Multi-Modal Spectral Image Super-Resolution

IVRL Prime
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Multi-Modal Input

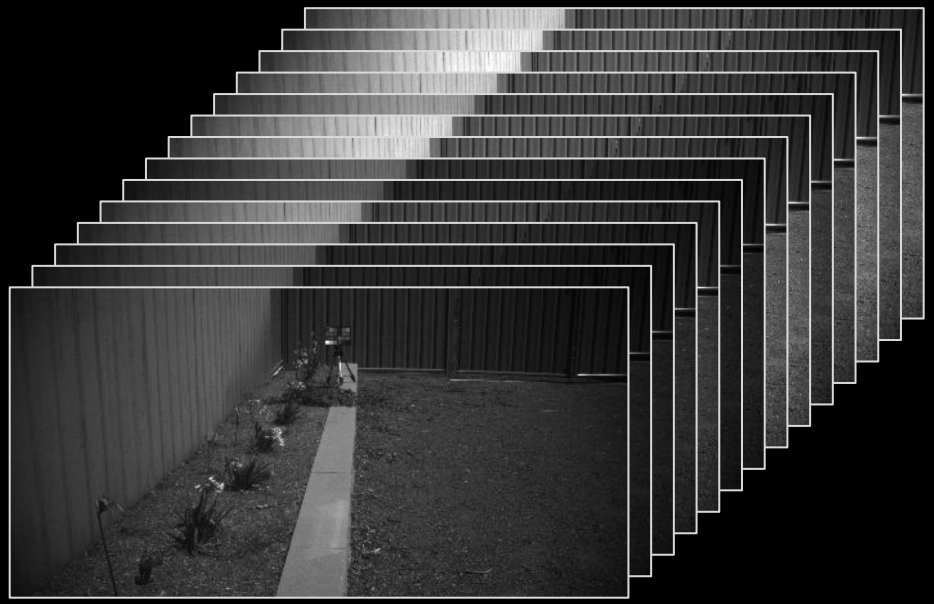
- Multi-Scale: different spatial resolutions

Downsampled x2 (LR2)

Downsampled x3 (LR3)

Multi-Modal Input

- Multi-Scale: different spatial resolutions
- Multi-Spectral: different spectral resolutions



14-channel spectral

3-channel RGB

Small Dataset

- Track 1
  - 200 14-channel spectral images (LR2, LR3)
  - Solution: Upsampling + Stage-I
- Track 2
  - 100 registered pairs
    - 14-channel spectral image (LR2, LR3)
    - 3-channel RGB image (HR)
  - Solution: Upsampling + Stage-I + Stage-II

