Learning to Compress Unmanned Aerial Vehicle (UAV) Captured Video: Benchmark and Analysis

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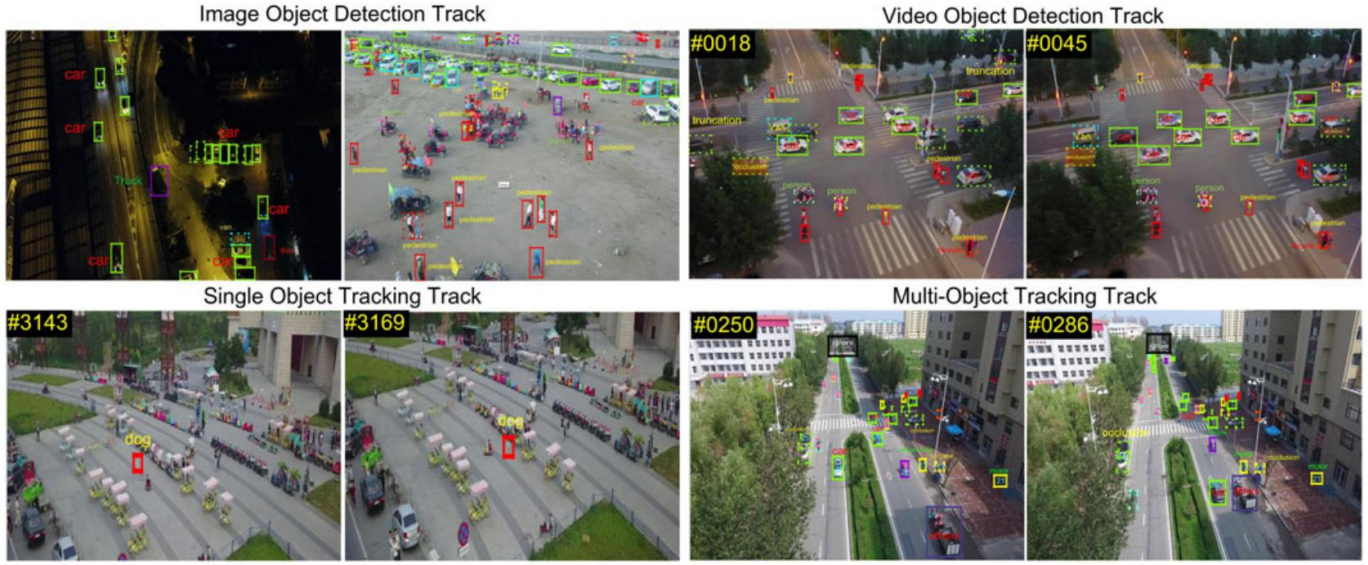
Background & Related Work

- Drone video compression
  - Detection and Tracking Challenge in ECCV 2018, ICCV 2019 and ECCV 2020
  - Other dataset including iros2016, iros2018, in-door scene



Zhu, P., Wen, L., Du, D., Bian, X., Fan, H., Hu, Q., & Ling, H. (2021). Detection and tracking meet drones challenge. IEEE Transactions on Pattern Analysis and Machine Intelligence, 44(11), 7380-7399.

Kouris, A. and Bouganis, C.S., Learning to Fly by MySelf: A Self-Supervised CNN-based Approach for Autonomous Navigation. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2018

