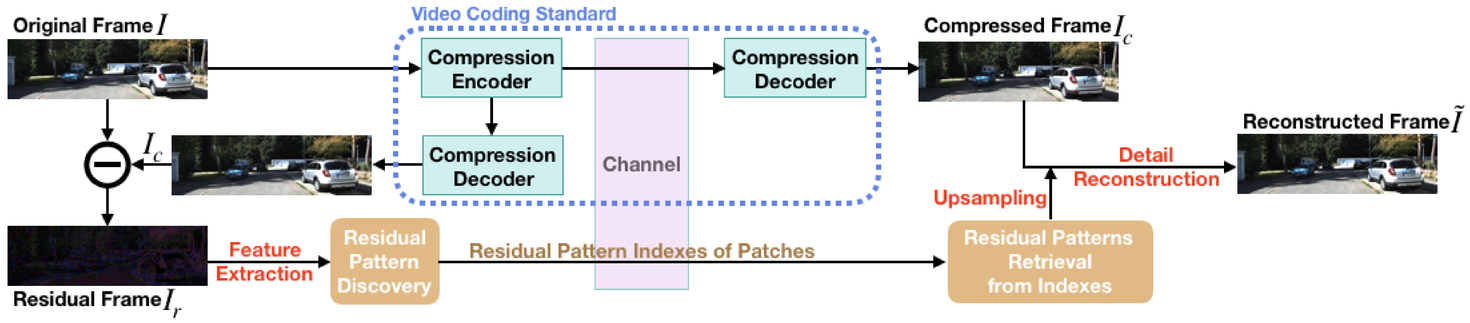
Learning Patterns of Latent Residual for Improving Video Compression

Yen-Chung Chen[1*] Keng-Jui Chang[1*] Yi-Hsuan Tsai[2] Wei-Chen Chiu[1]

(* indicates equal contribution) [1]National Chiao Tung University, Taiwan [2]NEC Laboratories America

Overview

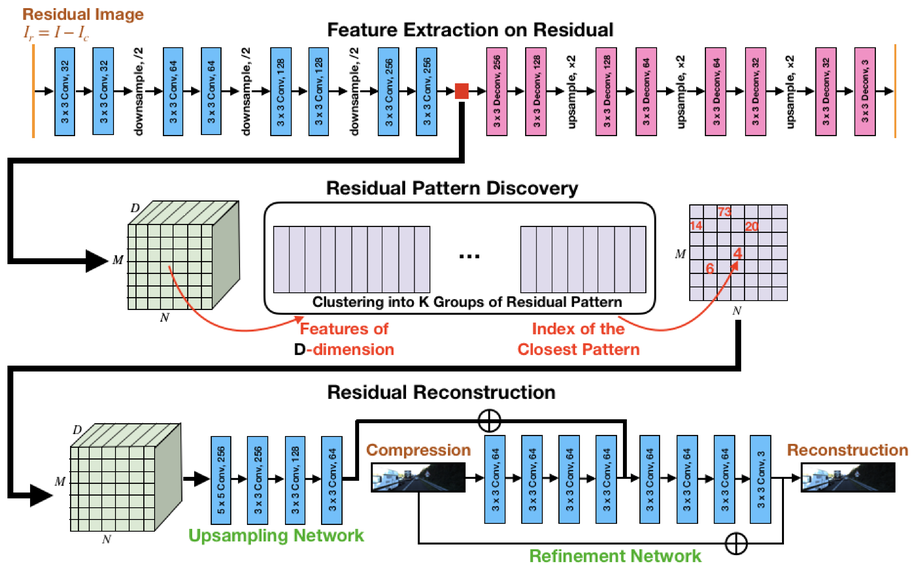
Our goal is to perform frame-by-frame video compression enhancement. The proposed pipeline first takes the residual frame as input, which is the difference between the original and compressed frame. We then extract features from the residual information and perform residual pattern discovery on the patch level, stored as a form of residual pattern indexes to reduce required bandwidth during transmission through the channel, e.g., during video streaming. On the client side, we first utilize the received indexes to retrieve the corresponding residual patterns, which are further used to reconstruct the residual information and improve the quality of compressed frames.



