



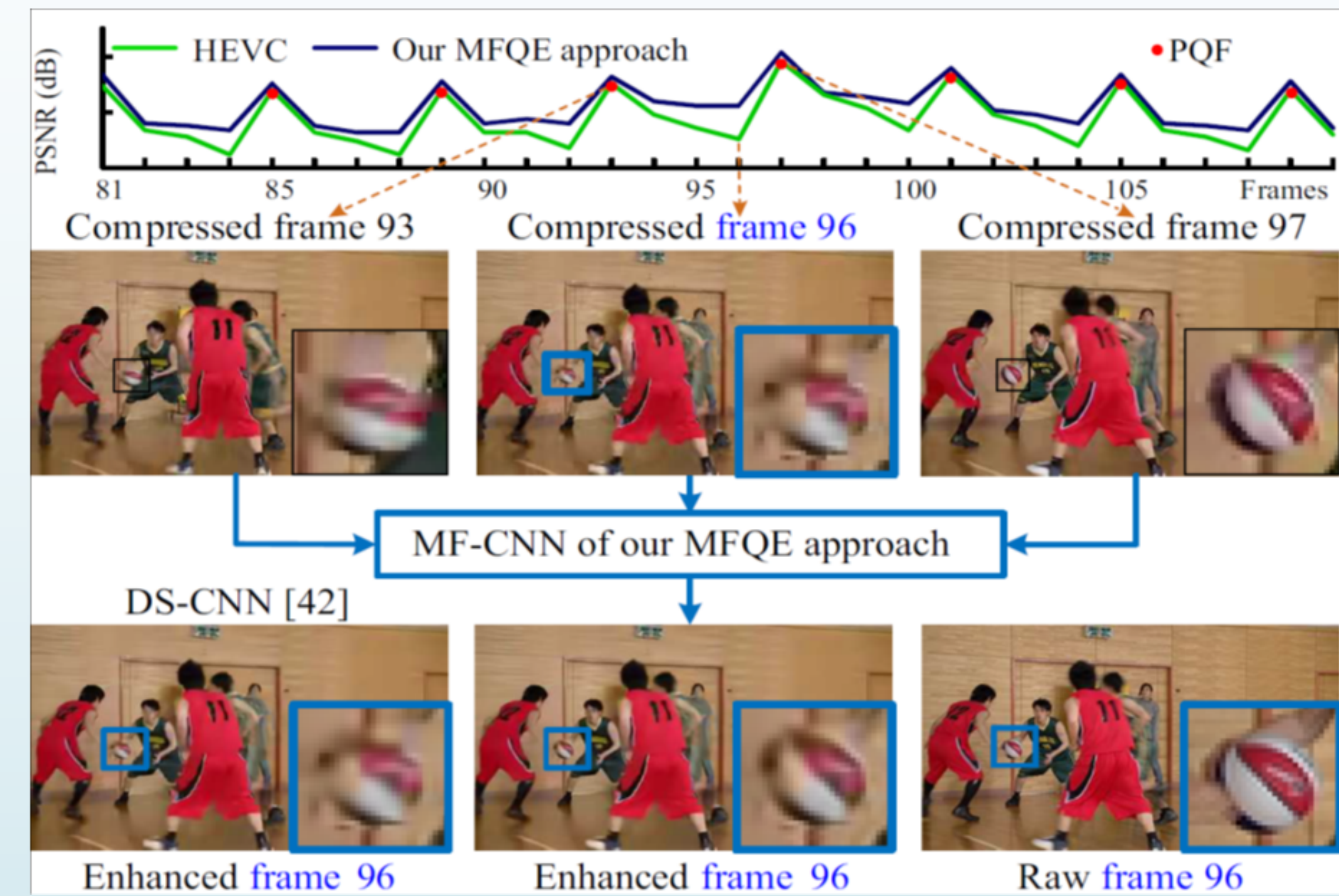
Multi-Frame Quality Enhancement for Compressed Video

