

# DEEP IMAGE DEBLURRING

K. V. Kolchin

Media Processing Team

SAMSUNG Research Russia

# Problem Statement

**Long exposures** and camera shake lead to **image blur**, which makes images unusable. This can happen both in low light and normal situations.



Camera Motion



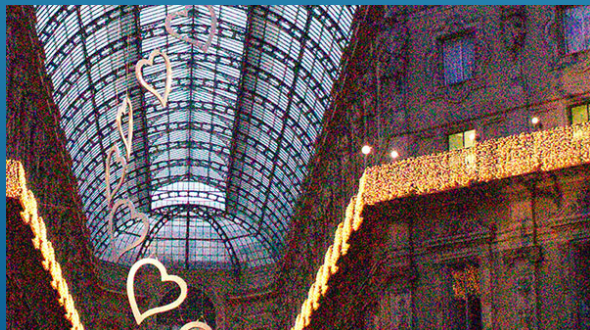
Normal light blur



Low light blur

**Simple solution** -> Reduce exposure time and increase sensitivity

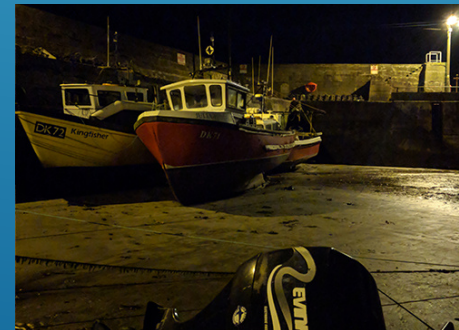
*But it induces noise and color degradation*



