OBJECTIVE QUALITY ASSESSMENT METHODS AND MODELS FOR COMPRESSED VIDEO

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Abstract

Number of compression methods for video sequences has been introduced in last several years. These methods produce artefacts whose visibility strongly depends on the actual image content. It is important to devise video quality assessment algorithms that help to evaluate, compare and improve compression methods. In this paper two models for objective quality assessment and results from subjective and objective tests of several codecs are introduced. First model is based on mathematical characteristics that describe perception of video distortion and second model is based on human visual system model parameters.

1. Introduction

In last several years many compression methods for digital video systems were introduced. It has become very important to devise objective video quality assessment algorithms. The subjective measurement Mean Opinion Score (MOS) is a widely used method on the assessment of image or video quality, but it has several obvious disadvantages. It is very tedious, expensive and impossible to be executed automatically. Instead, an objective image or video quality metric can provide a quality value for a given image or video automatically in a relatively short time. This is very important for real world applications.

2. Models for objective quality assessment

The easiest objective quality measures are some simple statistics features on the numerical error between the reference and the distorted image. Widely used statistics are Mean Squared Error (MSE) and Peak Signal to Noise Ratio (PSNR). However, MSE and PSNR do not correlate well with subjective quality measures because human of perception distortions and artefacts is unaccounted for.

Systems for objective quality measurement can use measures that correlate with perceptual distortion or can use Human Visual System (HVS) features. Widely used models are Tektronix/Sarnoff, NASA – DVQ Digital Video Quality Model and EPFL – PDM Perceptual Distortion Metric.

First system for video quality evaluation I adapted and used for tests uses mathematical measures that correlate with perception of distortion (Fig.1). These mathematical characteristics were selected by ITS in Colorado [3] from the quality features and parameters suggested by American National Standard Institute, ANSI. The quantitative metric is linear combination of three quality impairment measures. First measurement is a measure of spatial distortion and second and third measurements are both measures of temporal distortion.

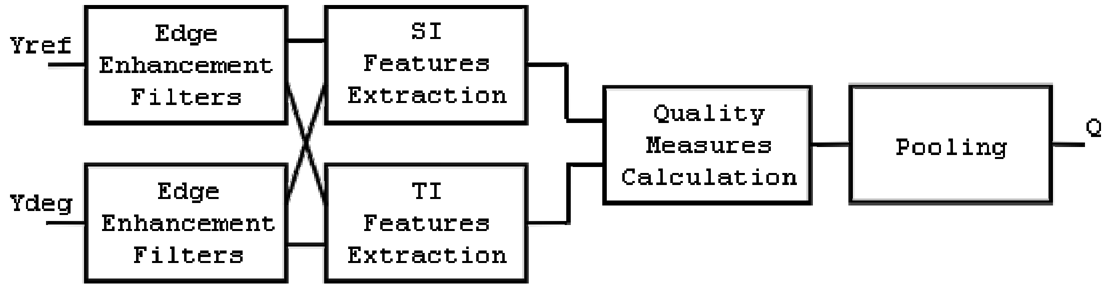

Fig. 1 Model based on mathematical measures

Second model for video quality evaluation is shown on Fig. 2. It simulates some stages of human visual system HVS. First steps are decomposition of sequence into different spatial channels and conversion to local contrast LC. Next block is temporal filtering which implements temporal part of CSF. Then DCT coefficients are converted to just-noticeable difference (jnd). At the next stages sequences are subtracted, mean and maximum distortion is calculated, weighted and pooled to implement masking operation. The result is quality of video sequence.

