Data compression analysis

Forschungszentrum Karlsruhe
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Research University · founded 1825

U. Stevanovic

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Data compression analysis - Overview

Reasons for data compression:

- Los-less data compression
- Increase the data information (number of pixels) sent using same bandwidth
- Keep same data format → easy recovering mechanism in case of occurrence of data errors during transfer
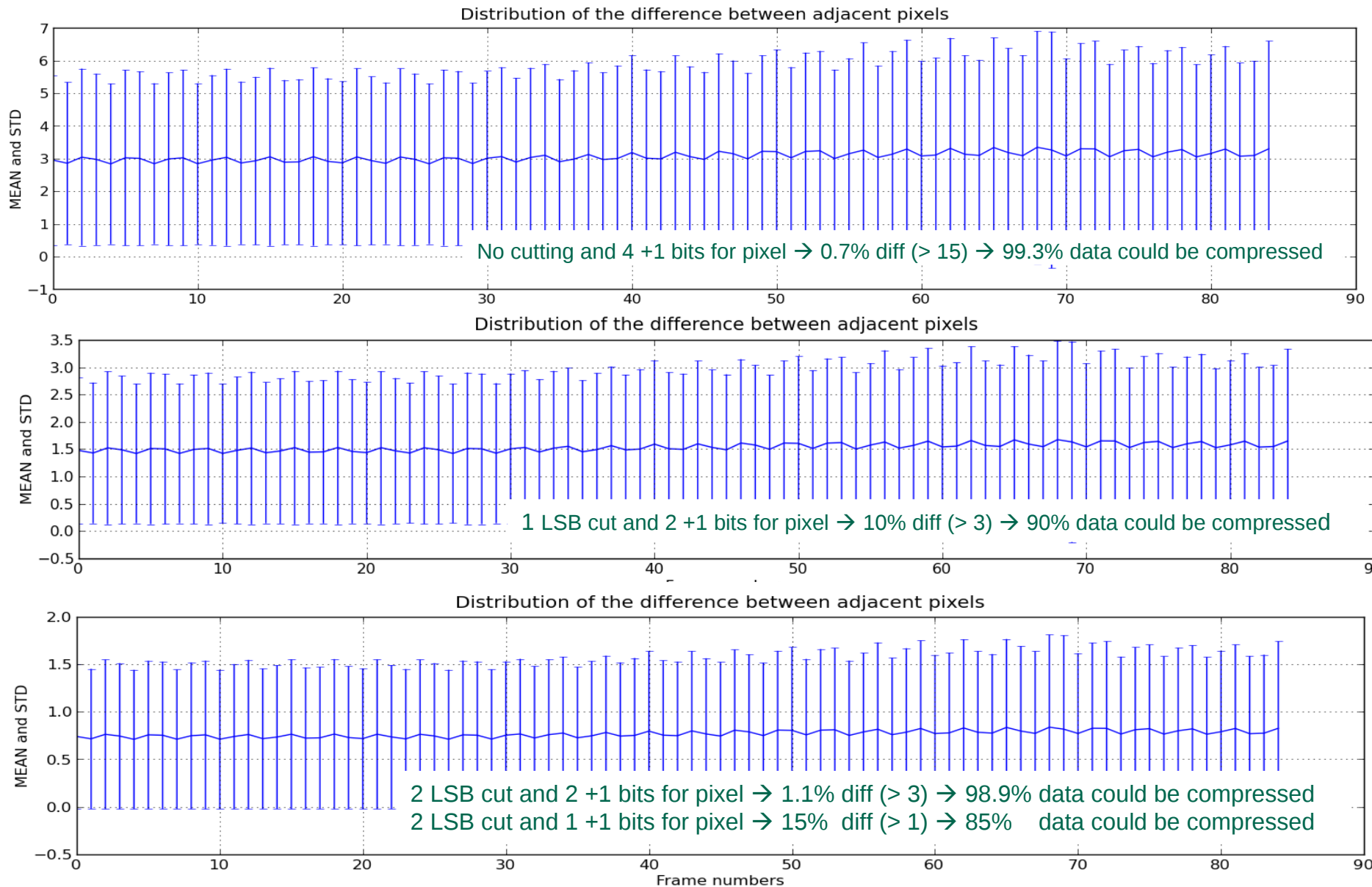
Algorithm strategy for image data compression:

- We want remove the redundancy information between pixels → Subtracting adjacent pixels, sending 2, 3, 4 bits as value with additional 1 bit as sign per pixel
- Improvements of data compression by initial noise reduction → Removal of 1 or 2 LSB bits (by cutting) without loosing pixel data information *(see the analysis method in the next point)*

Mathematical approach and estimation/performance of the data compression:

- Estimation of the "lost data per pixel" by cutting → Using Pearson linear correlation coefficient between frames without and with bit cutting
- Estimated gain of the speed by factor (2 x 1.25)X (for 4 bits) and by factor (3 x 1.25)X (for 3 bits)

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Estimation of the pixel redundancy information compressed

Distribution of the difference between adjacent pixels

No cutting and 4 +1 bits for pixel → 0.7% diff (> 15) → 99.3% data could be compressed