Dataset

- Benchmark including the following sequences


BasketballGround


NightMall


CrossBridge


Classroom


Campus


GrassLand


SoccerGround


Highway

Elevator


RoadByTheSea


Intersection


Circle


Hall


Theater

Dataset

- Benchmark including the following sequences

Source	Sequence Name	Spatial Resolution	Frame Count	Frame Rate	Bit Depth	Scene Feature
Class A VisDrone-SOT TPAMI2021 [1]	BasketballGround	960x528	100	24	8	Outdoor
	GrassLand	1344x752	100	24	8	Outdoor
	Intersection	1360x752	100	24	8	Outdoor
	NightMall	1920x1072	100	30	8	Outdoor
	SoccerGround	1904x1056	100	30	8	Outdoor
Class B VisDrone-MOT TPAMI2021 [1]	Circle	1360x752	100	24	8	Outdoor
	CrossBridge	2720x1520	100	30	8	Outdoor
	Highway	1344x752	100	24	8	Outdoor
Class C Corridor IROS2018 [9]	Classroom	640x352	100	24	8	Indoor
	Elevator	640x352	100	24	8	Indoor
	Hall	640x352	100	24	8	Indoor
Class D UAVDT_S ECCV2018 [10]	Campus	1024x528	100	24	8	Outdoor
	RoadByTheSea	1024x528	100	24	8	Outdoor
	Theater	1024x528	100	24	8	Outdoor

Experiment

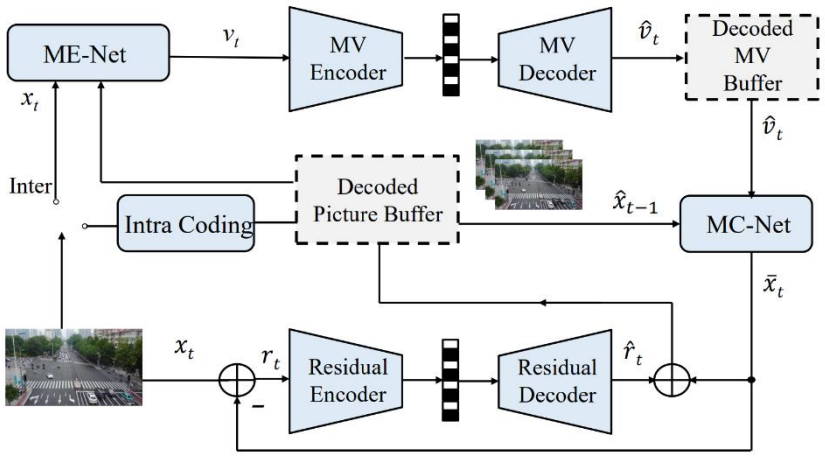
Pre-processing:

- Down-sampling
- Boundary cropping
- Color space alignment(in RGB domain)
- Center-cropping the resolutions to be multiple of 16
- Employing the RGB planar data structure to store the raw data

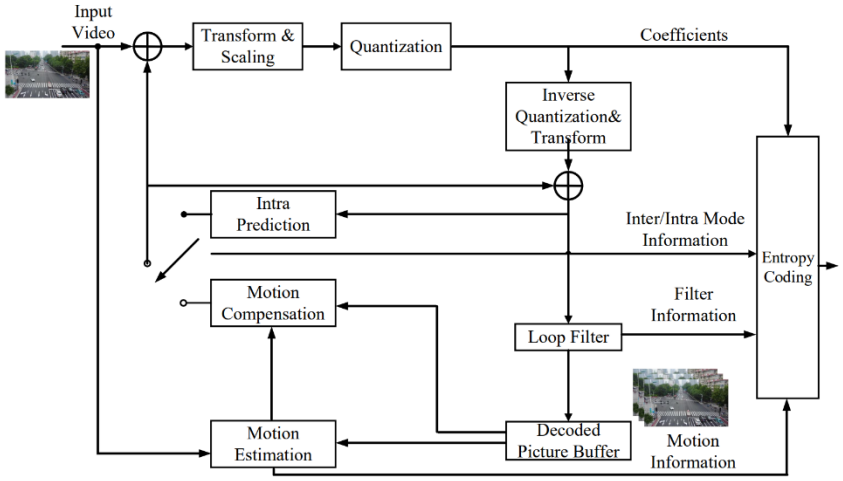
Experiment

Codecs selection:

