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A comparison between JPEG XL and other codecs

Marc Bornand

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Outlines

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Introduction

- We compared different image codecs one per person
- We use objective metrics to compare them

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Overview

- Recent codec (2022)
- JPEG reencoding
- Modular mode
- VarDCT mode
- Good performances
- More complex than JPEG 1, but still reasonable

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Overview

- Modular means modular
- RCT: 7 transforms of 3 channels all permutations
- Palette: explicit, implicit, can be lossy
- Squeeze: 1D wavelet transform either direction
- Parameters per region
- MA tree (meta-adaptive)
- Predictors

https://arxiv.org/pdf/2506.05987, Jon Sneyers, Jyrki Alakuijala, Luca Versari, Zolt´an Szabadka

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Implementations

- libjxl https://github.com/libjxl/libjxl
  Used a lot: GIMP, Adobe dng converter, firefox (experimental), ...
- jxl-rs https://github.com/libjxl/jxl-rs (decoder only)
- wrapper in different languages
- jxl-oxide (decoder only)
- Other users: Different Softwares, phones, dng specification, ...

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BRISQUE

- From https://ieeexplore.ieee.org/document/6272356
- Maps perceived quality from 0 best to 100 worst
- Feature space see next slide
- SVM with RBF kernel

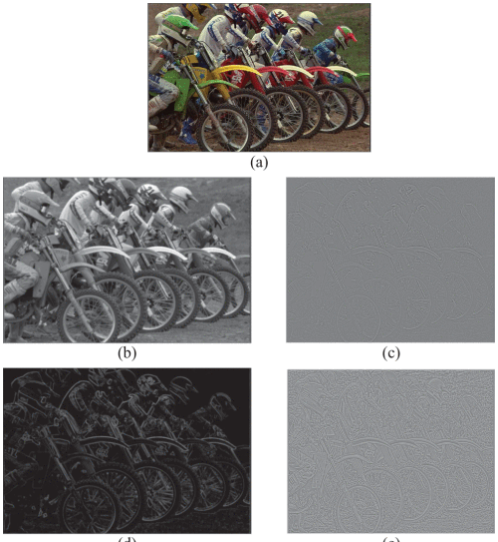

Figure: https://ieeexplore.ieee.org/document/6272356

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- We used the implementation from PIQ
- There is an issue with with this implementation
- Negative values are produced for some images
- One probable cause is due to the way the image are downsampled
- Different implementation use different weights

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Comparison

- Comparison between different codec at 4 compression
- Lowest is defined with a jpeg encoder with quality=65
- Highest is defined by the best lossless compression of the codecs
- The two other are in equal steps

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Compression prodecure

- We started with png encoded images.
- The images were encoded with the cjxl utility of libjxl
- To achieve a specific bitrate the newton method was used
- Lossy compressions were done using the default parameters except for distance -d
- Lossless compression was done with -m 1 -d 0 -e 10 (modular, distance=0, effort 10)
- For metrics calculation all images were transformed back with djxl to png

Lossless Rates

HEIF lossless	JPEG2000 lossless	JPEG XL lossless	WebP lossless	AVIF lossless
10.77	7.55	6.43	7.35	9.25
9.39	7.60	6.55	7.24	8.49
10.68	8.65	7.07	8.49	10.54
11.67	7.43	6.37	7.40	11.04
11.04	7.54	6.25	7.60	10.30
7.91	6.48	5.67	6.53	7.34
10.33	7.45	5.89	7.04	9.75
9.24	6.48	5.48	6.80	8.87
16.42	11.51	10.48	11.84	16.78
15.55	13.06	11.13	11.54	15.91
14.97	11.54	10.40	11.47	15.62
13.10	8.08	6.80	8.28	12.94
12.48	9.39	8.89	8.96	12.49
14.51	10.82	9.47	10.00	14.56
8.10	7.47	5.83	6.85	8.32

