GPU-FRIENDLY VARIANT OF JPEG 2000's ENTROPY CODER

Volker Bruns, Miguel Á. Martínez-del-Amor, Heiko Sparenberg
Fraunhofer Institute for Integrated Circuits IIS
{volker.bruns, miguel.martinez, heiko.sparenberg} @iis.fraunhofer.de

PROBLEM

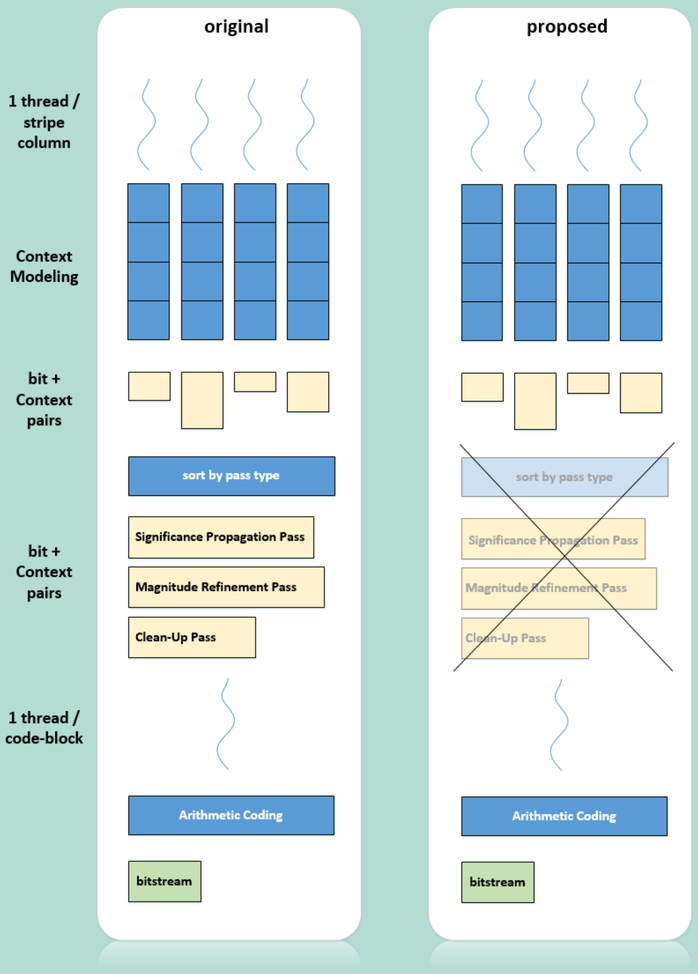
JPEG 2000 on a GPU: entropy coder limits the max. throughput.

When **medium to high bit-rates** are used, such as in **Digital Cinema Packages** (DCP) or the **Interoperable Master Format** (IMF), what could be done differently to increase the throughput?

GOAL

Compression Efficiency → Throughput with GPU

NEW1 – No intra-bitplane Truncation Points

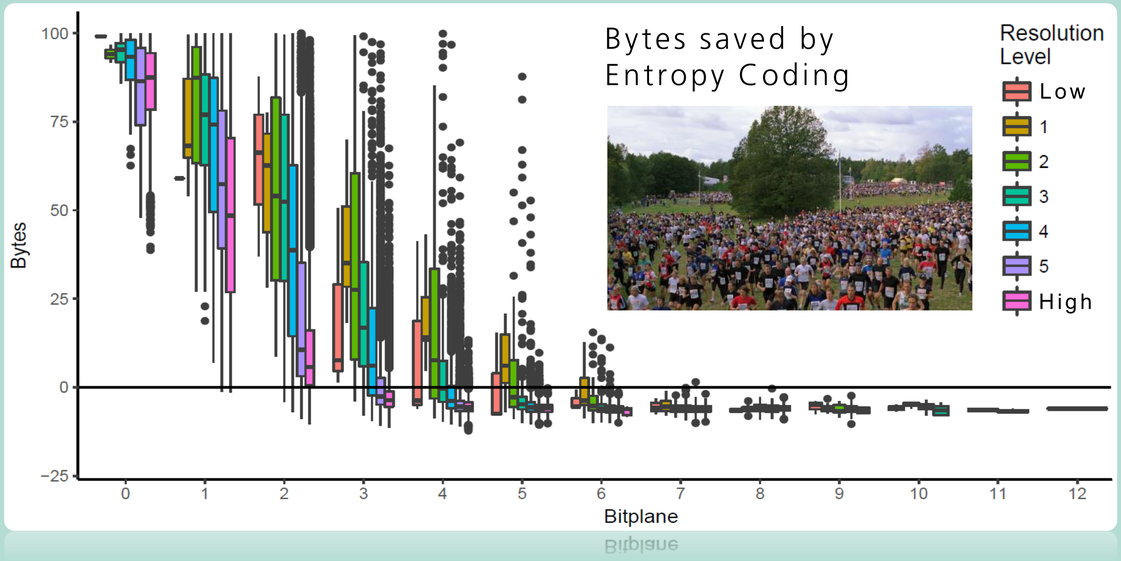


Intra-bitplane truncation points are most beneficial at low bit-rates. For medium- and high bit rates, they yield little benefit.

Therefore, we propose to maintain all 19 pass-specific contexts and 4 coding operations, but emit bits in a single-pass scan order without sorting them first by pass-type.