High Sensitivity -> More Noise



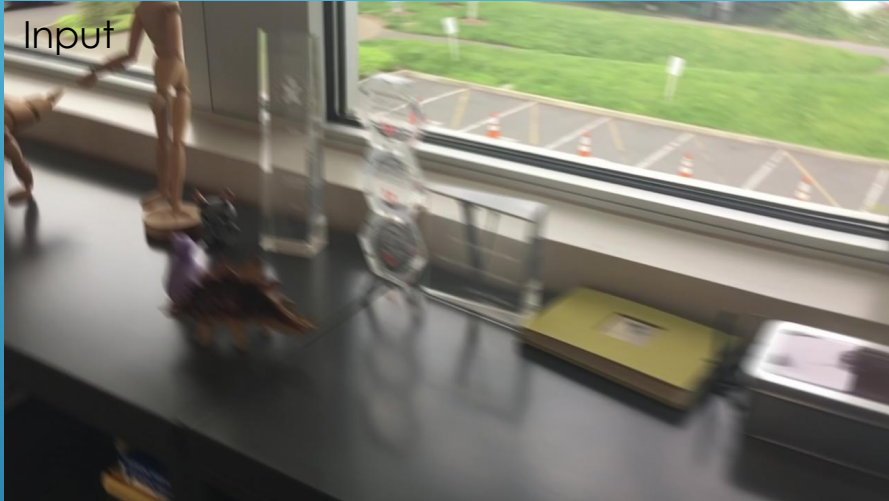
Short exposure -> Underexposure



Low light -> Color Degradation

# Deblur Examples

All the images were processed by neural networks





# Deblur Examples

All the images were processed by neural networks

Input



Deblur



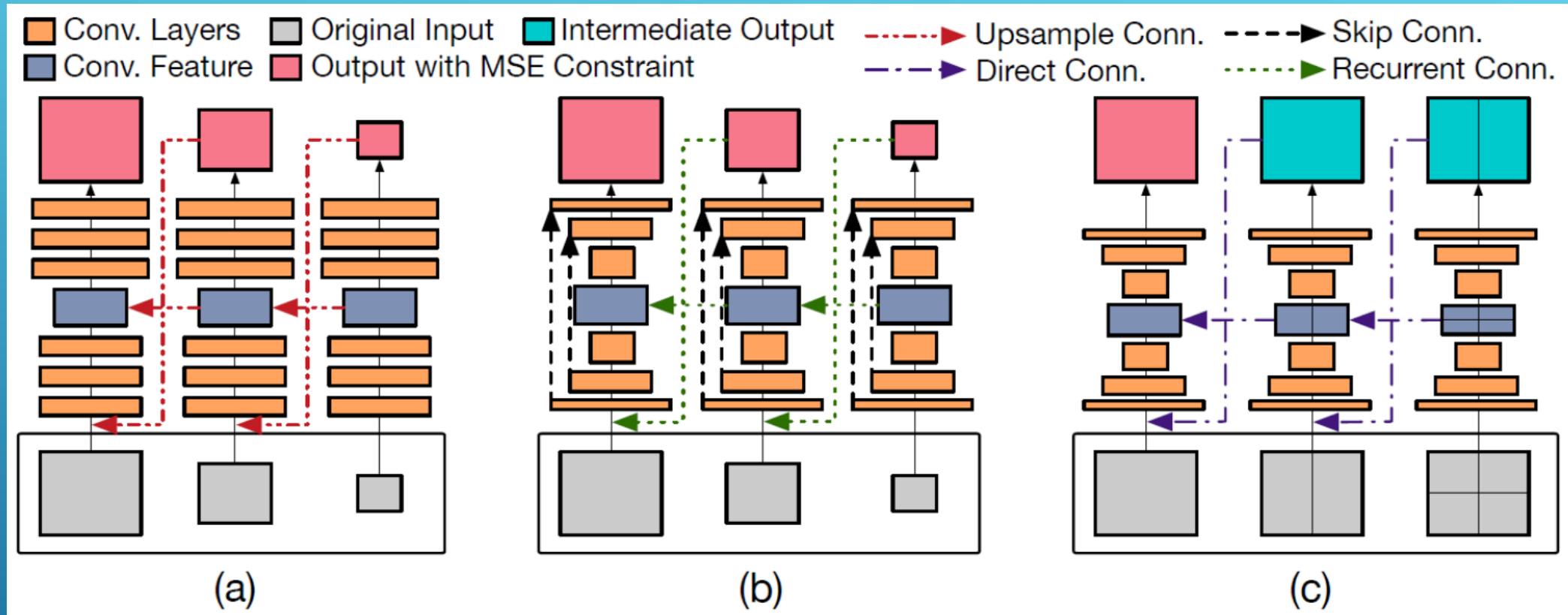
Input



Deblur



# Three Recent Solutions

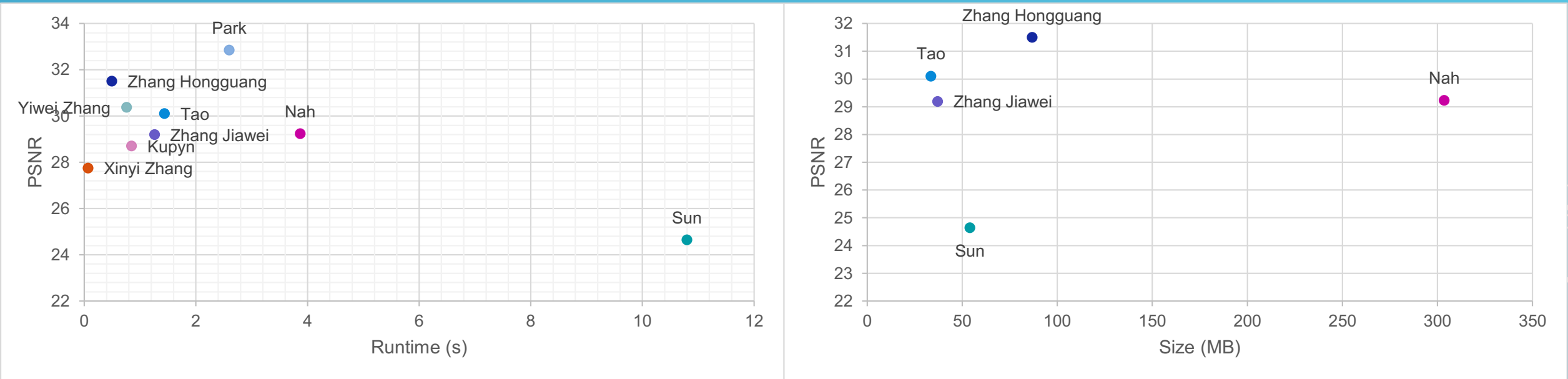


Comparison of three recent network architectures - (a) multi-scale, Nah et al. [2], (b) multi-scale recurrent, Tao et al. [3] and (c) H. Zhang's hierarchical multi-patch architecture [10].

Notice that H. Zhang's model does not employ any skip or recurrent connections. That is why it is faster than the other two solutions.

# State of the Art

Charts of PSNR as a function of runtime, sec, and neural network size , MB.





# References

1. J. Sun, W. Cao, Z. Xu, and J. Ponce. Learning a convolutional neural network for non-uniform motion blur removal. In CVPR, pages 769–777. IEEE, 2015.
2. S. Nah, T. H. Kim, and K. M. Lee. Deep multi-scale convolutional neural network for dynamic scene deblurring. pages 3883–3891, 2017.
3. Xin Tao, Hongyun Gao, Xiaoyong Shen, Jue Wang, Jiaya Jia, Scale-recurrent Network for Deep Image Deblurring, CVPR 2018.
4. Orest Kupyn, Volodymyr Budzan, Mykola Mykhailych, Dmytro Mishkin, Jiri Matas, DeblurGAN: Blind Motion Deblurring Using Conditional Adversarial Networks, CVPR 2018.
5. Jiawei Zhang, Jinshan Pan, Jimmy Ren, Yibing Song, Linchao Bao, Rynson Lau, and Ming-Hsuan Yang, "Dynamic Scene Deblurring Using Spatially Variant Recurrent Neural Networks", CVPR 2018.
