

iSIZE BitClear: Deep Perceptual Denoising and Upscaling for Video Delivery Systems

iSIZE's BitClear is an AI technology for denoising and upscaling of compressed low-resolution video assets. The focus of BitClear is on removal of encoding artifacts (blocking, blurring, ringing, aliasing, etc.). However, the neural network solution can also be trained to remove any other types of artifacts if indicative training data is available. Our solution is **2 to 10 times faster than the state-of-the-art in video denoising, while offering significantly-superior quality**. Via our patented perceptual quality optimization technology, BitClear is (Fig. 1): (i) able to optimize both standard perceptual quality metrics like VMAF, SSIM and similar, but also visual quality as assessed by human viewers under controlled test conditions like ITU-T Rec. P.910 (Fig. 2); (ii) allowing for single-pass processing with single-frame latency, without needing any side information on the exact encoding or processing that has already taken place; (iii) able to (optionally) upscale the input video by up to 4x. Unlike competing approaches for video denoising that can generate artifacts, BitClear operates at scale without manual tuning, as it is trained to disentangle the source and noise manifolds and recover video details without changing the aesthetics of the decoded video.

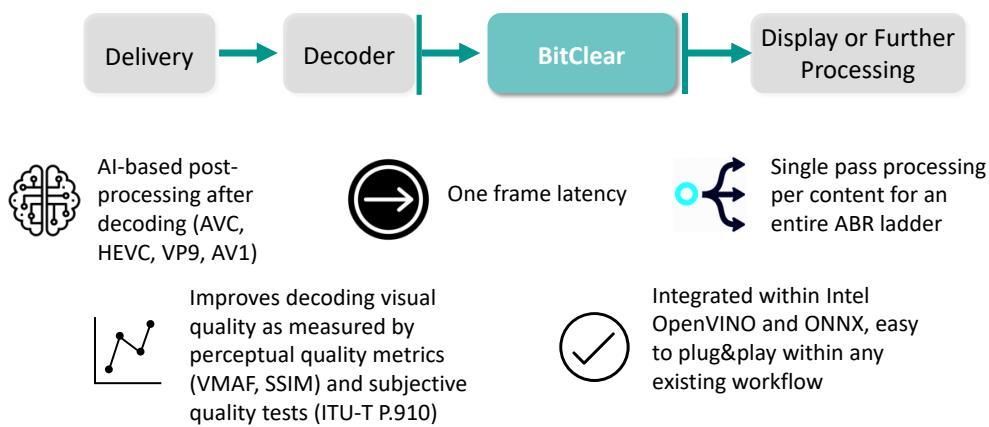


Figure 1. iSIZE's BitClear pipeline for AI-based removal of compression artifacts.