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00003_945x840.png

Size: 946x840 Dataset: JPEG AIC-3 Dataset

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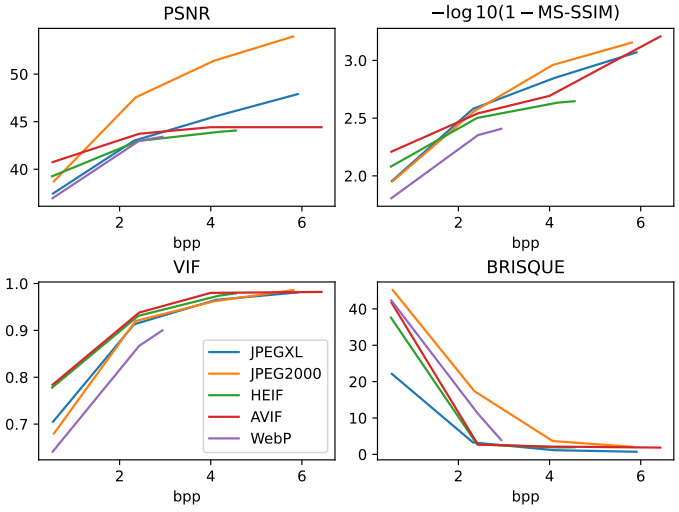
■ JPEG XL

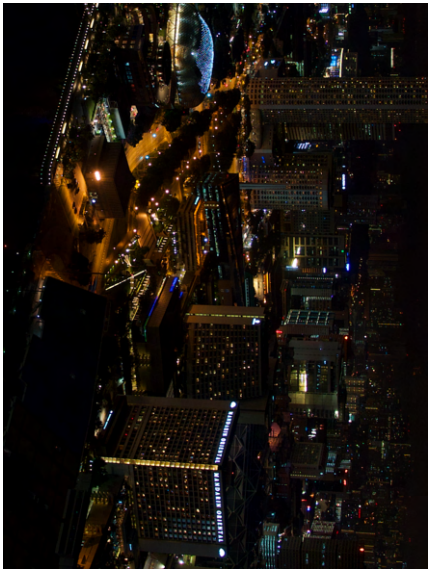
00003_945x840.png

Size: 946x840 Dataset: JPEG AIC-3 Dataset



00007_1600x1200.png

Size: 1600x1200 Dataset: JPEG AIC-3 Dataset



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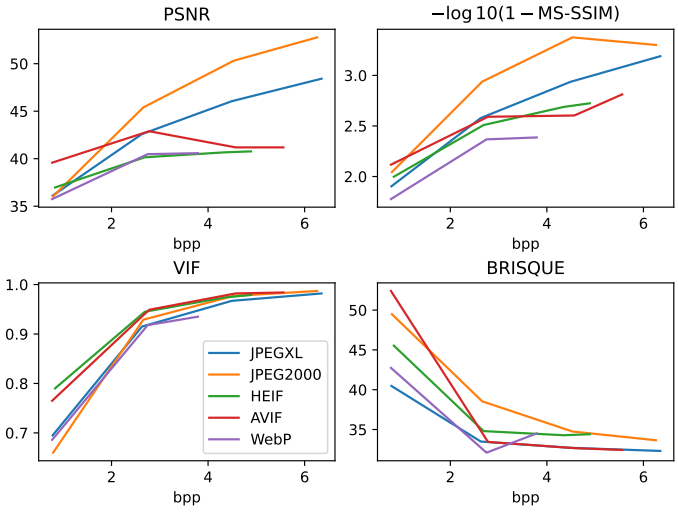
00007_1600x1200.png

Size: 1600x1200 Dataset: JPEG AIC-3 Dataset



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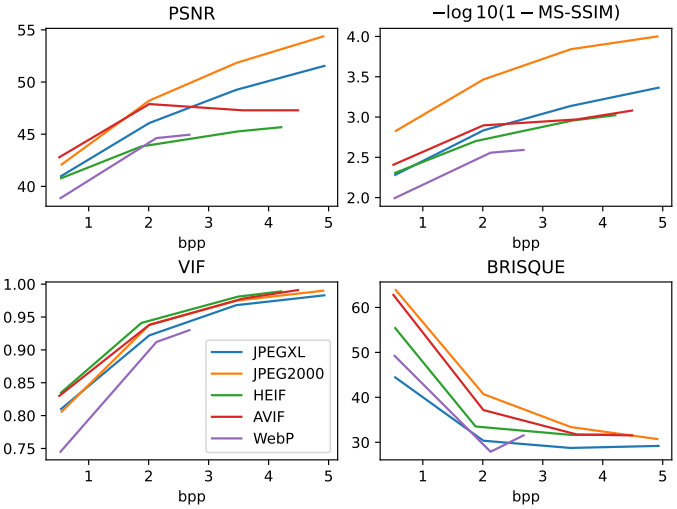
celebration_2048_1365.png

