

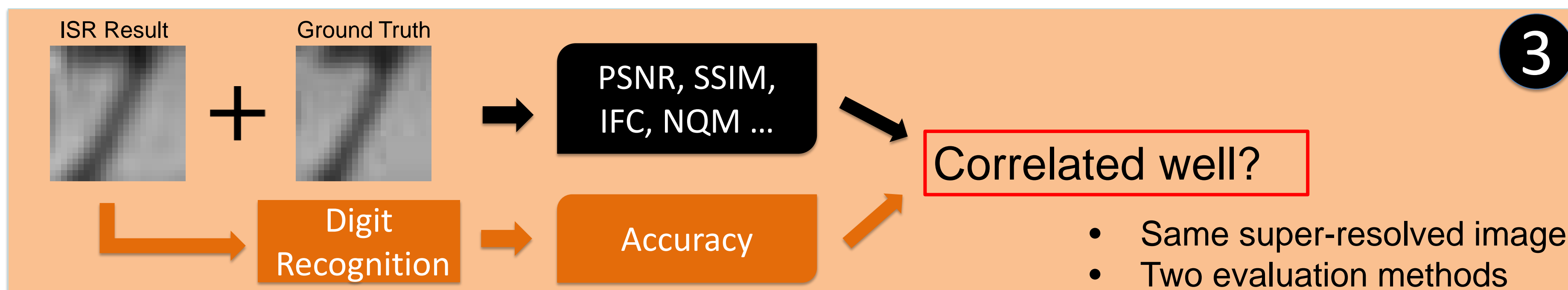
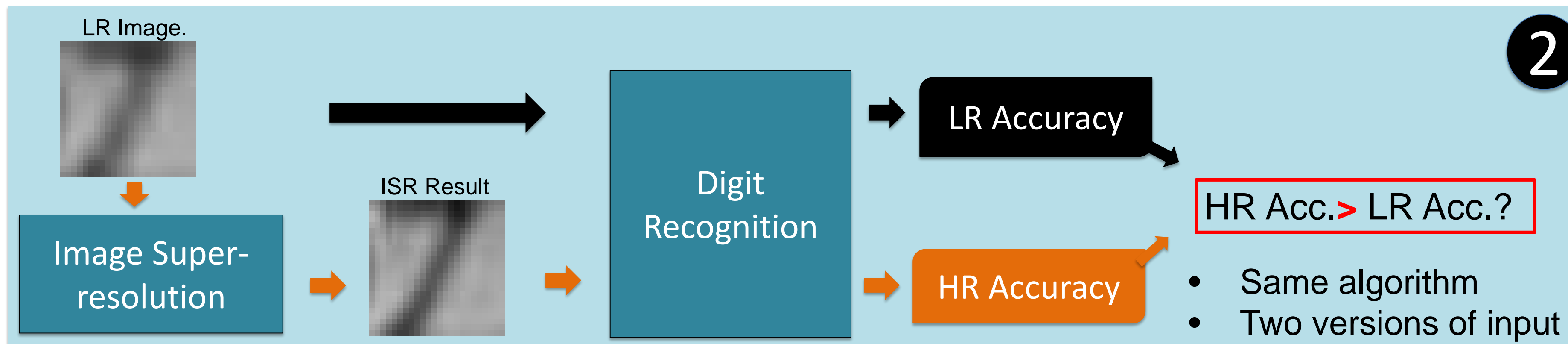
Motivation:

- 1 Image Super-resolution (ISR) methods are merely evaluated perceptually!
- 2 Are ISR methods helpful for other vision tasks when images are of low-resolution?
- 3 Is their usefulness correlated to perceptual quality of the super-resolved results?

Evaluation: summary

- ❑ **Six** SOTA ISR methods: Zeyde, ANR, A+, SRCNN, JOR, and SRF
- ❑ **Five** vision tasks: Boundary Detection, Semantic Image Segmentation, Digit Recognition, Scene Recognition, and Face Detection
- ❑ **Four** perceptual evaluation criteria: PSNR, SSIM, IFC, and NQM

Evaluation: method



Results

Boundary Detection

- Crisp Boundary [18]
- BSDS300 dataset
- AUC for evaluation
- **Helpful & Correlated**

