

Computational Photography

Assignment 3 Report

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Part 1 PSNR Results

Algorithm	PSNR
TVL1 single-image	53.26
TVL1 four-image	46.36

Part 2 PSNR Results

Algorithm	PSNR
ZebraSRNet F16B2	30.59
ZebraSRNet F64B8	30.551

Outline

- Comparison between different TVL1 parameters
- Comparison between different SR algorithms
- Super resolution on hidden images
- Super resolution on self-taken image

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- **Comparison between different TVL1 parameters**
- Comparison between different SR algorithms
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TVL1 Single-Image

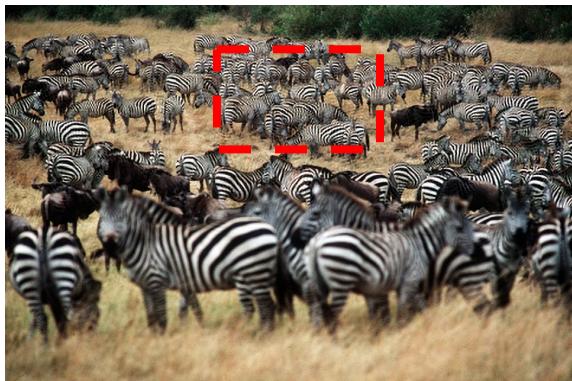
- I run TVL1 single-image SR algorithm and calculate PSNR of the results with the following combinations of parameters
 - $\sigma_s = 0.5, 1.0, 1.5, 2.0, 2.5, \lambda = 0.01$
 - $\lambda = 0.001, 0.005, 0.01, 0.05, 0.1, \sigma_s = 1.5$

$\lambda \backslash \sigma_s$	0.5	1.0	1.5	2.0	2.5
0.01	29.26	30.11	30.23	29.81	29.11

$\sigma_s \backslash \lambda$	0.001	0.005	0.01	0.05	0.1
1.5	30.39	30.29	30.23	30.13	29.78
$\lambda \backslash \sigma_s$	0.5	1.0	1.5	2.0	2.5

