Datasheet v20211221

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

iSIZE's BitClear provides a scalable solution to denoise and upscale severely distorted low-resolution video assets. The current focus of BitClear is on removal of encoding artifacts (blocking, blurring, ringing, aliasing, etc.). However, the underlined neural network technology 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 and upscaling, while offering 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 of controlled testing conditions like ITU-T Rec. P.910; *(ii)* allows 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)* can (optionally) upscale the input video by up to 4x with quality/complexity that is tunable according to the compute capability of the deployment hardware. Unlike competing approaches for video denoising that can generate artifacts, BitClear is designed to operate at scale without the need for human inspection, as it is designed to disentangle the source and noise manifolds, and recover video details without changing the aesthetics, perceptual intent or the structure of the decoded video.

- Fast and easily integrated with any encoder including AVC, HEVC, VP9, AV1, VVC, without breaking standards or requiring any changes on the client device
- Single-pass through the content with 1 frame latency
- Supports multi-codec, multi-recipe, multi-bitrate and multi-resolution ABR ladders
- Deep neural network models for denoising and upscaling after decoding provide 25% to 50% bitrate savings on top of any codec
- Next generation sustainable results and a significant reduction in costs for video delivery

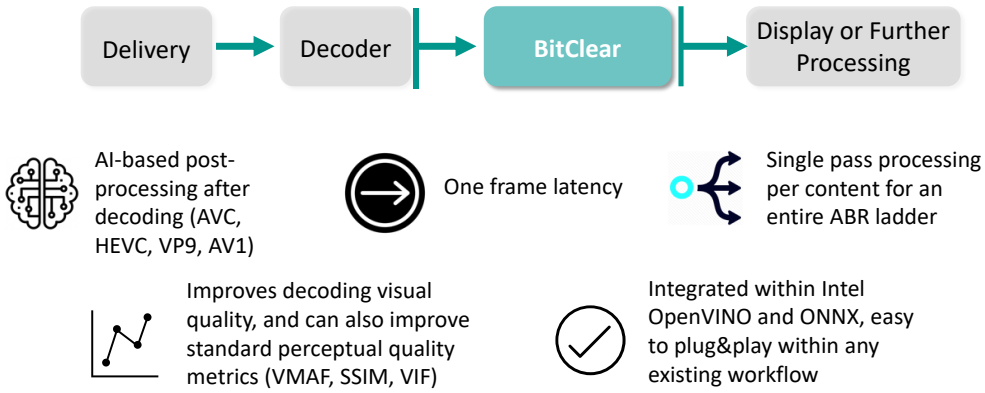

Figure 1. *iSIZE's BitClear pipeline for preprocessing.*

- **Simple integration**−BitClear post-processes video content without changing the encoding; consequently, these gains are attainable without any of the disadvantages associated with needing access to (or replacing) components of encoders, streaming infrastructures, or encoding devices. The BitClear post-processor can simply be plugged in just after the decoding pipeline without disrupting the existing pipeline.
- **Codec independent**−BitClear is compatible with any existing codec (including MPEG AVC/H.264, HEVC/H.265, EVC, VVC and AOMedia VP9, AV1, AV2), and supports all resolutions up to 8K. The post-processing accepts all video formats as input and outputs same-resolution or upscaled lossless video or a transport stream, before passing to any display or onward processing. Only a single pass over the content is required (with single frame latency), prior to any number of subsequent encodings or processing steps.
- **Breakthrough speedup vs. all competing approaches**−iSIZE's proprietary deep learning-based models can run on all CPU and GPU hardware. The current generation of BitClear models is able to run on 4 CPU cores or higher, achieving real-time processing on most cloud instances for up to 540p@30fps, and in general 7x to 32x faster runtime versus the best-performing deep neural network based denoising and upscaling solution in the market.

Boosting bitrate savings of off-the-shelf encoders: BitClear can be applied as a post-processor to bitstreams received by any device. When applied together with bitrate reduction and downscaling in video encoding, average bitrate savings on typical HD (720p), full-HD test (1080p) and 4K (2160p) videos are reported in Fig. 2 across multiple encoders (AVC, HEVC, AV1). All averages calculated for typical video data of each category using VMAF, PSNR and MOS ratings by test audiences. The anchors correspond to the same encoders with and without downscaling. All encoded bitstreams remain fully standard-compliant and do not require any changes in content packaging and delivery.

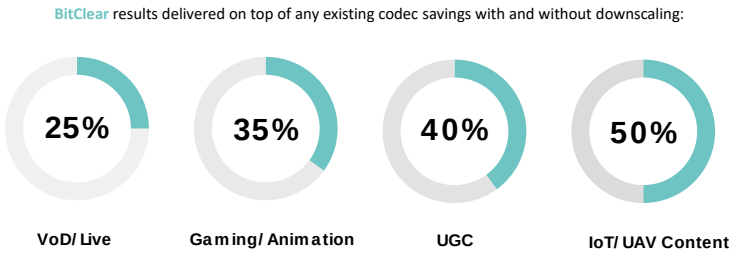

Figure 2. Additional bitrate savings delivered on top of AVC, HEVC and AV1 encoding (i.e., "anchor") results by using BitClear to denoise and upscale on the decoder (client) side.