Main Contributions

- LR2 + LR3 Upsampling

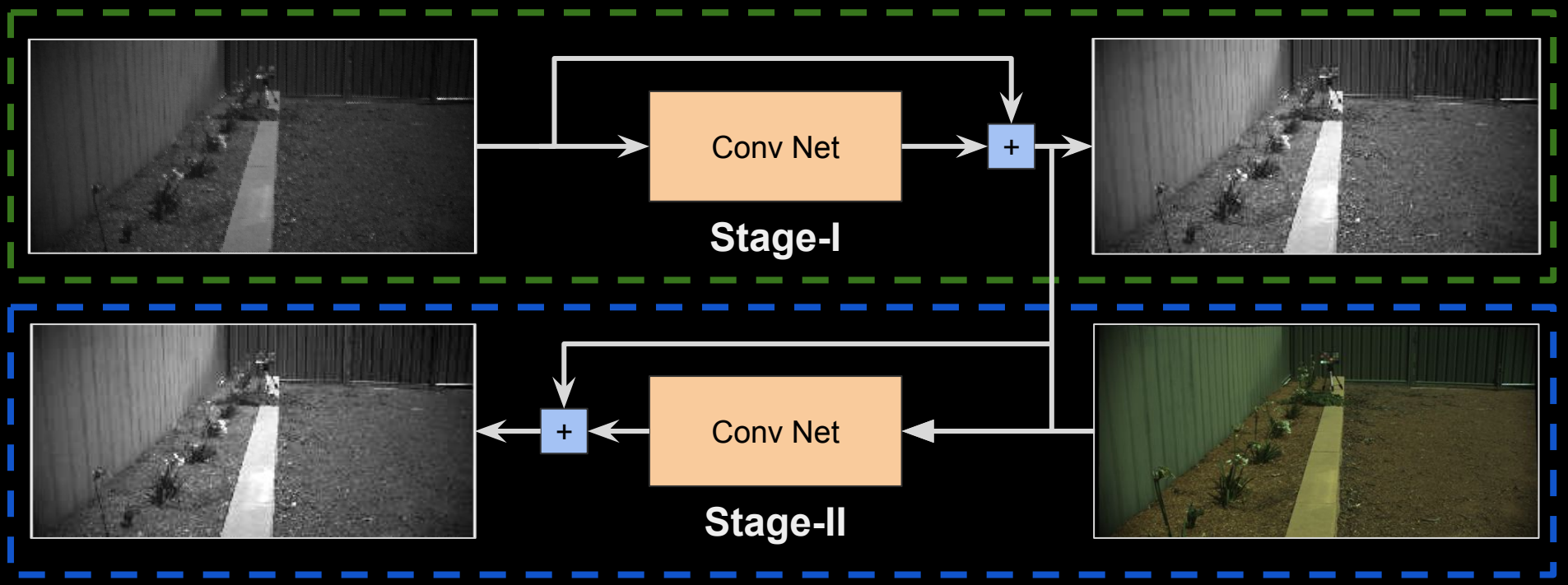
Downsampled x2

Downsampled x3

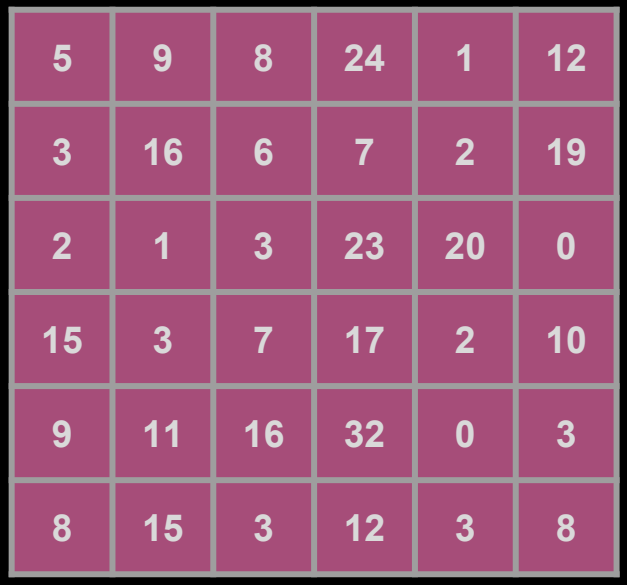
High Resolution Candidate

Main Contributions

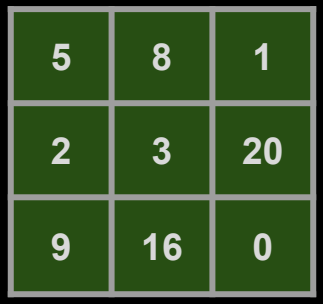
- LR2 + LR3 Upsampling and Image Completion
- Transfer Learning