TVL1 Single-Image Best Result

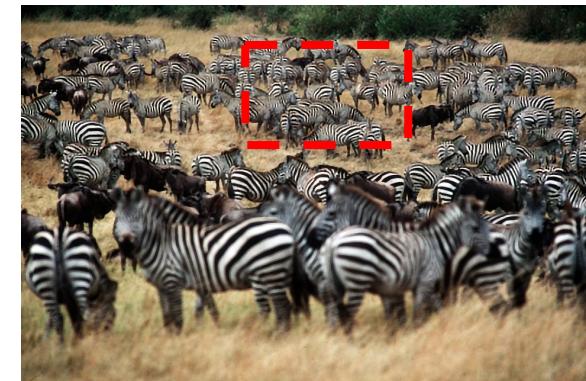




$\sigma_s = 1.5, \lambda = 0.001$

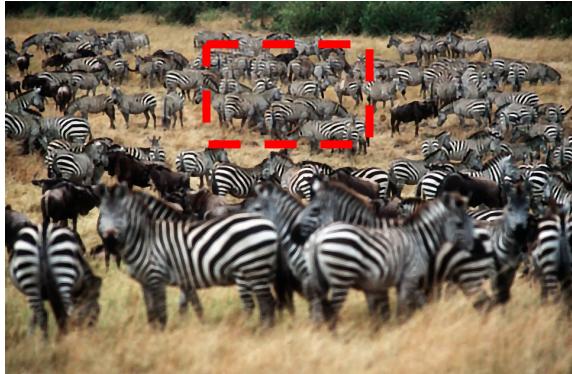


$\sigma_s = 1.5, \lambda = 0.005$



$\sigma_s = 1.5, \lambda = 0.01$

details are not preserved



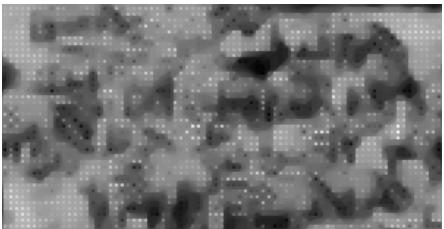
$\sigma_s = 1.5, \lambda = 0.05$



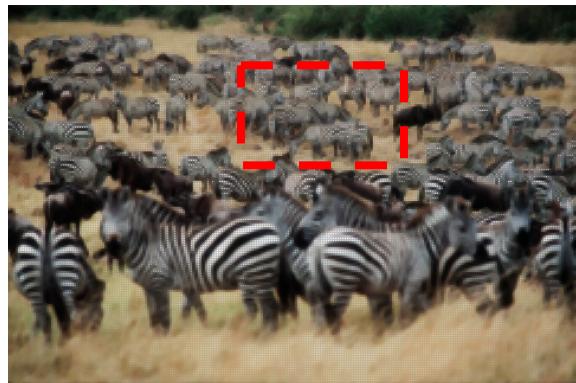
$\sigma_s = 1.5, \lambda = 0.1$



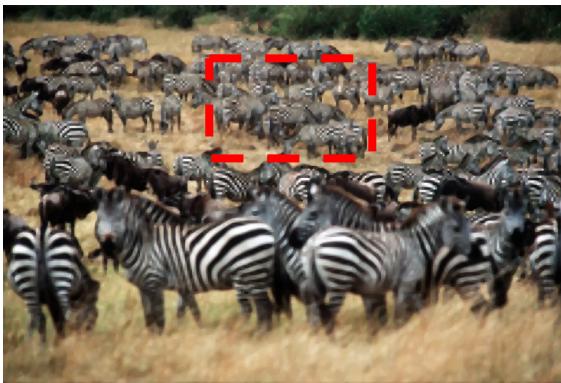
original HR image



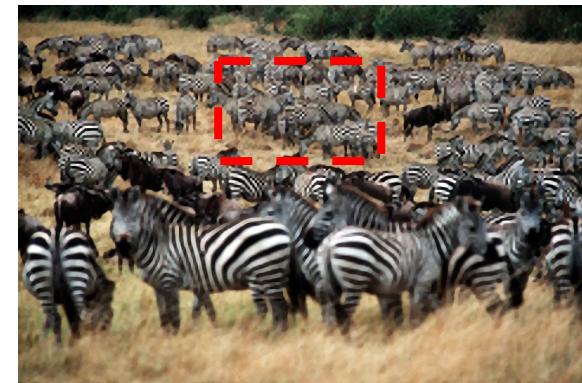
blurry



$\sigma_s = 0.5, \lambda = 0.01$

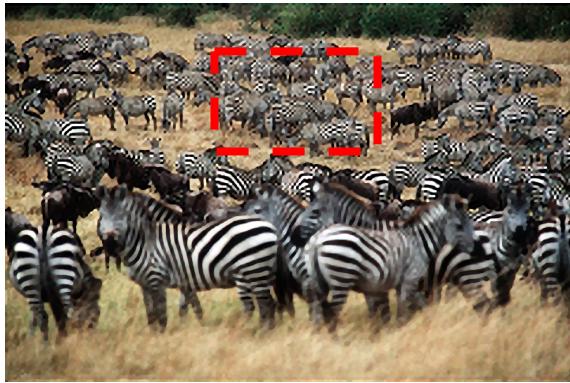


$\sigma_s = 1.0, \lambda = 0.01$

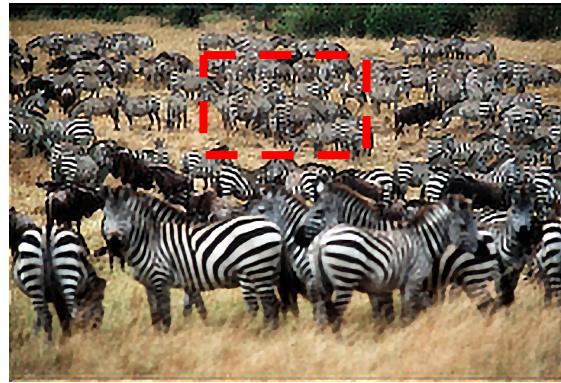


$\sigma_s = 1.5, \lambda = 0.01$

too sharp



$\sigma_s = 2.0, \lambda = 0.01$



$\sigma_s = 2.5, \lambda = 0.01$



original HR image

TVL1 Four-Image

- I run TVL1 four-image SR algorithm and calculate PSNR of the results with the following combinations of parameters
 - $\sigma_s = 0.5, 1.0, 1.5, 2.0, 2.5, \lambda = 0.01$
 - $\lambda = 0.001, 0.005, 0.01, 0.05, 0.1, \sigma_s = 1.5$

