Data Compression Conference

Standard Compatible Efficient Video Coding with Jointly Optimized Neural Wrappers

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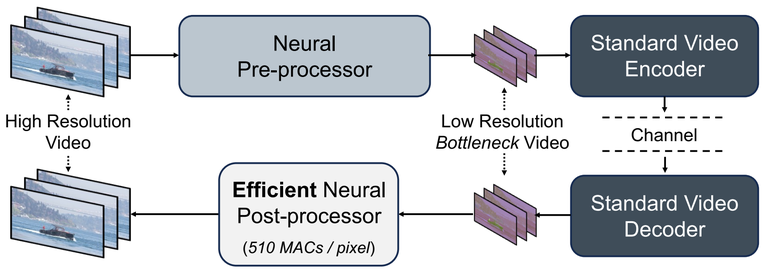
I. Introduction

- **Motivations**
  - **High resolution videos** (e.g. 4K / 8K in 60 fps**)**
  - **Streaming services** (YouTube, Netflix, etc.)
  - Cloud **storage** and **bandwidth** consumption.
  - We need to improve **video coding standards**.
  - Neural network-based **post-processing and super-resolution** techniques are promising.
  - **Complexity** is a roadblock.

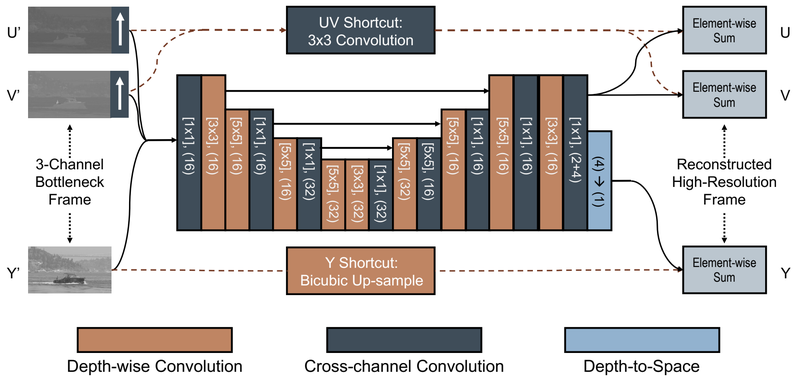
- **Neural Wrapper** for Codecs



  - **Down-sample** with a **neural** preprocessor.
  - Use **standard video codec** to code the low-resolution video (neural codes).
  - **Efficient** neural up-sampler as a postprocessor to decode high-resolution video.
  - The pre- and post-processors are **jointly optimized** with a **differentiable codec proxy.**
  - The same model works with **modern codecs (HEVC, VVC, AV1, etc.)**.
  - **Very low complexity:** 516 MACs per pixel.

II. Techniques

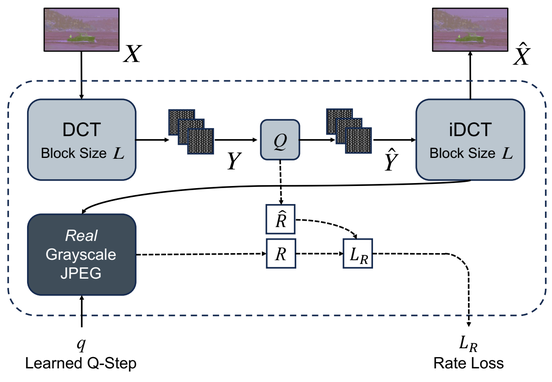
- **Efficient Postprocessor**



  - **Lower complexity**: 1x1 cross-channel conv. & 5x5 (3x3) **depth-wise** conv.
  - **Shortcuts**: maintain **luma** information in the neural codes and reduce post-processing learning burden.

- **Standard Codec Proxy**

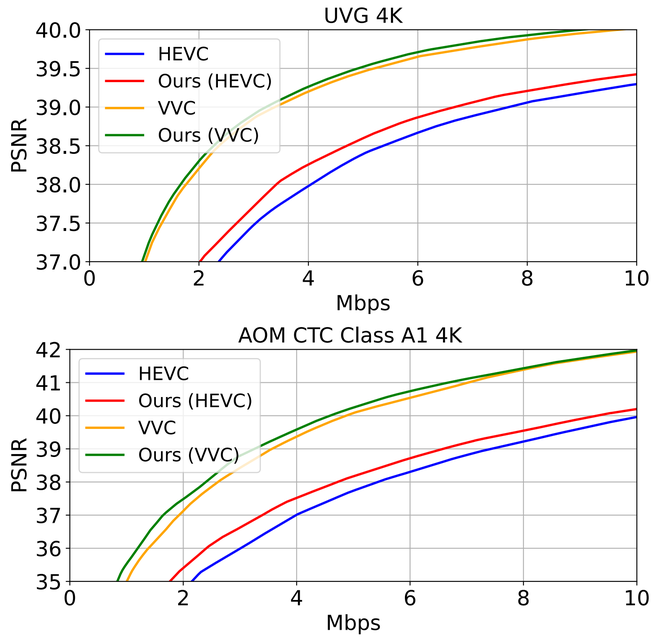
Code Available



  - Use **randomized block sizes** (4 – 32) for training.
  - Simulates video codec **quantization noise and applies bit-rate constraints**.
  - Generalizes to HEVC and VVC.

III. Experimental Results

- **Rate-Distortion Results**



Dataset	HEVC (x265)	VVC (VVEnC)
UVG 4K	-21.9%	-7.8%
AOM CTC Class A1	-12.3%	-8.7%

GPU	Resolution	Latency (ms)	Max Frame Rate (FPS)
RTX 3060	4K	30.7	33
RTX 3060	1080p	7.7	130
RTX 4080 Super	4K	8.6	116
RTX 4080 Super	1080p	2.2	448

- **More Projects at NYU Video Lab**

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