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Image and Video Compression

CSLP

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</Our Solution

{VideoReader}

Reads a YUV 4:4:4 video file sequentially frame-by-frame

{HybridCodec}

Encodes and decodes frames using inter-frame algorithms

{FramePredictor}

Encodes and decodes frames using predictive intra-frame algorithms

{Golomb}

Transforms the given integer values into an array of bits using Golomb algorithm

{BitStream}

Performs sequential bit read/write operations on the given files

</Features and Modes

- {01} Intra-frame (Lossless) — Encode/Decode all the frames based only on the current frame
- {02} Lossless Hybrid — Encode/Decode all the frames based on the current and previous frame
- {03} Lossy Hybrid — Quantize the encoded values allowing information to be lost to achieve better compression rates

</Tests and Best Parameters

Test 1

Selecting the best performing algorithm and lossy parameters

Test 2

Selecting the best Golomb M parameter for each algorithm

Test 3

Select the best block size

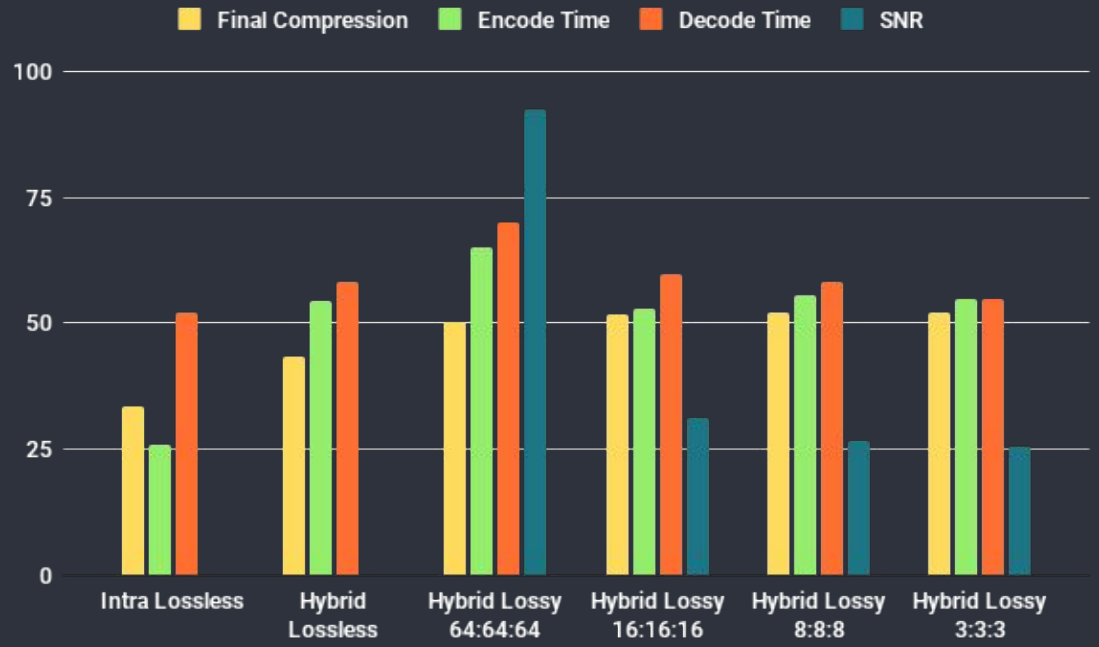
Test 4

Selecting the Best Block search area and Search block step length

Test 5

Selecting the most effective intra-frame frequency

</Test 1: Algorithms and Lossy parameters



Notes

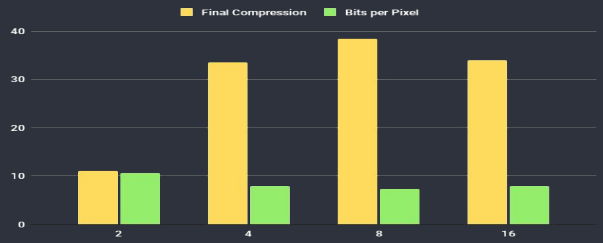
- The encode and decode time for all the hybrid solutions is similar, being affected mostly by other factors (like CPU temperature);
- For the Intra solution, the encode and decode time is considerably smaller;
- Lower values for the Lossy quantization parameters cause better compression at the expense of more loss of information (related to SNR).

