A Fast and Efficient Super-Resolution Network using Hierarchical Dense Residual Learning

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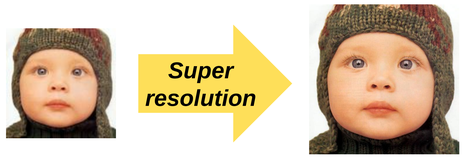
1. Introduction

- Goal: To restore high-resolution (HR) image from low-resolution (LR) image with detailed textures and important information



Low-resolution image *High-resolution image*

- According to the number of input LR images, super-resolution can be classified into:
  - ✓ Single image super-resolution (*Our interest*)
  - ✓ Multiple image super-resolution

2. Motivation

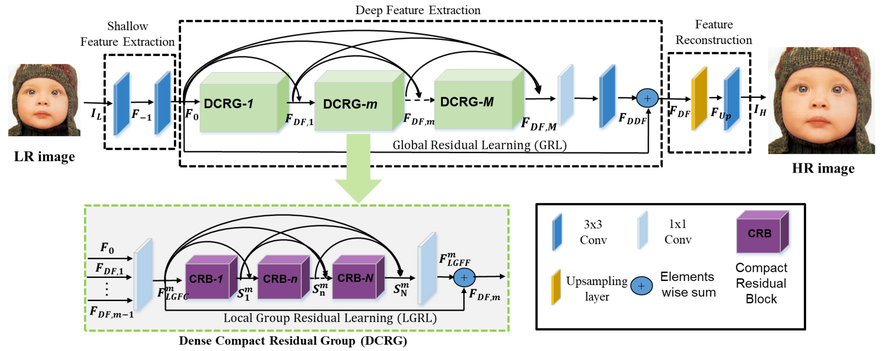
- **Problem:** The previous works do not pay enough attention to the key role of multi-level residual and multi-level dense connections

Method	First-Level Connection	Second-Level Connection
EDSR, RCAN, *etc.*	Residual	Residual
RDN, MGAN, *etc.*	Dense	Residual
CARN, CSFM, *etc.*	Residual	Dense
SRDenseNet, MemNet, *etc.*	Dense	Dense
HDRN (Ours)	Dense Residual	Dense Residual

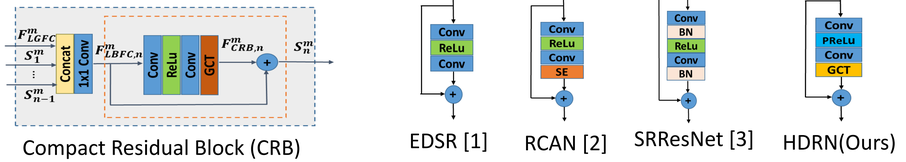
- **Our approach:** We propose a hierarchical dense residual network (HDRN) by effectively combining the hierarchical dense residual learning into a single CNN model

3. Proposed Network Architecture

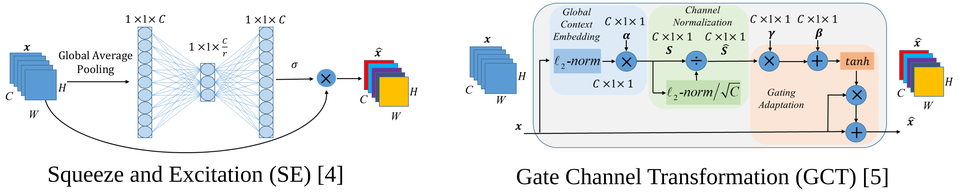
- We propose to use densely connected residual blocks in the DCRG module, helping to extract abundant information from the hierarchical dense residual connection



- We propose to use 1x1 Conv in each CRB and DCRG module to reduce the number of feature maps (i.e., model size), making our model more compact



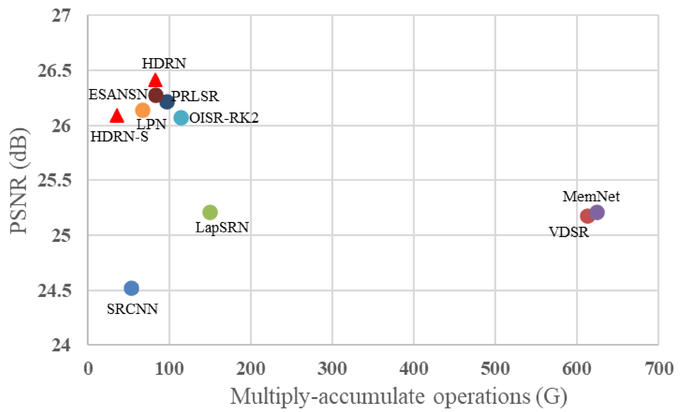
- We employ the light weight and efficient channel attention GCT instead of the conventional SE block



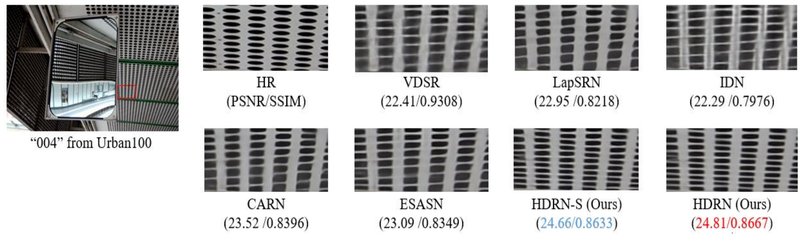
[1] B. Lim, et al., "Enhanced deep residual networks for single image super-resolution," in *CVPR 2017*.
[2] Y. Zhang, et al., "Image super-resolution using very deep residual channel attention networks," *in ECCV 2018*.
[3] C. Ledig, et al., "Photo-realistic single image super-resolution using a generative adversarial network," in *CVPR 2017*.
[4] J. Hu, et al., "Squeeze-and-excitation networks," in *CVPR 2018*.
[5] Z. Yang, et al., "Gated channel transformation for visual recognition," in *CVPR 2020*.

4. Experimental Results

- Our HRDN achieves the best performance, while has a similar number of parameters and operations



- Our HRDN can recover good object structures and detailed textures information compared to other methods



5. Conclusion

- This work presents a hierarchical dense residual network (HDRN) is presented for the fast and efficient single image super-resolution task by taking advantage of the hierarchical dense residual learning

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