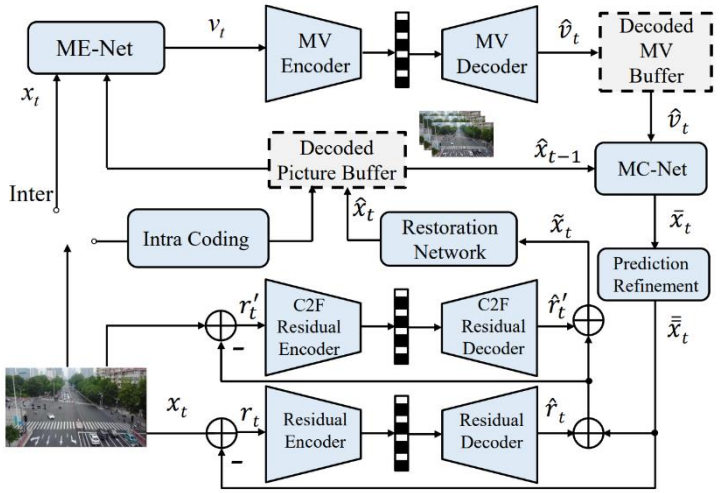
- The codecs
  - HEVC-HM.16.20-SCM-8.8
  - OpenDVC
  - MPAI EEV



HEVC-HM.16.20-SCM-8.8



OpenDVC



MPAI EEV

Experiment

Parameter Setting:

- Test conditions
  - HM-16.20-SCC-8.8:
    TAppEncoder -c encoder LDP.cfg -InputBitDepth 8 -InputChromaFormat 444 -Level 6.2 -wdt seq wid -hgt seq hgt -f 100 -fr fps -q QP -IntraPeriod 16 - InputColourSpaceConvert RGBtoGBR -SNRInternalColourSpace 1 -OutputColourSpaceConvert GBRtoRGB
  - OpenDVC:
    python test opendvc.py -path seqname -mode PSNR -IntraPeriod 16 -metric PSNR -l λ
  - EEV:
    python test eev.py -path seqname -mode PSNR -IntraPeriod 16 -metric PSNR -l λ

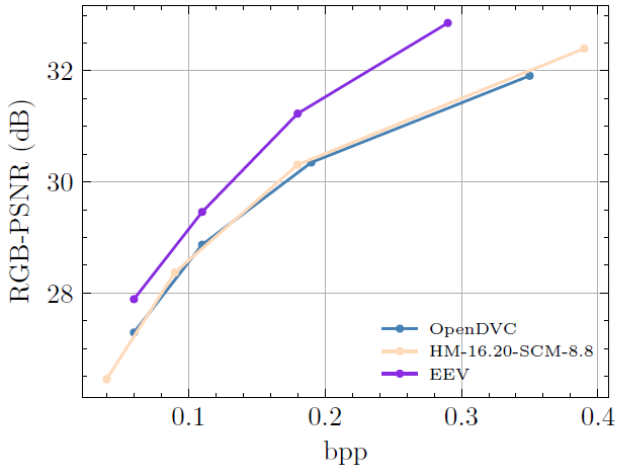
Evaluation Method:

- PSNR, BPP and BD-rate

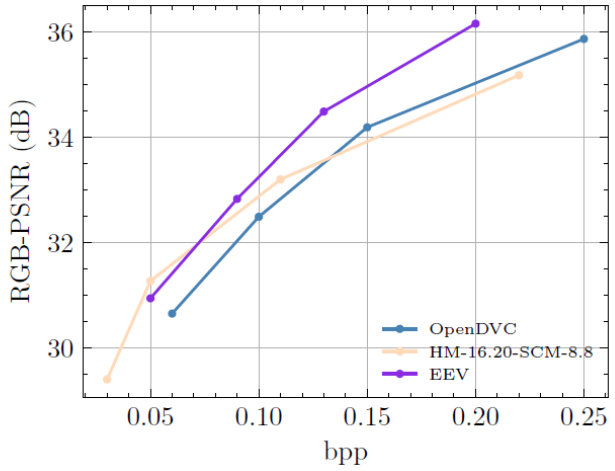
Analysis

Category	Sequence Name	BD-Rate Reduction EEV vs OpenDVC	BD-Rate Reduction EEV vs HEVC
Class A VisDrone-SOT	BasketballGround	-23.84%	9.57%
	GrassLand	-16.42%	-38.64%
	Intersection	-18.62%	-28.52%
	NightMall	-21.94%	-6.51%
	SoccerGround	-21.61%	-10.76%
Class B VisDrone-MOT	Circle	-20.17%	-25.67%
	CrossBridge	-23.96%	26.66%
	Highway	-20.30%	-12.57%
Class C Corridor	Classroom	-8.39%	178.49%
	Elevator	-19.47%	109.54%
	Hall	-15.37%	58.66%
Class D UAVDT_S	Campus	-26.94%	-25.68%
	RoadByTheSea	-20.98%	-24.40%
	Theater	-19.79%	2.98%
Class A		**-20.49%**	**-14.97%**
Class B		**-21.48%**	**-3.86%**
Class C		**-14.41%**	**115.56%**
Class D		**-22.57%**	**-15.70%**
Average		**-19.84%**	**15.23%**