Conclusions

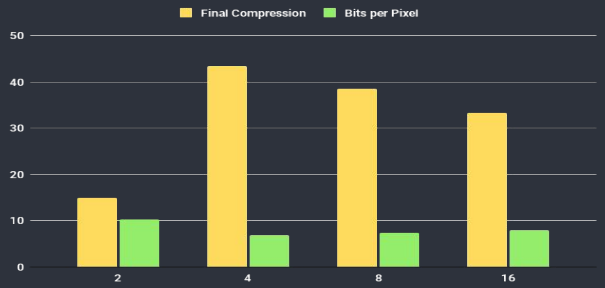
- The final lossy quantization parameters chosen were 16:16:16;
- For lossless encoding, the Hybrid option provides better compression rates at the expense of higher encode time.

</Test 2: Golomb M parameter

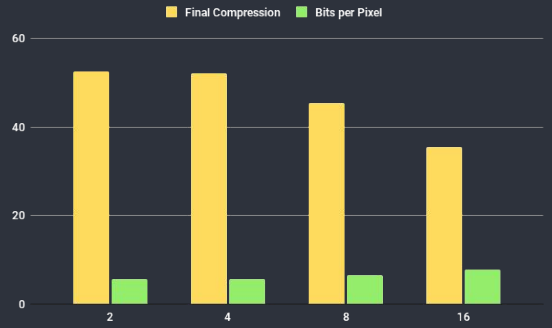
{Intra-Frame}



{Lossless Hybrid}



{Lossy Hybrid 16}



Notes

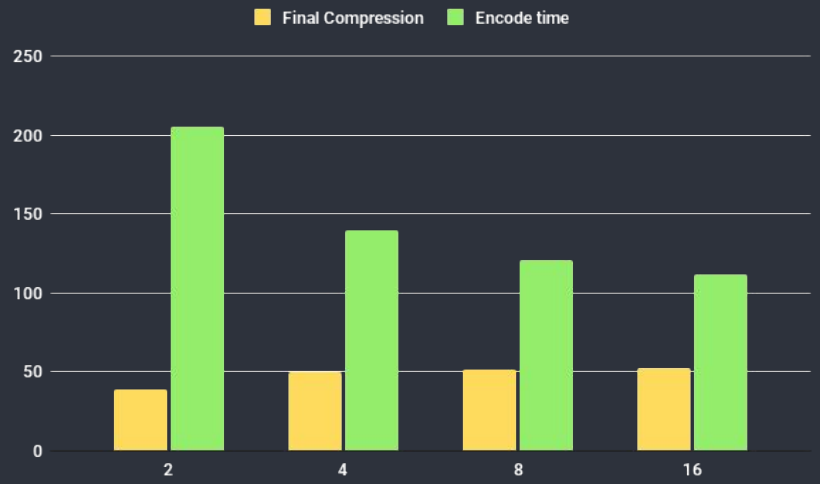
- The encode and decode times for each value of the M parameter are similar;
- The biggest difference is the average number of bits per pixel encoded.
- Other videos were used to test if these values would change and the results were similar;

Conclusions

- For intra-frame, the chosen value for the M is 8, since more higher values are encoded;
- For the hybrid algorithms, the chosen value for the M is 4;

</Test 3: Block Size

{Lossy Hybrid 16}



Conclusions

- A block size of 8 was chosen since the effects on compression are small compared to the effects on encoding time

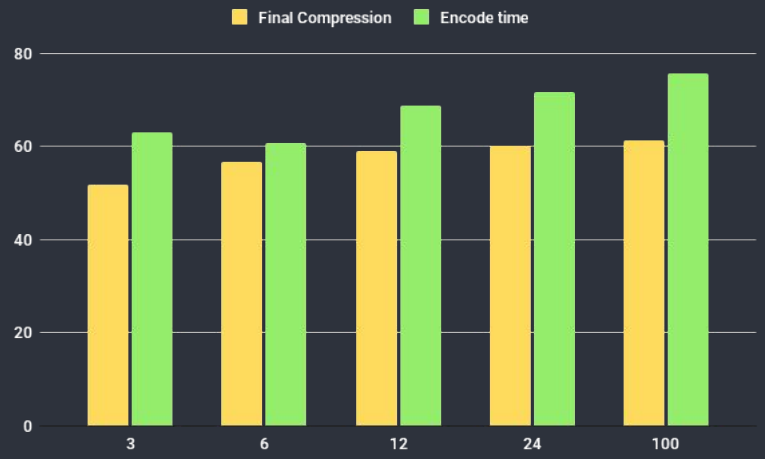
</Test 4: Best block search size and search step

Best Block Search Size	Step Size	Final Compression	Compressed file size	Encode time
2	2	52.09%	127.4mb	55.936s
4	2	52.06%	127.5mb	128.29s
4	4	52.06%	127.5mb	68.21s
8	2	52.00%	127.7mb	403.05s
8	4	52.00%	127.7mb	125.43s
8	8	52.03%	127.6mb	59.761s

Conclusions

- Large search areas and small search steps cause an exponential growth in the execution time of the encoding process, meaning that most time performance is lost when searching for the best block;
- Compression is little affected by the search size since the video has a high frame rate, meaning the best block is always near the current block;
- With this in mind, the final chosen values for both best block search area and step size were 4, giving more adaptability to lower frame rate videos.