$\lambda \backslash \sigma_s$	1.3	1.4	1.5	1.6	1.7
0.01	30.07	30.96	31.39	29.95	29.01

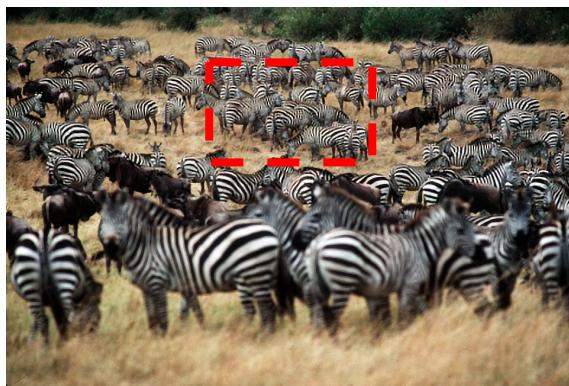
$\sigma_s \backslash \lambda$	0.001	0.005	0.01	0.05	0.1
1.5	31.24	31.47	31.39	30.99	30.83
$\lambda \backslash \sigma_s$	0.001	0.005	0.01	0.05	0.1

TVL1 Four-Image Best Result





$\sigma_s = 1.5, \lambda = 0.001$



$\sigma_s = 1.5, \lambda = 0.005$



details are not preserved



$\sigma_s = 1.5, \lambda = 0.05$



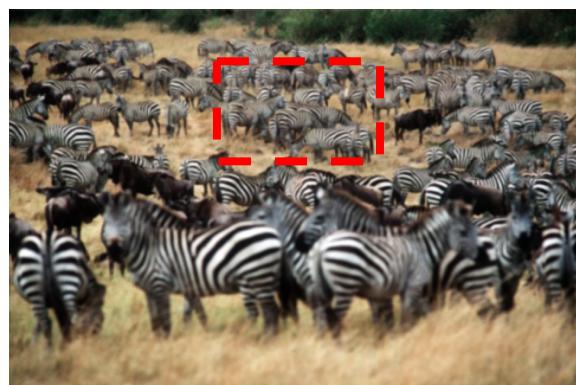
$\sigma_s = 1.5, \lambda = 0.1$



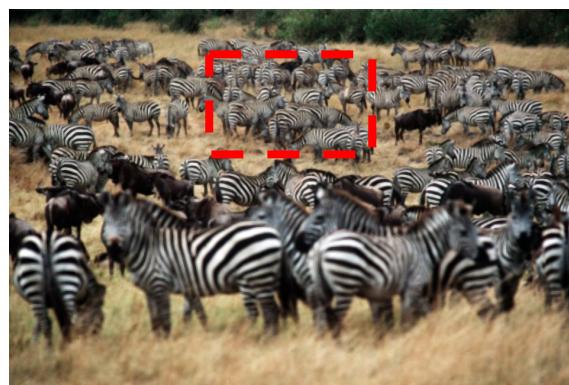
original HR image



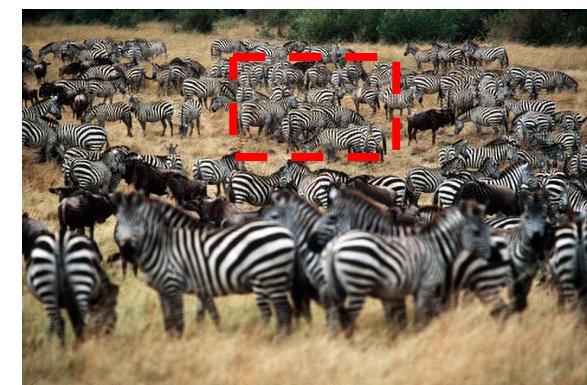
blurry



$\sigma_s = 0.5, \lambda = 0.01$



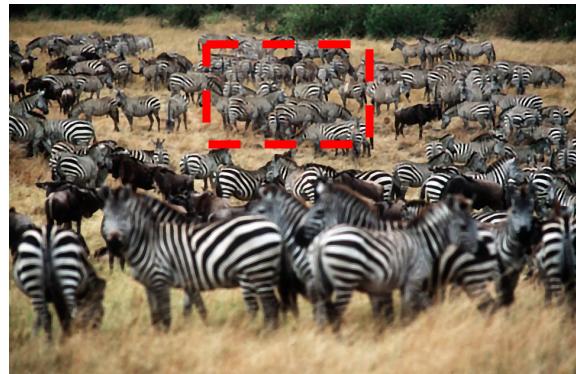
$\sigma_s = 1.0, \lambda = 0.01$



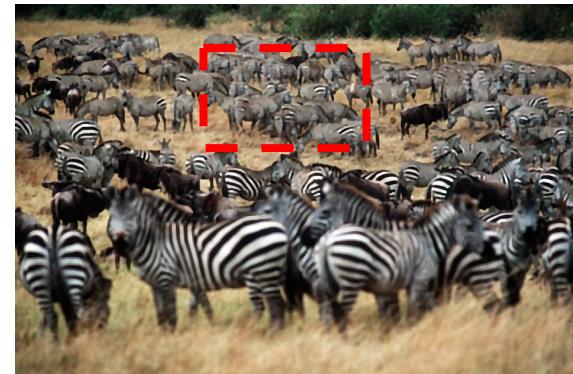
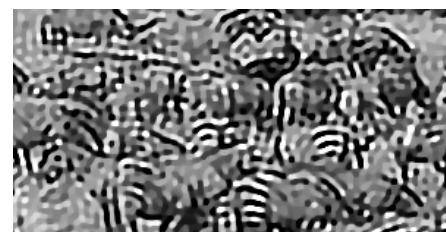
$\sigma_s = 1.5, \lambda = 0.01$



too sharp



$\sigma_s = 2.0, \lambda = 0.01$



$\sigma_s = 2.5, \lambda = 0.01$



original HR image

Outline

- Comparison between different TVL1 parameters
- **Comparison between different SR algorithms**
- Super resolution on hidden images
- Super resolution on self-taken image



