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ISO/IEC JTC 1/SC 29/WG 4
MPEG VIDEO CODING**

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Title: [MIV] Faster SSIM-derived metrics calculation in QMIV
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1 Abstract

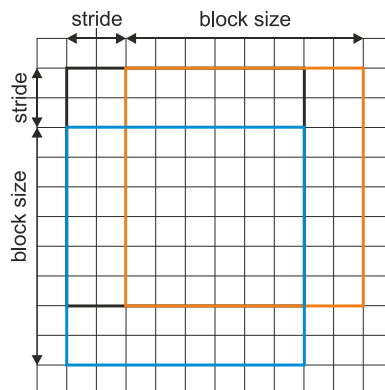
The document presents an analysis of using different block and stride sizes in calculation of SSIM and IV-SSIM. The results were compared to MOS for the dataset from MIV CfP and commonly used TID2013 VQA database.

The recommendations are: (1) to substitute 11x11 Gaussian window and calculation on floats by integer implementation of 8x8 rectangular window with stride equal to 4, as it is faster and provides the same or higher correlation between the metrics and MOS, (2) to create QMIV 2.0 based on this proposal, (3) to issue an output document for QMIV2 software manual.

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.

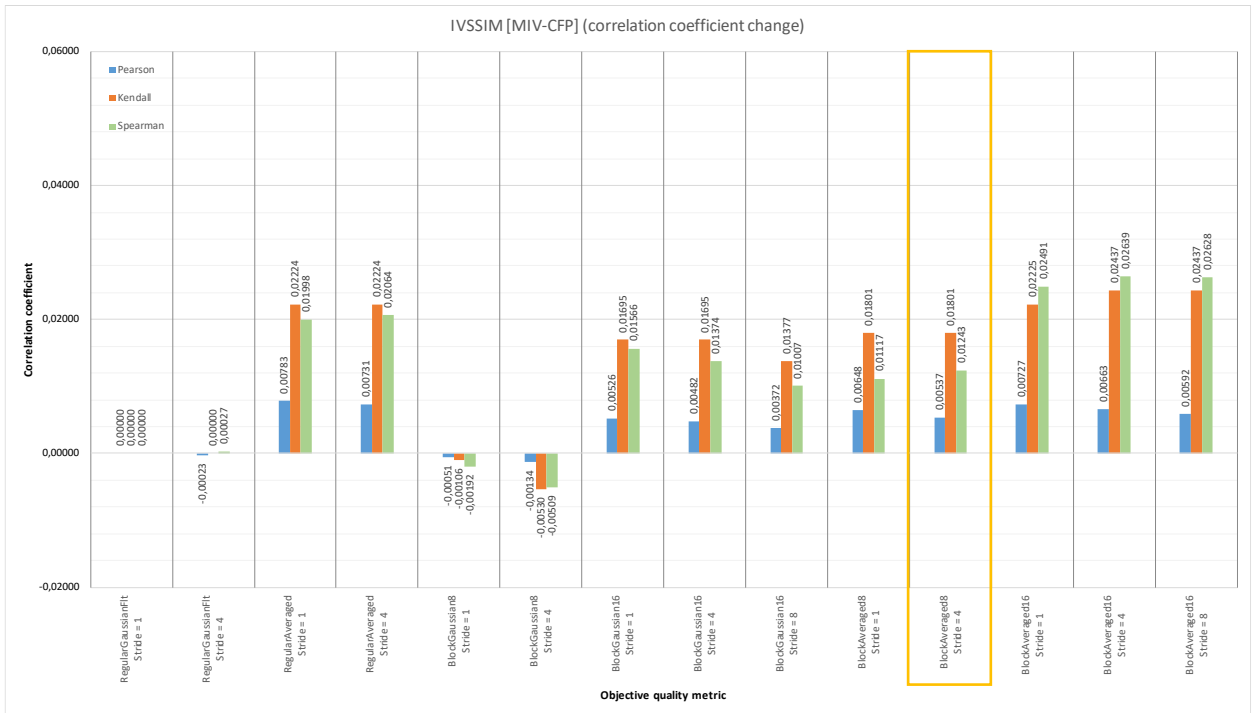
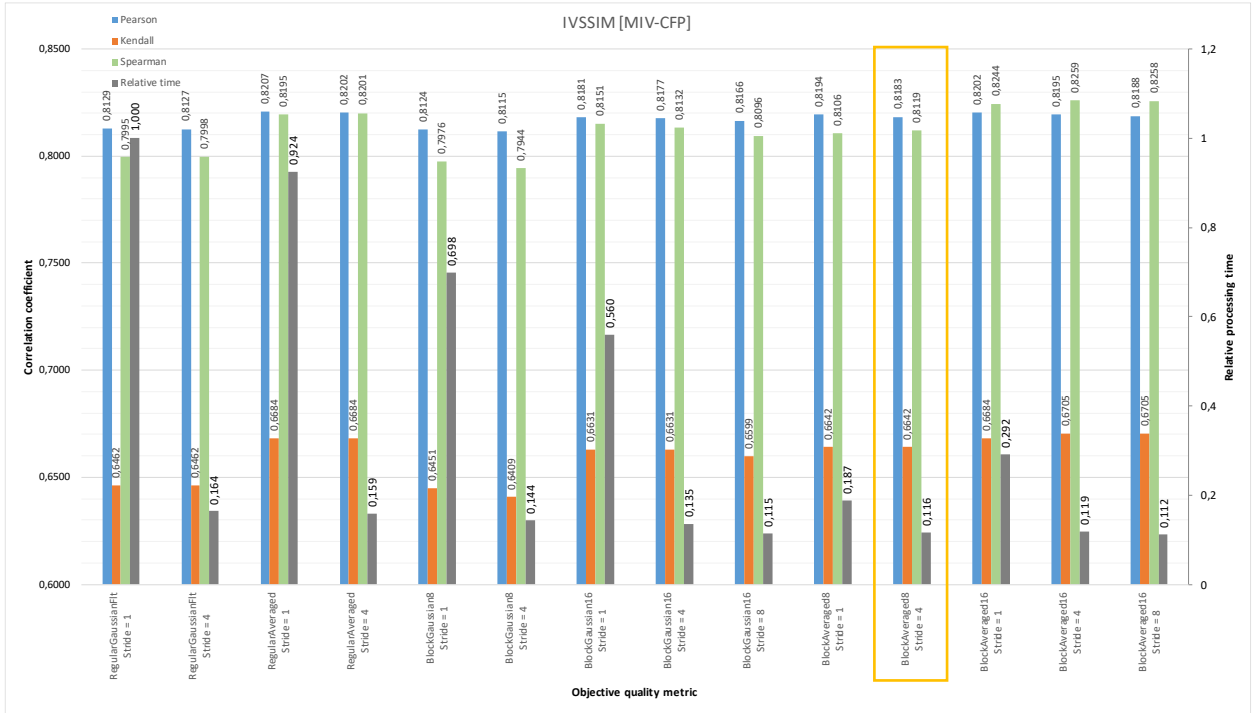
3 SSIM-based metric calculation



