

Comparison of Contemporary Image Resolution Upscaling Algorithms: a Survey

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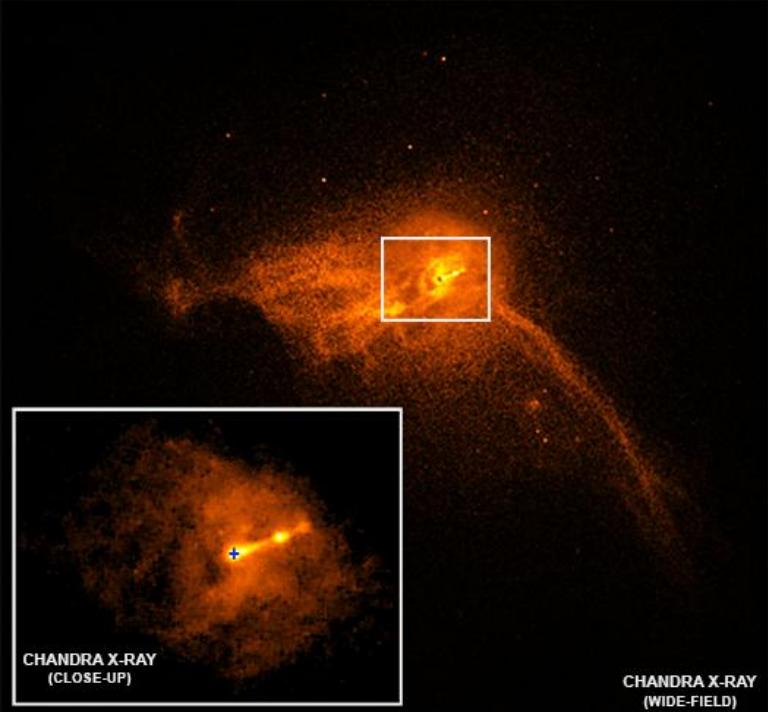
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Outline

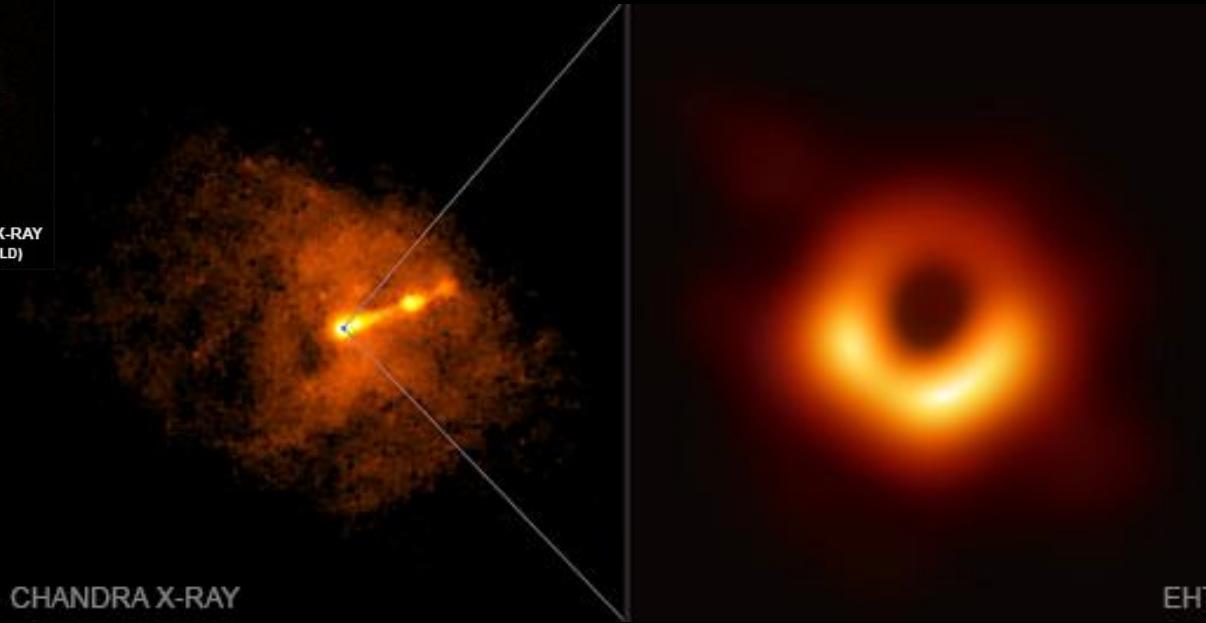
- Intro to superresolution
- Applications
- Algorithms review
- Results
- Image Quality Assessment
- Further plan

What is super-resolution?