bicubic



TVL1 single-image

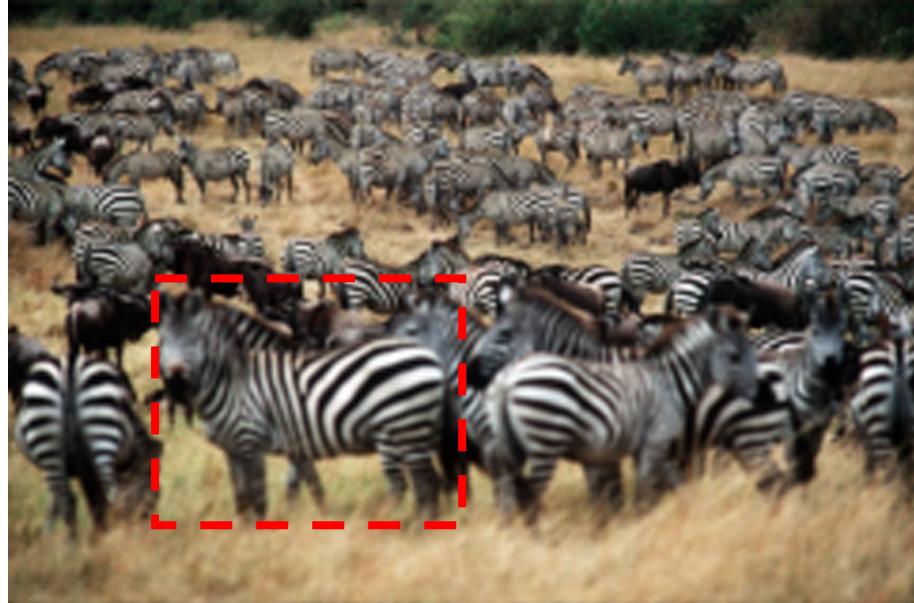


TVL1 four-image



ZebraNet-64F8B

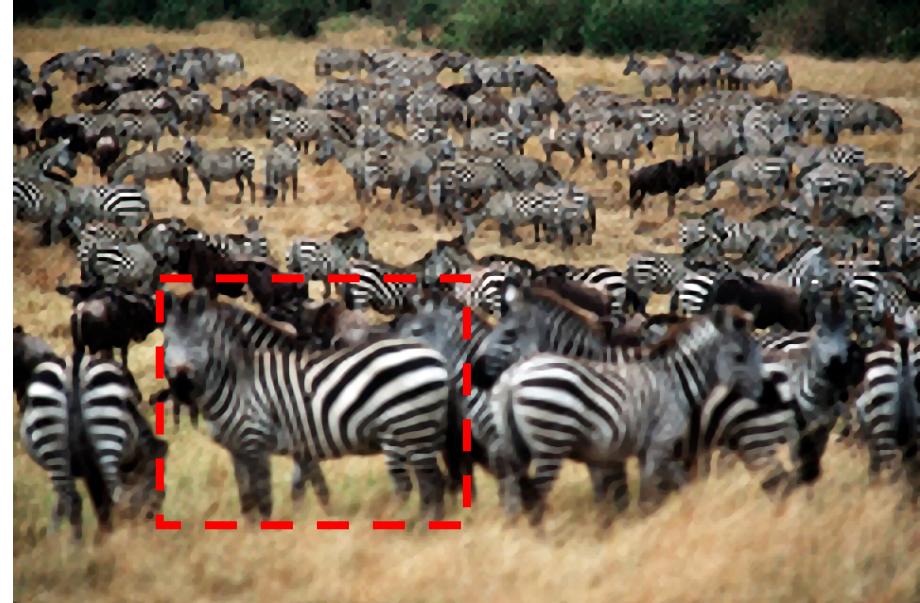
Bicubic vs TVL1 Single-Image



bicubic



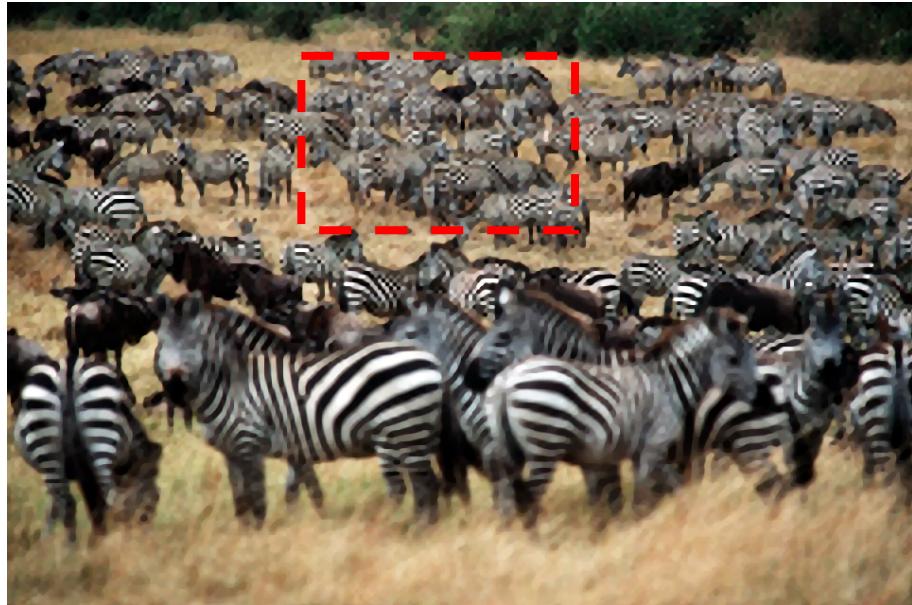
blurrier



TVL1 single-image



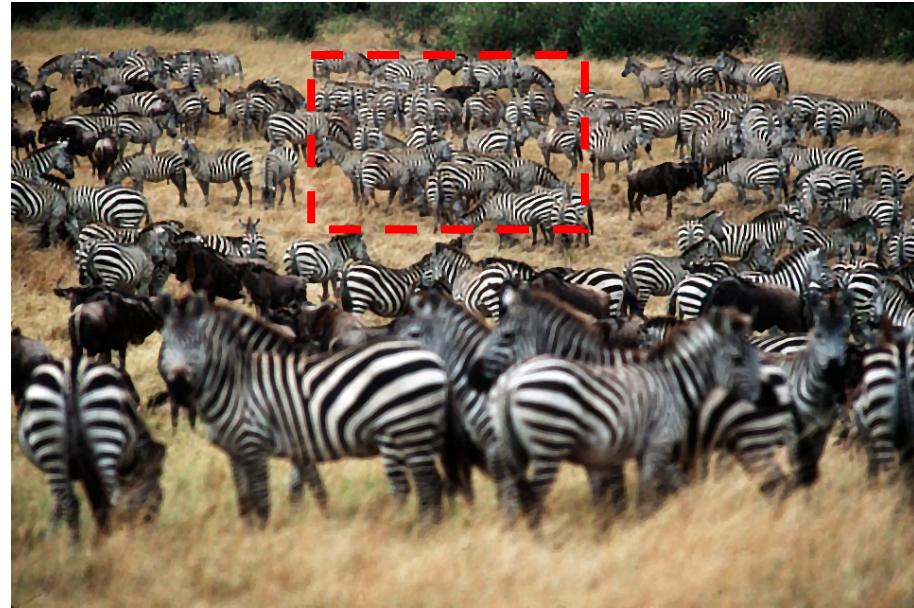
TVL1 Single-Image vs Four-Image



TVL1 single-image



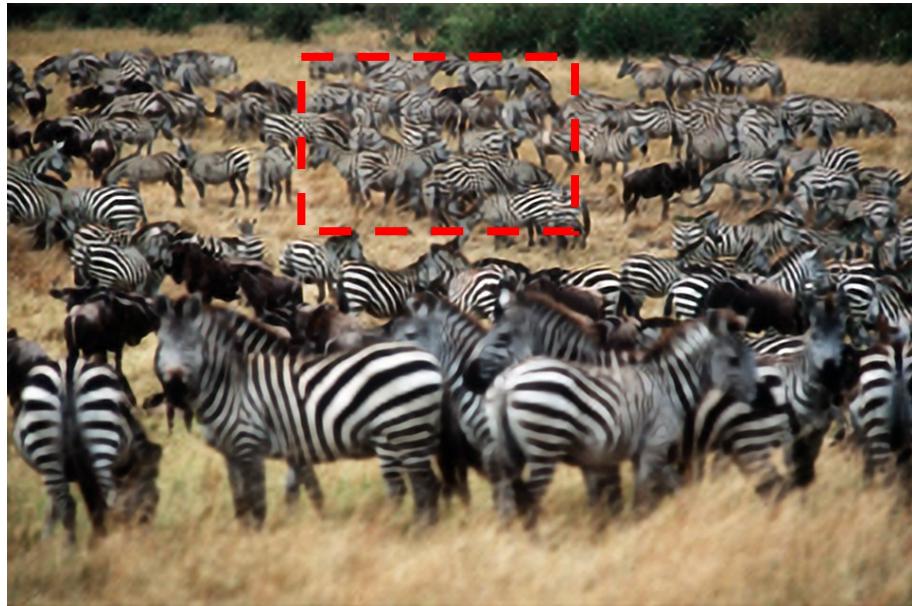
fail on preserving
details



TVL1 four-image



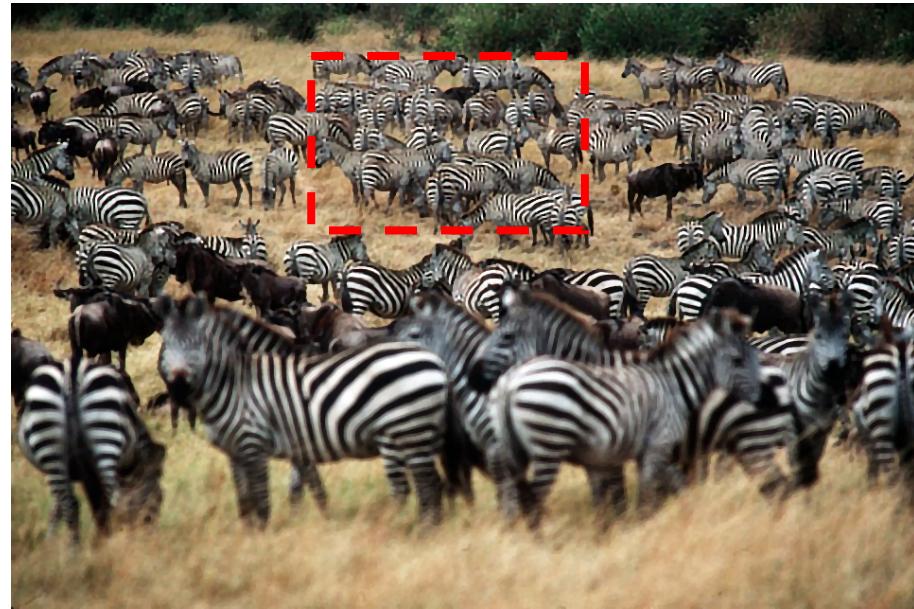
ZebraNet64F8B vs TVL1 Four-Image



ZebraNet-64F8B



severe
