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Divergence-Based Adaptive Extreme Video Completion (ADEFAN)

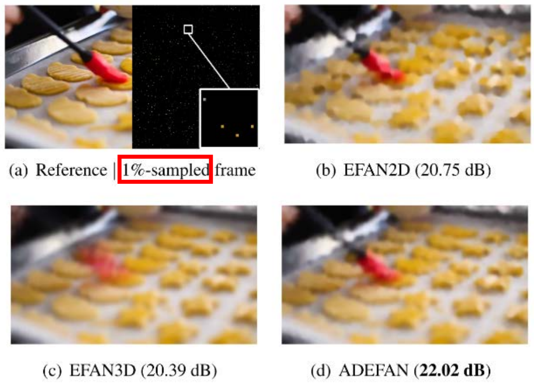

Fig 1: The sample reference frame is reconstructed from 1% randomly-sampled pixels (a), using different methods. (b) EFAN2D can track motion but causes disturbing video flickering. (c) EFAN3D achieves video stability at the cost of excessive temporal blurring effects. (d) Our adaptive ADEFAN method leverages the advantages of both (b) and (c). We achieve the best video reconstruction accuracy with minimal flickering.

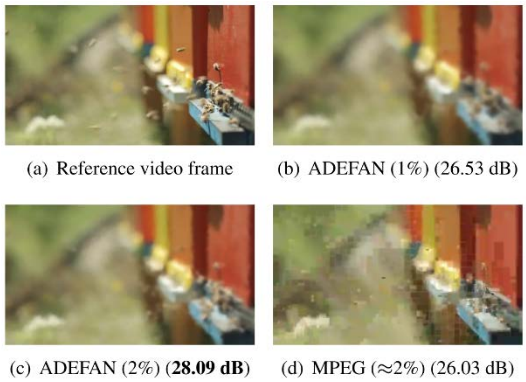

Fig 2: The frame (a) is reconstructed with ADEFAN from 1% and 2% random samples and with MPEG-4 decompression from a slightly larger than 2% MPEG-4 compression.

Ref. Nr

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Keywords

Extreme completion, sparse color motion, extreme compression, video inpainting

Intellectual Property

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Publications

“Divergence-Based Adaptive Extreme Video Completion” in IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), 2020

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Description

Extreme image or video completion, where, for instance, we only retain 1% of pixels in random locations, allows for very cheap sampling in terms of the required pre-processing. The consequence is, however, a reconstruction that is challenging for humans and inpainting algorithms alike. EFAN is a completion method that can only be applied to 2D images. To run it over a video, we apply it frame by frame and refer to this as EFAN2D (Fig 1b). If we extend it in a straightforward way to video data we obtain EFAN3D (Fig 1c). Our proposed ADEFAN (Fig 1d) is designed specifically for video completion, it leverages the sequence of frames available in a video to reconstruct each frame, and does so adaptively. It adapts to what we call color motion, which we manage to estimate over sparsely-sampled videos, to extract as much temporal information as possible while reducing blur.

Our patent thus covers a state-of-the-art extreme video completion apparatus. We analyze a color motion estimation approach based on color KL-divergence that is suitable for extremely sparse scenarios. Our algorithm leverages the estimate to adapt between its spatial and temporal filtering when reconstructing the sparse randomly-sampled video. We validate our results on 50 publicly-available videos using reconstruction PSNR and mean opinion scores.

Advantages

Extremely **energy-effective** compression: the videos are randomly sampled, no pre-processing computation is required, unlike standard codec such as MPEG.

Extremely **fast** compression: the videos are not pre-processed, and hence the compression is practically as fast as simply transmitting pixels.

No special hardware required at the sender: as the compression only requires pixel dropping, no specific hardware is needed such as for example DCT computation hardware that is needed in standard codec.

Adapts to **extreme compression** rates: our method is designed and tested on extremely sparse sampling rates. It can be applied at rates going down to just 1% of pixels.

Applications

- Internet of Things: ADEFAN is very low on energy consumption and requires no special hardware, making it ideal for IoT devices that need to transmit videos.
- Cheap surveillance / motion inspection: ADEFAN can go to extremely small compression, and needs almost no sender computation and power consumption, making it ideal for continuous transmission.
- Emergency deployment: ADEFAN is also practical when strong infrastructures are not available (remote areas, natural disasters relief missions, etc.) as it allows the transmission of extremely sparse videos without any needed pre-processing on the sender side.