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A perceptual macroblock layer power control for energy scalable video encoder based on just noticeable distortion principle ☆

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ABSTRACT

In most mobile video encoding systems, long battery life and high performance video encoding are competing design goals. This paper proposed a Macroblock (MB) level perceptual energy scalable video encoding method noted as PMP-ESVE, in which just noticeable distortion (JND) model is introduced as the perceptual cue. PMP-ESVE includes three parts, first, PMP-ESVE can dynamic adapt the variable energy resource budget in MB level, second, PMP-ESVE jointly consider the available energy resource and the perceptual feature in order to provide a MB level scalable video encoding method under variable energy consumption budget. Third, JND model, which refers to the maximum distortion that human visual system cannot perceive, is extended from spatial domain to temporal domain so as to determine perceptual cue in unit of MB. This provides the guideline of resource allocation in MB's. Finally, both objective and subjective quality evaluations are given to evaluate the proposed method. These experimental results demonstrate the efficiency of the proposed approach.

1. Introduction

With the wide progress of wireless communication, video compression has recently become an important feature of 3G cell phones, portable terminals and other battery-powered devices. An urgent requirement for portable wireless video systems is low power dissipation. As a result, power control and energy control play important roles in these systems. In portable video encoding systems, designing the energy aware systems so as to extend the battery lifetime is an effective way. Since the large computational complexity, video encoding systems need flexible tradeoffs between encoding quality and power consumption. Lian et al. (2007) present a power aware video encoding system by embedding some reconfigurable points inside so as to provide system-level power-aware control. They give the sufficient condition of a power-aware encoding. From the relation among rate, distortion and power consumption aspects, power-rate-distortion (P-R-D) model (He et al., 2004) was proposed. It analyzes the rate-distortion (R-D) behavior of video encoding system under the energy constraint. Based on this, further research in He et al. (2008) proves power is tightly coupled with rate, thus mapping bits to joules to perform energy minimization is a rapid method to achieve lower energy. These provide the comprehensive analysis for power scalable video encoding. From constructing a energy scalable video encoder aspect, De Schrijver et al. (2006) consider the memory, processing power, and bridge these with the amount of bandwidth which comes from video fragment. These researches demonstrate that energy consumption scalable video encoding becomes a tendency especially in energy constraint applications.

On the other hand, since the goal of video compression and coding aims at the lowest bit rate for signal representation at certain level of perceptual quality, or the highest perceptual quality with a given bit rate, video encoding system based on perceptual cues shows increasing potential. However, low power video encoding system with perceptual consideration has received relatively little attention. The reasons are as follows:

(1) Perceptual video quality evaluation is a very difficult problem. Current two accepted judgement methods are objective measurement in terms of PSNR or MSE, and subjective measurement in ways of MOS or human vision systems. For the sake of implement difficulty and stability requirement, objective measure becomes the mainstream in practical measurement. This leads to an large improvement space in

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