		Bicubic	Zeyde <i>et al.</i> [48]	ANR[38]	SRCNN[10]	A+[39]	JOR[6]	SRF[31]	Original	
×3	PSNR	27.15	27.87	27.88	28.10	28.18	28.17	28.17	—	
	SSIM	0.736	0.770	0.773	0.777	0.781	0.781	0.780	—	
	IFC	2.742	3.203	3.248	3.131	3.374	3.360	3.366	—	
	NQM	27.42	31.80	31.95	31.28	32.35	32.41	32.40	—	
	AUC	0.647	0.675	0.665	0.668	0.675	0.674	0.674	0.696	PSNR / 26.94
×4	PSNR	25.92	26.51	26.51	26.66	26.77	26.74	26.74	—	PSNR / 28.06
	SSIM	0.667	0.697	0.699	0.702	0.709	0.707	0.707	—	PSNR / 28.93
	IFC	1.839	2.195	2.231	2.117	2.325	2.316	2.293	—	AUC / 0.861
	NQM	21.15	24.30	24.37	24.19	24.98	24.96	24.98	—	AUC / 0.870
	AUC	0.595	0.647	0.635	0.650	0.656	0.655	0.652	0.696	AUC / 0.885

Semantic Segmentation

- Label Transfer [15]
- MSRC-21 dataset
- Accuracy for evaluation
- **Helpful & Correlated**

		Bicubic	Zeyde <i>et al.</i> [48]	ANR[38]	SRCNN[10]	A+[39]	JOR[6]	SRF[31]	Original	
×3	PSNR	25.29	26.02	26.00	26.21	26.28	26.28	26.35	—	
	SSIM	0.689	0.726	0.728	0.733	0.737	0.737	0.738	—	
	IFC	2.677	3.214	3.250	3.131	3.390	3.396	3.640	—	
	NQM	19.56	22.48	22.47	22.64	23.10	23.16	23.20	—	
	APP	0.692	0.762	0.770	0.777	0.780	0.783	0.782	0.844	PSNR / 17.49
	APC	0.592	0.662	0.674	0.681	0.684	0.687	0.685	0.743	PSNR / 17.83
×4	PSNR	24.04	24.65	24.63	24.77	24.88	24.86	24.90	—	PSNR / 17.85
	SSIM	0.608	0.641	0.643	0.646	0.654	0.652	0.660	—	APP / 0.639
	IFC	1.694	2.043	2.066	1.992	2.171	2.151	2.301	—	APP / 0.893
	NQM	14.75	16.56	16.55	16.73	17.10	17.12	16.99	—	APP / 0.909
	APP	0.582	0.665	0.677	0.673	0.682	0.674	0.674	0.844	APP / 0.937
	APC	0.505	0.569	0.584	0.588	0.591	0.586	0.605	0.743	

Digit Recognition

- SVM + HOG
- SVHN dataset
- Accuracy for evaluation
- **Helpful & Correlated**

		Bicubic	Zeyde <i>et al.</i> [48]	ANR[38]	SRCNN[10]	A+[39]	JOR[6]	SRF[31]	Original	
×3	PSNR	33.39	35.40	35.73	35.03	34.85	34.90	34.82	—	
	SSIM	0.912	0.946	0.949	0.946	0.946	0.948	0.948	—	
	IFC	2.050	2.331	2.417	2.291	2.389	2.346	2.355	—	
	NQM	10.23	12.59	12.91	12.16	12.17	12.21	12.19	—	
	Accuracy	0.766	0.774	0.777	0.779	0.778	0.775	0.778	0.793	25.44
×3[R]	PSNR	33.39	36.30	36.53	35.99	37.20	37.26	37.12	—	26.59
	SSIM	0.912	0.951	0.953	0.947	0.963	0.964	0.963	—	26.27
	IFC	2.050	2.484	2.550	2.427	2.726	2.730	2.701	—	26.27
	NQM	10.23	13.30	13.53	13.04	14.24	14.25	14.17	—	26.86
	Accuracy	0.766	0.775	0.774	0.773	0.783	0.786	0.778	0.793	26.77

