

摘 要

视频压缩的国际标准近年来得到了迅速的发展，但是编码性能的提高仍然有较大的空间。特别是随着无线网络与手持设备的发展，实现低带宽下高质量的视频压缩具有重要的意义。这些应用往往需要考虑低复杂度的高性能编码，其中基于降分辨率的视频编码是一种有效的解决方法，值得深入探索。

在本文中，我们重点探讨了降分辨率更新的编码，针对不同序列以及序列中不同区域具有不同的运动趋势以及因此导致的不同能量分布的预测残差，提出一系列对应的编码方法，提高了编码性能。另外，为低码率视频传输提出了一种帧级分辨率自适应的低复杂度的编码方法，同时保持良好的编码性能。此外，还尝试了与降分辨率密切相关的下采样和插值算法。

我们围绕降分辨率和原始分辨率编码的特点，进行分辨率自适应的混合视频编码的研究，从以下几个方面进行了创新：

首先，在 H.264/AVC 平台上，将降分辨率的更新模式 (RRU) 从帧级扩展到了宏块级，更好地利用了不同区域运动向量和残差分布的关系，又研究了降分辨率的运动向量和原始大小残差的编码模式 (RMFR)。

其次，采用 DCT 系数自适应扫描技术，实现 DCT 域的降分辨率编码 (DCTD)，将下采样和 DCT 变换结合起来，简化编码复杂度。至此，我们提出了一个宏块级的编码平台，能够实现以下模式的编码：RRU 模式，RMFR 模式，DCTD 模式和正常模式。

再次，在普通的降分辨率编码基础上，提出一种低复杂度的帧级分辨率自适应的编码方法，在低码率端取得了良好的编码性能。该方法能够快速准确地确定当前待编帧的最佳的分辨率大小，简单有效。

最后，提出一种在插值固定的情况下，自适应选择下采样的算法，不仅能比单一的下采样和上采样方法效果好，而且不会增加解码的复杂度。另外，将边缘检测和插值算法结合起来，利用最小平方估计，对边缘和非边缘区域采取不同的插值方法，能够提高重构图像的主观质量。

关键词：H.264/AVC 标准、分辨率、下采样，插值，降分辨率视频编码，自适应系数扫描

The Study of Video Coding With Adaptive Resolution

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The video compression standards have been developing rapidly these years, however, the compression performance could still be greatly enhanced. Especially with the development of wireless Internet and cellphones, it's important to investigate the bitstream with good quality in the low bandwidth. These applications always require the high performance coding with low complexity, and the video coding based on the reduced resolution is an efficient solution which needs further study.

In this paper, we focus on the reduced resolution update coding. For the different sequences and different regions with the different motion situation and hence residue with different energy distribution, we propose corresponding coding methods to improve performance. Besides, a frame-level adaptive resolution video coding with low complexity and good quality is proposed in order to transmit low bit rate video programs. Moreover, we try to study the down-sampling and interpolation which relate closely to the reduced resolution.

From the characteristics of reduced and full resolution coding, we investigate the hybrid video coding with adaptive resolution and have several novel improvements:

Firstly, we extend the reduced resolution update mode (RRU) from the frame level to the macroblock level based on the H.264/AVC, which could make better use of motion vector and residue of different regions. We also investigate the coding mode with reduced motion vector and full residue (RMFR).

Secondly, we propose the reduced resolution coding in the DCT domain allowing adaptive DCT coefficients selection (DCTD). Because of combining the down-sampling and DCT transform, it could reduce the encoding complexity and eliminate the blockiness. Therefore, we propose a macroblock level coding platform where we could realize the following coding modes: the RRU mode, the RMFR mode, the DCTD mode and the normal mode.

Moreover, we propose a frame level adaptive resolution coding method with good quality and low complexity at the low bit rate, based on the general reduced resolution video coding. It could determine the best resolution of current frame quickly and correctly.

Finally, we propose an adaptive down-sampling selection algorithm at the circumstance of fixed up-sampling method, which could perform better than the single method and don't add extra decoding complexity. In addition, we combine the edge detection and interpolation. With the minimum square estimation, we apply the different interpolation methods to the edge and non-edge regions and it could improve the subjective performance of the reconstructed images.