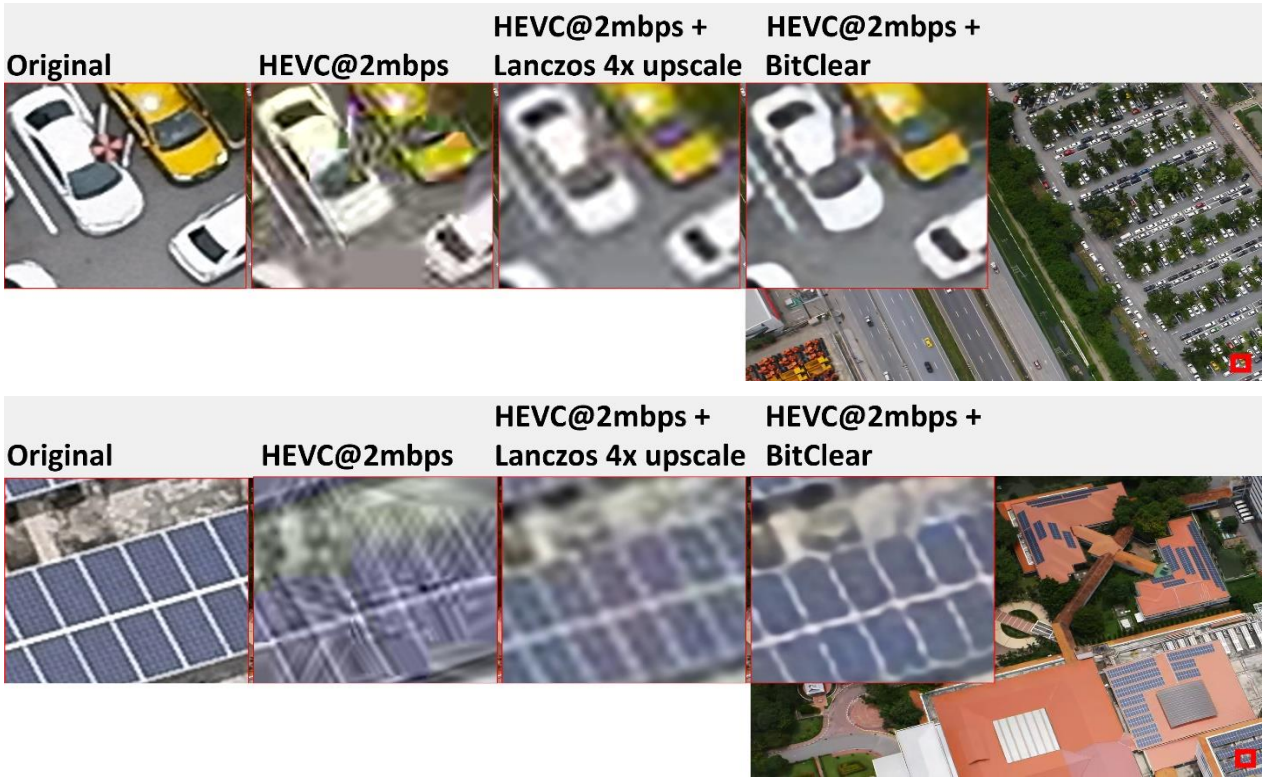

Figure 3. *The square insets show the zoomed in section of the red square shown at the bottom-right part of each of the two UAV captured aerial images. Visual comparison of: Original (uncompressed), HEVC, HEVC+Lanczos upscaling, iSIZE BitClear. All results except 'Original' are encoded at 2mbps using HEVC x265 preset=medium. All results except 'Original' and 'HEVC' are encoded at 4x lower resolution and the decoded frame is upscaled by x4 using each of the methods presented in order to recover superior quality to the encoder.*

Tables: (Left) Runtime (FPS) for single-socket CPU (AWS c5d.12xlarge, Intel Xeon Cascade Lake 24c) processing of common input resolutions. (Right) Theoretical complexity in terms of giga-MAC operations per frame.

	Frames-Per-Second (FPS)			
Resolution	BitClear fast	BitClear medium	BitClear slow	Best Competitor
144p	1176	800	423	62
240p	469	323	202	26
360p	208	121	94	14
480p	83	55	39	4
540p	66	40	32	2.5
720p	35	25	17	1
1080p	16	10	8	0.5

	Giga MAC Operations per Frame			
Resolution	BitClear fast	BitClear medium	BitClear slow	Best Competitor
144p	1.23	4.56	7.34	16.96
240p	2.56	9.49	15.3	35.33
360p	5.76	21.35	34.43	79.21
480p	13.63	50.54	81.49	187.76
540p	17.28	64.07	103.3	237.61
720p	30.72	113.88	183.6	423.9
1080p	69.11	256.23	413.11	953.49

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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