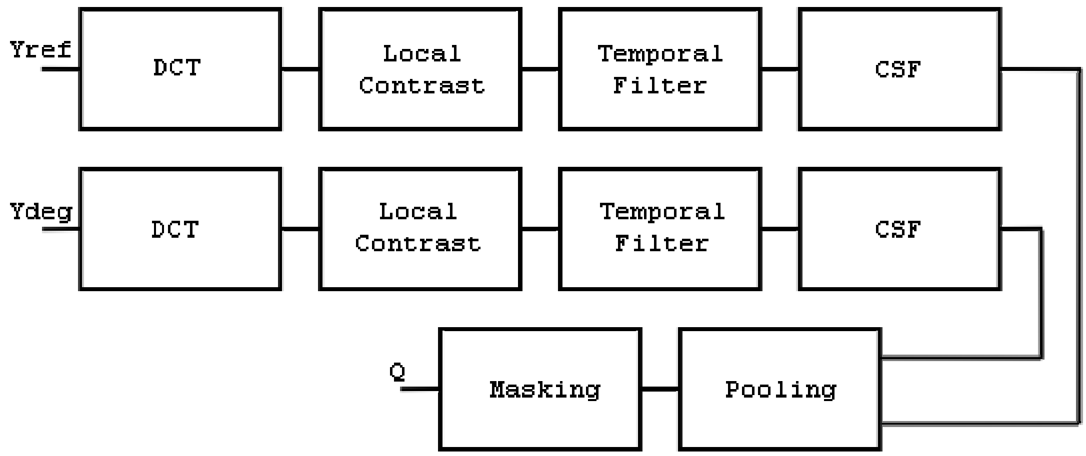

Fig. 2 Model based on DCT and JND

3. Models Evaluation

For quality tests of the models we have used five test sequences from the set of EBU test sequences. These sequences are in ITU-R 601 format and are 10 seconds in duration. We have tested 6 widely used compression methods (DivX, XviD, Quick Time, Windows Media, MP2 Tsunami and VP6). For each tested compression method we used 5 compression levels at 4096 kbit/s, 2048 kbit/s, 1024 kbit/s, 512 kbit/s and 256 kbit/s and we obtained set of 150 degraded sequences. As a reference values subjective rating of 14 observers were used. Subjective assessment was based on ITU-R Recommendation BT.500. We used Double Stimulus Continuous Quality Scale (DSCQS) method.

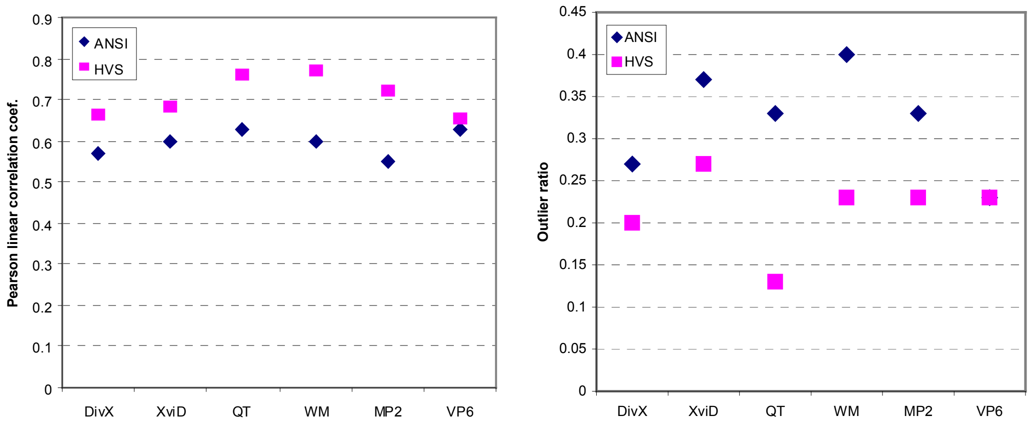

Fig. 3 Comparison of the models with respect to two performance attributes. On the left "accuracy" and on the right "consistency" of the models.

4. Conclusion

Two models for objective video quality assessment have been presented in this paper. Both models have been programmed in Matlab tool. Obtained data from both models is correlated with subjective results and it is possible to use proposed models, which are faster and cheaper, for quality tests.

5. Acknowledgement

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6. References

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