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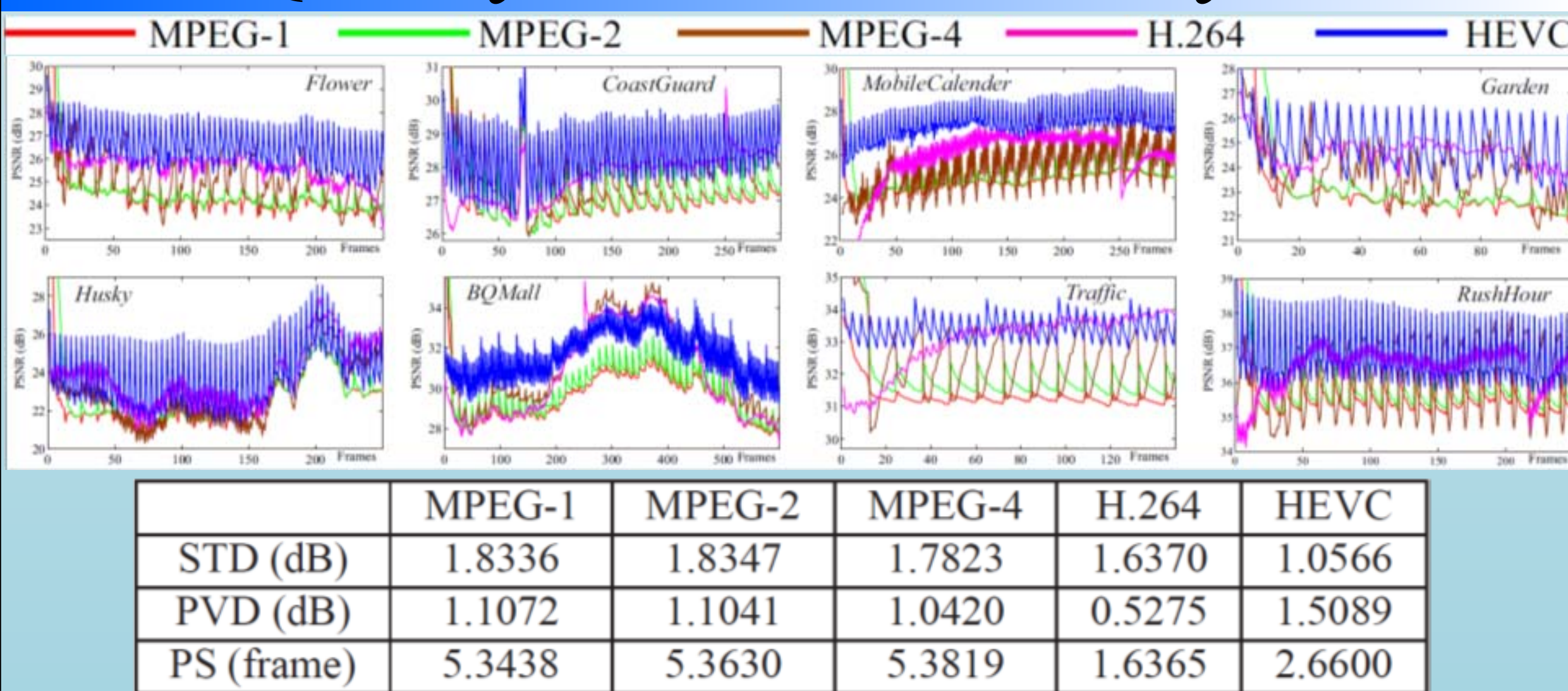