Size: 2048x1365 Dataset: CLIC 2025

celebration_2048_1365.png

Size: 2048x1365 Dataset: CLIC 2025



apple_tree_1365_2048.png

Size: 1365x2048 Dataset: CLIC 2022

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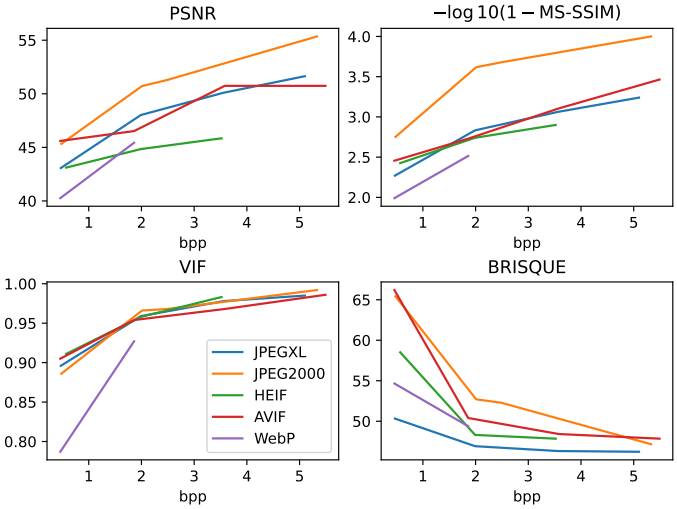
apple_tree_1365_2048.png

Size: 1365x2048 Dataset: CLIC 2022



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rapeseed_field_2048_1365.png

Size: 2048x1365 Dataset: CLIC 2022

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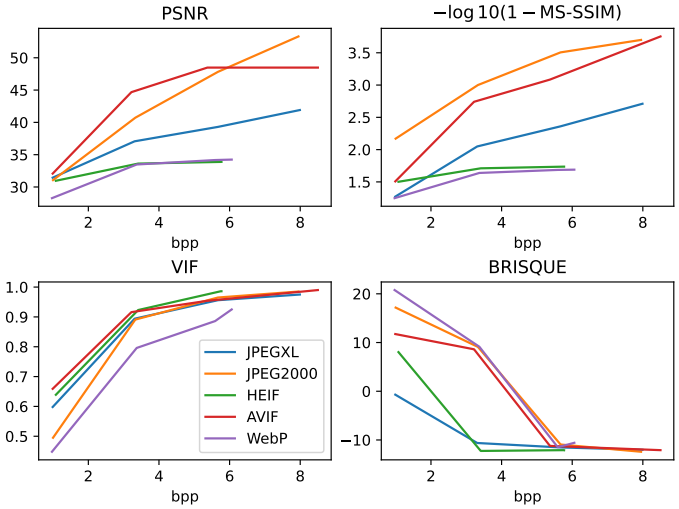
rapeseed_field_2048_1365.png

Size: 2048x1365 Dataset: CLIC 2022



portrait_veil_1391_2048.png

Size: 1391x2048 Dataset: CLIC 2025

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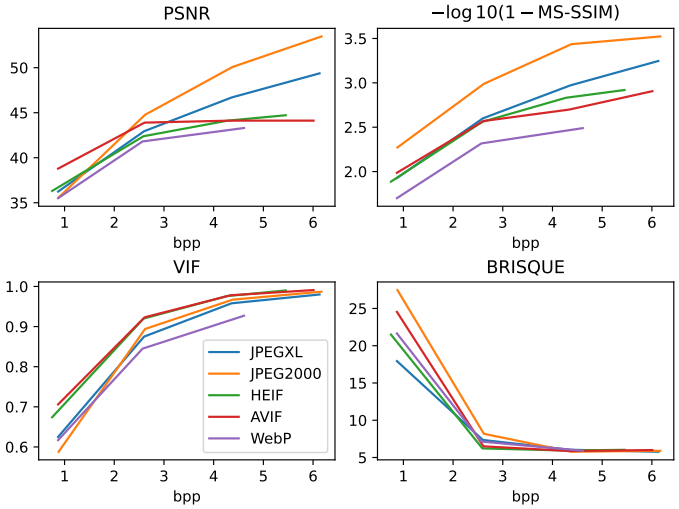
portrait_veil_1391_2048.png

