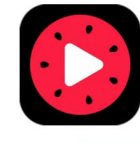


JVET-AF0206

AHG11: Complexity reduction of NN-based loop-filters

Junru Li, Yue Li, Chaoyi Lin, Kai Zhang, Li Zhang
ByteDance Inc.



Introduction

- The high operation point (HOP) filter with complexity of 477 kMac/pxl and low operation point (LOP) filter with complexity of 17.0 kMac/pxl are adopted in NNVC.
- Performance for HOP with 477 kMac/pxl
 - RA: -10.17%, -24.10%, -24.38%
- Performance for LOP with 17 kMac/pxl
 - RA: -5.28%, -10.92%, -10.40%

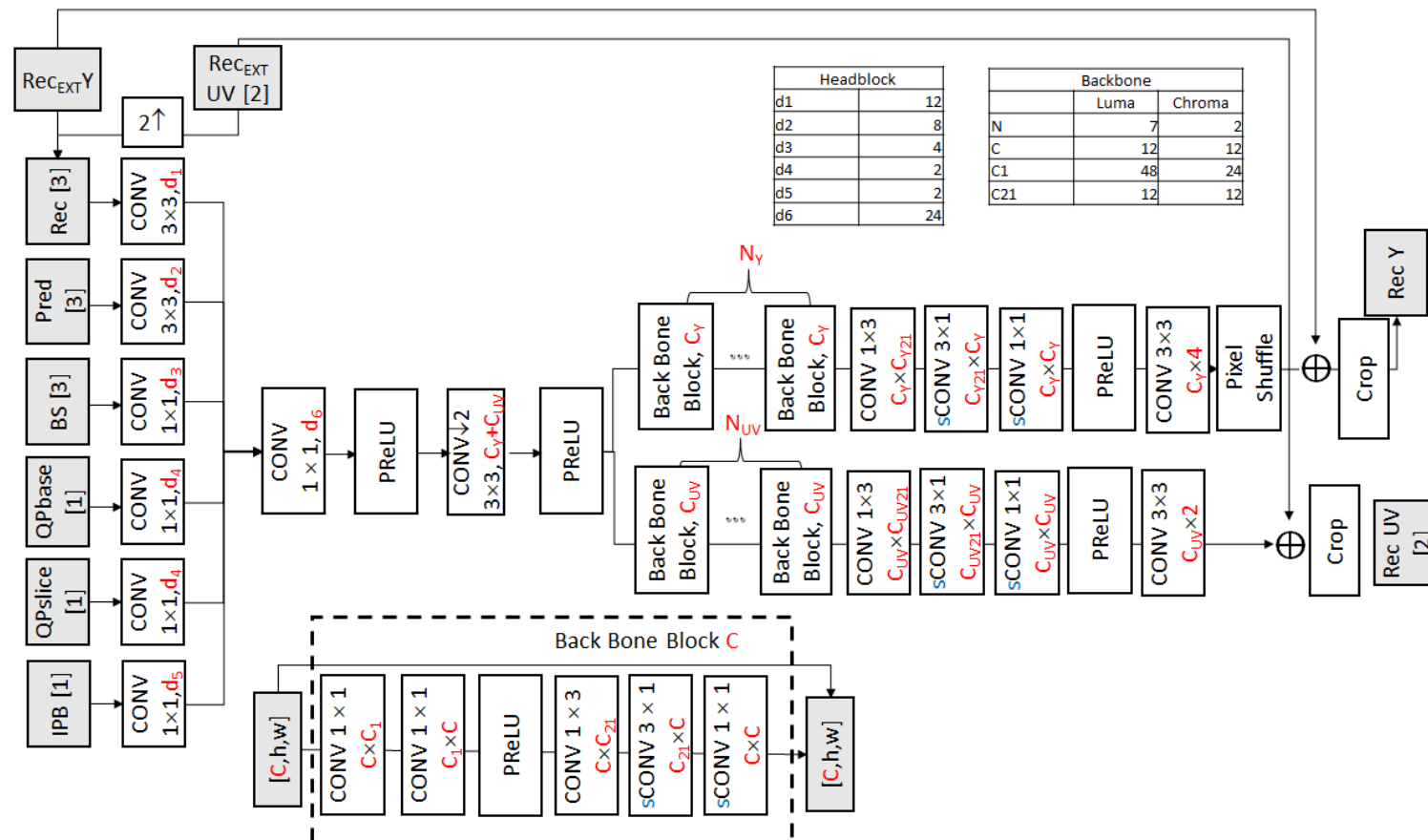
Proposed Method

- This contribution proposes a unified filter architecture at super-low operation points
 - Test #1: *7.3 kMac/pxl*
 - Test #2: *5.0 kMac/pxl*
 - Much lower than *17.0 kMac/pxl* of the lower operation point (LOP) in NNVC.
- The network architecture is designed based on the basic structure of LOP.
- The number of feature map and residual block are modified accordingly to reduce the network complexity.

Network: Test #1

■ Model-1 filter architecture:

- Complexity: 7.3 kMAC/pxl
- Model number: 1 model
- Model parameters: 0.025M.



Network: Test #2

- Complexity: 5.0 *kMAC/pxl*
- Model number: 1 model
- Model parameters: 0.018M.

Simulation results: Test #1

- Anchor: VTM-11.0_NNVC-6.0 VTM
- Test #1: model with 7.3 *kMac/pxl*
- QP for anchor and test: 22, 27, 32, 37, 42