Motivation

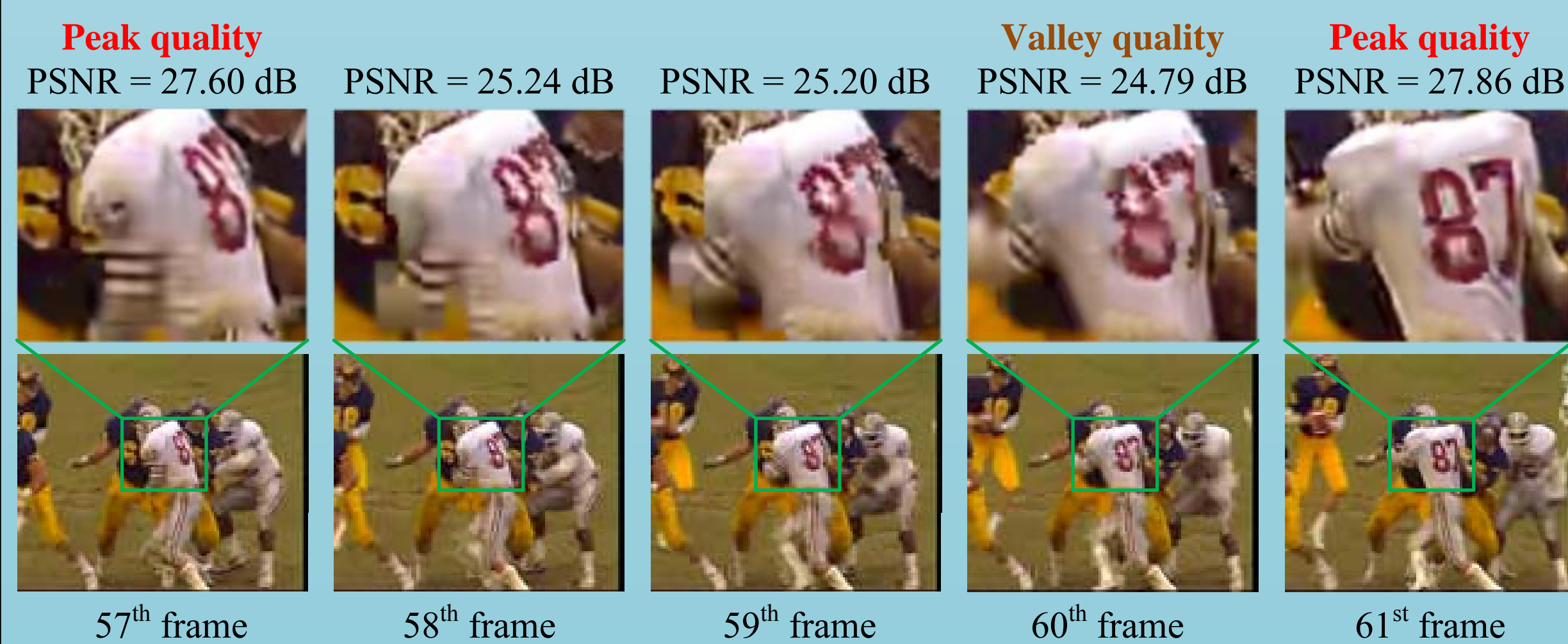


- The quality of compressed video **dramatically fluctuates** across frames.
- It is possible to use the **high quality frames** (Peak Quality Frames, called **POFs**) to enhance the quality of their neighboring low quality frames.
- Our approach also **mitigates quality fluctuation**, because the quality of non-POFs can be considerably improved.