distortion in
details



TVL1 four-image



Objective Results

- I calculate PSNRs (compared to *HR_zebra_test.png*) of the SR images generated by different SR algorithms
- It seems to me that the objective results do not differ as substantially as the subjective results do

Algorithm	PSNR
Bicubic	30.14
TVL1 single-image	30.23
TVL1 four-image	31.39
ZebraSRNet F64B8	30.55

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- Comparison between different TVL1 parameters
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ringing artifact



slight distortion



severe distortion



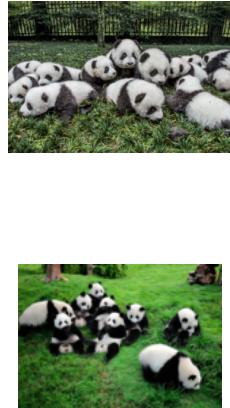
no obvious artifact



Analysis and Improvement

- It seems like learning-based SR result can be very bad if the class of such image does not appear in the training dataset. However, if an image does not have many details (e.g., the *airplane* image in the previous page), the SR result may still be acceptable
- To improve the learning-based SR result for a particular class of image, I train another model, named *PandaNet-F64B8*, which uses the same network architecture as *ZebraNet-F64B8* but different dataset

PandaNet Dataset



training set



validation set





the forms of the
pandas are more
real using *PandaNet*



PandaNet



ZebraNet

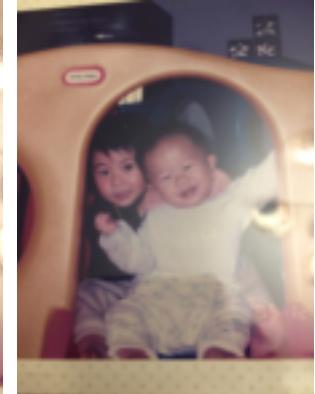
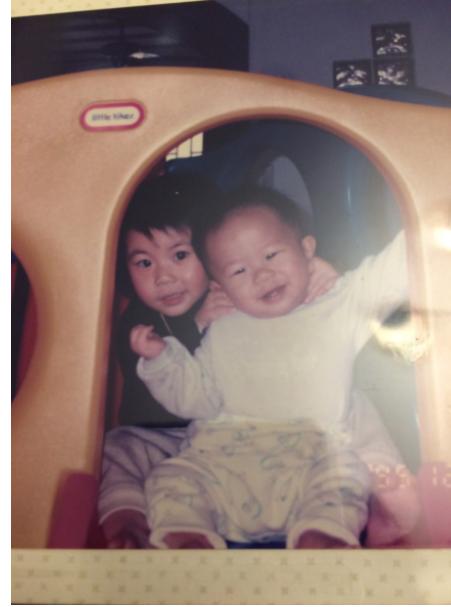
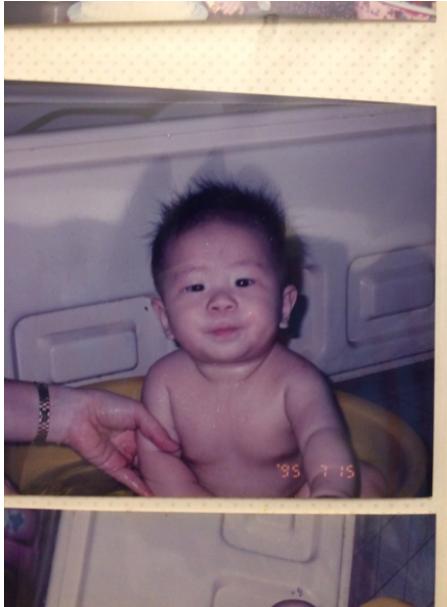
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- **Super resolution on self-taken image**

Self-Taken SR Image

- I use the same network architecture as ZebraSRNet-64F8B, and train on my own dataset

Dataset



training set



validation set

Result