Nearest Neighbor and Image Completion

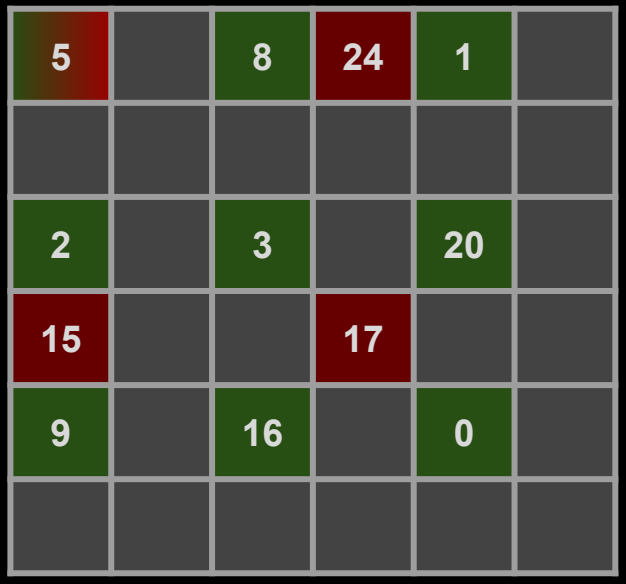


High Resolution



Downsampled x2

Downsampled x3

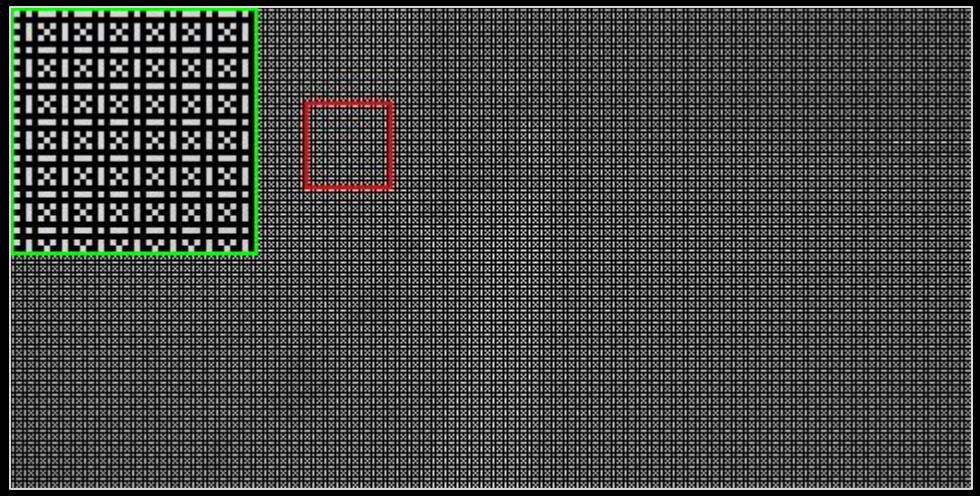


Reconstruction

Nearest Neighbor and Image Completion

Downsampled x2

Downsampled x3



Reconstruction

Nearest Neighbor and Image Completion