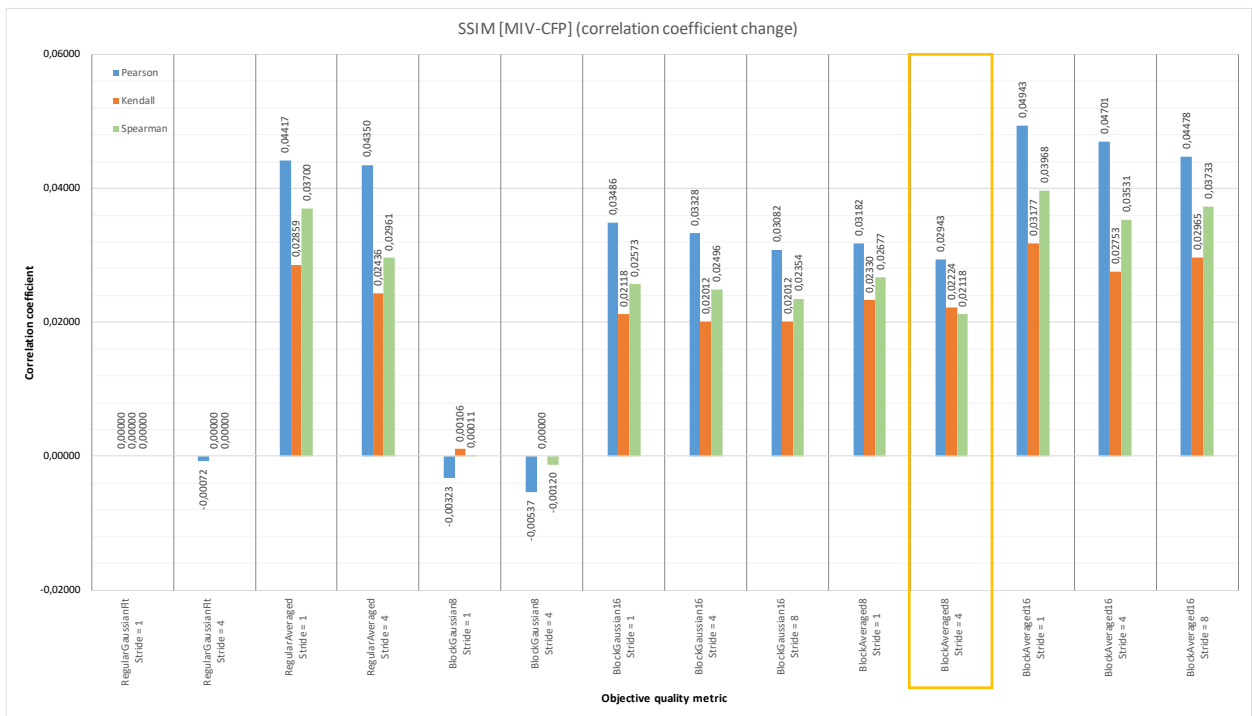
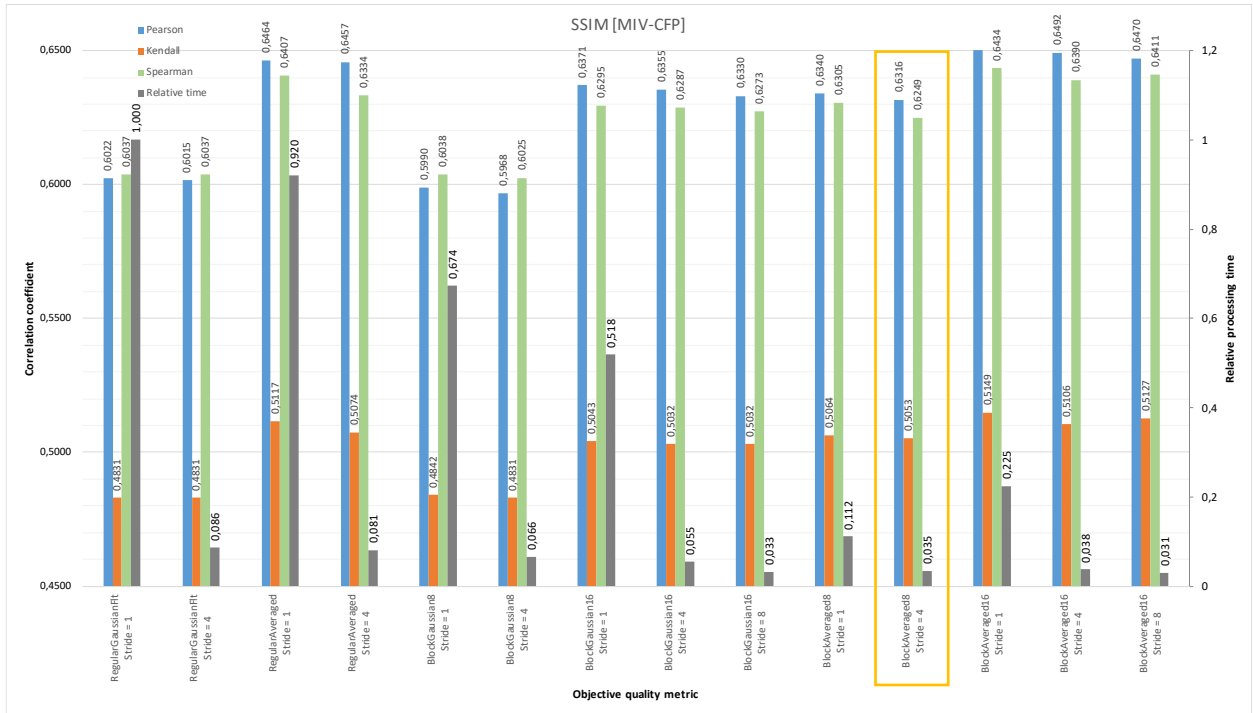
4 Experimental results