Quality fluctuation analysis

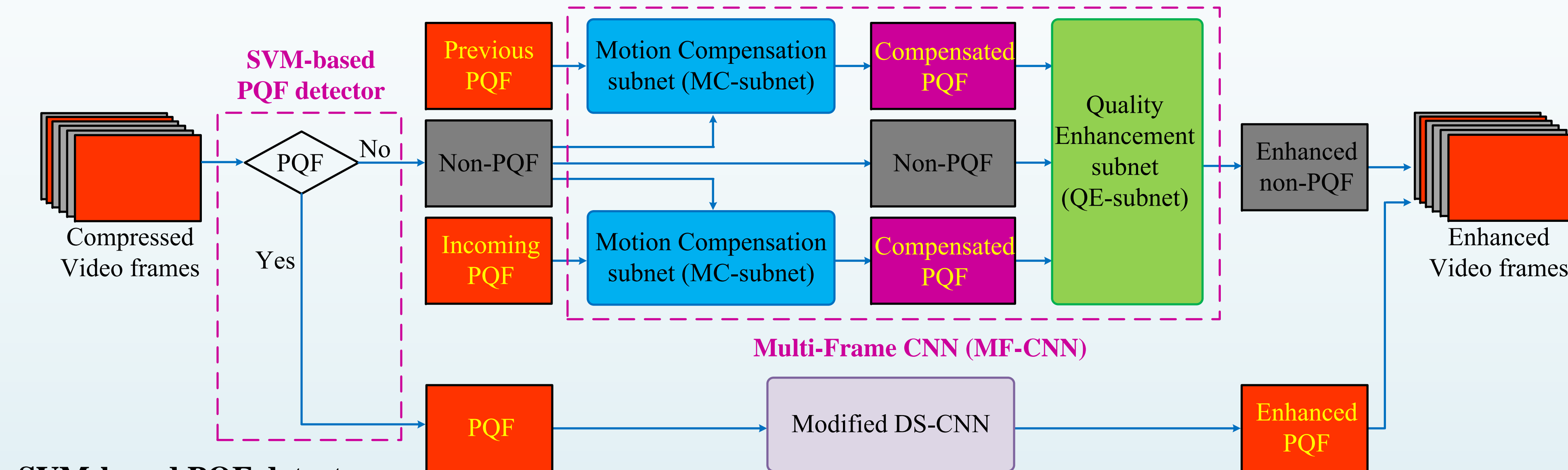


STD = Standard deviation; PVD = Peak-Valley Difference; PS = POF Separation



- The **remarkable fluctuation** of frame-level quality in compressed video.
- The content of frames between the adjacent POFs may be **highly similar**.
- The POFs probably contain some **useful content** which is distorted in their neighboring non-POFs.

Multi-Frame Quality Enhancement Approach



SVM-based POF detector

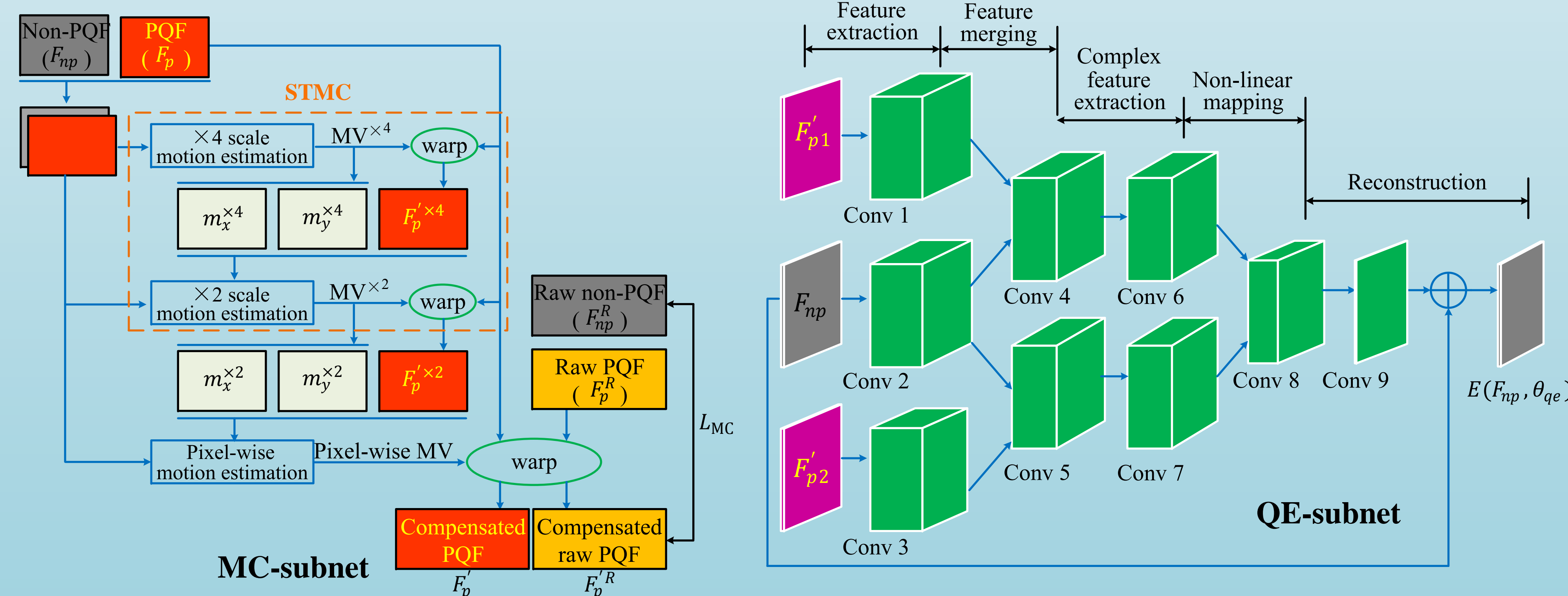
The SVM is trained from the BRISQUE features [1] of the adjacent five frames (totally 180 dimensions).