- Recovering high-resolution images from low-resolution images
- The task is underdetermined: has multiple possible solutions



- Wide variety of methods:
- Improves other image processing tasks
- Costs less than hardware solutions

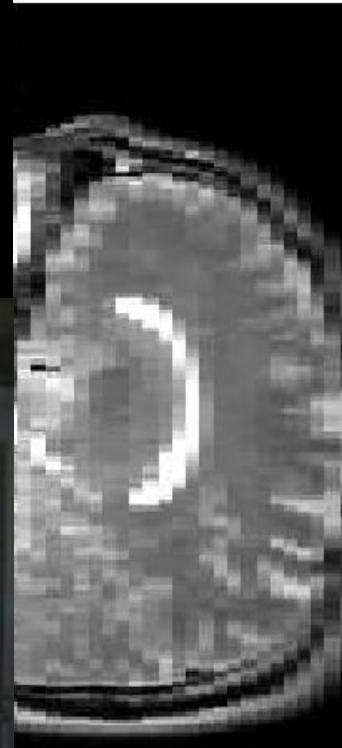


Super-Resolution Applications

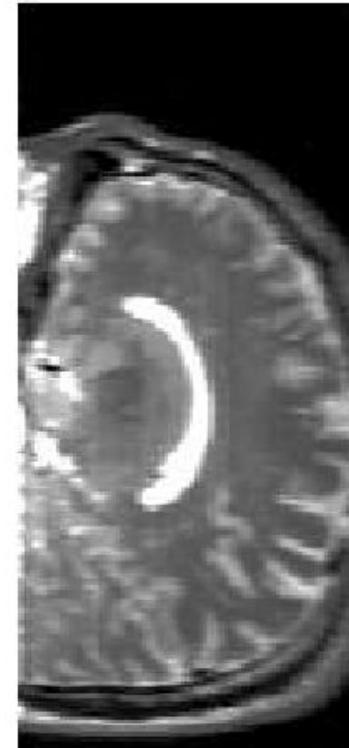
- Medical imaging
- Security and Surveillance
- Image printing



