Rate-Distortion and Complexity Comparison of HEVC and VVC Video Encoders

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Introduction

- This work presents experimental results of a performance comparison of the HEVC and VVC encoders
- The complexity was measured with processing time per module and of the complete encoding task, as well as compression/quality efficiency.

Method

Tools used to get the results	
Measuring the complexity of modules	GNU Profiler (GPROF)
Parsing of coding output data	Python 2.7
Calculation of parsed data	Bjontegaard delta (BD)

Coding configuration	
Nº of frames on BD measure	60
Nº of frames on profiling	30
QPs used	22, 27, 32, 37

Encoders versions	
HEVC	HM 16.9
VVC	VTM 5.1 / VTM 6.0

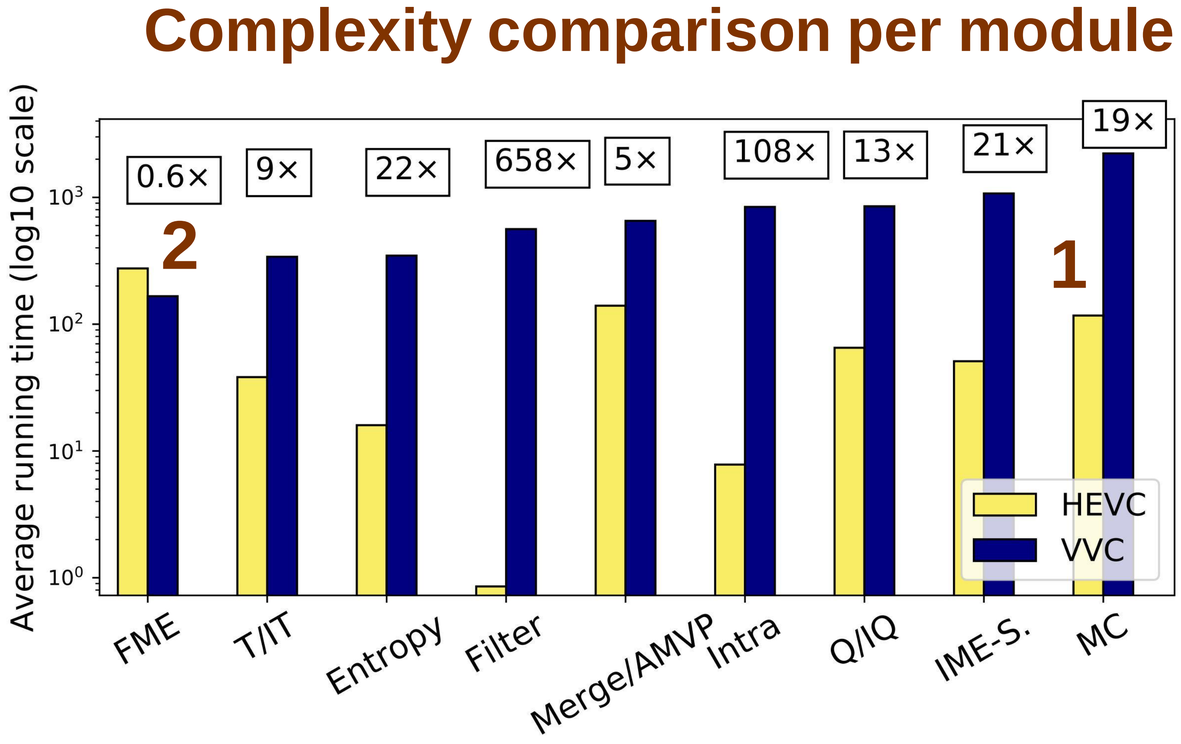
1. MC increase due to the addition of new VVC tools

