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Title Improved IV-PSNR software
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Abstract

The document presents improved version of IVPSNR software. The output of new version is exactly the same, as for IVPSNR v3.0, so they can be used interchangeably. Recommendations: * create IVPSNR 4.0 based on this proposal, * issue an output document for the IV-PSNR 4.0 manual, * cite [1] when using IV-PSNR.

1 IV-PSNR v4.0 software changes

The goal of the work was to improve flexibility and allow for easier modification of IV-PSNR related parameters. In addition, the experimental masked was implemented. Moreover, further decrease computational time (when compared to IVPSNR v3.0) without **any** change of the results. Source code is available on MPEG Git repository (dev tag).

1.1 IV-PSNR specific parameters available at runtime

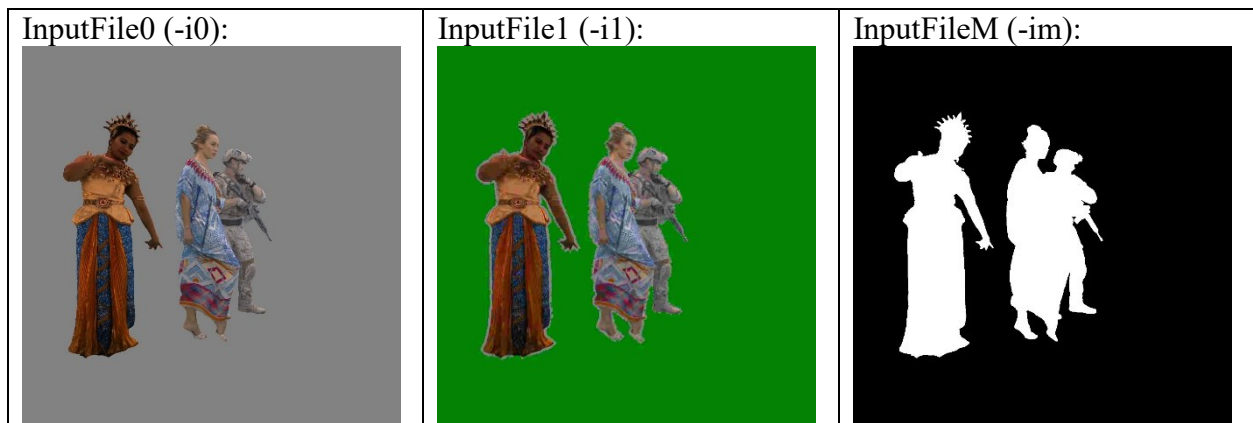
- **SearchRange** = IV-PSNR search range around center point (optional, default 2=5×5)
- **ComponentWeights** = IV-PSNR component weights ("Lm:Cb:Cr:0" - per component integer weight, default "4:1:1:0", quotes are required, requires USE_RUNTIME_CMPWEIGHTS=1)
- **UnnoticeableCoef** = IV-PSNR unnoticeable color difference threshold coeff ("Lm:Cb:Cr:0" - per component coeff, default "0.01:0.01:0.01:0", quotes are required)
- **InterleavedPic** = Use additional image buffer with interleaved layout for IVPSNR, (improves performance at a cost of increased memory usage, optional, default=1)

1.2 WS-PSNR specific parameters available at runtime

- **Legacy8bitWSPSNR** = Use 1020 as peak value for 10-bps videos in WSPSNR metric (provides compatibility with original WSPSNR implementation, optional, default=1)

1.3 Masked mode (experimental)

The masked operation mode allows for selection of image areas excluded from calculation of IV-PSNR metric (applies also for PSNR and WS-PSNR). To avoid confusion, the “masked” metrics are marked as IV-PSNR-M in log and output file.



In an example above, the IV-PSNR value is calculated only for occupied pixels (as indicated by mask), so different color of the unoccupied background does not impact outputted quality.

1.3.1 Masked mode parameters available at runtime

- **InputFileM** = File path - mask (optional, same resolution as InputFile0 and InputFile1)
- **BitDepthM** = Bit depth for mask (optional, default=BitDepth, up to 16)
- **ChromaFormatM** = Chroma format for mask (optional, default=ChromaFormat) [400, 420, 444]

1.3.2 Masked mode requirements and notes

- Resolution of mask file has to be identical as input file.
- Allowed mask values are 0 (interpreted as inactive pixel) and $(1 \ll \text{BitDepthM}) - 1$ (interpreted as active pixel). Behavior for other values is undefined at this moment.
- The data processing functions for masked mode are not implemented with the use of SIMD instructions.

1.4 Metrics calculation optimizations

- SIMD (SSE 4.1) implementation of IV-PSNR metric calculation (for interleaved picture buffers)
- wider SIMD (AVX2) implementation for most data processing functions

1.5 Other changes

- reading parameters from config file
- protection against `StartFrame >= DetectedFrames`
- writing error messages to `stdout` and `stderr`

2 Compilation requirements

The IVPSNR v4.0 software uses following external components:

- “Formatting library for C++“ (libfmt) – distributed under BSD licence and included in IVPSNR source package.

In order to build the software, the ISO C++17 conformant compiler is required.

3 Application parameters

3.1 Commandline parameters

Commandline parameters are not changed when compared to v3.0 except new parameters described in section 1.

3.2 Compile-time parameters

The IVPSNR v4.0 introduces new compile-time parameter. This parameter are defined in `xCommonDefIVPSNR.h` file:

- **USE_RUNTIME_CMPWEIGHTS** – Enables the usage of use component weights provided at runtime. (default = enabled),

The IVPSNR v4.0 removes some compile-time parameter since most non-performance critical parameters were moved from compile-time to run-time selection.

4 Results

4.1 Outputted quality

4.2 *The results obtained by proposed version are exactly the same as for IVPSNR v3.0.Performance*

The IVPSNR 4.0 is slightly faster than IVPSNR v3.0 but changes are not significant.

5 Other issues

A paper regarding IV-PSNR metric is now published in the [IEEE Transactions on Circuits and Systems for Video Technology](#):

[1] A. Dziembowski, D. Mieloch, J. Stankowski and A. Grzelka, "IV-PSNR – the objective quality metric for immersive video applications," in *IEEE Transactions on Circuits and Systems for Video Technology*, 2022, doi: 10.1109/TCSVT.2022.3179575.

6 Recommendations

We recommend to:

- create IVPSNR 4.0 based on this proposal,
- issue an output document for the IVPSNR v4.0 manual,
- cite [1] when using IV-PSNR.

7 Acknowledgement

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