Chapter 1

Introduction

The demand for fast and location-independent access to multimedia services over internets is steadily increasing. Most current and future networks, wireless or wired, contain a variety of packet-oriented transmission modes to allow transportation of any type of IP-based traffic. Due to the convenience of wireless transmission, multimedia over wireless networks is attracting a lot of attentions.

In wireless communications, bandwidth and transmission power are limited. The end-user's costs are likely to be proportional to the volume of transmitted data. Hence, compression efficiency is usually a major concern in wireless visual communications. This fact makes H.264/AVC coding an attractive candidate for various kinds of wireless applications, including conversational applications, multimedia messaging services (MMS), and packet-switched streaming services (PSS) [1-6]. H.264 is ITU-T's new video coding standard. It not only supports high coding efficiency but also possesses a network adaptation layer (NAL) to adapt bit strings to networks in a network-friendly way. However, to make H.264 suitable for wireless networks, two main problems in wireless transmissions, bandwidth variation and packet losses, have to be taken into account. These two factors increase the difficulty of visual communications over wireless communications. Moreover, in some applications, like conversational applications, repeated retransmission is impractical. In these cases, how to improve the error-resilience capability of the video codec would be of major concern.

From the aspect of wireless communications, scalability coding is a suitable solution. The original goal of scalability coding is to optimize the video quality over a range of bit-rates instead of at a specific bit rate. In MPEG-4, FGS (Fine Granular Scalability) has already been adopted as the suggested scalability profile [7]. This coding technique is very suitable for multicasting and for wireless networks of varying bandwidth. Actually, scalable video coding is also an efficient tool for error resilience. With this coding scheme, the important parts of the video data can be well protected to provide better error resilience [10-12]. This FGS tool possesses good error resilience capability but is less efficient in compression ratio. To improve the performance of FGS, RFGS is proposed to offer an adjustable way to make trade-off between coding efficiency and error drifts [8]. The adjustment is achieved via two parameters α, β. In this thesis, we apply the H.264 + RFGS as the test bed to further discuss the improvement of visual communications in terms of error resilience and error concealment techniques.

Currently, errors in wireless networks can be suppressed in application layer or physical layer. In physical layer, errors are reduced by using channel coding techniques, like the channel coding tools provided in IEEE 802.16 [16]. In application layer, several error resilience techniques [9-12] and error concealment techniques [9, 13-14] have been proposed. Since current channel coding techniques are already quite efficient, it would be impractical to adopt an error resilience tool that needs plenty of overheads. Hence, in this thesis, a major goal would be to enhance the error resilience capability of the H.264 + RFGS coding scheme with a small amount of overheads but without having to modify the original H.264 standard too much.

In this thesis, the use of field coding for error resilience would be proposed for the improvement of error resilience. The interlaced coding structure in field coding makes itself very suitable for error resilience and error concealment. This interlaced structure scatters errors to reduce the visual defects caused by data loss. Moreover, efficient error concealment can also be easily achieved based on the coding structure [15]. In this thesis, a modified field coding structures with high coding efficiency is proposed and is applied to H.264+RFGS coding. The corresponding error concealment methods are also discussed.

This thesis is organized as follows. In Chapter 2, we describe the characteristics of wireless networks, H.264/AVC, RFGS coding, and tools of error resilience and error concealment. Chapter 3 shows the enhancement of error resilience of H.264 after RFGS is applied. Next, in Chapter 4, we give a detailed introduction of our video coding structure – H.264+RFGS with field coding. The corresponding concealment strategies are included. Chapter 5 shows the experiment results and comparisons are made. Finally, we give conclusions in Chapter 6.