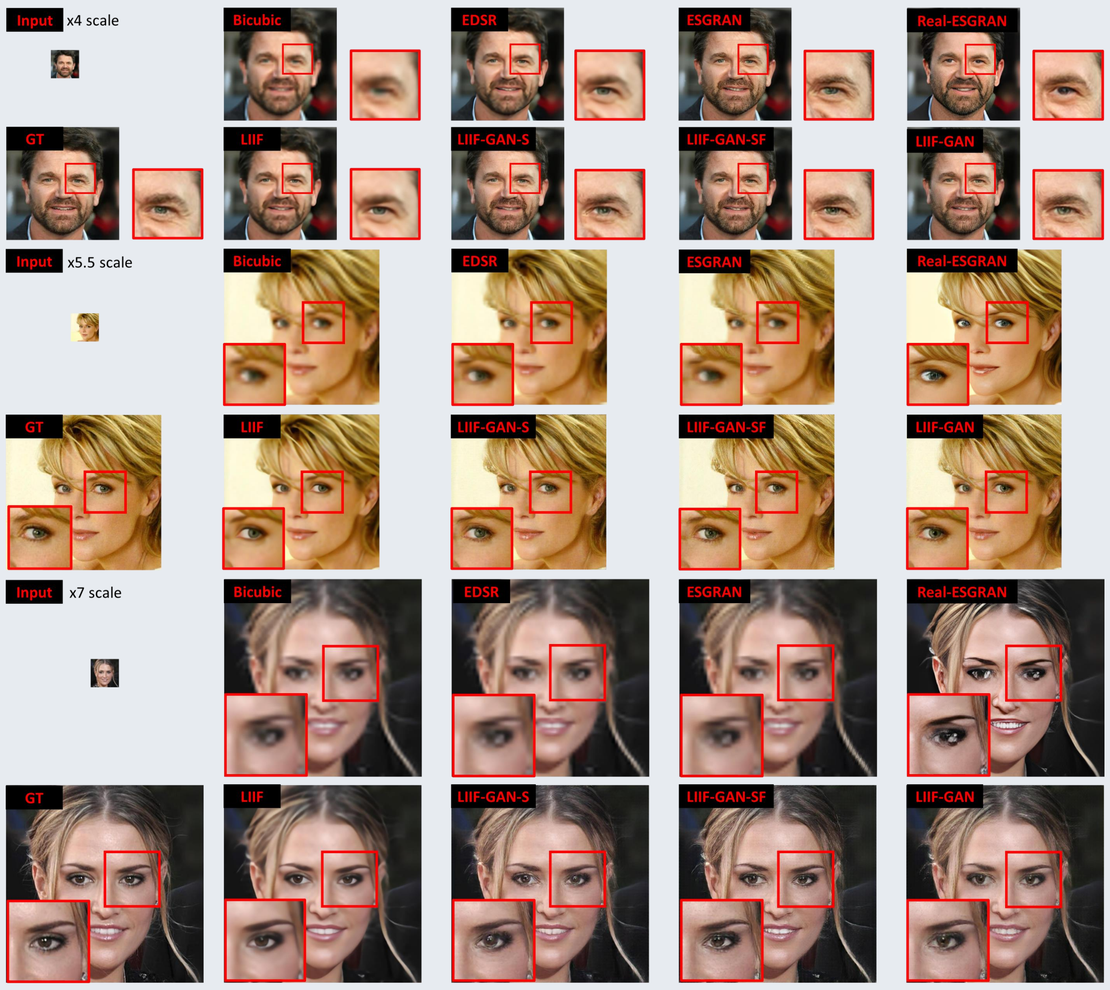

Fig. 5. Comparing LIIF-GAN results with others

2 Quantitative evaluation

Upscale		x2	x3	x4	X4.5	x5	X5.5	x6	X6.5	x7
Bicubic	PSNR↑	30.9714	29.2363	28.4716	28.2475	28.0842	27.9647	27.8762	27.8063	27.7518
	SSIM↑	0.9341	0.8774	0.8347	0.8193	0.8068	0.7973	0.7899	0.7846	0.7805
	LPIPS↓	0.0833	0.2030	0.2879	0.3136	0.3372	0.3556	0.3699	0.3830	0.3930
EDSR(x4)	PSNR↑	N/A	N/A	**31.5746**	28.5453	28.1175	27.9908	27.9038	27.8249	27.7682
	SSIM↑	N/A	N/A	**0.8941**	0.8282	0.8107	0.8000	0.7919	0.7857	0.7810
	LPIPS↓	N/A	N/A	0.1266	0.2110	0.2362	0.2752	0.3220	0.3568	0.3771
ESRGAN(x4)	PSNR↑	N/A	N/A	28.7142	27.8192	27.4741	27.489	27.5702	27.5575	27.5219
	SSIM↑	N/A	N/A	0.8343	0.8100	0.7944	0.7873	0.7829	0.7790	0.7753
	LPIPS↓	N/A	N/A	**0.0464**	0.1392	0.1757	0.2355	0.2988	0.3401	0.3643
Real-ESRGAN(x4)	PSNR↑	N/A	N/A	26.2777	26.1900	26.1801	26.1369	26.0222	25.8703	25.6724
	SSIM↑	N/A	N/A	0.7706	0.7576	0.7516	0.7451	0.7380	0.7317	0.7257
	LPIPS↓	N/A	N/A	0.0995	0.1099	0.1182	0.1289	0.1414	0.1547	0.1680
LIIF	PSNR↑	**35.5841**	**32.7435**	31.4977	**31.122**	**30.8457**	**30.6499**	**30.4998**	**30.3812**	**30.2843**
	SSIM↑	**0.9696**	**0.9284**	0.8927	**0.8785**	**0.8662**	**0.8561**	**0.8475**	**0.8406**	**0.8345**
	LPIPS↓	0.0152	0.0683	0.1271	0.1491	0.1671	0.1822	0.1942	0.2046	0.2133
LIIF-GAN-S	PSNR↑	32.9169	29.898	28.7579	28.3655	28.0506	27.9345	27.8234	27.7208	27.6255
	SSIM↑	0.9491	0.8807	0.8276	0.8052	0.7847	0.7727	0.7616	0.7519	0.7429
	LPIPS↓	0.0079	0.0249	0.0478	**0.0603**	**0.0740**	**0.0860**	**0.0970**	**0.1078**	**0.1177**
LIIF-GAN-SF	PSNR↑	32.9727	30.0689	28.6173	28.1539	27.8675	27.5539	27.3645	27.1901	27.1289
	SSIM↑	0.9491	0.8823	0.8219	0.7971	0.7752	0.7587	0.7440	0.7308	0.7169
	LPIPS↓	0.0080	**0.0245**	0.0479	0.0611	0.0767	0.0908	0.1040	0.1148	0.1258
LIIF-GAN	PSNR↑	32.6175	30.4208	28.7587	28.3877	28.4902	27.9698	27.8260	27.7487	27.8936
	SSIM↑	0.9146	0.8895	0.8289	0.8084	0.7981	0.7764	0.7644	0.7544	0.7497
	LPIPS↓	**0.0075**	0.0300	0.0484	0.0615	0.0852	0.0891	0.1014	0.1130	0.1370

Table. 1. Quantitative evaluation on CelebA-HQ dataset.
LIIF-GAN has the most **balanced (PSNR/SSIM – LPIPS)** scores.
(bold – best, red – best among using GAN).

Please see our paper for more details