Size: 1391x2048 Dataset: CLIC 2025



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neon_2048_1365.png

Size: 2048x1365 Dataset: CLIC 2022

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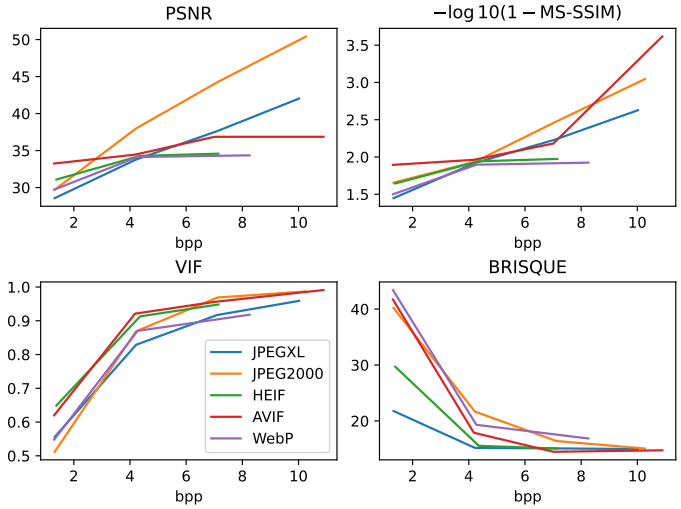
neon_2048_1365.png

Size: 2048x1365 Dataset: CLIC 2022



video_game_2048_1152.png

Size: 2048x1152 Dataset: CLIC 2025

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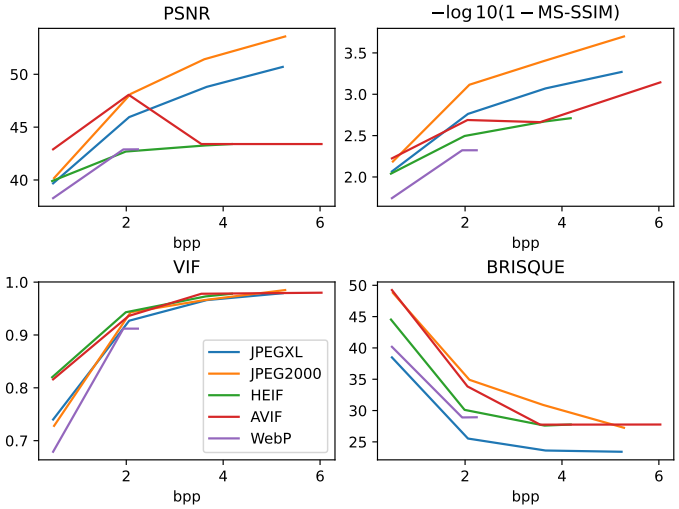
video_game_2048_1152.png

Size: 2048x1152 Dataset: CLIC 2025



street_dusk_2048_1135.png

Size: 2048x1135 Dataset: CLIC 2022

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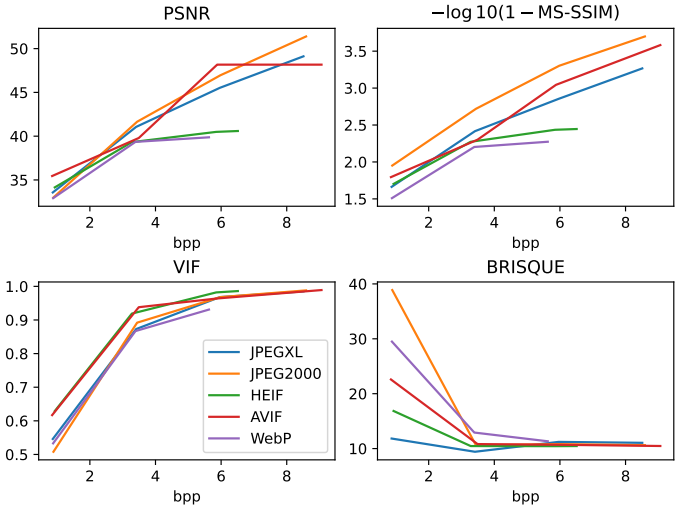
street_dusk_2048_1135.png

