

摘要

近年来,有线网络和无线网络逐渐普及,网络视频无处不在。数字视频已经与人们的生活息息相关。视频压缩技术在数字视频应用中占据核心地位。一方面,为了提高压缩效率,视频压缩算法的复杂度越来越高,例如,最新的国内标准 AVS 与传统的 MPEG-2 相比,压缩效率提高将近 2 倍,复杂度提高了 5 倍左右;最新的国际标准 H.264 的复杂度比 MPEG-2 提高 10 倍到 20 倍。因为数字视频本身具有数据量大的特点,再加上复杂的视频压缩算法,使得当前的视频压缩技术需要巨大的运算能力。另一方面,数字视频格式也越来越多,应用比较多的有 MPEG-2、VP6、H.264、VC-1、RM 以及国内视频压缩标准 AVS。视频格式的增多,对视频转码技术提出了更高的要求。视频转码应用要求具有快速的转码速度和高质量的压缩效率。本文针对视频转码实际应用中复杂度高的问题,重点研究了低复杂的转码技术。具体来说,本文的研究内容包括:

1. 根据 H.264 帧内模式的分布特性和高低码率帧内模式的相关性,提出了一种降码率的快速帧内转码算法。该算法的复杂度较低,对有些序列转码性能还可以得到提高。
2. 根据最优码率分配理论提出了一种 AVS 降码率时的快速模式映射算法。该算法根据 λ 值可以快速确定最优编码模式,降低了转码的复杂度。
3. 根据 AVS 中 B 帧预测方向分布的特性,提出了一种降码率时 B 帧快速方向决策算法。该算法可以在保证转码性能的情况下大幅度的降低 B 帧转码的复杂度。
4. 传统的转码算法主要采用重用编码模式的方法降低复杂度,本文研究发现 AVS 与 H.264 视频压缩标准之间重用跳过模式会出现严重的块效应。文中给出了一种简单的解决方法,可以在复杂度很低的情况下有效的去除块效应。
5. 根据 AVS 和 H.264 之间帧内模式的特性,提出了一种 AVS 到 H.264 的快速帧内转码算法。该算法建立了从 AVS 到 H.264 的模式映射表,可以在保证转码性能的同时,大幅度降低转码的复杂度。

关键词: H.264, AVS, 转码算法, 降码率, 快速转码算法

Abstract

In the recent years, wired and wireless network become more and more popular. Video programs can be accessed from the network anywhere. Digital video technology becomes closely related to our daily life. Digital video compression technology is the key technology in the digital video application. On the one hand, the video compression algorithms become more and more complicated to improve the compression efficiency. For example, the compression efficiency of AVS is about twice higher than MPEG-2. But the complexity of AVS is about 5 times higher than MPEG-2. The complexity of H.264 is even up to 10 to 20 times higher than MPEG-2. Because the data volume of digital video is very huge, complicated compression algorithms make the compression technology require huge computation capacity. On the other hand, there are more and more video coding formats. The most popular video coding format is MPEG-2, VP6, H.264, VC-1, RM and AVS. These video coding formats need more transcoding technologies to be developed. In this paper, we focus on the low complexity video transcoding technology to tackle the problems encountered in the transcoding applications. The followings are the main contributions of this paper:

1. According to the H.264 intra mode distribution characters and the intra mode correlations between the high bitrate and the low bitrate, a fast intra mode decision algorithm for H.264 bit rate reduction transcoding is proposed. This algorithm can reduce the complexity of INTRA 4x4 mode decision process with little loss in the transcoding performance. The rate distortion performance of this algorithm can even be better than the original mode decision algorithm on some video sequences.
2. According to the optimal bit allocation theory, an efficient mode mapping method is proposed for AVS inter frame bitrate reduction transcoding. This algorithm takes advantage of λ to decide the best mode. Thus the transcoding complexity is reduced.

3. According to the B frame prediction direction distribution characters, a fast direction decision algorithm for the B frame is proposed. This algorithm can reduce the computation complexity of B frame with little loss in the transcoding performance.
4. Traditionally the main method of reducing the transcoding complexity is reusing the mode information. We find that simply reusing the SKIP mode will cause artifacts when we transcode the AVS bitstream to the H.264 bitstream. An efficiency method is proposed to solve this problem with low computation complexity.
5. According to the characteristics of the intra mode in AVS and H.264, a fast intra mode decision algorithm for fast transcoding AVS bitstream to H.264 bitstream is proposed. This algorithm builds a mode mapping table between AVS and H.264. The transcoding complexity is reduced greatly with neglectable loss in the transcoding performance.

Keywords: H.264, AVS, transcoding algorithm, bitrate reduction, fast transcoding algorithm