Joint Rate Distortion Optimization with CNN-based In-Loop Filter For Hybrid Video Coding

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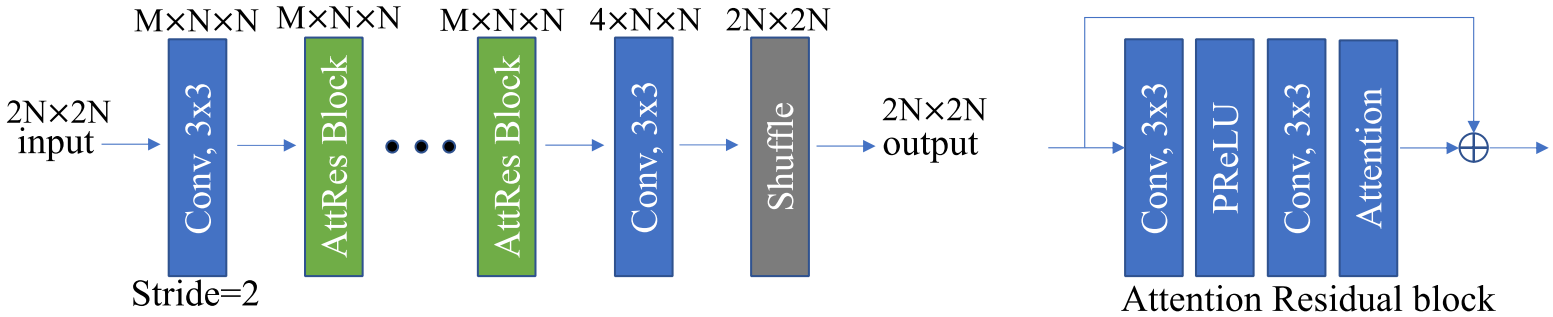
Summary

- Motivation
  - In current design, the CNN-based filtering procedure is not considered in the RDO process when deep learning-based in-loop filtering is used.

- Proposed Method
  - CNN-based filtering is integrated into the RDO process for a better estimation of RD cost.

Proposed Method

- The CNN-based filtering is involved during the partitioning mode selection:
  - The samples obtained after CNN-based filtering are compared with original samples to calculate the distortion.
  - The optimal partitioning mode is then selected based on the refined rate-distortion (RD) cost.
  - Several fast algorithms are proposed:
    - A simplified version of CNN models is additionally trained and used in the RD stage.
    - Only one filter is included in the RDO process without considering filter selection.
    - The filter is only applied to the coding units with height and width no larger than 64.



Simulation results

- Anchor: VTM-11.0 + new MCTF
- QP for anchor and test: 22, 27, 32, 37, 42

	RA				
	Y	U	V	EncT	DecT
Class A1	-11.59%	-22.13%	-22.72%	338%	104083%
Class A2	-13.41%	-26.19%	-26.49%	330%	98281%
Class B	-12.40%	-31.25%	-28.98%	346%	97995%
Class C	-13.80%	-28.33%	-29.68%	269%	84291%
Class E					
Overall	-12.81%	-27.64%	-27.42%	319%	95333%
Class D	-15.37%	-30.01%	-30.70%	258%	75923%
Class F	-6.70%	-17.44%	-17.74%	470%	37503%

	AI				
	Y	U	V	EncT	DecT
Class A1	-8.12%	-18.18%	-16.77%	372%	71824%
Class A2	-8.58%	-22.94%	-22.86%	290%	60613%
Class B	-8.70%	-23.53%	-22.91%	293%	55360%
Class C	-10.25%	-21.45%	-24.09%	263%	36590%
Class E	-12.75%	-26.21%	-26.37%	290%	60392%
Overall	-9.61%	-22.52%	-22.71%	297%	54317%
Class D	-9.84%	-23.02%	-24.33%	252%	32492%
Class F	-5.16%	-13.62%	-11.76%	182%	21594%

Conclusion

- The proposed optimization method can bring promising coding gains

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