6. Xinyi Zhang, Hang Dong, Zhe Hu, Wei-Sheng Lai, Fei Wang, Ming-Hsuan Yang, Gated Fusion Network for Joint Image Deblurring and Super-Resolution, arXiv, 2018.
7. Yiwei Zhang, Chunbiao Zhu, Ge Li, Yuan Zhao, Haifeng Shen, Bi-Skip: A Motion Deblurring Network Using Self-paced Learning, arXiv, 2019.
8. Kai Zhang, Wangmeng Zuo, Lei Zhang, Deep Plug-and-Play Super-Resolution for Arbitrary Blur Kernels, CVPR 2019.
9. Dongwon Park, Jisoo Kim, Se Young Chun, Down-Scaling with Learned Kernels in Multi-Scale Deep Neural Networks for Non-Uniform Single Image Deblurring, arXiv, 2019.
10. Zhang, Hongguang, Yuchao Dai, Hongdong Li, Piotr Koniusz, "Deep Stacked Hierarchical Multi-patch Network for Image Deblurring," CVPR 2019.
11. J Cai, W Zuo, L Zhang, Extreme Channel Prior Embedded Network for Dynamic Scene Deblurring, arXiv preprint arXiv:1903.00763, 2019.

# Blurred Image from the GOPRO dataset





# Blurred Image Deblurred by Tao [3]





# Blurred Image Deblurred by Zhang [10]



# Project Proposal

- ❖ The goal of the project is to develop a neural network to recover the image closest to the original one.
- ❖ The expected result is a neural network model that, after training, could eliminate motion blur in digital photos in no more than a few (2-3) seconds (on a PC with an NVIDIA GTX 1080 Ti) and with a quality of at least 30 decibels of PSNR for test images (in the presence of a reference image without blur).





THANK YOU

감사합니다

СПАСИБО

**SAMSUNG**