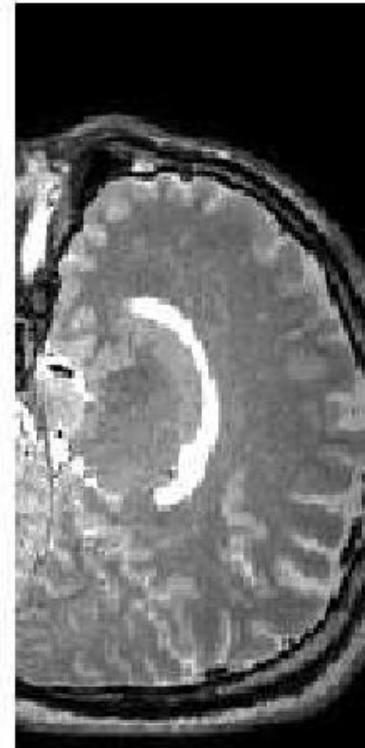
A LR image



Reconstructed HR image



A HR image





Survey Methodology

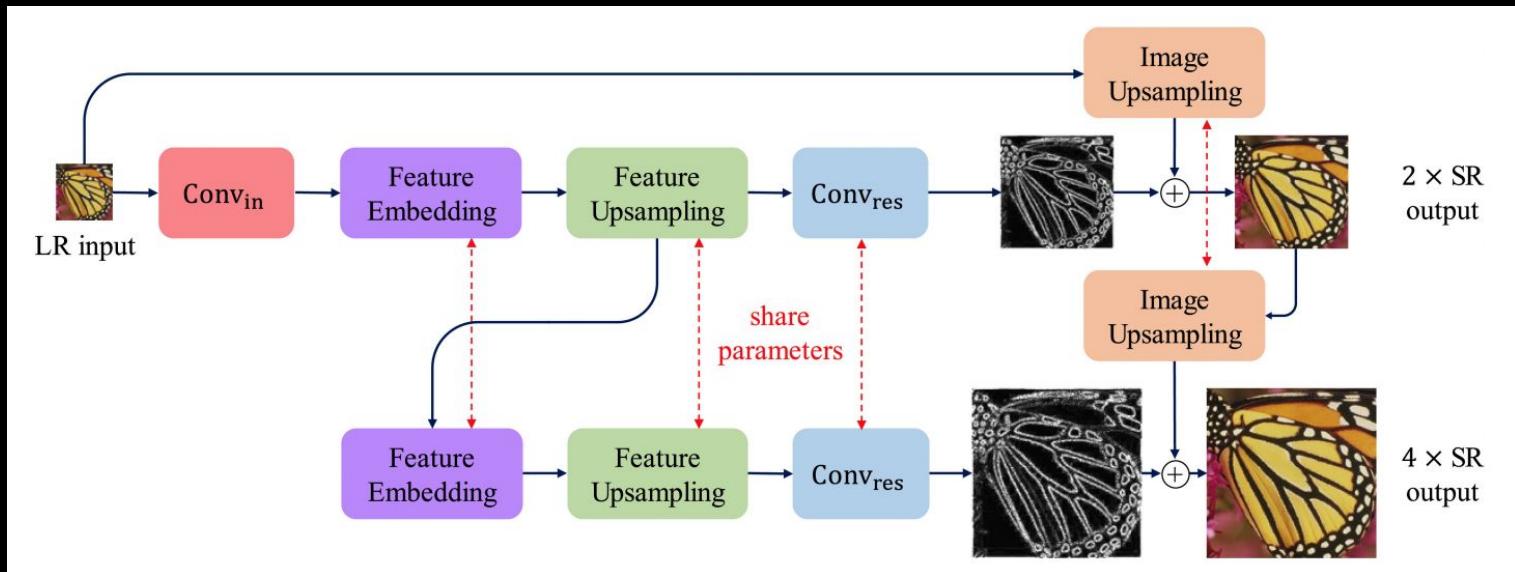


- 4x and 8x downsampled resolution
- Result evaluation is based on human perception
(at current stage)

