



Learning True Rate-Distortion-Optimization for End-To-End Image Compression

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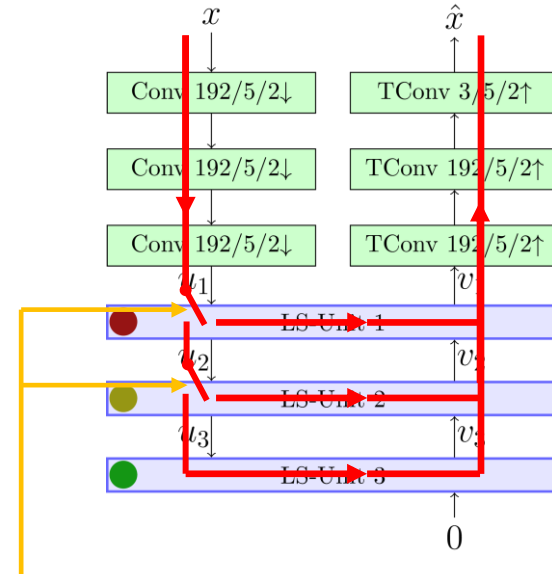


Rate-Distortion Optimization

- Rate-Distortion Optimization important component of image and video compression
 - E.g. adaptive block partitioning in hybrid coders
- RDO possibilities limited in deep-learning-based image coding
 - Typically fixed decoding function
 - No free parameters after training

RDONet^[1]

- Compressive Autoencoder capable of coding at adaptive depth
- Masks control compression depth
- Decision on block-level
 - Compression as whole image
 - No block artifacts
- Multiple coding runs needed for optimal compression
- RDO not part of training

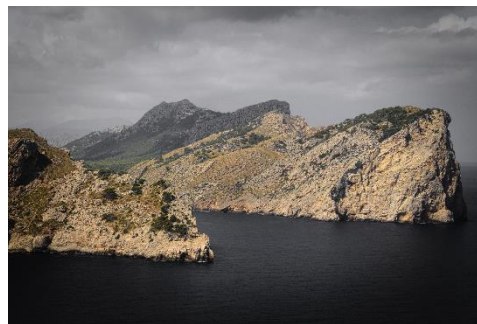


Transmitted masks

[1] Brand, Fischer, Kaup: „Rate-Distortion-Optimized Image Compression using an adaptive hierarchical autoencoder with conditional hyperprior“, CVPRW, 2021

Proposed Mask Estimation

- Estimate optimal mask from image content
- Inspired by block partitioning observed in HEVC
- Based on pixel-value variance
 - Large variance \rightarrow small blocks
 - Small variance \rightarrow large blocks
- Low complexity
- Independent of network



Enhanced RDONet

Training Procedure

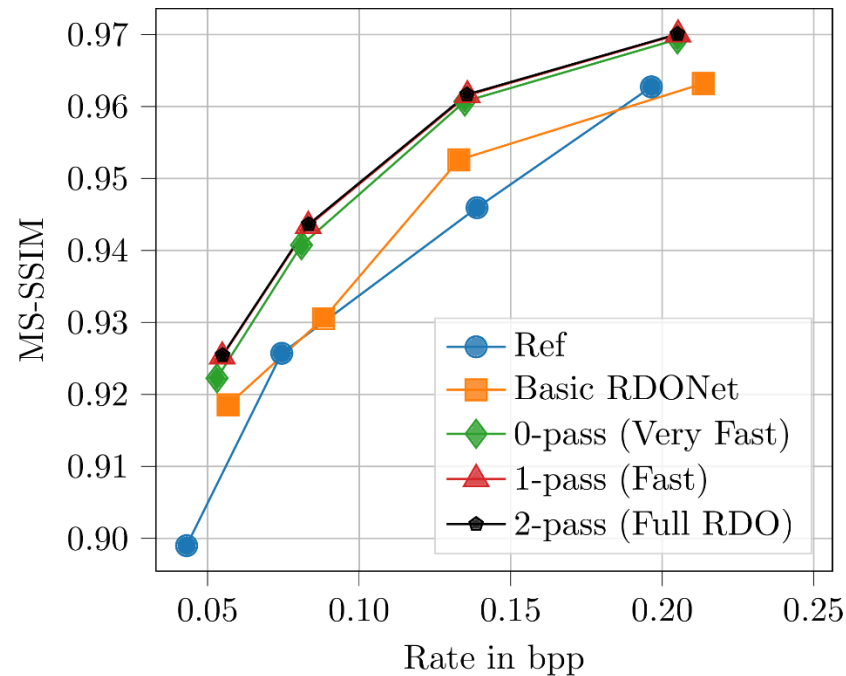
- Training with random masks for 2000 epochs
- All levels can compress general image content
- Continue training with variance-based masks for 600 epochs
- Levels can specialize

RDO Search

- Initialize RDO with variance-based mask
- Faster convergence
 - 1-pass RDO possible
- „Zero-pass“ RDO
 - Only compress with estimated mask
 - Only one coding run needed

Results

- Reference: conventional autoencoder with hyperprior and context model [2]
- Proposed training method superior
- Performance about 20% better than previous method
- Fast RDO performs as good as full RDO
- Zero-pass RDO saves 23.6% rate



[2] Minnen et al.: „Joint Autoregressive and Hierarchical Priors for Learned Image Compression”, NeurIPS, 2018

Conclusion

- RDONet became feasible compression network
- Large rate-savings by improved training procedure
- Accelerated encoding by reliable mask estimation
- Successfully transferred great strength of block-based coding to deep-learning-based methods

