B-DRRN: A Block Information Constrained Deep Recursive Residual Network for Video Compression Artifact Reduction

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Contents

▷ Block Artifact in video coding
▷ Related works
▷ Our proposal
▷ Experiment – Results
▷ Conclusion
1.

Block Artifact in HEVC

The problem
Block-based video coding
Video coding process

Original frame

Prediction

In-Loop Filtering

Transform & Quantization

video codec

Reconstruction

Entropy coding

Output frame
HEVC artifact

Original

Decoded, QP = 37
2. Artifacts reduction using Convolutional Neural Network

Related works
Re-design in-loop filter by CNN

1 Residual Highway Convolutional Neural Networks for in-loop Filtering in HEVC, IEEE Transactions on Image Processing, vol 27, 2018
2 A Convolutional neural network approach for post-processing in HEVC intra coding, MMM 2017
3 Deep learning based HEVC in-loop filtering for decoder quality enhancement, PCS 2018
Post processing

A Novel Deep Learning-Based Method of Improving Coding Efficiency from the Decoder-End for HEVC, DCC 2017

Deep residual network for enhancing quality of the decoded intra frames of HEVC, ICIP 2018

1 A Novel Deep Learning-Based Method of Improving Coding Efficiency from the Decoder-End for HEVC, DCC 2017
2 Deep residual network for enhancing quality of the decoded intra frames of HEVC, ICIP 2018
Post processing with block information

Decoded frame → Features extraction → Fusion & Reconstruction → Enhanced frame

Block information → Feature extraction

Double-input framework*

* Enhancing HEVC compressed videos with a partition-masked convolutional neural network, ICIP 2018
3. Proposal

B-DRRN: A Block Information Constrained Deep Recursive Residual Network
Proposals

1. Improve quality using block information
2. Reduce the number of parameters:
   a. Recursive Residual Block (RRN)
   b. Weights sharing
Overview of the proposed B-DRRN
Block information representation

- Decoder
  - Bitstream
    - Decoded frame
      - Size & Position of CUs
        - Mean operator
          - Mean mask frame

a. Decoded frame with block information
b. Mean mask frame
Proposed RRN-based two branches network

*Deep Recursive Residual Network for Super Resolution, CVPR 2017*
Fusion and proposed weight-sharing scheme
4. Experiment and Results

By HM software
Data

209,512 frames
64x64 each

600 YUV videos
3 frames each

7 resolutions
qcif, cif, 360p, 480p, HD, fullHD and uHD
# Results in rate-distortion

Table 2. Results on BD-rate reduction (%)

<table>
<thead>
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<tbody>
<tr>
<td>2560 x 1600</td>
<td>-3.32</td>
<td>-4.74</td>
<td>-6.26</td>
<td>-7.12</td>
<td>-7.84</td>
<td>-7.69</td>
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<tr>
<td>1920 x 1080</td>
<td>-1.32</td>
<td>-2.58</td>
<td>-3.60</td>
<td>-4.67</td>
<td>-5.59</td>
<td>-5.55</td>
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<tr>
<td>1280 x 720</td>
<td>-0.55</td>
<td>-1.86</td>
<td>-3.82</td>
<td>-4.80</td>
<td>-5.90</td>
<td>-5.59</td>
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<tr>
<td>832 x 480</td>
<td>-0.58</td>
<td>-1.98</td>
<td>-3.84</td>
<td>-4.66</td>
<td>-5.96</td>
<td>-5.67</td>
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<tr>
<td>416 x 240</td>
<td>-0.65</td>
<td>-3.03</td>
<td>-3.25</td>
<td>-6.26</td>
<td>-7.08</td>
<td>-7.60</td>
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<tr>
<td>Average</td>
<td>-1.10</td>
<td>-2.60</td>
<td>-3.94</td>
<td>-5.23</td>
<td>-6.24</td>
<td>-6.16</td>
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Performance trade off

![Graph showing performance tradeoff between number of parameters and BD-rate reduction. The graph includes points for ARCNN, VRCNN, DCAD, DRRN, and Our Adding. There are two main input types: single-input and double-input. The graph compares the performance of these models across different numbers of parameters.]
More details (PSNR/SSIM)

Decoded, 36.98/0.9152

Our_Adding, 33.93/0.8759

Decoded, 33.61/0.8668

Our_Adding, 36.38/0.9409
Conclusion

▷ A two branches Recursive Residual Network with -6.16% BD-rate reduction
▷ Increase the image quality without adding more parameters of the main branch.
▷ A large-scale dataset with 209,152 frames.
Thanks!

Q&A?

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