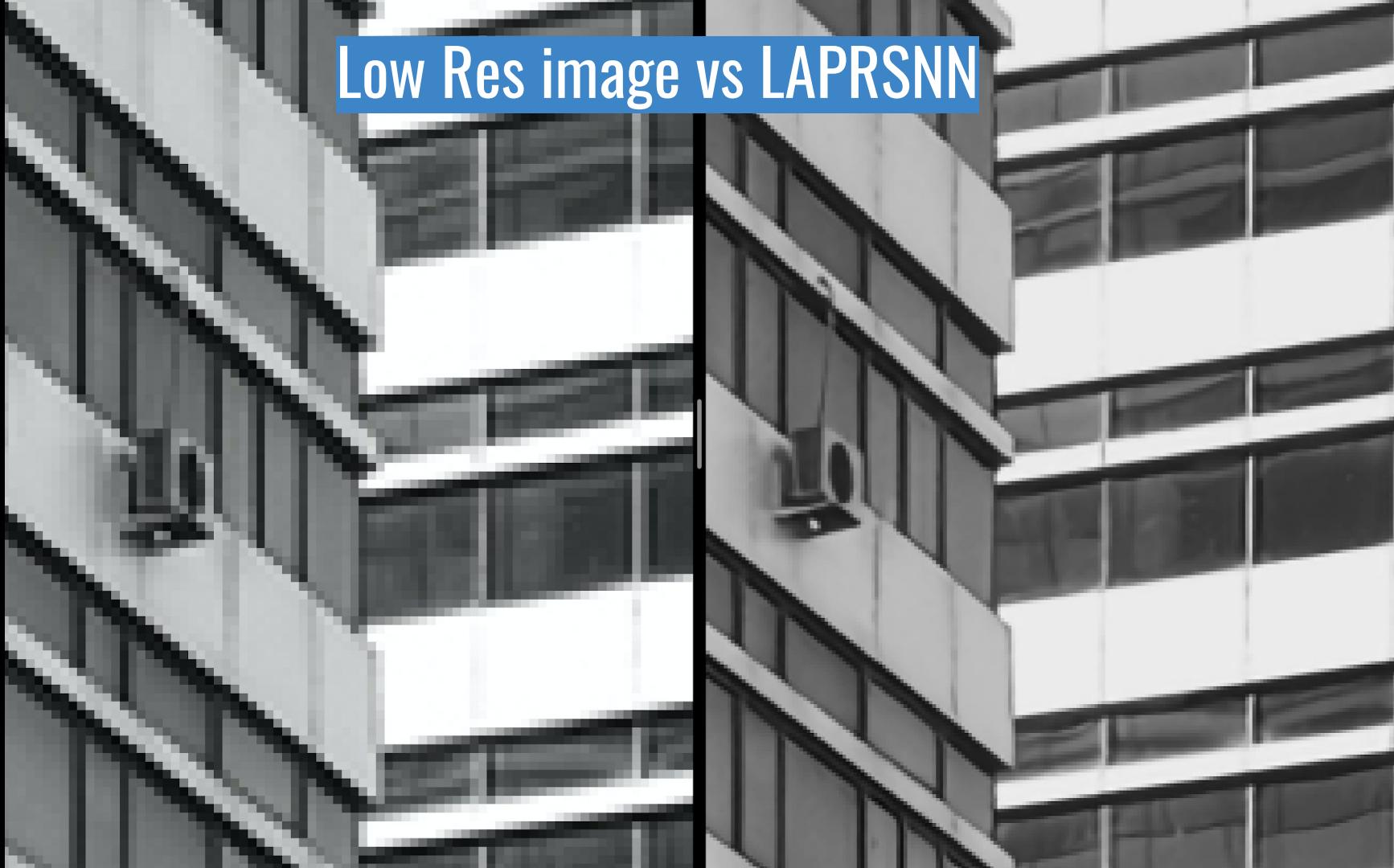


Method #1: Image Super-Resolution with Deep Laplacian Pyramid Networks (Lai et al. 2017)

- Based on the Laplacian pyramid framework
- Progressive upsample
- Features at low-res are extracted and collapsed in the upsample



Low Res image vs LAPRSNN

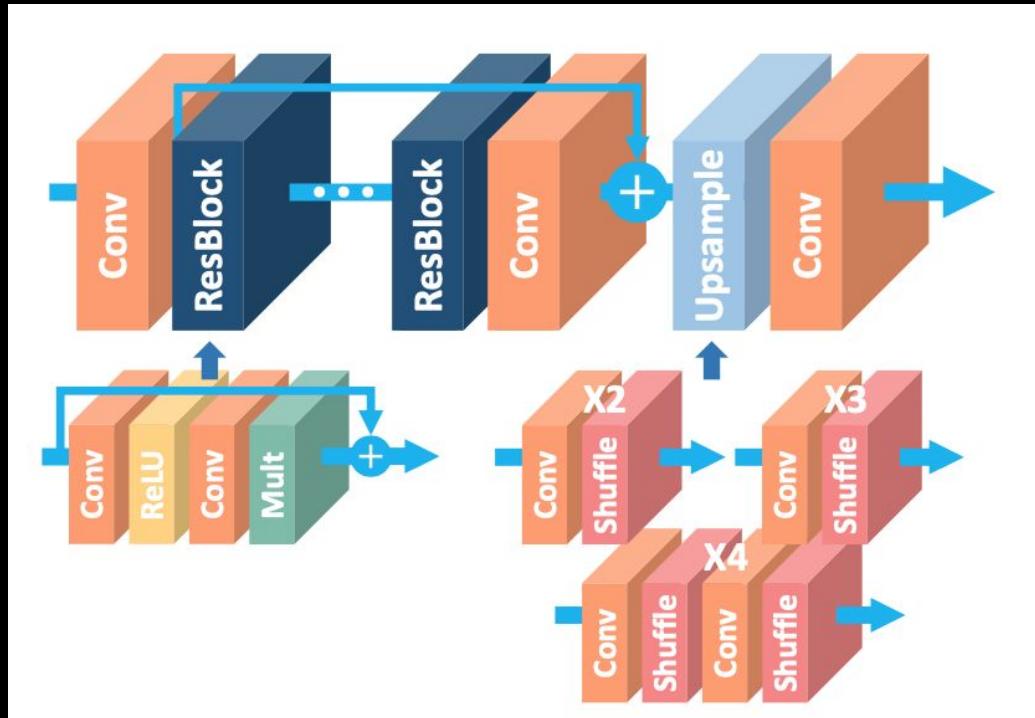


High Res image vs LAPRSNN



Method #2: Enhanced Deep Residual Networks for Single Image Super-Resolution (Lim et al. 2017)