[1] A. Mittal, A. K. Moorthy, and A. C. Bovik. No-reference image quality assessment in the spatial domain. *IEEE Transactions on Image Processing*, 21(12):4695–4708, 2012.

Modified DS-CNN [2,3] (Single-Frame Quality Enhancement)

[2] Ren Yang, Mai Xu and Zulin Wang, “Decoder-Side HEVC Quality Enhancement with Scalable Convolutional Neural Network”, in *IEEE International Conference on Multimedia and Expo (ICME)*, 2017.

[3] Ren Yang, Mai Xu, Zulin Wang and Zhenyu Guan, “Enhancing Quality for HEVC Compressed Videos”, *arXiv preprint arXiv:1709.06734*, 2017.



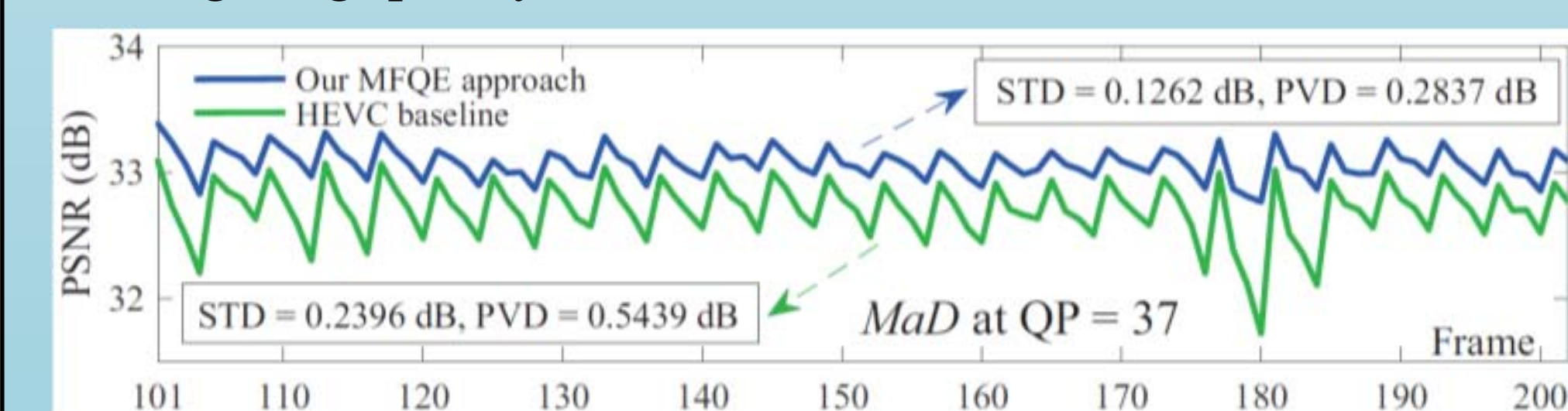
Objective Results

State-of-the-art PSNR improvement

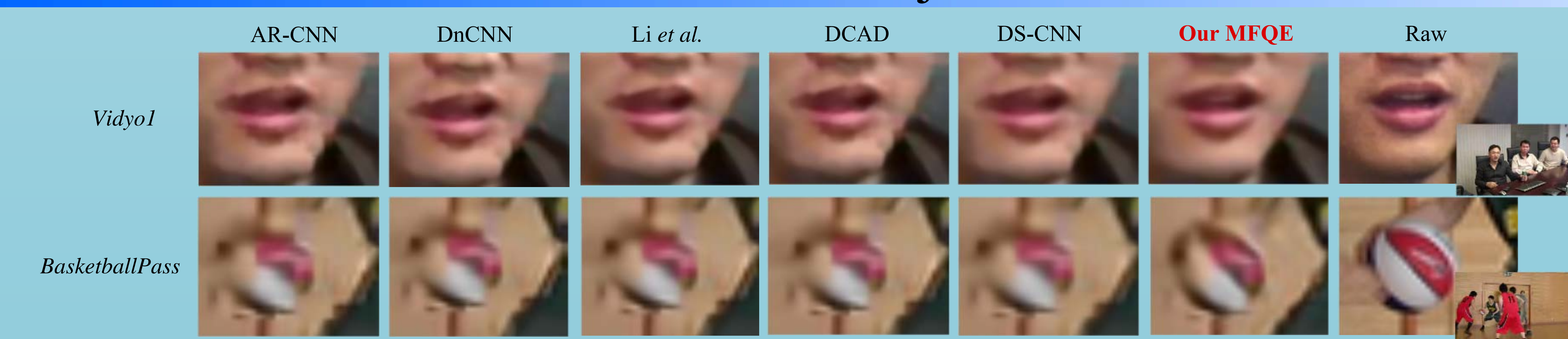
QP	Seq.	AR-CNN [9]	DnCNN [40]	Li et al. [24]	DCAD [34]	DS-CNN [38]	MFQE (our)
37	1	0.1287	0.1955	0.2523	0.1354	0.4762	0.7716
	2	0.0718	0.1888	0.2857	0.0376	0.4228	0.6042