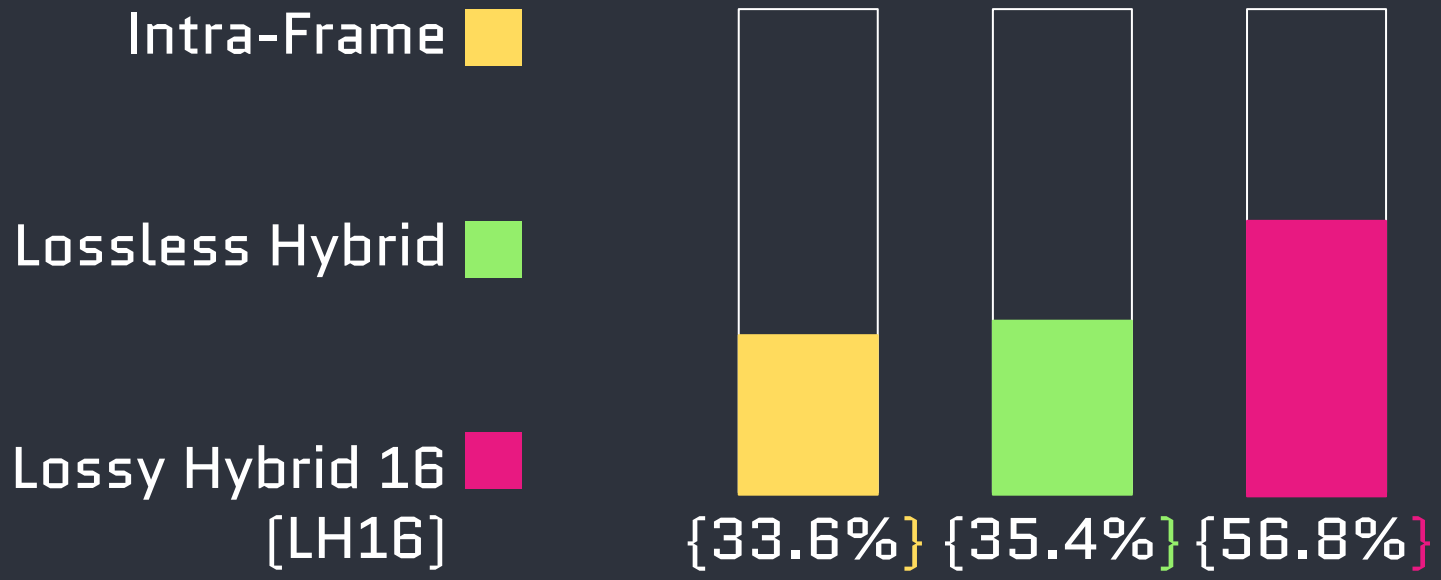
</Test 5: Intra-frame frequency



Conclusions

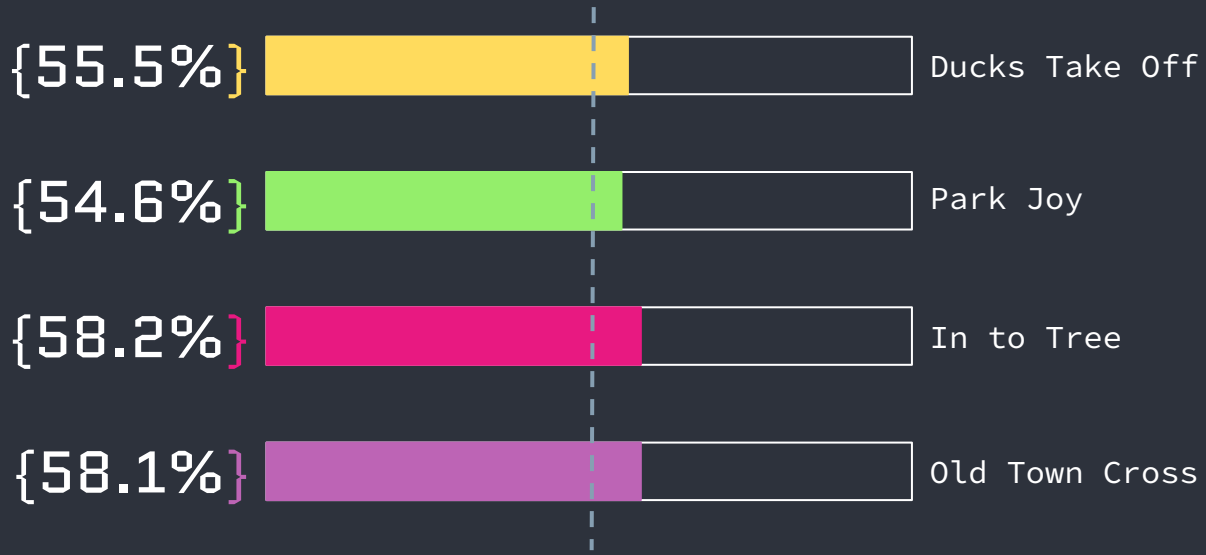
- In our solution, intra-frame encodings are always lossless, meaning that a higher frequency (less intra-frames) causes higher accumulated information loss on the pixels;
- A small intra-frame frequency will prevent the final pixel values from drifting too far from the original or intended value;
- A final value of 6 was chosen to improve the compression rates without compromising the final readability of the video.