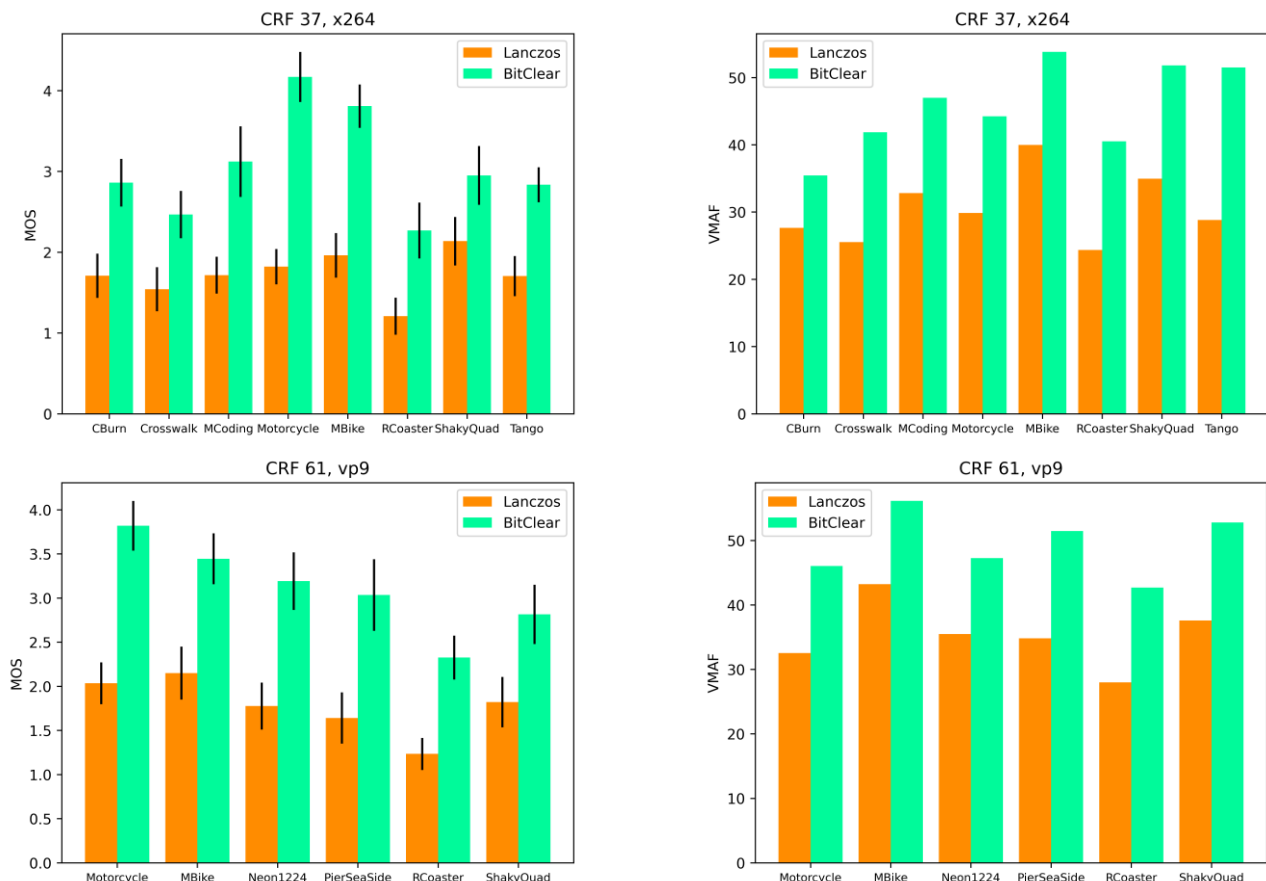


Figure 2. P.910 mean opinion score (MOS) and VMAF for BitClear vs. decoding & Lanczos upscaling: AVC x264 CRF=37 encodes (top row) and VP9 vpxenc CRF=61 (bottom row). The test content is from the AV2 CTC dataset.

Boosting quality of compressed content: BitClear can be applied as a post-processor to bitstreams received by any device. Rigorous ITU-T P.910 ACR testing, as well as objective quality metrics (VMAF) show that BitClear offers very significant quality improvement versus the decoded and upscaled AVC or VP9 video for high and medium CRF encodes (i.e., $CRF \in \{30, \dots, 51\}$ for AVC and $CRF \in \{40, \dots, 61\}$ for VP9/AV1/VVC that correspond medium and low-bitrates, see Fig. 2). Indicative visual examples are shown in Fig. 3.