4.1 MIV-CFP database

4.1.1 IV-SSIM metric

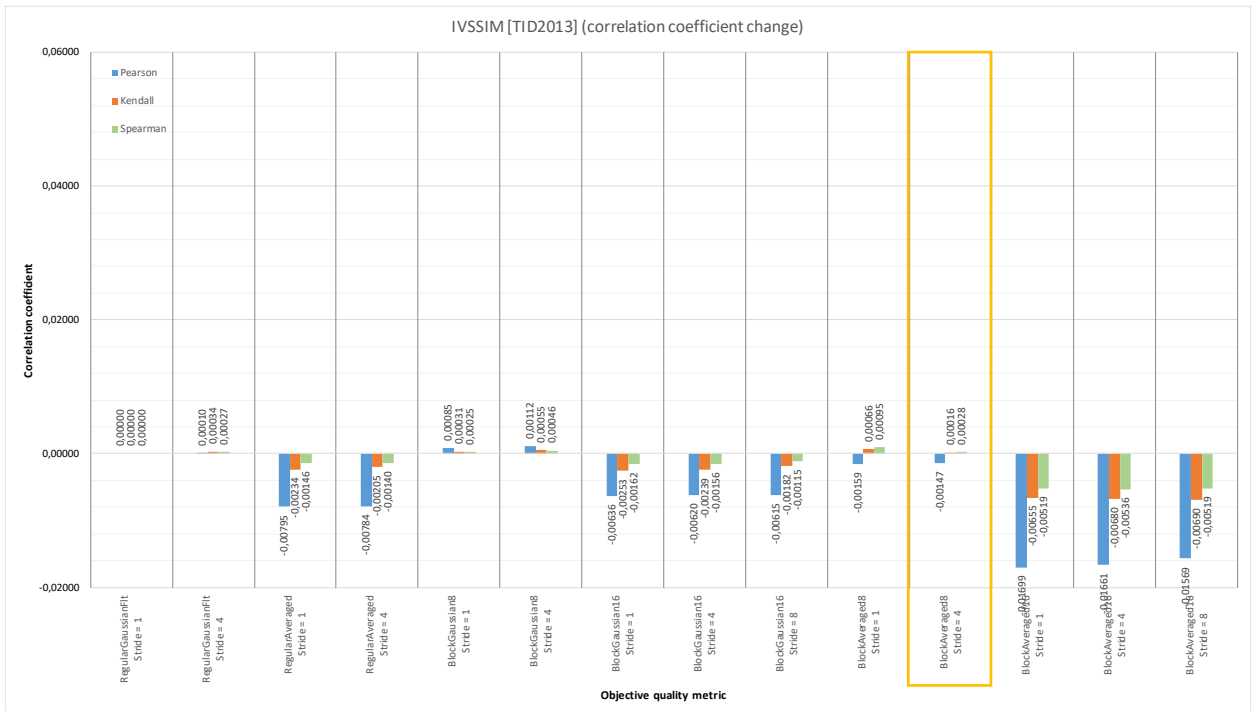
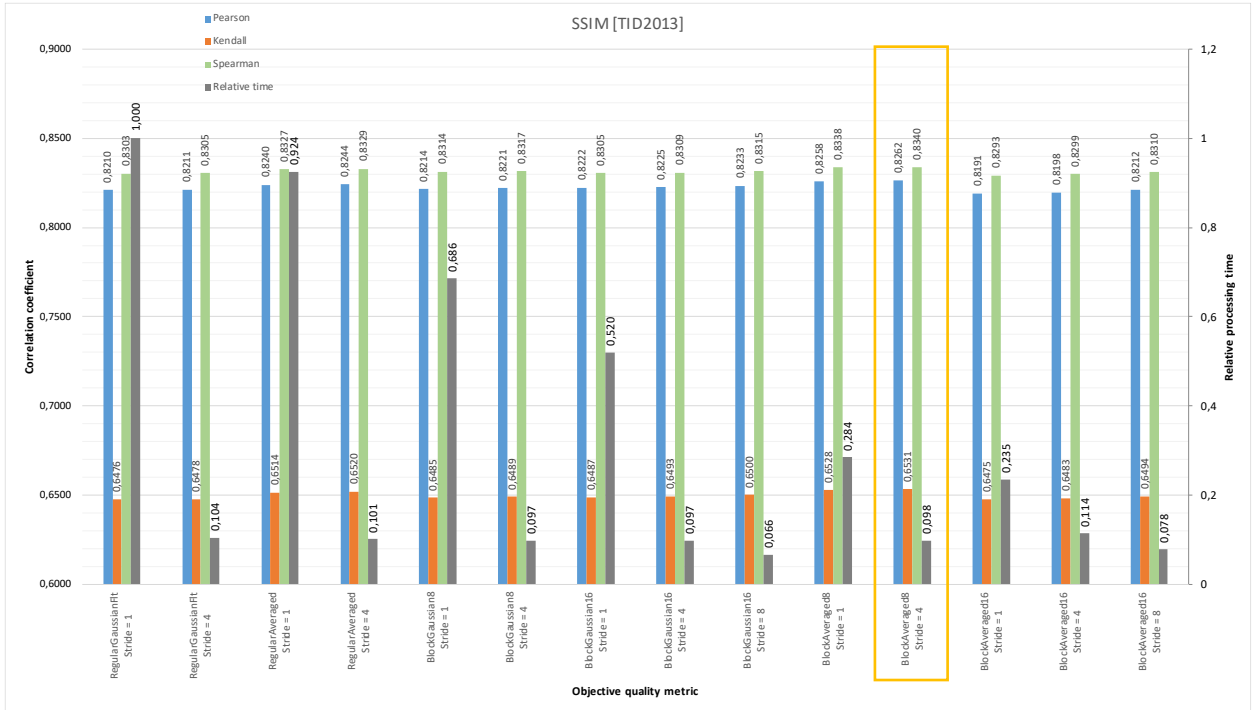