	3	0.1095	0.1328	0.1872	0.1112	0.2394	0.4715
	4	0.1304	0.2084	0.2170	0.0796	0.3173	0.4381
	5	0.1900	0.2936	0.3645	0.2334	0.3252	0.5496
	6	0.1522	0.1944	0.2630	0.1619	0.3728	0.5980
	7	0.1445	0.2224	0.2570	0.1775	0.2777	0.3898
	8	0.1305	0.2424	0.2939	0.1940	0.2790	0.4838
	9	0.1573	0.2588	0.3034	0.2224	0.2720	0.3935
	10	0.1490	0.2509	0.2926	0.2026	0.2498	0.4019
	Ave.	0.1364	0.2188	0.2717	0.1556	0.3232	0.5102
42	Ave.	0.1627	0.2073	0.1924	0.1282	0.2189	0.4610

1: PeopleOnStreet 2: TunnelFlag 3: Kimono 4: BarScene 5: Vidyo1
6: Vidyo3 7: Vidyo4 8: BasketballPass 9: RaceHorses 10: MaD

Mitigating quality fluctuation



Subjective Results



Comparison methods:

- AR-CNN: Dong et al., in *ICCV*, 2015.
- DnCNN: Zhang et al., *IEEE TIP*, 2017.
- Li et al.: Li et al., in *ICME*, 2017.
- DCAD: Wang et al., in *DCC*, 2017.
- DS-CNN: Yang et al., in *ICME*, 2017.