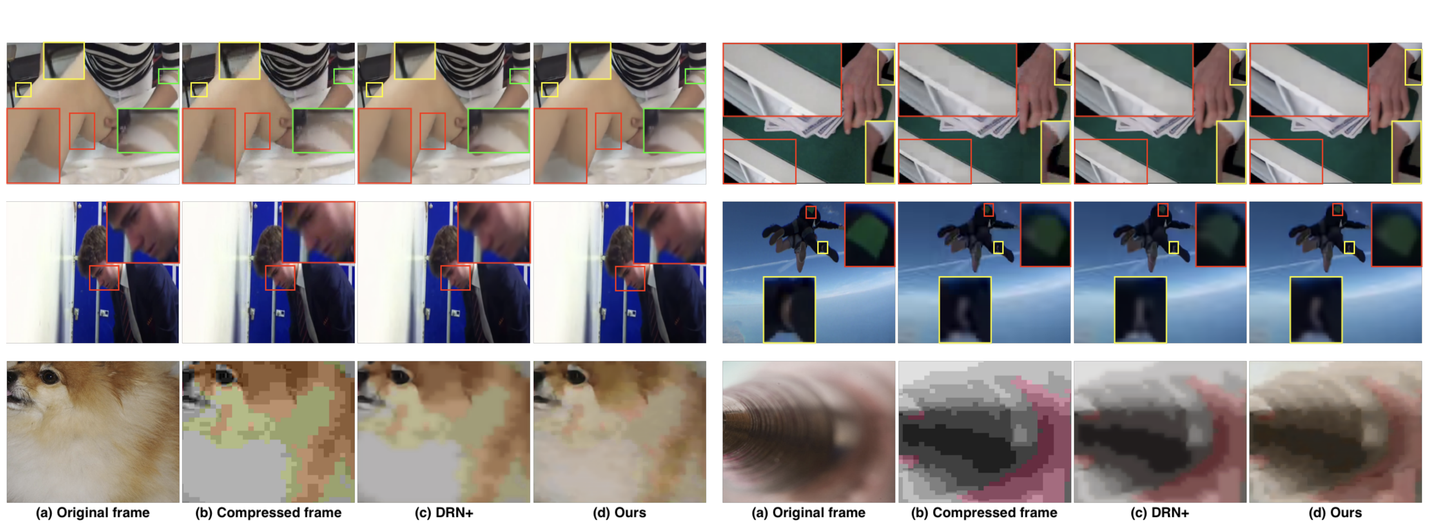
Contributions

- We propose a unified image and video compression enhancement network driven by residual information without the requirement of knowing any prior knowledge of compression method, and thus any off-the-shelf image/video compression method can be applied to our method.
- Our method reduces the cost of transmitting residual by transmitting indexes obtained from residual pattern discovery, which particularly benefits video streaming.
- We conduct extensive experiments on assisting numerous video compression methods.

Proposed Method



Qualitative Results



Quantitative Results

Kinetics	Coding Standard	H.264			HEVC			VP9		
	BitRate (bits/sec)	1M	2M	5M	1M	2M	5M	1M	2M	5M
PSNR	Original	31.638	34.680	37.271	29.209	33.255	37.512	33.152	35.008	36.445
	DRN+ [1, 2]	32.776	36.264	39.432	29.944	34.550	39.536	34.276	36.296	38.162
	Ours	**33.044**	**36.384**	**39.651**	**30.030**	**34.570**	**39.702**	**34.425**	**36.555**	**38.292**
SSIM	Original	0.939	0.967	0.984	0.878	0.927	0.983	0.951	0.968	0.979
	DRN+ [1, 2]	0.947	0.973	0.988	0.885	0.932	0.986	0.957	0.972	**0.984**
	Ours	**0.949**	**0.974**	**0.989**	**0.889**	**0.933**	**0.987**	**0.958**	**0.973**	**0.984**

Vimeo-90k	Coding Standard	H.264	HEVC	VP9
	BitRate (bits/sec)	5M		
PSNR	Original	38.327	39.013	39.624
	DRN+ [1, 2]	40.182	40.890	41.503
	Ours	**40.468**	**41.242**	**41.794**
SSIM	Original	0.985	0.987	0.988
	DRN+ [1, 2]	0.989	0.990	0.991
	Ours	**0.990**	**0.991**	**0.992**

References

[1] O. Kirmemis, G. Bakar, and A. Murat Tekalp, "Learned compression artifact removal by deep residual networks," in *IEEE Conference on Computer Vision and Pattern Recognition Workshops*, 2018.

[2] K. Zhang, W. Zuo, Y. Chen, D. Meng, and L. Zhang, "Beyond a gaussian denoiser: Residual learning of deep cnn for image denoising," *IEEE Transactions on Image Processing (TIP)*, 2017.