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MPEG VIDEO CODING

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Title: [INVR] Faster SSIM and IV-SSIM calculation in INVR
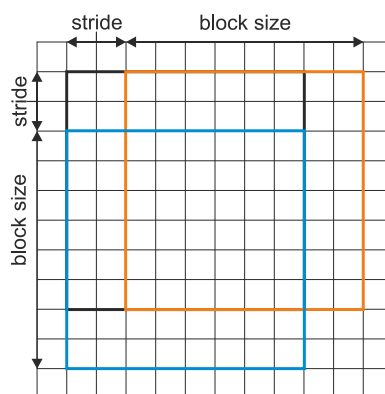Source: Adrian Dziembowski, Jakub Stankowski (PUT), Bart Kroon (Philips)

1 Abstract

The document presents QMIV 2.0 [m70071], already accepted by the MIV group to be included in the new MIV CTC. QMIV 2.0 is significantly (ten times) faster than the first version of the software in terms of SSIM and IV-SSIM calculation. The recommendation is to update the INVR CTC and to use v2.0 in INVR activities.

2 Software changes

- Configurable SSIM-based calculation method:
    - Block size,
    - Stride size,
    - Weighting method (Gaussian, average),
    - Gaussian weighting implementation (floats, quantized integers),
- Added MSSSIM (multiscale SSIM), IV-MSSSIM,
- Extended list of input file extensions (added .bmp),
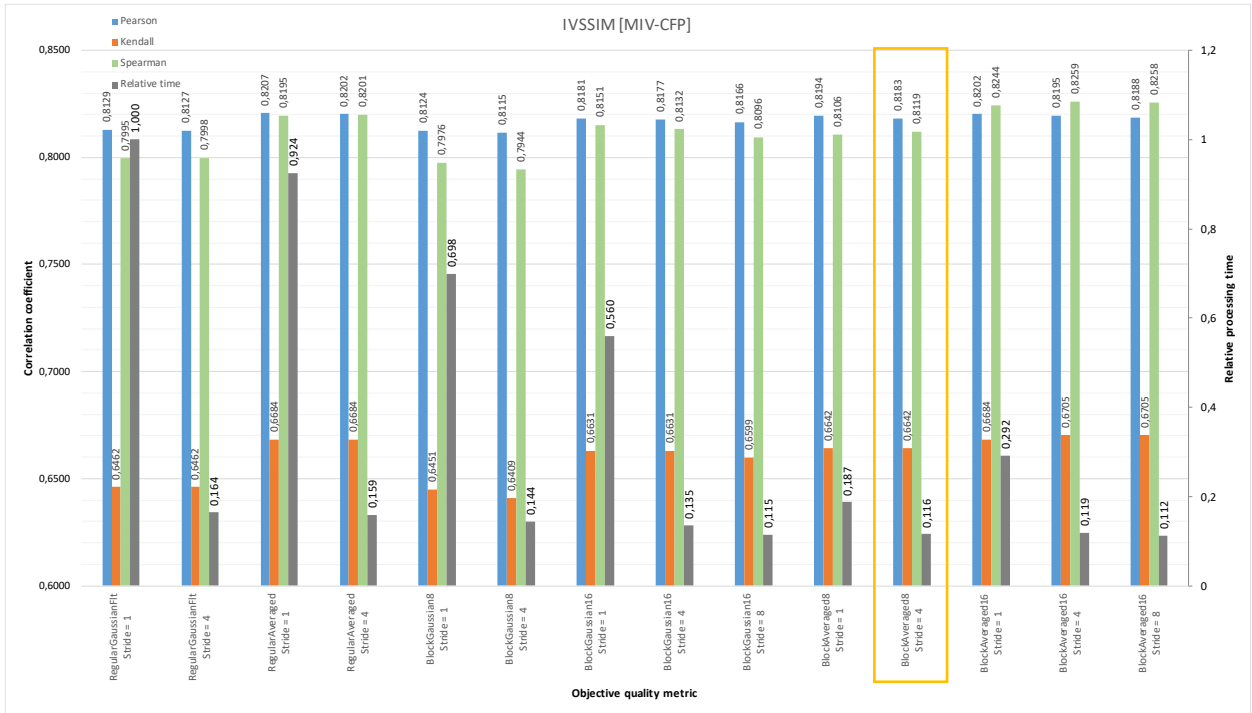- Minor changes.
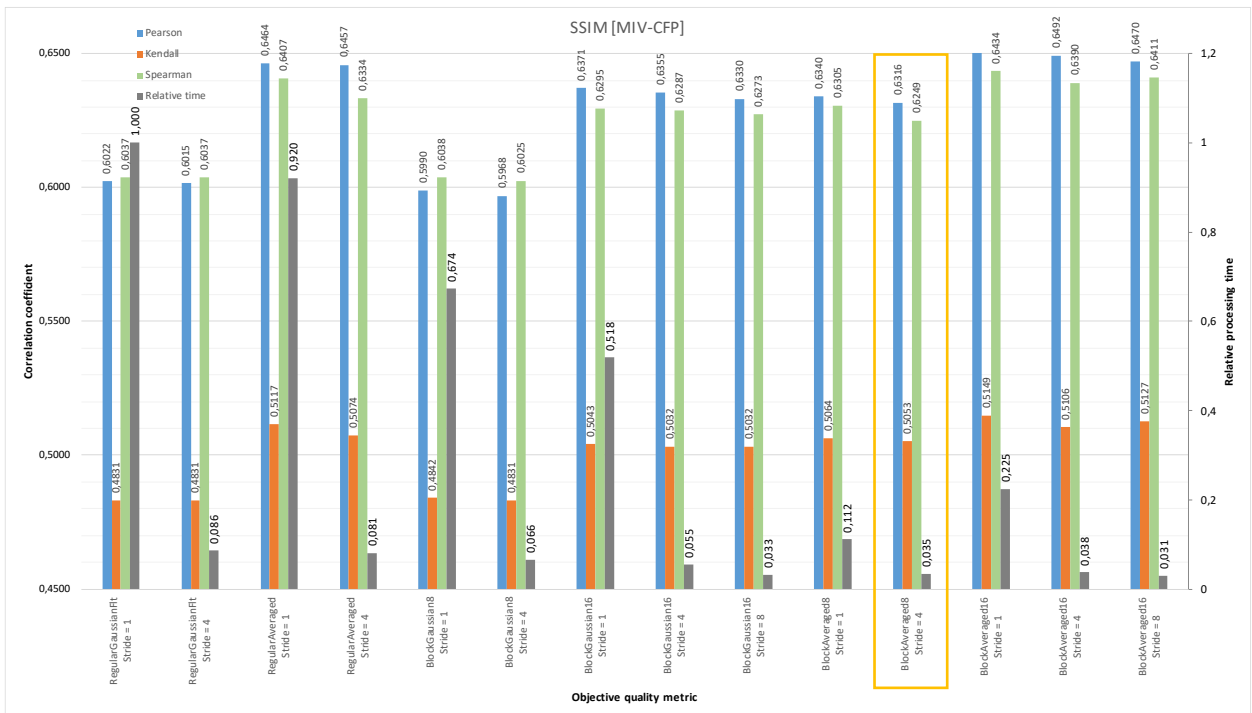
3 SSIM-based metric calculation

4 Experimental results

4.1 MIV-CFP database

4.1.1 IV-SSIM metric

4.1.2 SSIM metric

4.2 Summary

- Using stride>1 (e.g. stride=4) does not influence metric efficiency (correlation with MOS), however significantly reduces computational and memory complexity.
- The usage of Gaussian weighting sometimes leads to degradation of metric efficiency (MIV-CFP). In terms of metric efficiency, it is not conclusive if Gaussian weighting is beneficial over simple averaging. Gaussian weighting introduces significant computational complexity when compared to simple averaging.
- Calculation in power-of-two size blocks (instead of using 11x11) window allows for straightforward vectorization using common vector extensions (SSE, AVX, NEON).
- The calculation of SSIM with simple averaging and 8x8 block approach is used in some of libraries and tools, e.g. ffmpeg uses averaging approach with 8x8 blocks and stride=4.
- The calculation of IV-SSIM (and SSIM) using 8x8 averaging window with stride=4 seems to be a reasonable trade-off between metric efficiency and computational complexity:
  - slight improvement in IV-SSIM metric efficiency,
  - significant reduction of processing time (89% reduction, 8.9x speedup).

5 Recommendation

The authors recommend to update the version of QMIV used in INVR activities to v2.0.

6 Acknowledgement