Exh. D

DIGITAL CODING OF WAVEFORMS
Principles and Applications to Speech and Video

N. S. JAYANT
Bell Laboratories, Inc.
Murray Hill, NJ

PETER NOLL
Technical University of Berlin

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Differential PCM

6.1 Introduction

In Chapter 2, we characterized speech and image signals as redundant waveforms. In this and in the two succeeding chapters, we describe *differential coding* or *predictive coding* systems where waveform redundancy is utilized in time-domain operations to realize straightforward reductions in bit rate, for a specified quality of digitization. *Differential PCM* (DPCM) coders, which are based on the notion of quantizing a prediction error signal, are important examples of predictive coding systems [Cutler, 1952] [Oliver, 1952] [Elias, 1955]. DPCM systems with one-bit quantizers constitute an important subclass, *deltamodulation* (Chapter 8).

The *linear predictors* mentioned in Section 2.5 constitute a central topic of discussion in the present chapter. The complexity of a DPCM system is directly related to that of the predictor algorithm. Predictors based on recent waveform history and time-invariant predictor coefficients (Section 6.4) lead to a class of coders which constitutes one example of the *low-to-medium-complexity* designs in Figures 1.5 and 1.6. These coders utilize *time-invariant* or *fixed* speech predictors and *intraframe* image predictors for high-quality digitizations at bit rates in the order of $R = 3$ or 4 bits/sample, in each case. DPCM systems of *high complexity* are characterized by the use of *adaptive predictors* matched to short-time input spectrum (Section 6.5), and/or the use of *distant-sample-memory* for utilizing waveform periodicities (Section 6.6). Examples of the latter are *pitch predictors* for speech and *interframe* predictors for video. These complex approaches are necessary for high-quality coding with $R = 2$ or 1 bits/sample.