4.1.2 SSIM metric

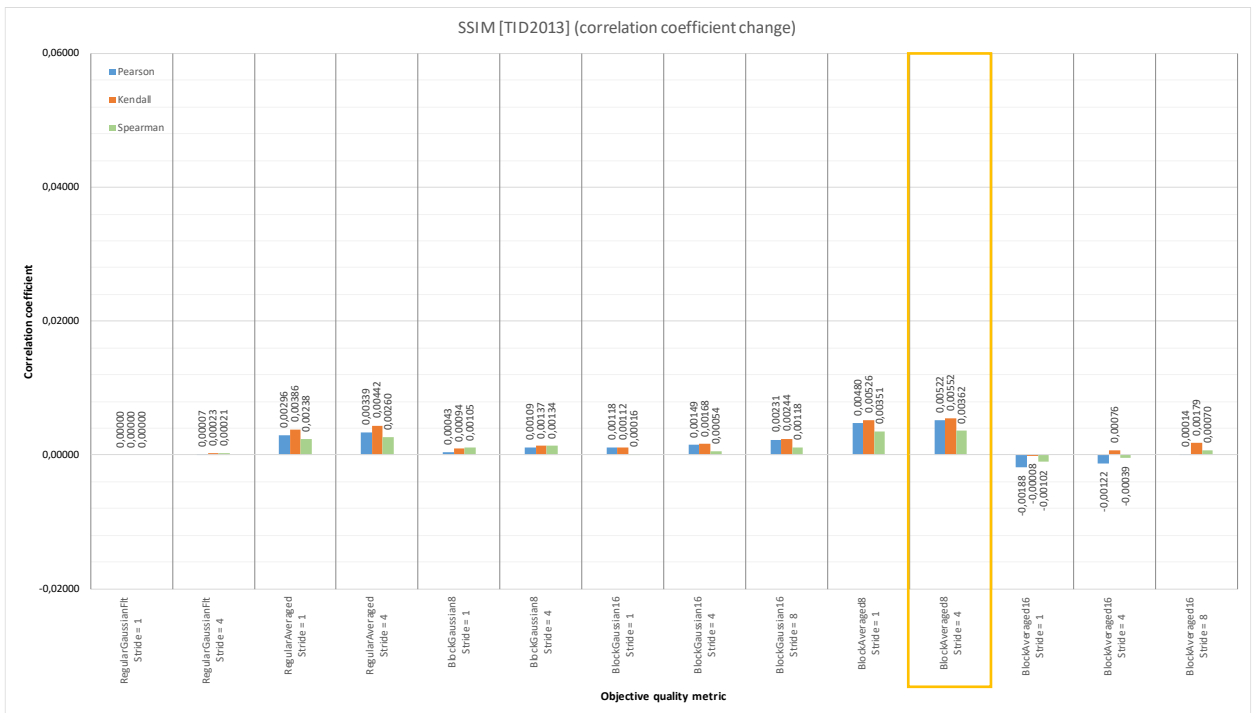
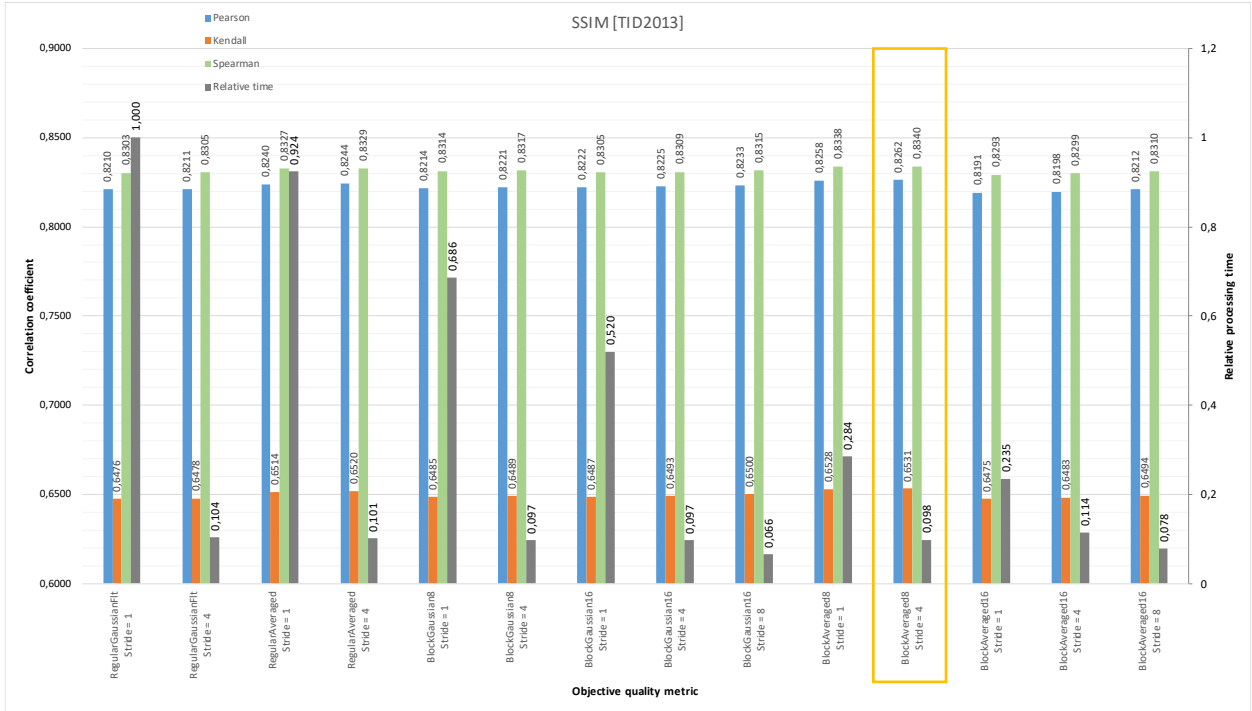