	AI				
	Y	U	V	EncT	DecT
Class A1	-2.82%	-5.45%	-4.90%	118%	5713%
Class A2	-3.06%	-6.73%	-4.90%	110%	4909%
Class B	-2.91%	-6.46%	-5.40%	108%	4809%
Class C	-2.98%	-7.26%	-6.34%	104%	3367%
Class E	-4.11%	-5.42%	-4.45%	109%	4952%
Overall	-3.14%	-6.34%	-5.29%	109%	4611%
Class D	-3.22%	-6.31%	-5.54%	104%	3151%
Class F	-2.07%	-5.28%	-4.68%	102%	3796%
Class TGM	-2.82%	-5.45%	-4.90%	118%	5713%

	RA				
	Y	U	V	EncT	DecT
Class A1	-3.42%	-3.71%	-3.13%	117%	8524%
Class A2	-3.30%	-6.69%	-3.59%		
Class B	-2.80%	-6.62%	-4.15%	115%	8171%
Class C	-3.04%	-7.26%	-4.93%	112%	7783%
Class E					
Overall	-3.09%	-6.22%	-4.04%		
Class D	-3.24%	-5.16%	-2.60%	112%	7228%
Class F	-1.81%	-4.25%	-3.18%	125%	2941%
Class TGM	-3.42%	-3.71%	-3.13%	117%	8524%

Simulation results: Test #2

- Anchor: VTM-11.0_NNVC-6.0 VTM
- Test #2: model with 5 *kMac/pxl*
- QP for anchor and test: 22, 27, 32, 37, 42

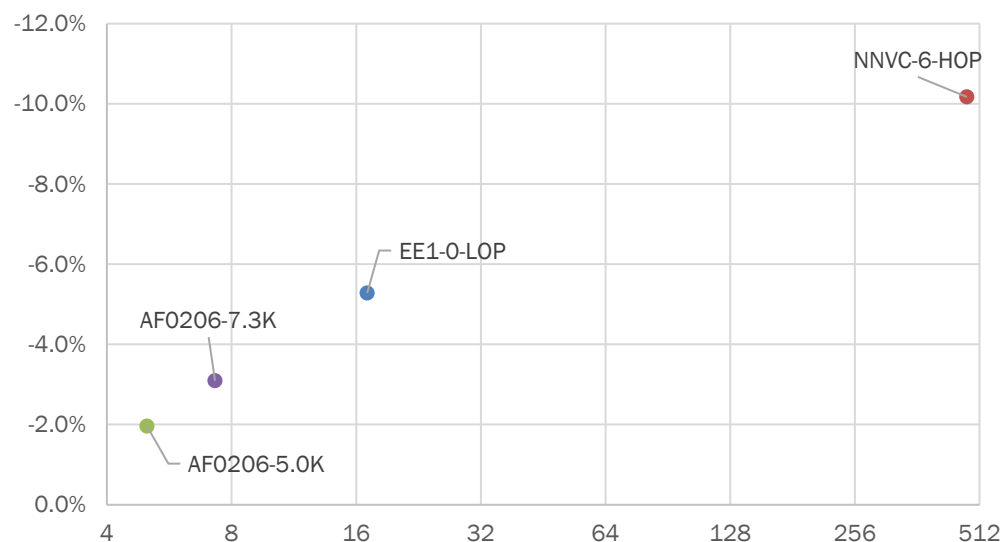
	AI				
	Y	U	V	EncT	DecT
Class A1	-2.05%	-3.83%	-3.54%	114%	4341%
Class A2	-2.41%	-4.65%	-3.60%	109%	3821%
Class B	-2.36%	-4.90%	-4.43%	107%	3705%
Class C	-2.36%	-5.50%	-4.41%	105%	2644%
Class E	-3.28%	-3.79%	-4.87%	108%	3788%
Overall	-2.47%	-4.63%	-4.21%	108%	3561%
Class D	-2.53%	-4.49%	-4.42%	105%	2500%
Class F	-1.54%	-4.22%	-2.56%	101%	2922%
Class TGM	-2.05%	-3.83%	-3.54%	114%	4341%