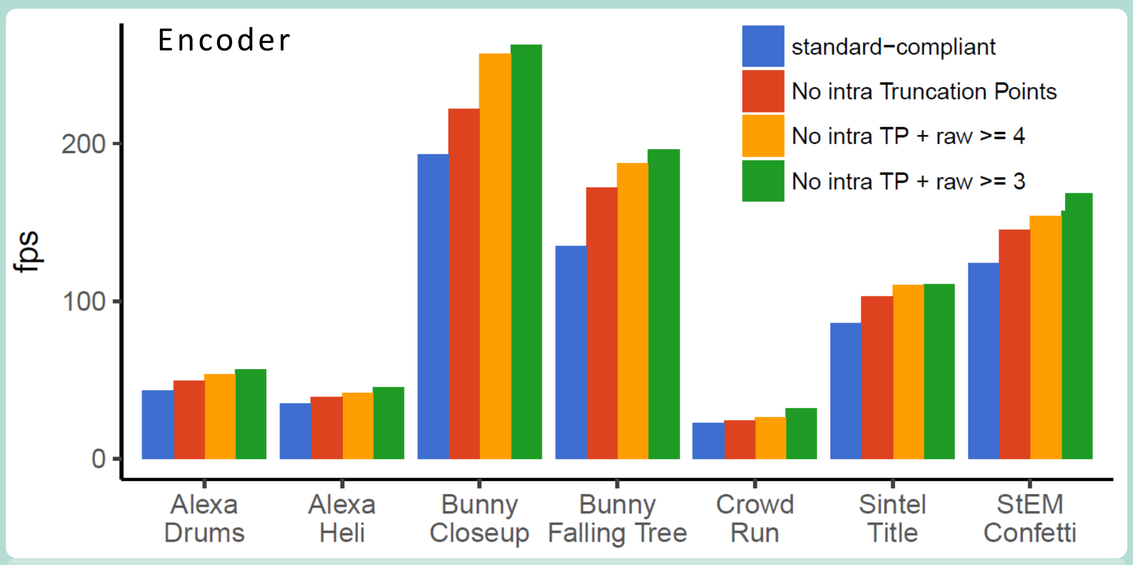
NEW2 – Raw-Coding mode

The arithmetic coder's compression efficiency is high in the significant bit planes, but decreases steadily in the less significant bit planes.



The standard offers the **Fast Mode** (aka **Selective Arithmetic Bypassing**), but that only bypasses symbols from two of the three passes and it still requires context-modeling. Instead we propose to raw-code all magnitude and remaining sign-bits starting after 3 or 4 significant bit planes.

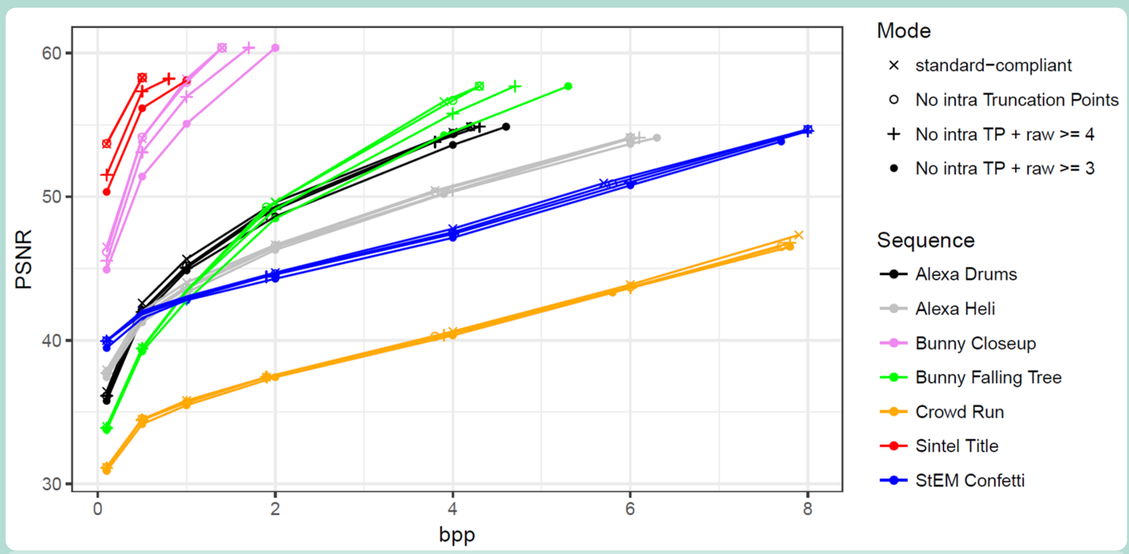
RESULTS



Encoder throughput on GeForce GTX 1080 with 6 bpp 4:4:4 36 bit

Speed-up with proposed modes on a GeForce GTX 1080 with 6 bpp 4:4:4 36 bit

	No intra-bitplane Truncation Points	No intra TP raw-coding ≥ 4	No intra TP raw-coding ≥ 3
Encoder	up to 1.3x	up to 1.4x	up to 1.5x
Decoder	up to 1.15x	up to 1.4x	up to 1.6x



The Rate-Distorion Plot shows that the quality loss is mostly within 1 dB.

SUMMARY

With the proposed modes, the throughput of both encoder and decoder can be increased. The quality loss in terms of PSNR caused by giving up intra-bitplane truncation points is within 0.5 dB. Raw-coding decreases the PSNR most for sequences with few details.

Fraunhofer IIS