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GENERAL ASPECTS OF DIGITAL TRANSMISSION SYSTEMS

CODING OF SPEECH AT 8 kbit/s USING CONJUGATE-STRUCTURE ALGEBRAIC-CODE-EXCITED LINEAR-PREDICTION (CS-ACELP)

ITU-T Recommendation G.729

(Previously "CCITT Recommendation")

FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation G.729 was prepared by ITU-T Study Group 15 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 19th of March 1996.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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CODING OF SPEECH AT 8 kbit/s USING CONJUGATE-STRUCTURE ALGEBRAIC-CODE-EXCITED LINEAR-PREDICTION (CS-ACELP)

(Geneva, 1996)

1 Introduction

This Recommendation contains the description of an algorithm for the coding of speech signals at 8 kbit/s using Conjugate-Structure Algebraic-Code-Excited Linear-Prediction (CS-ACELP).

This coder is designed to operate with a digital signal obtained by first performing telephone bandwidth filtering (Recommendation G.712) of the analogue input signal, then sampling it at 8000 Hz, followed by conversion to 16-bit linear PCM for the input to the encoder. The output of the decoder should be converted back to an analogue signal by similar means. Other input/output characteristics, such as those specified by Recommendation G.711 for 64 kbit/s PCM data, should be converted to 16-bit linear PCM before encoding, or from 16-bit linear PCM to the appropriate format after decoding. The bitstream from the encoder to the decoder is defined within this Recommendation.

This Recommendation is organized as follows: Clause 2 gives a general outline of the CS-ACELP algorithm. In clauses 3 and 4, the CS-ACELP encoder and decoder principles are discussed, respectively. Clause 5 describes the software that defines this coder in 16 bit fixed-point arithmetic.

2 General description of the coder

The CS-ACELP coder is based on the Code-Excited Linear-Prediction (CELP) coding model. The coder operates on speech frames of 10 ms corresponding to 80 samples at a sampling rate of 8000 samples per second. For every 10 ms frame, the speech signal is analysed to extract the parameters of the CELP model (linear-prediction filter coefficients, adaptive and fixed-codebook indices and gains). These parameters are encoded and transmitted. The bit allocation of the coder parameters is shown in Table 1. At the decoder, these parameters are used to retrieve the excitation and synthesis filter parameters. The speech is reconstructed by filtering this excitation through the short-term synthesis filter, as is shown in Figure 1. The short-term synthesis filter is based on a 10th order Linear Prediction (LP) filter. The long-term, or pitch synthesis filter is implemented using the so-called adaptive-codebook approach. After computing the reconstructed speech, it is further enhanced by a postfilter.

TABLE 1/G.729

Bit allocation of the 8 kbit/s CS-ACELP algorithm (10 ms frame)

Parameter	Codeword	Subframe 1	Subframe 2	Total per frame
Line spectrum pairs	*L*0, *L*1, *L*2, *L*3			18
Adaptive-codebook delay	*P*1, *P*2	8	5	13
Pitch-delay parity	*P*0	1		1
Fixed-codebook index	*C*1, *C*2	13	13	26
Fixed-codebook sign	*S*1, *S*2	4	4	8
Codebook gains (stage 1)	*GA*1, *GA*2	3	3	6
Codebook gains (stage 2)	*GB*1, *GB*2	4	4	8
Total				80

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