2. VVC supports SIMD optimizations, causing a large decrease in the FME complexity

BD-BR/PSNR and complexity analysis

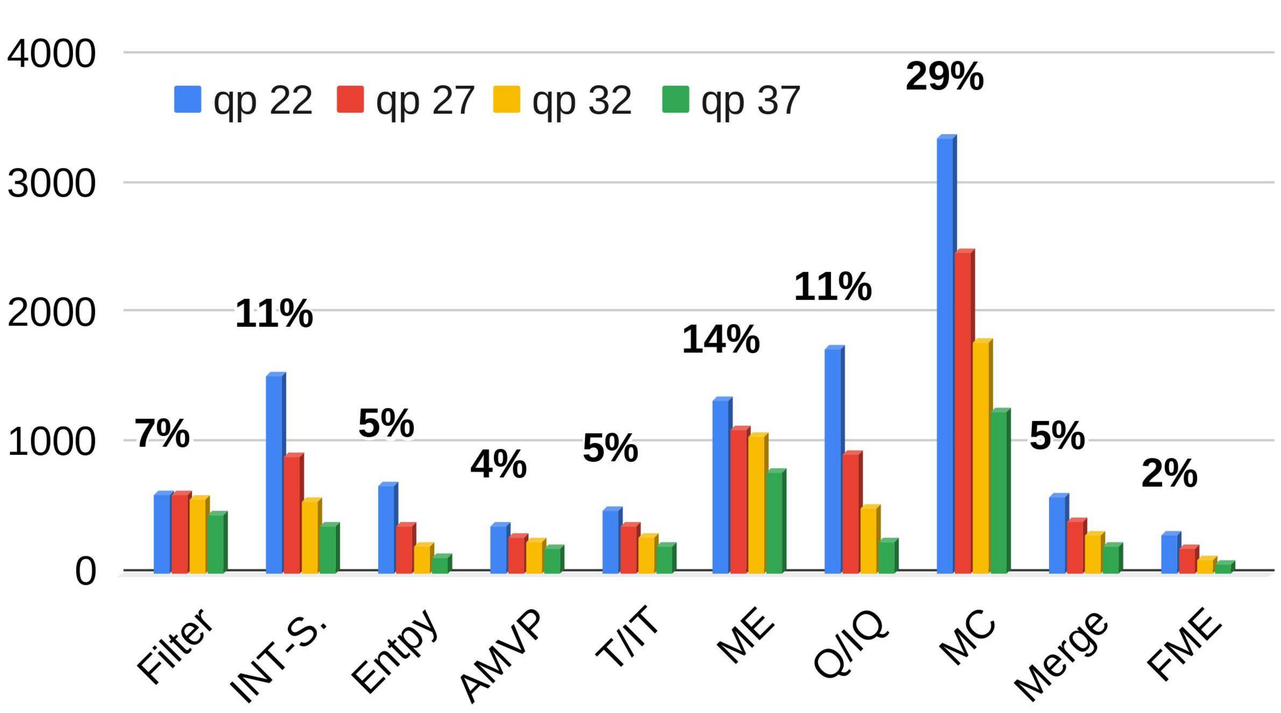
Sequence Name	BD-BR (%)	BD-PSNR (db)	TR SIMD	TR no SIMD
PeopleOnStreet	-38.85	1.97	11.07	15.18
Traffic	-49.35	1.91	9.18	15.34
BasketballDrive	-46.06	1.21	9.31	13.10
BQTerrace	-59.71	1.57	11.18	16.41
Cactus	-47.01	1.23	13.00	18.92
Kimono	-28.91	1.00	8.68	15.07
ParkScene	-43.02	1.53	14.54	25.79
Tennis	-41.05	1.48	11.36	15.71
BasketballDrill	-46.22	2.31	5.52	8.19
BQMall	-42.77	2.17	4.88	8.25
PartyScene	-48.53	2.77	13.16	16.87
RaceHorses	-40.60	1.80	8.48	13.27
BasketballPass	-40.96	2.37	11.78	18.20
BlowingBubbles	-40.73	1.87	10.87	14.17
BQSquare	-60.92	4.10	13.24	19.04
RaceHorses	-41.00	2.19	13.15	24.06
FourPeople	-41.68	1.78	3.12	4.66
Johnny	-50.11	1.45	12.41	24.68
SlideEditing	-34.47	5.53	8.28	14.81
Average	**-44.40**	**2.07**	**10.17**	**15.88**

Complexity comparison per module



Results

VVC average complexity for each QP.



Conclusion

- VVC average bitrate savings of 44.4% for the same video quality
- At same bitrate, VVC reaches a quality improvement of more than 2 db
- VVC encoding is 10 to almost 16 times more complex than HEVC
- Considerable increase in the intra search and filtering steps (ALF)

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