4.2 TID2013 database

4.2.1 IV-SSIM metric



4.2 SSIM metric



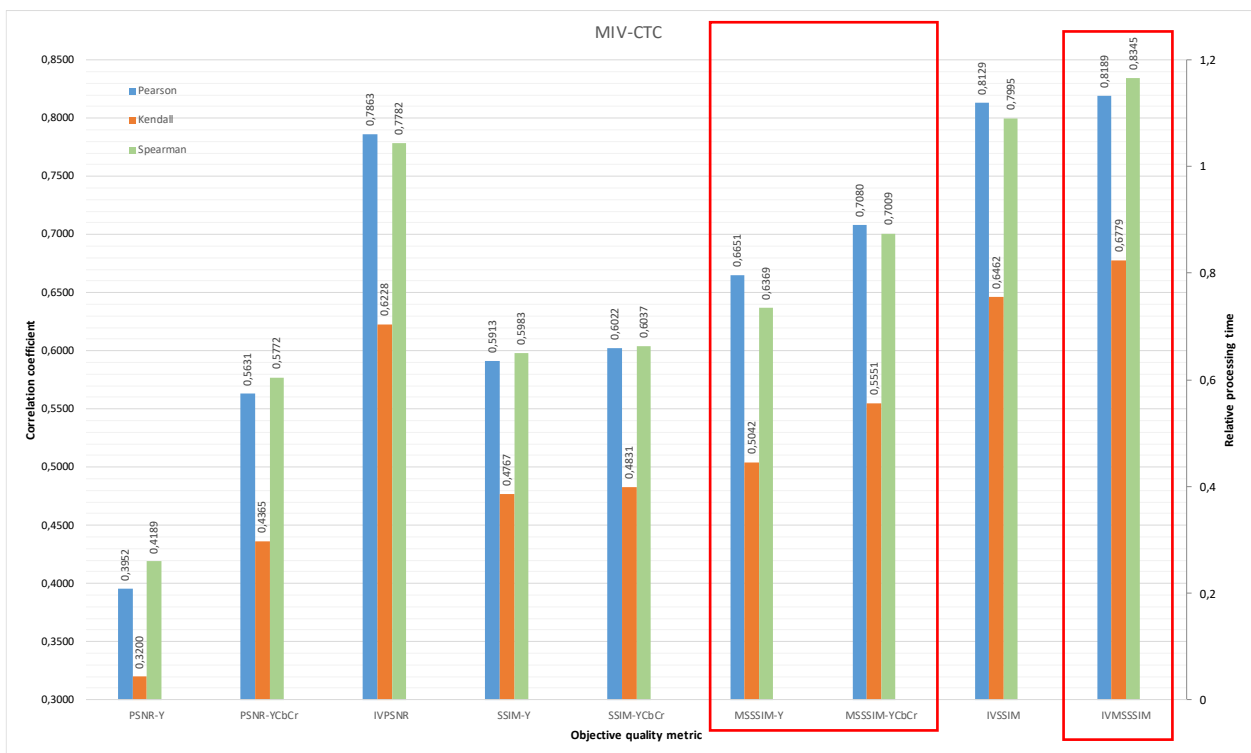
4.3 Summary

- 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).

4.4 Additional metrics implemented in QMIV



5 Recommendation

The authors recommend:

- Using the integer implementation of 8x8 rectangular window with stride equal to 4 in calculation of SSIM and IV-SSIM in QMIV,
- Creating QMIV2 based on this proposal,
- Issue an output document for QMIV2 software manual.

6 Acknowledgement

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