摘要

数字音视频编解码技术标准 AVS 1.0 的确立、宽带 Internet 接入的普及以及即将广泛部署的 3G 网络，为实现 Interent 和无线网络上的视频流式传输奠定了基础，但同时也对当前视频传输系统中的不足之处提出了改进的要求。本论文主要研究视频传输系统中的速率控制问题，提出了一种用于无线网络中视频传输的新型速率控制机制；本文还实现了 AVS 视频的 MP4 文件封装，使流媒体服务器可以根据文件中的信息实现 AVS 视频基于 IP 网络的传输。

论文首先综述了一般流媒体传输系统的各个组成部分及其功能，指出 AVS 流式封装在流媒体服务器中所处的位置和作用，并重点描述了与本文研究内容相关的应用层 QoS 控制模块。

其次论文介绍了 MP4 文件格式及其组织结构，然后叙述了 AVS 的流式文件中 Hint Track 和 AVS Video Track 的关系，描述了 AVS 视频的 MP4 流式文件的生成过程及其具体封装方法，并详细阐述了 AVS Video Track 及其 Hint Track 的创建过程。

然后本文专注于视频传输的速率控制机制的研究。TFRC 是有线 IP 网络中最为常用的速率控制机制，但是它在无线网络中的性能会发生急剧降低。论文先指出该问题的现有各种解决方案的不足之处，其后引入我们的新型速率控制机制 LERD。LERD 算法的主要思路是将原始 TFRC 连接分为多个折扣层次，每个层次以相应的折扣因子对丢包率进行修正处理，以减轻无线传输错误丢包所引起的负面影响，然后根据网络提供的反馈信息，采用 IIAD 算法收敛到当前网络状况所对应的折扣层次。最后论文给出了 TFRC-LERD 和原始 TFRC 的对比实验并详细解释了实验结果。实验结果显示了 TFRC-LERD 可以更加精确地探测出无线链路的带宽，而且具有 TCP 友好的性质。

本文最后将 LERD 机制应用于 MULTFRC 并取得了极好的效果，实验结果对比显示了 MULTFRC-LERD 在多个指标上改善了 MULTFRC 的性能，它降低了资源消耗，拓展了其应用范围，并减轻了 MULTFRC 在低错误率情况下的量化效应。

关键词：视频传输；速率控制；服务质量；AVS；TFRC

QoS control for video streaming over Internet and wireless networks

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The emerging national audio/video coding standard AVS 1.0, the availability of high bandwidth Internet access and the forthcoming deployment of 3G networks together lay the foundation of video streaming over Internet and wireless networks, but the existing multimedia streaming systems must be improved in order to provide satisfactory performance. This thesis proposed a novel rate control scheme for video streaming over wireless, and put forward a method to encapsulate AVS video stream into a MP4 file, which makes possible the streaming of AVS video over IP networks.

In this thesis we first reviewed the main components of a general multimedia streaming system, and pointed out the necessity and importance of MP4 encapsulation of AVS. The application layer QoS control module was reviewed in detail.

Second, we briefly introduced the MP4 file format and its organization, and explained the relation between AVS Video Track and Hint Track. The method to encapsulate AVS video stream into a MP4 file was presented in detail, and the process of creating AVS Video Track and Hint Track was particularly emphasized.

Then we focused on the research on rate control scheme for video streaming over wireless. TFRC was the widely accepted rate control scheme in wired IP networks, but it suffered performance degradation in wireless networks. We reviewed the current solutions to this problem, analyzed their limitation, and proposed our novel scheme LERD. LERD divides each TFRC connection into multiple discounting levels. Each level is characterized by a unique discounting factor to revise the untruly high loss event rate. The proper discounting level of different network situation was determined by IIAD algorithm based on the feedback information provided by the network. Then we gave the experimental results of TFRC-LERD and TFRC and explained the reason. The result indicated that TFRC-LERD could detect the bandwidth of wireless link more precisely, and it was TCP friendly.

Finally we applied LERD to MULTFRC and achieved significant performance improvement. The experimental results demonstrated that MULTFRC-LERD outperformed MULTFRC in several aspects. Specifically speaking, it reduced the resource consumption, extended the area of applicability and mitigated the quantization effect at the low error rate environment.

Keywords: video streaming, rate control, QoS, AVS, TFRC