Universal Perturbation Attack on Differentiable No-Reference Image- and Video-Quality Metrics

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Motivation
No-reference (NR) image- and video-quality metrics are widely used for video processing tasks including different algorithms comparison. Comparison participants can dishonestly increase the metric scores by attacks to get better results. The goal of attacks on quality metric is to increase the quality score of an output image, when visual quality does not improve after the attack. We make the first attempt in attacking differentiable no-reference (NR) image- and video-quality metrics through universal adversarial perturbations (UAPs). We use UAP attack as quickest attack since we are investigating the possibility of injecting attacks on quality metrics in video compression and processing algorithms.

Contributions
1. We employed a universal perturbation attack against seven differentiable NR metrics (PaQ-2-PiQ, Linearity, VSFA, MDTVSFA, KonCept512, Nima and SPAQ)
2. We applied trained UAPs to Full-HD video frames before compression and proposed a method for comparing metrics stability based on RD curves to identify metrics that are the most resistant to UAP attack.

Code availability
The code is available on GitHub: https://github.com/katiashh/UAP_Attack_on_Quality_Metrics

Proposed Method
1. UAP attack: we trained UAP on the dataset of 256x256 images from COCO dataset.
2. Stability score: we applied UAP as preprocessing to the frames of 20 Full-HD videos taken from Xiph.org datatet, compress original and attacked videos with four bitrates (200k, 1M, 5M and 12M) and on the basis of RD curver calculate stability score as area under target-metric gain versus proxy-metric loss dependencies multiplied by -100

Results
SPAQ, Nima and KonCept512 proved to be resistant to UAP attack, while PaQ-2- PiQ, Linearity, VSFA and MDTVSFA proved vulnerable. We recommend the proposed method as an additional verification of NR metric reliability to complement traditional subjective tests and benchmarks.

References
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