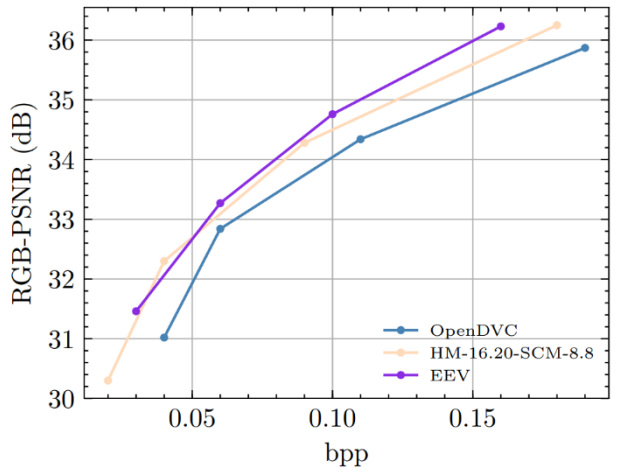
Analysis



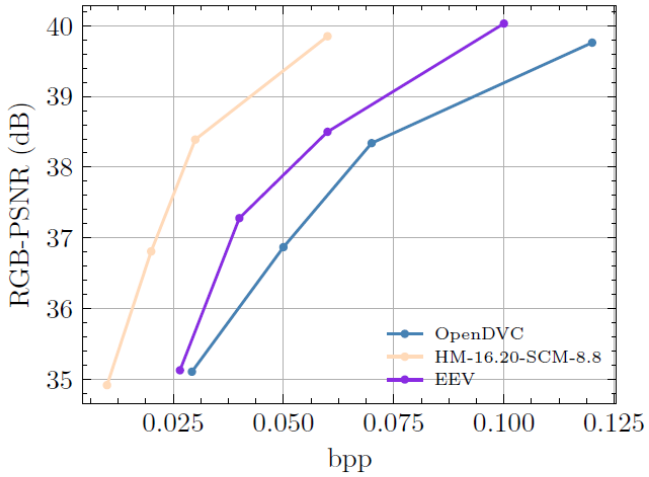
(a) Campus 1024×528



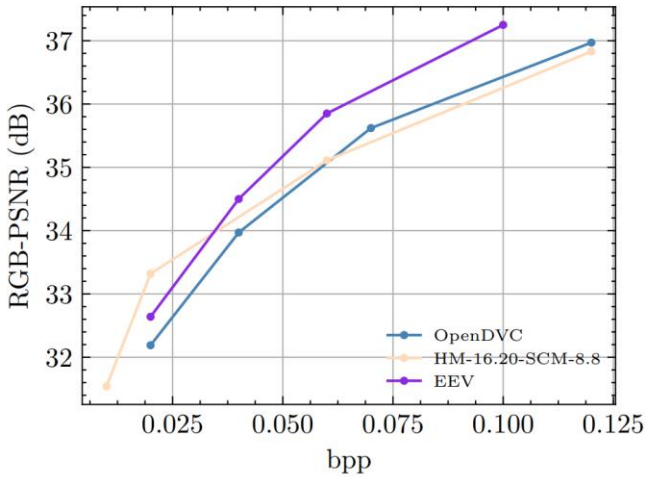
(b) Highway 1344×752



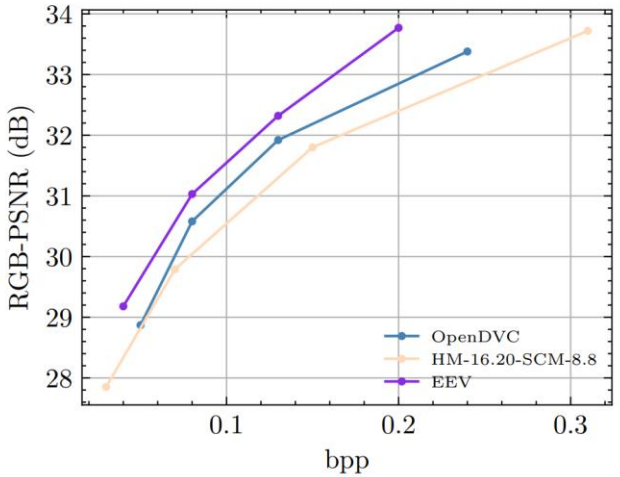
(c) NightMall 1920×1072



(d) Elevator 640×352

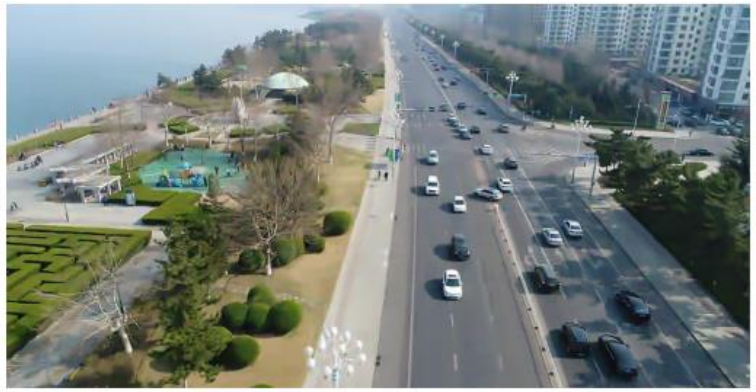


(e) SoccerGround 1904×1056

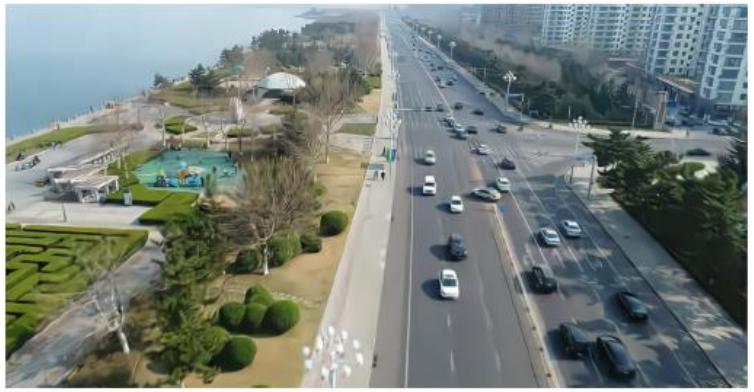


(f) Intersection 1360×752

Analysis



(a) HEVC 0.065bpp 25.20dB



(b) OpenDVC 0.078bpp 25.99dB

(c) EEV 0.077bpp 26.44dB

(d) HEVC 0.055bpp 32.30dB

(e) OpenDVC 0.063bpp 32.84dB

(f) EEV 0.058bpp 33.27dB

Conclusion

- We build the first benchmark for the task of learning based UAV video coding.
- The proposed benchmark has constructed a solid baseline for compressing UAV videos and facilitates the future research works for related topics.
- Attendance at MPAI-EEV meetings is open to interested experts(http://eev.mpai.community).

Thanks!