Data Sequence Selective Timing Recovery for Multi-Level PAM Signals

The 6th International Conference on Signal Processing Applications and Technology ICSPAT
Boston, MA, 24. - 26. Oktober 1995

Abstract

The usage of Trellis Coded Modulation schemes in high bit-rate transmission systems over bandwidth-limited channels such as HDSL requires an alternative equalization technique instead of the usual decision feedback equalizer due to the delay of the sequence estimator. A common approach is precoding, which is incorporated in the ITU-T V.34 recommendation for voice-band modems. The main drawback of this equalization scheme is the dynamics of the receiver input signal, which results in an effective symbol sequence with an alphabet size much larger than that of the original alphabet (up to -55...55 for 8-PAM input and a twisted pair line of 4 km). This alphabet size severely reduces the performance of the receiver timing recovery circuit.
Based on the statistics of the effective symbol sequence (especially the joint probability distribution functions of groups of two and three symbols) a novel method of a data sequence selective timing recovery is proposed and investigated via theoretical analysis and computer simulations.
The timing recovery circuit is all digital and operates at the system baudrate. It uses a timing function similar to the schemes proposed by Muller and Mueller in 1976, but instead of fixed weighting vector functions a ROM is used to select the weighting vectors. The data sequences which correspond to each weighting vector are reduced to five symbols and those yielding an exact estimate of the sampling phase error are derived. To reduce complexity (i.e. the number of sequences to be incorporated in the ROM) while retaining a short mean delay between timing phase updates only the most likely sequences are considered.
Computer simulations show very good initial acquisition and steady state jitter performance of this timing recovery scheme even in an environment where the receiver input signal is not ISI-free (i.e. if the channel equalized by the precoder is not minimum-phase).

Stand: 10.01.1996, Marcus Draheim