Quality Analysis Framework

Overview

In TOSCA-MP a framework for automatic quality assessment of videos was developed. In the project, six quality metrics for single quality artefacts were developed. An overall quality metric was also modelled based on single quality predictions.

In depth description

Although human observers can effectively judge the quality of an image, involving them is highly time and resource consuming. Therefore, no-reference (NR) quality metrics were developed in TOSCA-MP to predict image quality scores in the project due to the lack of reference video sequences. NR metric is typically designed for measuring a particular distortion type. Thus, six NR quality metrics were optimized and benchmarked in the project according to the characteristics of each quality distortion:

- Blocking artefacts: This metric is based on the perceptibility of blocking artefacts according to the strength of the blocking boundaries, the discontinuities across the block boundaries and the flatness of the image.

- Brightness: The brightness metric is a technical measurement in the luminance channel.

- Contrast: The contrast metric is a perceptual-based measure based on the human attention model and the picture dynamic measurement. Compared to traditional contrast metrics, which only use the luminance information, the developed metric also uses the colour information of images. According to a human attention model, the technical contrast measure is mapped onto a perceptual-based measure.

- Noise: The noise metric is based on a discretized thin-plate smoothing spline algorithm. This metric predicts the strength of noise based on the generalized cross validation score between the signal of the DCT transformed image and an original 2D cosine signal.

- Picture dynamic: The dynamic ranges of colour components can be obtained by taking the log values in the range between the brightest and darkest picture samples. The overall picture dynamic is defined as a weighted linear combination of the dynamic ranges of the respective colour channels.

- Sharpness: The sharpness metric can be divided into two stages. First, the probability of local blurriness is fragmentarily measured based on the Just Noticeable Blur (JNB) metric [Ferzli, 2009]. Then, the visually salient high frequency components are measured to extend the probability of local blurriness to the whole image.

An overall quality measure was implemented by integrating the structural (blocking artefacts, noise and sharpness) and non-structural distortions (brightness, contrast and picture dynamic). The NR metrics were evaluated using CSIQ, LIVE and TID2008 image databases. The Pearson (CC) and Spearman (SROCC) correlation coefficient scores were used to evaluate the performances of the NR metrics. Higher scores mean better performances. Two full-reference metrics, PSNR and SSIM, were used for benchmarks. According to Table 1, it can be observed that the HHI metrics show a high correlation to the Mean Opinion Scores (MOS). Overall, the implemented NR metrics perform better than full-reference metrics on predicting the quality scores of blocking artefacts, contrast and noise. The NR sharpness metric produces comparable results to the FR metrics.

	CC	SROCC	Dataset
PSNR	0.876	0.926	LIVE JPEG
	0.834	0.965	LIVE Noise
	0.795	0.840	LIVE Gaussian blur
	0.833	0.861	TID2008 JPEG
SSIM	0.904	0.922	CSIQ JPEG
	0.722	0.740	CSIQ Contrast
	0.850	0.925	CSIQ Gaussian blur

	CC	SROCC	Dataset
Blocking artifacts	0.936	0.932	CSIQ JPEG
	0.826	0.881	LIVE JPEG
	0.934	0.909	TID2008 JPEG
Contrast	0.923	0.936	CSIQ Contrast
	0.908	0.801	TID2008 Contrast
Noise	0.939	0.971	LIVE noise
Sharpness	0.887	0.873	CISQ Gaussian blur
	0.930	0.927	LIVE Gaussian blur
Overall	0.825	0.808	CSIO All
	0.815	0.873	LIVE All

Table 1: Performance of NR metrics evaluated by using corresponding image datasets

Potential fields of Application

Automatic no-reference quality assessment framework can be applied in variety of image/video processing system for artefact detection, quality prediction, quality controlling. Moreover, it can also be used to estimate parameters for image/video quality optimization and restoration.

Possibilities for exploitation

Exploitation in the form of following collaborative projects is targeted.

Further Information

Further technical information is available in TOSCA-MP WP2 confidential deliverables D2.1 and D2.2 on "Automatic Metadata Extraction and Enrichment".

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