	RA				
	Y	U	V	EncT	DecT
Class A1	-1.88%	-2.59%	-2.92%	114%	6547%
Class A2	-2.10%	-3.68%	-2.23%		
Class B	-1.79%	-4.47%	-3.26%	112%	6129%
Class C	-2.12%	-4.64%	-3.06%	109%	6051%
Class E					
Overall	-1.96%	-3.98%	-2.93%		
Class D	-2.20%	-3.27%	-3.01%	110%	5397%
Class F	-1.16%	-3.11%	-1.45%	120%	2166%
Class TGM	-1.88%	-2.59%	-2.92%	114%	6547%

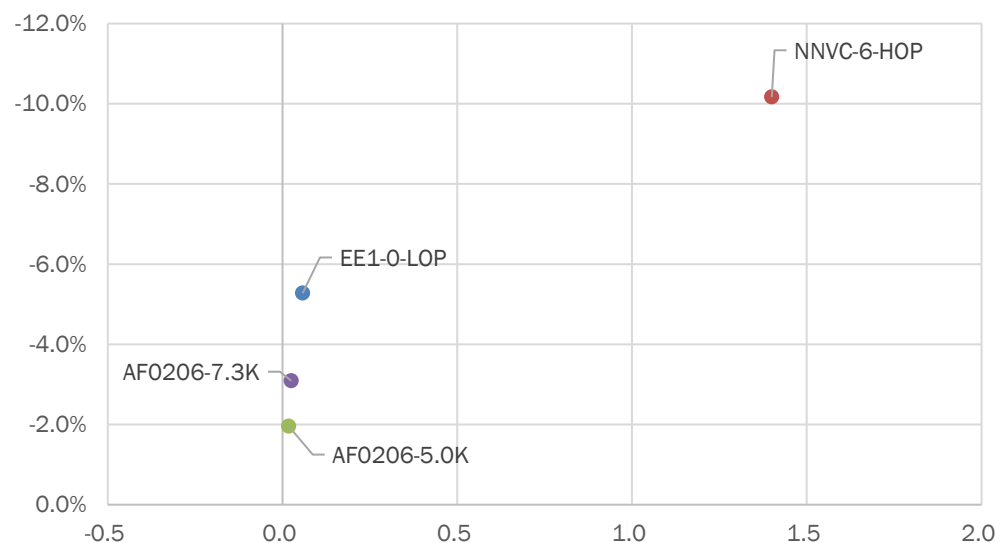
Summary

- Test #1 (7.3 kMac/pxl, 0.025M)
 - AI: -3.14%, -6.34%, -5.29%,
 - RA: -3.09%, -6.22%, -4.04%
- Test #2 (5.0 kMac/pxl, 0.018M)
 - AI: -2.47%, -4.63%, -4.21%
 - RA: -1.96%, -3.98%, -2.93%