Size: 2048x1135 Dataset: CLIC 2022



night_event_1463_2048.png

Size: 1463x2048 Dataset: CLIC 2025

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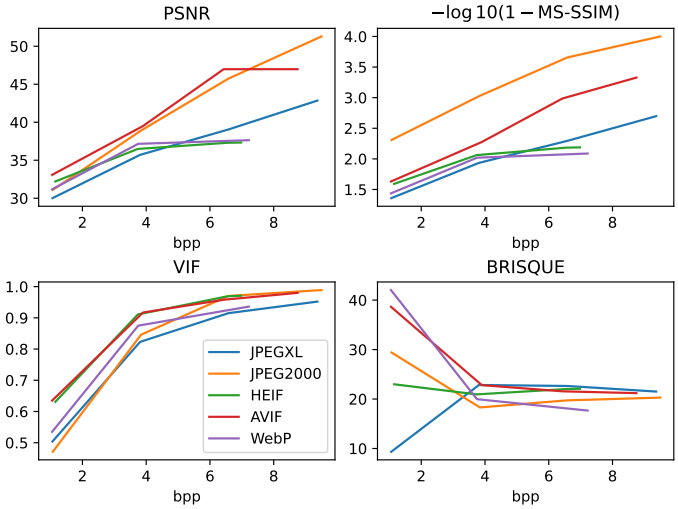
night_event_1463_2048.png

Size: 1463x2048 Dataset: CLIC 2025



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crosswalk_backlight_2048_1360.png

Size: 2048x1360 Dataset: CLIC 2025

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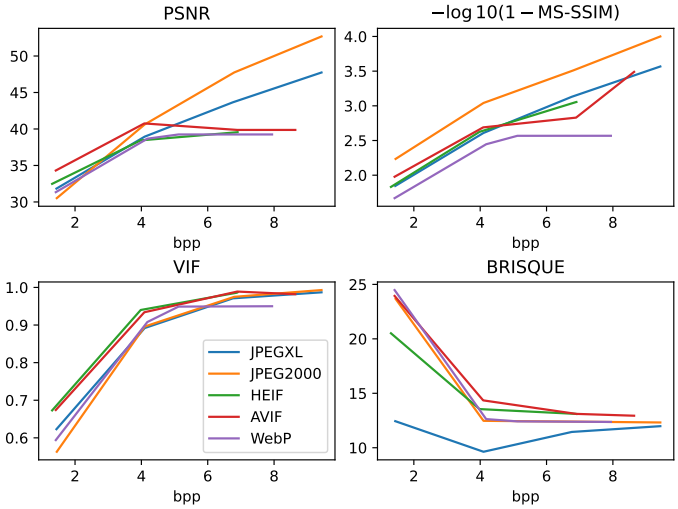
crosswalk_backlight_2048_1360.png

Size: 2048x1360 Dataset: CLIC 2025



00002_853x945.png

Size: 853x945 Dataset: JPEG AIC-3 Dataset

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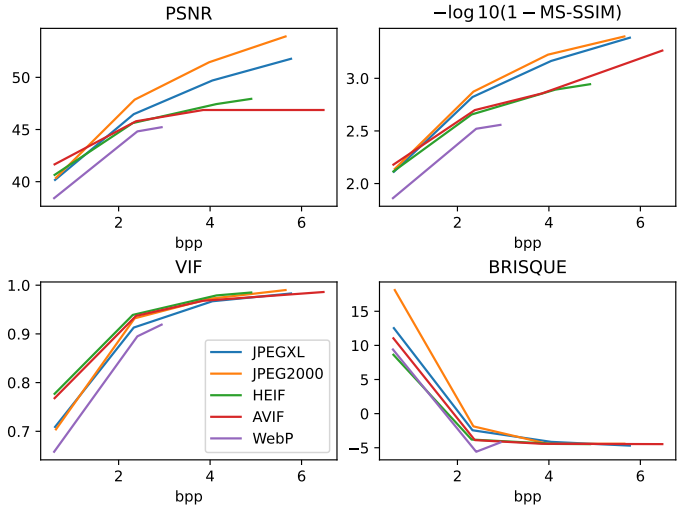
00002_853x945.png