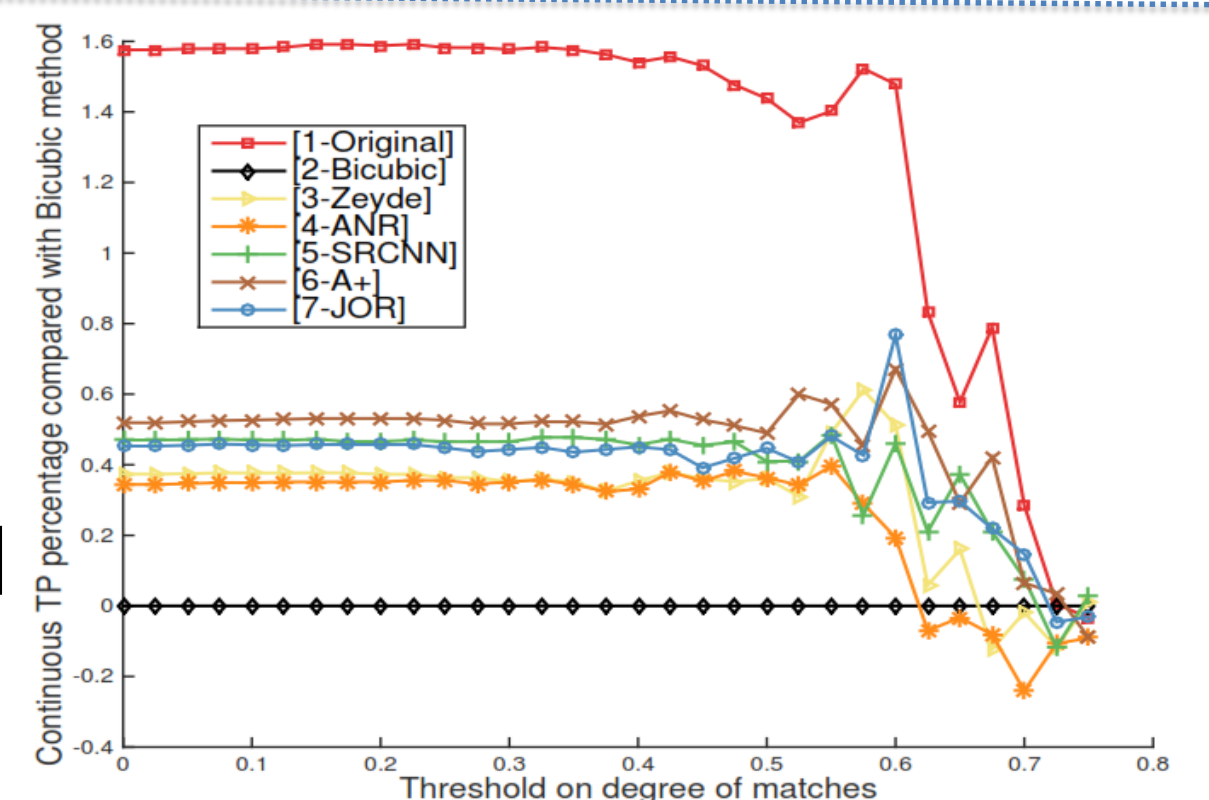
Scene Recognition

- SVM +CNN [2]
- Scene-15 dataset
- Accuracy for evaluation
- **Helpful & Correlated**

		Bicubic	Zeyde [48]	ANR[38]	SRCNN[10]	A+[39]	JOR[6]	SRF [31]	Original	
×3	PSNR	25.12	25.85	25.87	26.10	26.19	26.18	26.13	—	
	SSIM	0.73	0.78	0.77	0.78	0.79	0.79	0.80	—	
	IFC	2.82	3.34	3.43	3.20	3.58	3.60	3.58	—	
	NQM	19.75	22.69	22.73	22.81	23.39	23.43	23.30	—	
	Accuracy	0.770	0.777	0.777	0.780	0.782	0.782	0.778	0.809	25.44
×4	PSNR	24.32	24.99	24.95	25.06	25.24	25.22	25.19	—	29.24
	SSIM	0.674	0.701	0.702	0.704	0.720	0.719	0.722	—	27.87
	IFC	1.597	1.923	1.911	1.806	2.021	2.010	2.014	—	27.71
	NQM	14.43	16.12	16.05	16.07	16.62	16.61	16.57	—	33.00
	Accuracy	0.735	0.752	0.753	0.748	0.754	0.753	0.753	0.809	32.82

Face Detection

- Viola-Jones
- FDDB
- Accuracy
- **Helpful & Correlated**



Conclusion:

- ❑ Image Super-resolution is **helpful** for the other vision tasks when the images are of LR
- ❑ Perceptual criteria correlate **quite well** with the usefulness of ISR to other vision tasks
- ❑ The performance on super-resolved images are still **inferior** to that on HR images
- ❑ The **code** and **data** will be available soon at <http://people.ee.ethz.ch/~daid/SR4VisionTask>