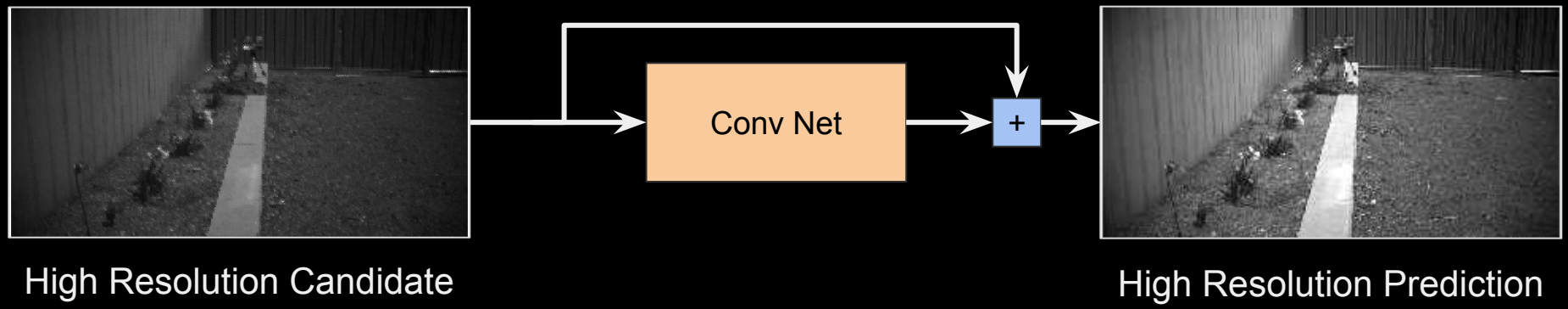
Downsampled x2

Downsampled x3

High Resolution Candidate

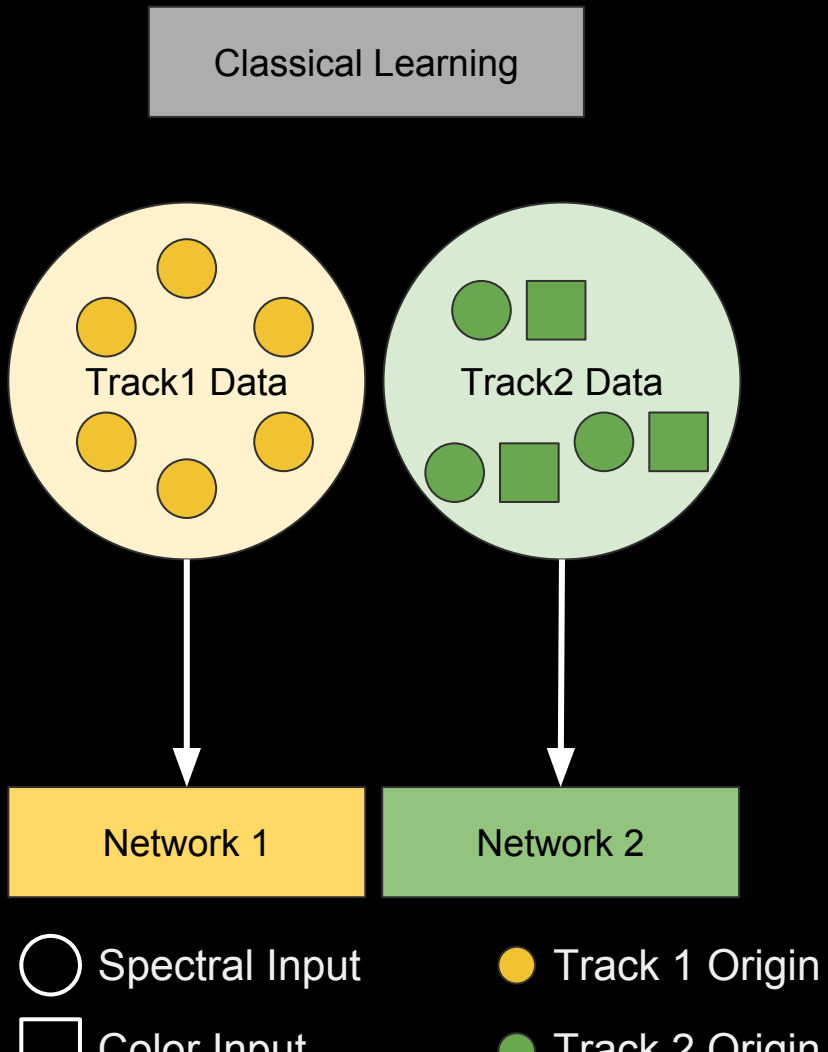
R. Achanta, N. Arvanitopoulos, and S. Süsstrunk, "Extreme image completion," in the IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2017.