</Comparison of compression



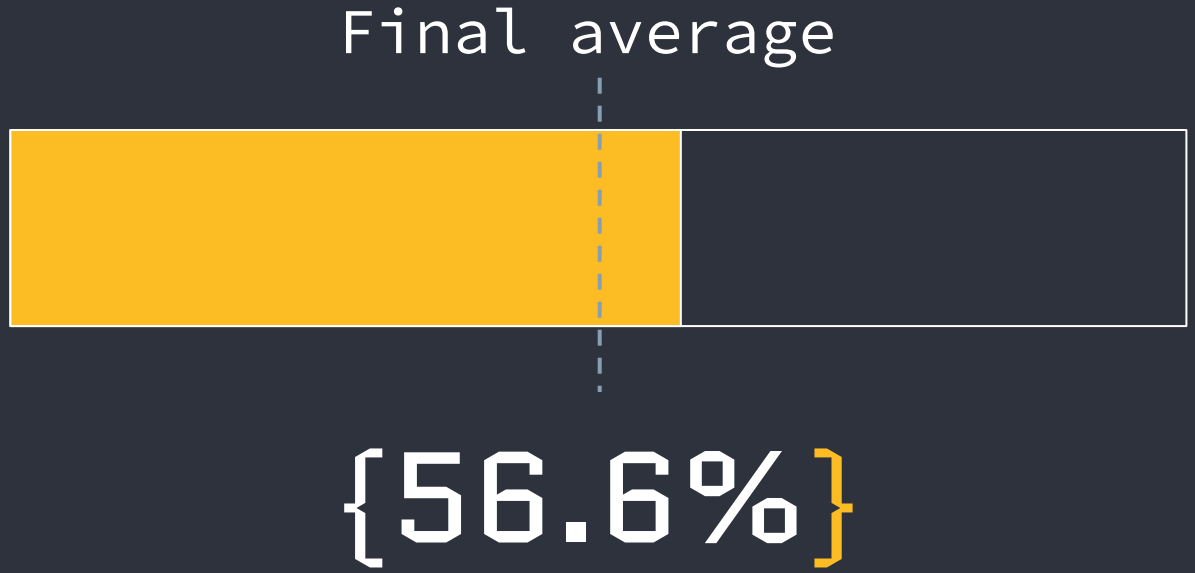
</Final compression ratio

Using LH6 option



</Final compression ratio

Using LH6 option



{56.6%}

</Other performance factors

Memory Usage

Maximum

Maximum number of allocated bytes at any given time

89.2mb

Only 7% of the original processed file size!

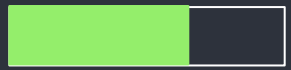
Measured using the /bin/time tool

Performance between machines

Ryzen 7

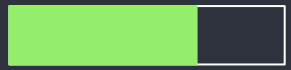
16@4.3 Ghz

Encode time



650ms /frame

Decode time



681ms /frame

Intel i7

8@4.8 Ghz

Encode time

558ms /frame

Decode time

572ms /frame

</Conclusion

{01}

Intra-frame

Wastes less time on encoding at the expense of final compression

Good for:
- Quick edits
- Small videos

{02}

Lossless Hybrid

Provides a better compression ratio but worse time performance

Good for:
- Lossless encoding of larger videos

{03}

Lossy Hybrid

Loses some information to achieve the best compression ratio

Good for:
- Obtaining the maximum compression rate at the expense of loss of information and encoding time

</ Thank you />

Any Questions?

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