RA BD-rate Y vs. kMAC/pxl



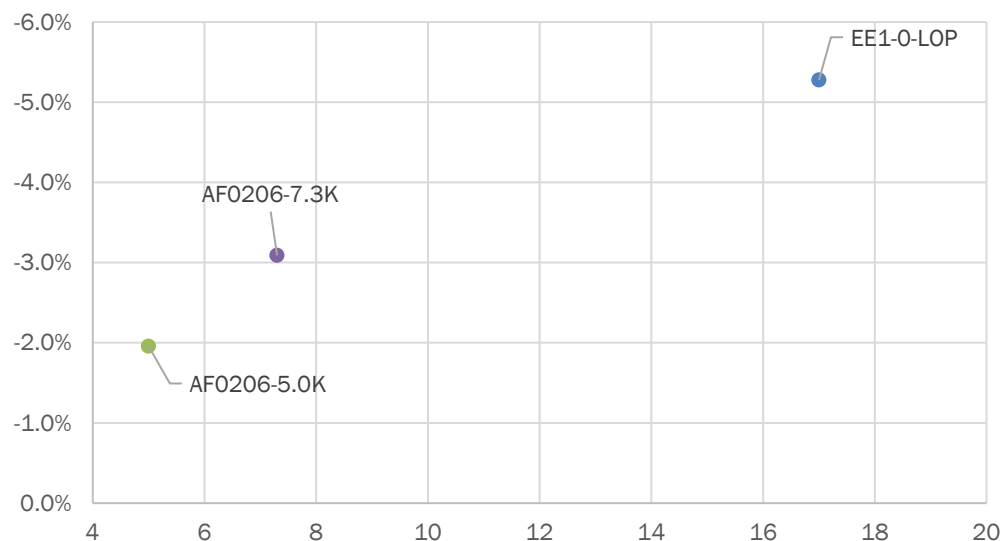
RA BD-rate Y vs. numParam, M



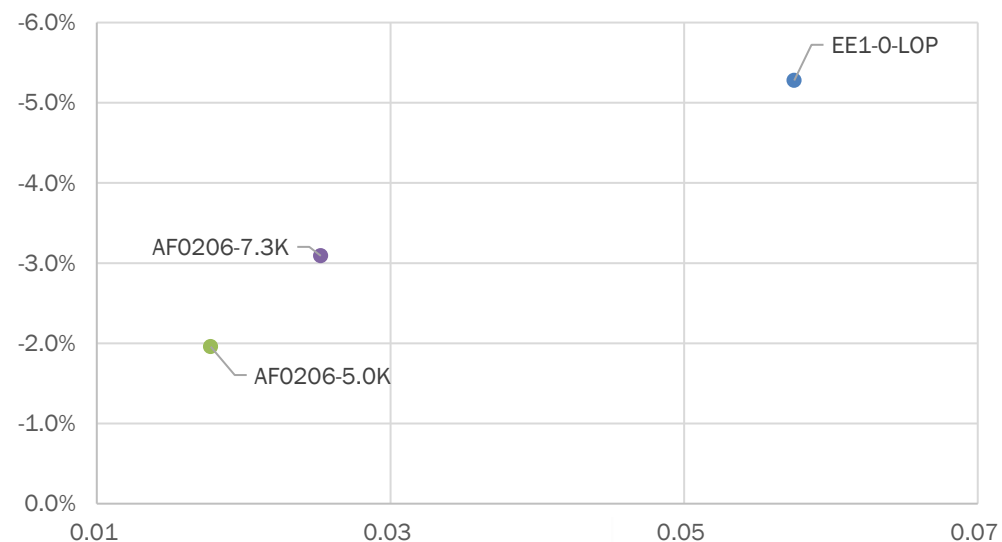
Summary

- Test #1 (7.3 kMac/pxl, 0.025M)
 - AI: -3.14%, -6.34%, -5.29%,
 - RA: -3.09%, -6.22%, -4.04%
- Test #2 (5.0 kMac/pxl, 0.018M)
 - AI: -2.47%, -4.63%, -4.21%
 - RA: -1.96%, -3.98%, -2.93%

RA BD-rate Y vs. kMAC/pxl



RA BD-rate Y vs. numParam, M



Conclusion

- This contribution presents a NN-based filter at super-low operation points. It is recommended to study in EE.