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A Framework for Computationally Efficient Video Quality Assessment

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Abstract

Objective video quality assessment (VQA) methods are essentially algorithms that estimate video quality. Recent quality assessment methods aim to provide quality predictions that are well correlated with subjective quality scores. However, most of these methods are computationally costly, which limits their use in real-time applications. A possible solution to this problem is to decrease the video resolution (spatial, temporal or both) in order to reduce the amount of processed data. Although reducing the video resolution is a simple way of decreasing the running time of a VQA method, this approach might impact the prediction accuracy of the VQA method. In this paper, we analyze this impact. More specifically, we analyze the effects of resolution reduction on the performance of the VQA methods. Based on this analysis, we propose a framework that decreases the overall processing time of VQA methods, without decreasing significantly the performance accuracy. We test the framework using six different VQA methods and four different video quality databases. Results show that the proposed framework reduces the average runtime performance of the tested VQA methods, without considerably altering their performance accuracy.

Keywords: Video Quality Assessment Methods, Spatial Resolution, Runtime Performance

1. Introduction

In recent years there has been an increasing demand for video-based services. In a recent report, Conviva® has shown that viewers are demanding a higher quality of delivered multimedia content [1]. But, in the context of video, higher quality content generally corresponds to larger file sizes, which implies higher network traffic and storage space. According to Cisco, in 2019 eighty percent of all consumer Internet traffic comes from video applications [2]. As users' demands for a higher quality content increase, it is important to design automatic tools that are able to predict the quality of the video as perceived by the user.

The quality of a video can be altered in any stage of the communication chain, such as capture, compression, transmission, reproduction, and display. There are basically two methods for assessing the quality of a video: subjective and objective methods. Subjective quality assessment methods require performing psychophysical experiments. In these experiments, subjects watch a set of videos and give a quality score to each video. Although subjective video quality assessment (VQA) methods are known to be the most reliable methods available today [3], these methods are expensive and time-consuming, being, therefore, unsuitable for real-time applications. On the other hand, objective VQA methodologies consist of computer algorithms that are able to automatically estimate the quality of a video. These methods are faster and cheaper than subjective methods, but often less accurate.

In the early days, a common approach consisted of adapting image quality assessment (IQA) methods to measure video quality. Outputs of IQA methods, such as Peak Signal-to-Noise Ratio (PSNR), were obtained for each video frame and averaged to provide a single video quality

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