Residual Learning

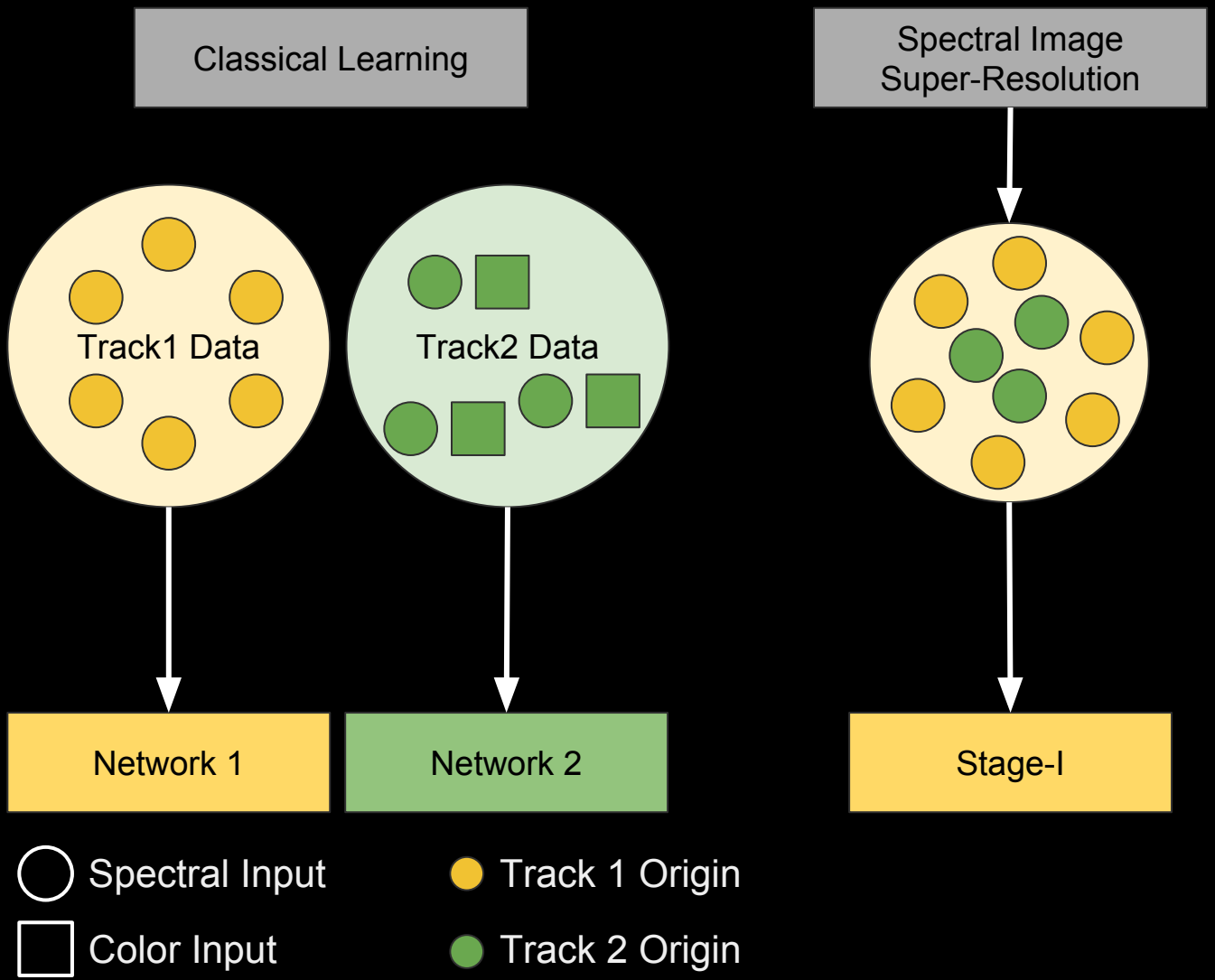


- Small model size
  - Stage-I: 1.6MB
  - Stage-II: 1.1MB
- Fast inference
- Low memory requirements