Distribution of the difference between adjacent pixels

1 LSB cut and 2 +1 bits for pixel → 10% diff (> 3) → 90% data could be compressed

Distribution of the difference between adjacent pixels

2 LSB cut and 2 +1 bits for pixel → 1.1% diff (> 3) → 98.9% data could be compressed
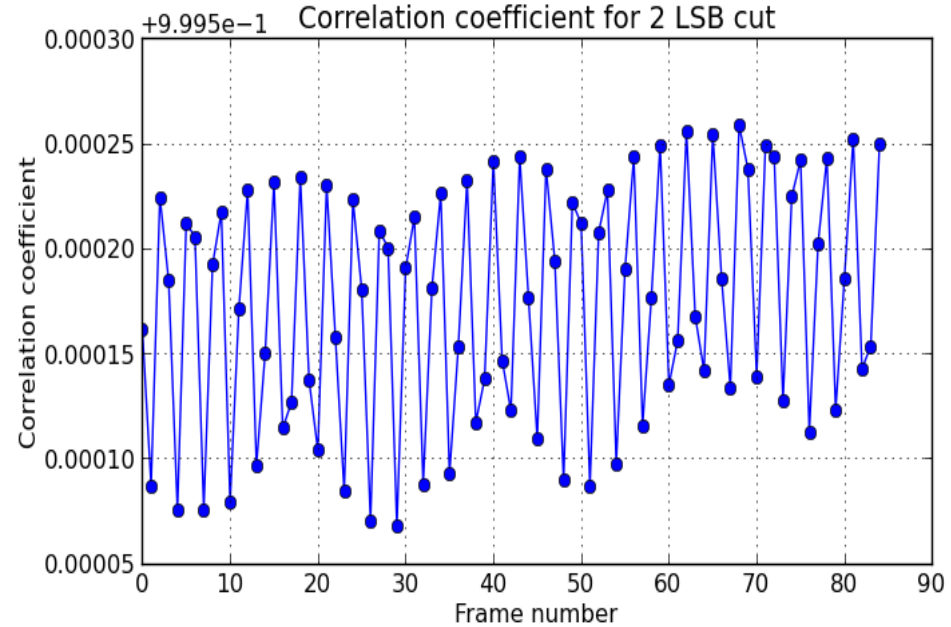2 LSB cut and 1 +1 bits for pixel → 15% diff (> 1) → 85% data could be compressed
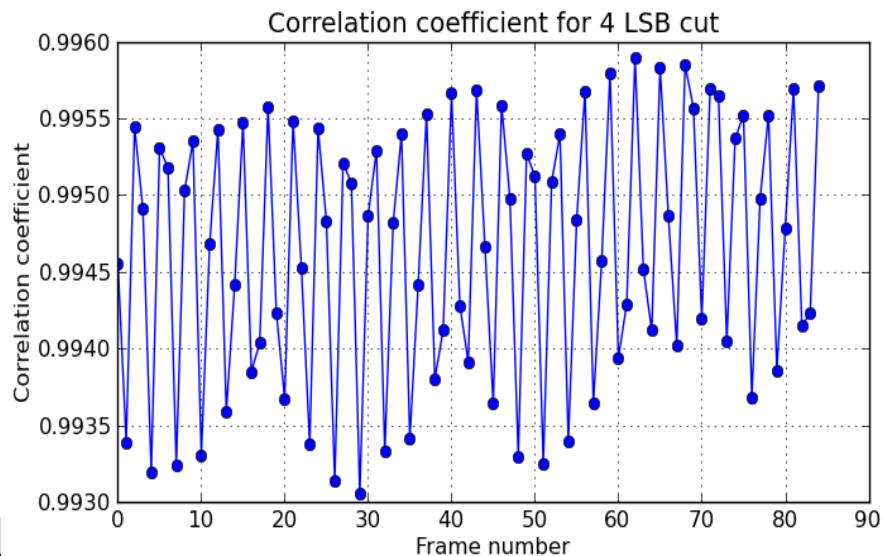
Estimation of the lost information by LSBs cut

Pearson linear correlation coefficient between frames
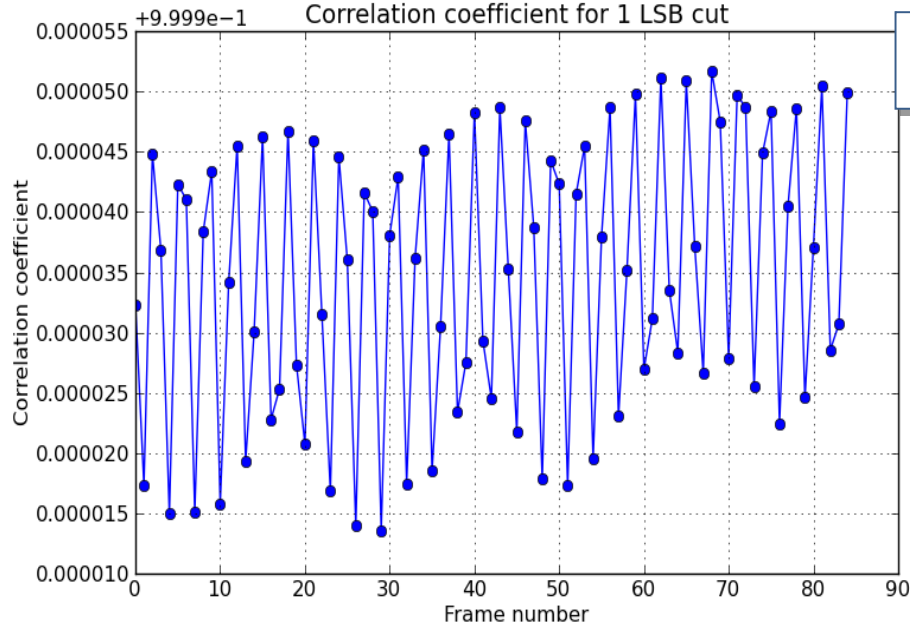
r = (0.999913 – 0.999952)
Error ~ 0.01%

r = (0.999507 – 0.999526)
Error ~ 0.1%

r = (0.9930 – 0.9958)
Error ~ 1%

Comparison of two frames, 10b pixels with 9b pixels

water-three-screws-1088.raw.bit_remove (1200%)
1/85; 2048x1088 pixels; 16-bit; 361MB

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