Size: 853x945 Dataset: JPEG AIC-3 Dataset



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00009_2048x1536.png

Size: 2048x1536 Dataset: JPEG AIC-3 Dataset

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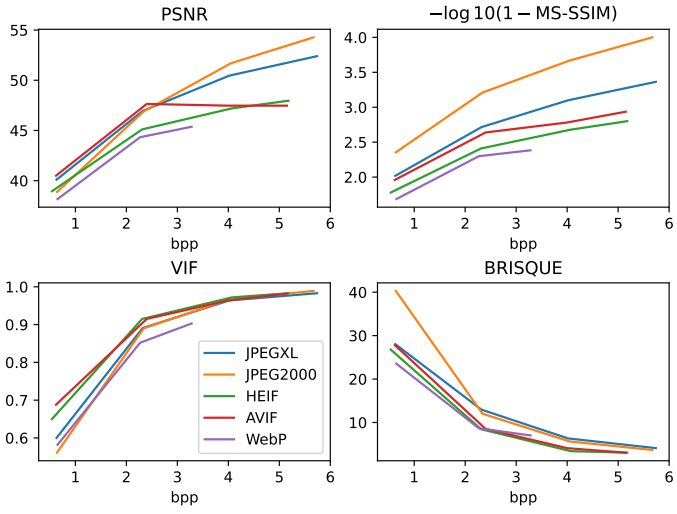
00009_2048x1536.png

Size: 2048x1536 Dataset: JPEG AIC-3 Dataset



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00010_2592x1946.png

Size: 2592x1946 Dataset: JPEG AIC-3 Dataset

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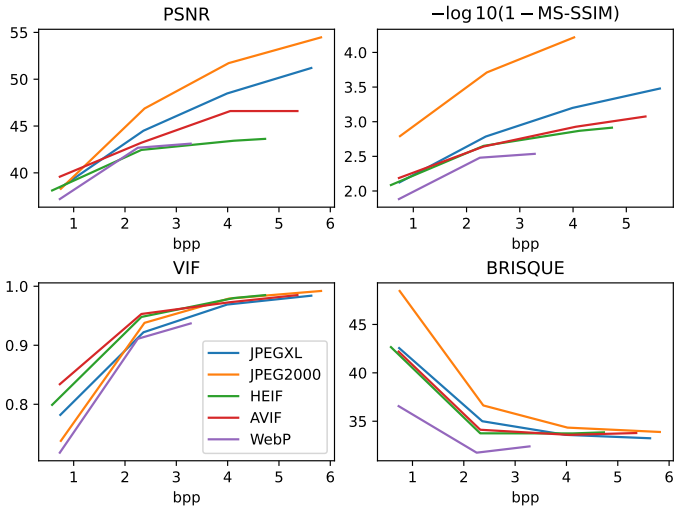
00010_2592x1946.png

Size: 2592x1946 Dataset: JPEG AIC-3 Dataset



bridge_1848_1224.png

Size: 1848x1224 Dataset: CLIC 2020

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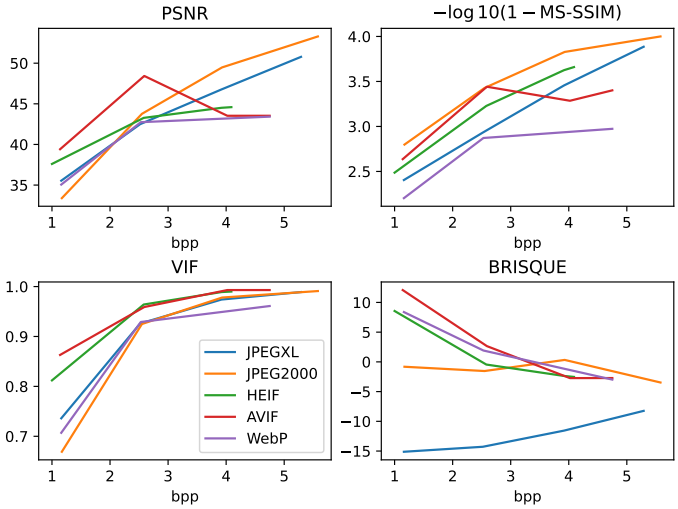
bridge_1848_1224.png

Size: 1848x1224 Dataset: CLIC 2020



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Summary

- Depending on how we trust the brisque results, JPEG XL has images that are perceived as higher quality
- It holds up in VIF an MS-SSIM but is not the best with the standard parameters.
- Other advantages: Standard, JPEG reencoding, Consistent metrics with higher file sizes
- Disadvantages: Not the best in all metrics (as of today), currently bad native browser support

Credits

Other codec analysis: Alain Girard, Frédéric Sébastien Piguet, Katherine Qin, Pierre Dupuy

Original Beamer Template: Mahmoud S. Shaqfa (GPL 3)

JPEG logos: Mr. Masahito TAKIZAWA