- Optimized conventional residual networks by removing unnecessary modules
- Expanded the model size while stabilizing the training procedure
- NTIRE2017 Super Resolution Challenge winner



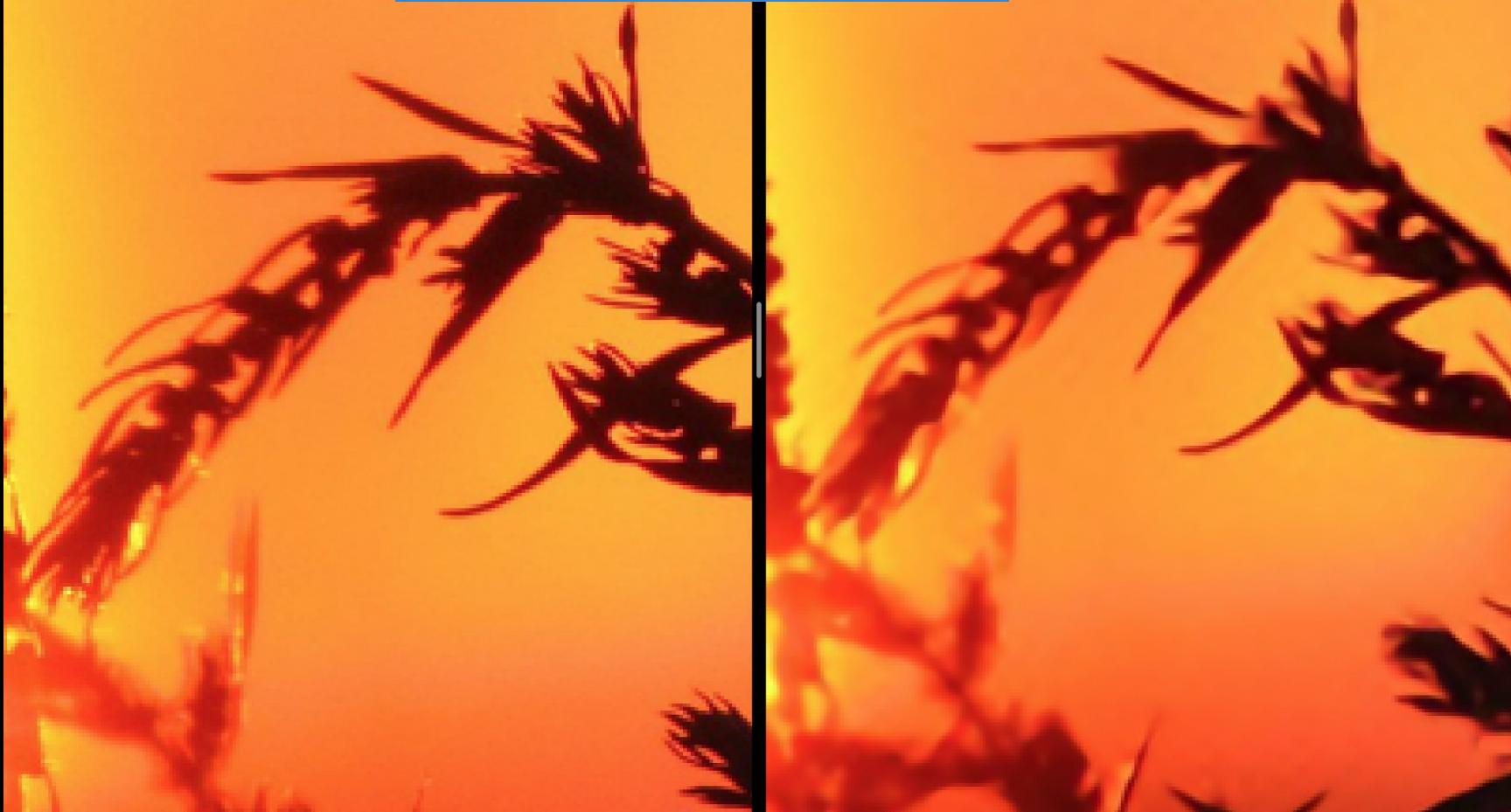
Low Res image vs EDSR



Low Res image vs EDSR



High Res image vs EDSR

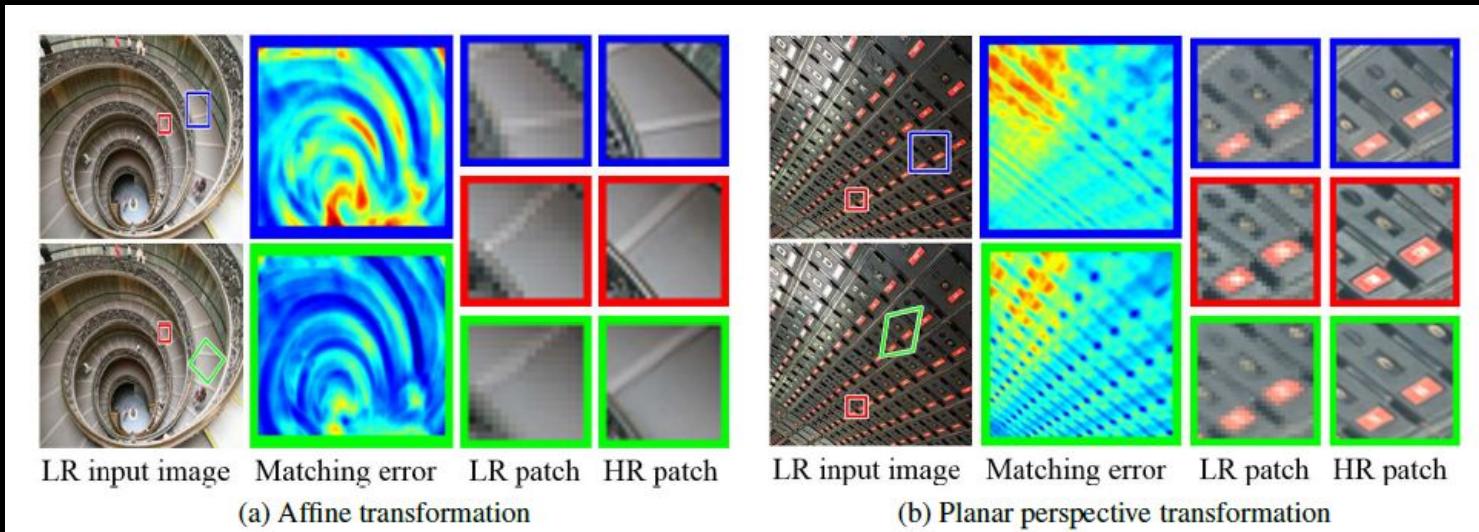


EDSR vs LAPRSNN



Method #3: SelfExSR

- Is not Machine Learning based technique: does not require any external data
- Exploits internal patch redundancy of images,
- Utilizes 3D scene geometry to search patches in different perspective planes
- Uses affine transformation to address local shape variations.



Low Res vs SelfExSR



High Res vs SelfExSR



EDSR vs SelfExSR



Mathematical Image Quality Assessment

- Reference based
 - Mean Square Error (MSE) and Peak Signal-to-Noise Ratio (PSNR) (easily deceived).
 - Structural Similarity index (SSIM)
 - **Information Fidelity Criterion (IFC) (human perception-like)**
- No-reference
 - Codebook Representation for No-Reference Image Assessment (CORNIA) (2012, no code available)
 - **CNN for No-Reference Image Quality Assessment (2014, same author as CORNIA)**

Encountered issues

- Older neural network systems (ex: MATLAB-based) are no longer supported and are not reproducible
- Some of the implementations are limited in use (gray-scale only, fixed upscale ratio)
- x5 and higher models require better workstations

Further Plan

- Implement at least 3 more methods of image upscaling
- Implement IQA's both for reference and no-reference methods

Thank you!