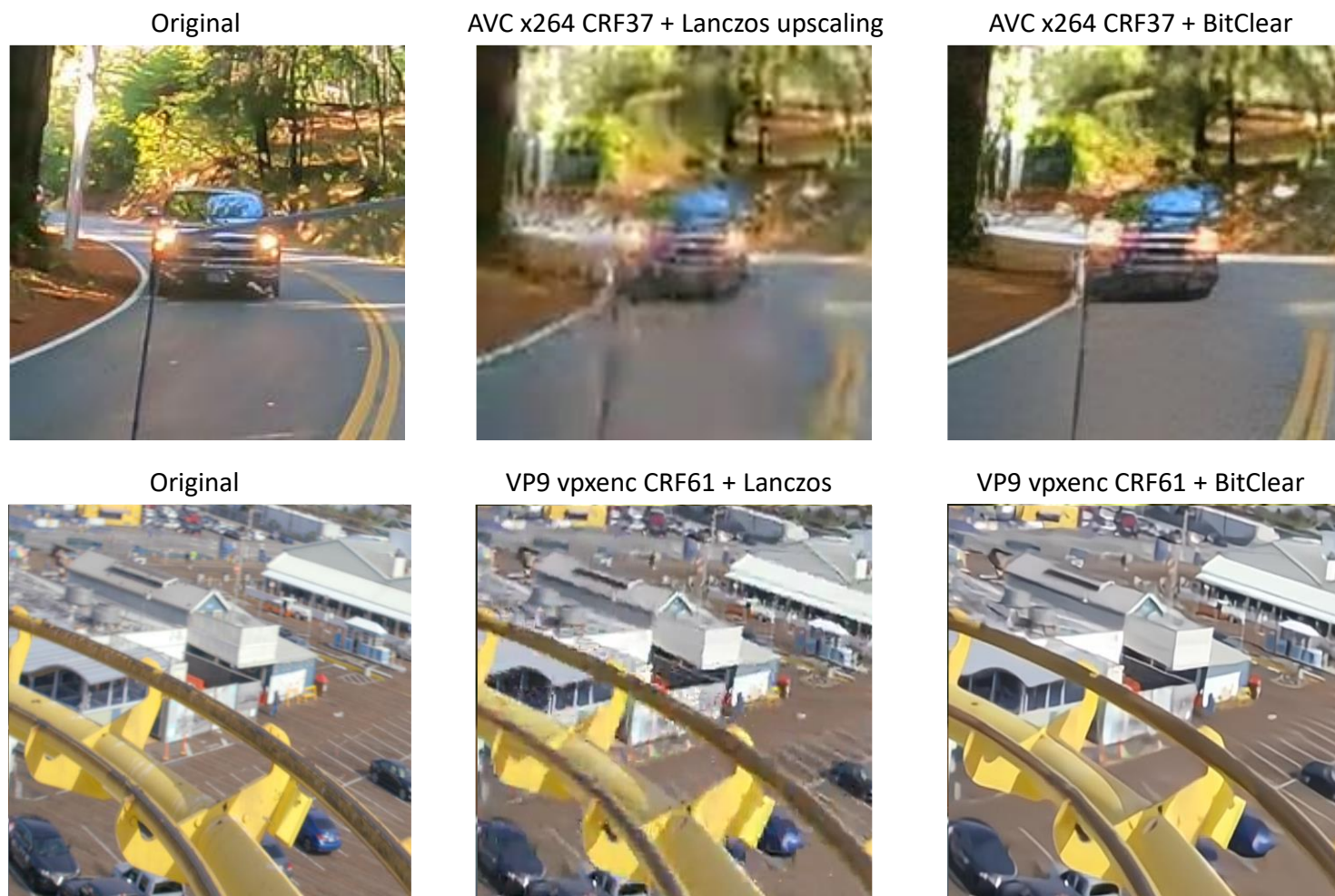


Figure 3. Visual examples of: original crop, codec + Lanczos x2 upscaling and codec + BitClear denoising and x2 upscaling.

Table: (Left) Runtime (FPS) for single-socket CPUs, GPUs and NPUs of common input resolutions and no upscaling. Notes: (i) The Intel and NVIDIA benchmarks were carried out on cloud instances. (ii) The Qualcomm Snapdragon benchmarks were carried out in Samsung S21 and Oppo X3 Pro phones using the [Qualcomm Neural Processing SDK](#) and the NPU of the Snapdragon 888 chipset.

BitClear denoising without upscaling: Frames-per-second (FPS) on single-socket CPU/GPU/NPU hardware								
Input Resolution	Intel 8275 CPU (24c, 3.0GHz)	Intel 6330 CPU (24c, 3.1GHz)	AMD 7542 CPU (64c, 2.9GHz)	NVIDIA T4 GPU	NVIDIA A10 GPU	NVIDIA A40 GPU	NVIDIA A100 GPU	Qualcomm Snapdragon 888
144p	632	581	401	892	1369	1515	1923	700
240p	277	261	187	393	775	1041	1470	500
360p	134	129	93	186	389	460	515	330
480p	54	52	39	82	188	227	304	240
540p	43	42	32	67	150	181	256	125
720p	23	24	18	38	89	117	173	66
1080p	10	10	8	17	40	54	87	38

iSIZE BitClear Specification:

Inputs and output containers

yuv, y4m, mp4, webm, mov, ts, m2ts, mkv, streaming (http, tcp, udp, m3u8)

Input and output video codecs

raw YUV, AVC, HEVC, VP9, ProRes

Input & output audio codecs

passthrough (optional)

Deliverable/Integration:

Linux binary

Docker container

C/C++ Library

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