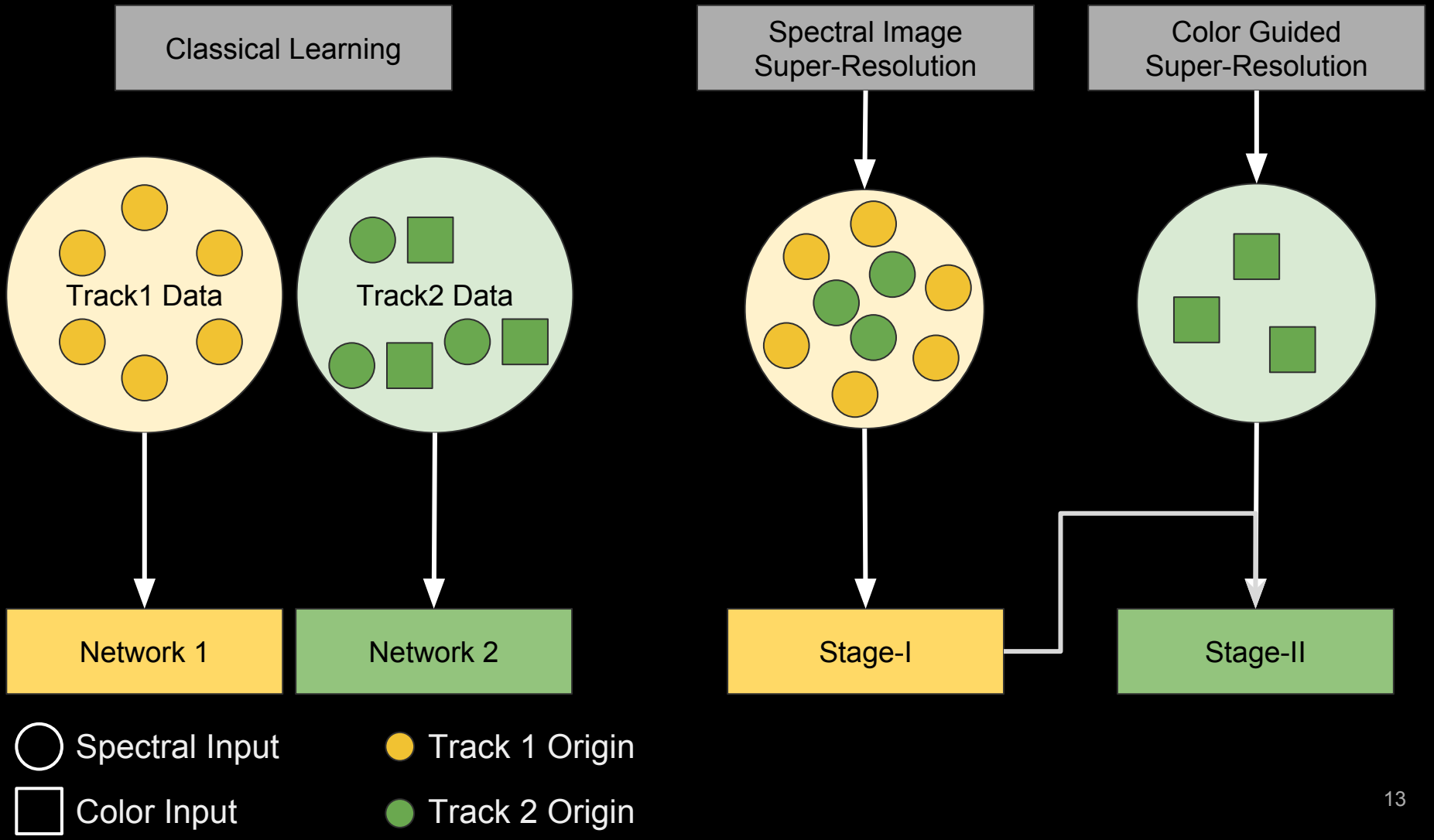
Transfer Learning



Transfer Learning



Transfer Learning



Transfer Learning

Blind Residuals

High Resolution Candidate

Conv Net

Stage-I

+

Track1 Prediction

Color Guided Residuals

Track2 Prediction

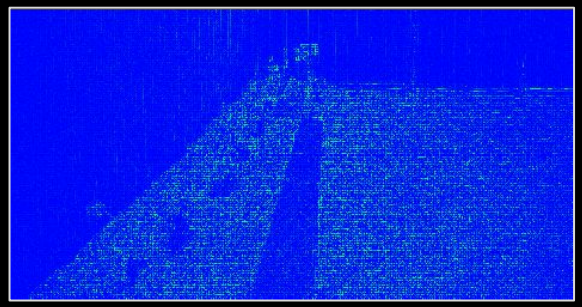
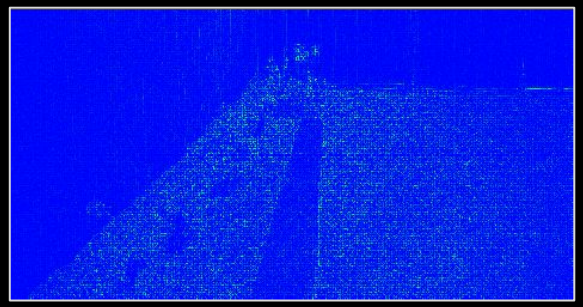
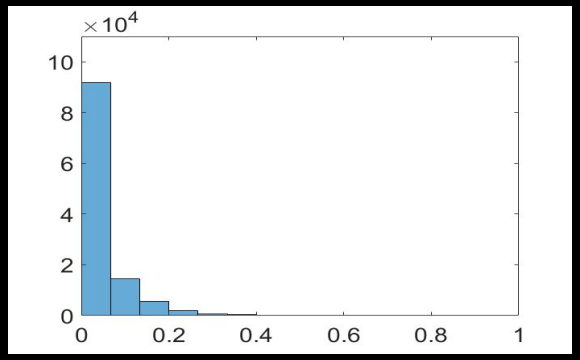
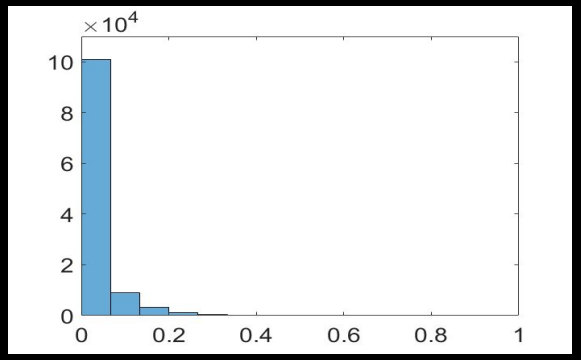
+

Conv Net

Stage-II

Color Guide

Transfer Learning: Example Output

	Stage-I	Stage-II
Output		
Error		
Histogram of Residuals		

Comparative Results

Metric	Bicubic x2	EDSR	Stage-I
MRAE	0.11	0.10	**0.08**
SID	57.39	43.57	**43.48**
PSNR	36.07	37.27	**37.44**

Validation Track 1

Lim, B., Son, S., Kim, H., Nah, S. and Lee, K.M., "Enhanced Deep Residual Networks for Single Image Super-Resolution," in the IEEE conference on computer vision and pattern recognition (CVPR) workshops, 2017.

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Validation Track 1

Metric	Bicubic x2	EDSR	Stage-I	Stage-II
MRAE	0.13	0.16	0.10	**0.09**
SID	43.32	30.67	38.04	**24.51**
PSNR	36.48	37.13	37.02	**39.17**

Validation Track 2

Lim, B., Son, S., Kim, H., Nah, S. and Lee, K.M., "Enhanced Deep Residual Networks for Single Image Super-Resolution," in the IEEE conference on computer vision and pattern recognition (CVPR) workshops, 2017.

Conclusion

- Multi-Modal Spectral Super Resolution
  - Use any signal you get your hands on!
  - Difficulty in obtaining new modalities can be overcome by transfer learning

https://github.com/IVRL/Multi-Modal-Spectral-Image-Super-Resolution

Thank you!

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