MODELLING AND ESTIMATION OF BIT & FRAME ERRORS FOR DATA LINK PROTOCOLS

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This abstract outlines research carried out by the author in the areas of real time estimation of bit error probability and frame error probability, burst-error modelling, adaptive data link protocols and codeword combining for hybrid-ARQ protocols for the purpose of link optimization, particularly in burst-error channels.

The probability of bit error and the probability of frame error are the most important measures of performance of a digital communication link. Methods for estimating these parameters of a link with inherent error-control coding are presented. These methods are entirely dependent on the information available in the received signal and, as a result, they do not require any test sequences be transmitted. It will be shown that they are applicable to both block-coded and convolutionally-coded systems and they display good performance over realistic channels.

Bit error estimates can be used for realizing a system which rapidly adapts the data rate to the prevailing channel conditions in order to improve the error free throughput of the data link protocol such as that of an ARQ protocol. The performance results are compared to those of fixed rate ARQ and hybrid-ARQ systems. In addition, the performance of an ARQ scheme that uses the normalized decoder metrics for frame error estimation will be compared to one that uses an error detection code.

A burst-error model which can be used to formulate various error content probabilities in a frame of bits received from a bursty channel is described. The formulations are first tested using computer generated burst patterns. Then, a semi-theoretical and a purely experimental approach are taken for testing in channels which cause burst errors. Comparisons are made to random error channels.

Data link protocols such as hybrid-ARQ of type II are overlaid on digital data links in order to reduce the bit errors to virtually zero while keeping the average throughput and time delay at reasonable levels. It is shown that codeword combining can be used to improve such a protocol at high error rates. Using a state model of the generalized combining scheme and the burst model, the average throughput and the average time delay are derived for realistic channels. The parameters of the protocol can be optimized by using arbitrary burst distributions described by the burst model. The results are compared to those of the scheme which does not use any codeword combining.

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