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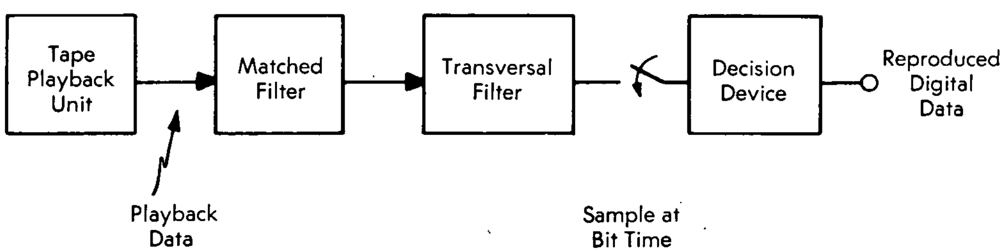
NASA TECH BRIEF

NASA Pasadena Office

Processor for High-Density Digital Tape-Recorded Signals

Magnetic tape recording of digital data involves the storage and processing of information utilizing discrete, distinguishable states of the storage medium. It is widely recognized that each recorded data transition results in a playback signal of a pulse-like nature. Under rather general conditions, isolated playback pulses may be superimposed in time, as determined by recorded data and the bit packing density on tape, to generate the multibit playback voltage waveforms.



The significance of the linear superposition concept in tape recording is as follows: Since the output of the tape recorder playback heads can be generated from a single pulse which is characteristic of the system using a linear technique even when these pulses overlap, the principles of linear filter and detection theory can be brought to bear on the problem of reconstructing (i.e., detecting) the recorded bit stream. Thus, the bit detection problem can be taken out of the realm of nonlinear problems even though the basic record process is still recognized as (necessarily) highly nonlinear; the digital tape recorder can be modeled as a particular type of linear communication channel with intersymbol interference.

Ignoring irregularities in the playback signal due to flutter and dropouts and assuming timing is known, the detection problem can be stated as: Find the optimum receiver structure for the case of synchronous transmission of binary data over fixed, known, dispersive channels. This problem has been solved using a decision-theory approach which leads to the equations which specify the operations the receiver must perform on its input to minimize the probability of error. The interpretation of these equations results in the optimum equalizer structure, a nonlinear device which in this case is unfortunately too complex and impractical to construct, but which nonetheless offers insight into practical suboptimum equalizer structures.

One suboptimum equalizer structure that has been developed from such insight is the equalizer shown in the diagram. This is a cascade of a matched filter, matched to the signal waveshape, followed by a transversal filter. Grossly, this structure may be thought of as a matched filter to reduce the effects of noise followed by a transversal filter to reduce the effects of intersymbol interference. This mechanization has been used with recorded Manchester coded data of 7874 bits per centimeter (20,000 bits per inch) and has been extended to be self-adaptive.

(continued overleaf)

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103
Reference: TSP 73-10354

Patent status:

NASA has decided not to apply for a patent.

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