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Automatic Speech Recognition for VoIP with Packet Loss Concealment.

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Abstract

This paper proposes a packet loss concealment (PLC) technique for increase the robustness of automatic speech recognition (ASR) of speech coded with the G729 codec, on the Voice over Internet Protocol (VoIP). Many of the standard ITU-T CELP based speech coders, such as the G.723.1, G.728, and G.729, model speech reproduction in their decoders. These decoders have enough state information to integrate PLC algorithms directly in the decoder, and are specified as part of their standards in particular by PLC based ITU-T G711 Appendix I. Speech is transmitted with source and channel codes optimized, this channel is simulated by two states Markov model to modeled loss packets. The objective of PLC based ITU-T G711 Appendix I is to generate a synthetic speech signal to cover missing data or loss packets in a received bit stream for the ASR application, i.e., to minimize word error rate.

Keywords: VoIP, RAP, OLA, PLC, G729, ITU-I G711 Appendix I, HMM;

1. Introduction

In communication networks, losses are caused by several factors at different stages, particularly congested nodes (routers). In a VoIP system, at the receiver, some packets may be missing, because of delays, congestion or transfer errors. We also know that the packet loss causes loss of synchronization between the encoder and decoder. Packet errors. We also know that the packet loss causes loss of synchronization between the encoder and decoder. Packet
loss degrades the voice quality and affects the quality of speech. This results in breaks of the conversation and a sense of the speech hatching. It is therefore essential to establish a mechanism for packet loss concealment. Several packet loss concealment algorithms (PLC) are used, both at the transmitter at the receiver [1].

In this work, we are interested by the effect of packet loss on the performance of ASR systems. To achieve this aim, we have implemented the technique of PLC based on ITU G.711 Appendix I, and then, adapted it to G.729. We used the database ARADIGIT8K which was passed through the G.729 codec, to obtain the database transcoded by G.729 codec, the so called ARADIGIT_G729. This paper is organized as follows: after a brief introduction, we describe the principle of VoIP networks in transmission and the PLC technique in the section 2. The section 3 presents the ASR system. Performance results obtained for the speech recognition are presented and discussed in section 4. Section 5 presents the main conclusion of this paper.

2. Packet loss concealment technique

2.1. Speech transmission in VoIP

The transmission networks over IP (VoIP commonly use the codec G.711. However, because of its high-rate (64 Kbits / s), it begins to be gradually supplanted by the much lower rate G.729. The voice codec G.729 is based on the prediction algorithm CS-ACELP (Conjugate-Structure Algebraic Code-Excited Linear Prediction) and operates on speech frames of 10 ms which correspond to 80 samples digitized in 16-bit for a sampling frequency of 8 kHz [2]. The speech signal is analyzed to extract the features of encoder packet and sent through the IP network. The decoder uses these features to reconstruct a synthetic speech signal as shown Fig. 1.

![Speech Transmission System with G729 codec and PLC techniques](image_url)

2.2. Packet loss model

We used a simple network model called two-state Markov process to model point-to-point packet loss on the IP network[3]. State 0 indicates that the packet is received and state 1 that is lost. Fig. 2 shows the packet loss modelled by a Markov random process with two states.
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